CONTRACTING FOR SCHEDULE PERFORMANCE: THE RELATIONSHIP BETWEEN PRE-CONTRACT-AWARD MANAGEMENT ACTIONS BY THE DoD AND THE RESULTANT SCHEDULE PERFORMANCE

THESIS

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THESIS

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Abstract

This research focused on the pre-contract-award management actions of small-scale, design and development contracts and the relationship of these actions to schedule performance. Three phases of the contractual process were studied: the planning, specifying, and controlling phases. A sample of 25 contracts from SPOs at Wright-Patterson AFB was obtained.

Data on the variables were obtained directly from the contract files and from the contract-management database, AMIS. Regression analysis techniques were used to identify the pre-contract-award management actions that were related to schedule performance.

The number of contract modifications was found to be the most significant factor related to schedule performance. Pre-contract-award management actions that showed a significant relationship to schedule performance were whether the contract was pre-scheduled, whether the contract involved concurrency, whether a preliminary WBS had been developed, whether the contract utilized a Type A or Type B specification, whether the contract required the schedule information to be presented in network format, and the number of DIDs specified in the CDRL. In addition to the identification of these actions, the study revealed that the management of schedule was not well understood within the SPOs.

CONTRACTING FOR SCHEDULE PERFORMANCE:

THE RELATIONSHIP BETWEEN PRE-CONTRACT-AWARD MANAGEMENT

ACTIONS BY THE DoD AND THE RESULTANT SCHEDULE PERFORMANCE

I. Introduction

Within the DoD, the acquisition of equipment is achieved by specialist personnel within System Program Offices (SPOs). The efforts of these personnel are coordinated by the designated Program Manager to ensure that each acquisition achieves the specified cost, schedule, and performance requirements (Cavendish and Martin, 1987:I). Of these three requirements, only schedule performance will be addressed by this thesis.

Within the DoD, the typical acquisition contract is characterized as being "behind schedule and over budget" (Christensen, 1993:37). This situation occurs despite a rigorous and well-defined acquisition process. The question that arises from this, and which encapsulates the essence of this research project, is: Why is "behind schedule and over budget" the *typical* situation? This thesis addresses part of this question, through an analysis of the relationship between the pre-contract-award management actions by the DoD and the resultant schedule performance.

To introduce the issues that result from the preceding paragraphs, this chapter will proceed through a coverage of the following topics:

a. the project management body of knowledge,

b. the general issue,

c. the specific problem,

d. the investigative questions,

e. the scope and limitations of the research,

f. the definitions of terms, and

g. an overview of the remainder of the thesis.

Project Management Body of Knowledge

The Project Management Institute (PMI), the international professional organization for project managers, has established a project-management body of knowledge (PMBOK). The PMI and PMBOK were established to "improve the effectiveness and efficiency of the management of [projects] ..." (Wideman, 1987:Part 1:1) As this research has the same goals and falls within the bounds of project management, it is appropriate to locate this research within the relevant area of the PMBOK. For this purpose, note that the terms *acquisition management* and *project management* are considered to be synonymous (Cavendish and Martin, 1987:I).

The PMBOK divides the project management field into eight major functions, namely:

a. scope management,

b. quality management,

c. time management,

d. cost management,

e. risk management,

f. human resources management,

g. contract/procurement management, and

h. communication and information management (Nunn, 1987:Part 3:5).

MacDonald states that these functions are not mutually exclusive and exhibit a degree of interdependence. He further states that, with respect to the time-management function, the interdependencies are small (MacDonald, 1983:22). The time-management function subsumes all aspects associated with schedule management; hence, for the purposes of this thesis, the individual management actions which comprise the schedule-management function are considered to be independent of all other management actions.

The PMBOK further divides the time-management function into four sub-functions, namely:

a. time planning,

b. time estimating,

c. time scheduling, and

d. time control (MacDonald, 1983:21; Beck, 1986:56).

The focus of this thesis -- contracting for schedule performance -- impinges upon each of these sub-functions. Furthermore, the tasks associated with each sub-function, as given in the PMBOK, define the scope of this research (Beck, 1987:Part C:4).

General Issue

Most projects have a three-dimensional goal: to accomplish the requisite work within specified cost, schedule, and performance requirements. The three elements are not mutually exclusive, and placing emphasis on any one element is likely to have a negative impact on the other two (Nicholas, 1990:9-10). This inter-relationship complicates the management function: in specifying schedule-management requirements in a Request For Proposal (RFP) or contract, the relative importance of schedule, with respect to the other two elements, needs to be ascertained. Furthermore, the methods used to specify the schedule-management requirements must facilitate the evaluation process, and the resultant management and control functions. Moreover, these schedule-management requirements must be cost-effective and efficient, commensurate with the magnitude, complexity, cost, and importance of the specific acquisition.

Schedule overruns have the potential to negatively impact the acquisition process in three ways, as follows:

a. Schedule overruns typically lead to cost overruns (MacDonald, 1983:20; Otegui, 1990:42).

b. For acquisitions where the equipment being procured is required by a specific date, schedule overruns ensure that the user will not receive the equipment as planned.

c. The DoD has limited resources; hence, schedule overruns ensure that the resources attached to a particular project are unavailable for reallocation, as planned, to other projects.

From an overall DoD perspective, the impact of schedule overruns would not be as significant if a high percentage of acquisitions were to meet their schedule goals. As stated earlier, however, the typical DoD acquisition is characterized by schedule slippage. In an interview with LtCol Gotcher and Mr Witham from the Source Selection Office, Aeronautical Systems Center, WPAFB, LtCol Gotcher stated that the evaluation of schedule risk during the source-selection process was currently a high priority within Air Force Materiel Command (AFMC). This additional requirement had been incorporated into the source-selection process because a significant proportion of DoD acquisition contracts were not meeting the contracted schedules (Gotcher and Witham, 1992).

Norman R. Augustine, Chairman of Martin-Marietta, developed a number of 'laws' related to major systems development programs, and documented them in his book, Augustine's Laws (Augustine, 1982). Augustine performed an analysis on a large number of major system development programs, and was able to identify trends with respect to cost, schedule, and performance. Law Number XXII, which is diagrammatically explained in Figure 1-1, states: *"Any task can be completed in only one-third more time than is currently estimated"* (Augustine, 1982:115). The data presented in Figure 1-1 was derived from official schedule estimates predicting when various milestones, such as first flight, first delivery, etc., would occur. While this 'law' implies that little can be done to improve the acquisition process, the reasons underlying the Fantasy Factor of 1.33 are not forthcoming. Only through a thorough and detailed analysis of the significant number of factors which could cause or control schedule overruns will the process be able to be improved. This is the intent of this research. The information presented in Figure 1-1, however, does provide a clear picture of the magnitude of the problem.

Otegui discusses potential reasons for *cost* growth in DoD acquisitions (Otegui, 1990:41). Cost and schedule, however, have long been recognized as correlated (Garvey and Taub, 1992:i). As a

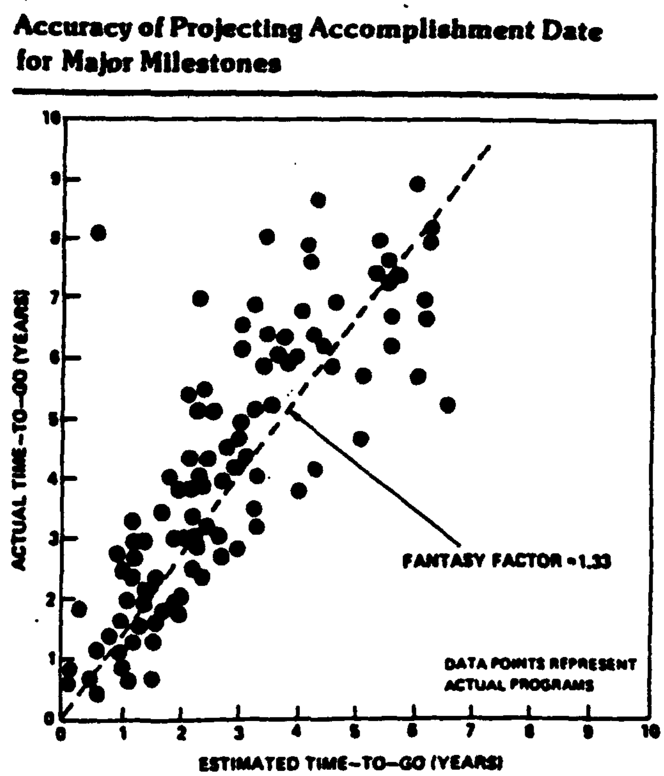

Figure 31 Like cost, the prediction of schedule involves uncertainties and risks. When the time actually required to complete a task is compared with the time which had originally been projected, a quite predictable correction factor can be empirically derived.

Figure 1-1. Augustine's Schedule Correction Law (Peter, 1993:86)

consequence of this correlation, therefore, the reasons given by Otegui for cost growth are also applicable to schedule. These reasons include changes in "economic, quantity [sic], [...], engineering, estimating, [...], and support assumptions or events" (Otegui, 1990:41). A number of these reasons are outside the control of either the DoD or the contractor (e.g., economic events). Many of the reasons, however, *do* fall within the span of control of either the DoD or the contractor. This implies, therefore, that the DoD has the ability to obtain improved schedule performance.

The intent of this study is not to undertake a detailed investigation into the causes of schedule overruns. Instead, this study will take it as given that problems exist, and will investigate the current DoD pre-contract-award management actions to determine the effect of those actions on schedule performance. It is the authors' belief that knowledge of the relative impact of these actions, with respect to schedule performance, will be of considerable use to Program Managers.

Specific Problem

As stated earlier, there are many factors with the potential to affect the contracted schedule performance, some of which are unknowable at the time of contract award. This research, however, is only concerned with those factors that are either known or predictable prior to contract award. By considering the "known" factors, Program Managers can incorporate the necessary management actions, to address those factors, into the contractual documentation. Specifically, this research analyzes those DoD pre-contract-award management actions which are believed to affect the contracted schedule performance.

In addressing these issues, the contractual process can be divided into the following four activity areas:

a. planning the acquisition,

b. specifying the requirement,

c. evaluating the proposals, and

d. monitoring and controlling the resultant contract.

While the last of these four activities is not a pre-contract-award action, the ability to effectively and efficiently monitor and control a contract is highly dependent upon consideration of the relevant issues during the planning, specifying, and evaluating phases.

Each of the four activity areas involves specific management actions which have the potential to affect schedule performance. The first step in this research, therefore, is to identify those actions which may affect schedule performance. Secondly, those actions need to be analyzed to determine which actions are (and are not) related to schedule performance. Thirdly, the effect on schedule performance, of those actions which demonstrate a relationship, needs to be quantified (i.e., the magnitude, and whether positive or negative). Finally, it is necessary to determine which actions, of those which have a positive relationship with schedule performance, can be implemented in a cost-effective and efficient manner.

Investigative Questions

To address the specific problem, a series of investigative questions were developed, and these are listed below:

a. Which management actions, with the potential to affect schedule performance, may occur prior to contract award?

b. Which DoD management actions, during the planning phase, influence schedule performance?

c. Which DoD management actions, during the specification-of-requirements phase, influence schedule performance?

d. Which DoD management actions, during the evaluation phase, influence schedule performance?

e. Of the DoD management actions which positively influence schedule performance, which can be cost-effectively implemented (commensurate with the selected project characteristics)?

Scope and Limitations

The DoD acquisition and contracting processes encompass a significant number of interrelated sub-processes. To ensure that a research proposal is executable, only a small portion of related sub-processes can be effectively studied within the allotted time-frame. From the outset, the scope of this research has been limited to schedule-management issues. A number of other aspects further limit the scope of the research. To address these issues, this section will discuss:

a. the scope of the research,

b. sample limitations,

c. data limitations, and

d. possible confounds.

Scope of the Research

The management of schedule performance, throughout the contractual process, involves a relationship between the DoD and the contractor. This relationship is defined by four groups of factors, specifically:

a. those under the control of the DoD,

b. those under the control of the contractor,

c. those associated with the relationship between the two, and

d. those outside the control of either (CPG No 8 (draft), 1992).

The latter two groups of factors (which, in the first instance, includes the face-to-face interaction between DoD and contractor personnel, and, in the second instance, includes Congressional influence, changes in requirement, and *force majeure* factors) are essentially post-contract-award factors, and are outside the scope of this research. On the other hand, the first two groups of factors are controllable in a rigorous and defined manner (e.g., through directives, instructions, and guidance documents in the first instance, and through the contractual process in the second). A study of these two groups of factors, in an attempt to improve the effectiveness and efficiency of schedule management, therefore, is a worthwhile endeavor.

Limitations with the Sample

The population of interest for this research is defined as: all DoD acquisition contracts which meet the requisite project characteristics. (Note, Chapter III specifies which project characteristics define the population.) The sample frame, which has been selected for economic reasons, is defined as: USAF acquisition contracts at WPAFB within approximately the last fifteen years. This sample frame is believed to be representative of DoD acquisition-contracting practices for the following reasons:

a. WPAFB is the major acquisition center within the USAF, especially for the population of interest. This sample frame, therefore, is representative of USAF acquisition-contracting practices.

b. The major acquisition directives and instructions (e.g., the Federal Acquisition Regulations (FAR), the DoD 5000 series of acquisition directives, and the MIL-STDs referenced by the 5000 series) are multi-service documents. Furthermore, DoD Directive 5000.1, Defense Acquisition, and DoD Instruction 5000.2, Defense Acquisition Management Policies and Procedures, contain specific instructions that prohibit supplementation of the requirements mandated therein (DoD Directive 5000.1, 1991:3; DoD Instruction 5000.2, 1991:4). The mandated requirements, therefore, are common to all services.

Limitations with the Data

A number of limitations with the data are evident for this thesis, and these limitations can be broken down into two areas:

a. limitations stemming from the data type, and

b. limitations stemming from sampling concerns.

Limitations Stemming from the Data Type. The primary concern with the data type is that the available data reflects the end-product of a considerable number of hours spent planning, discussing, arguing, and assimilating feedback. The available data are "hard" data and do not reflect the reasons underlying the selection process. There is little visibility into the situational factors prevalent at the time that the acquisition documents were created. The effect of this aspect on the research is that there is virtually no ability to allow for variances due to situational factors (e.g., posited schedule optimism as a result of political considerations).

Limitations Stemming from Sampling Concerns. Due to the unique nature of this research, a suitable database does not exist from which the requisite data can be extracted; hence, the data must be obtained directly from the available contract files. This mode of data collection is extremely time-consuming and impacts upon the ability to obtain a statistically-significant sample size. Furthermore, the ability to obtain a meaningful sample size was further impacted by the availability of the requisite contractual documentation (i.e., documents may be incomplete, missing, or classified).

Problems with Confounds

Many factors have the potential to confound the measurement of schedule performance. For example, the interactive nature of the three acquisition goals -- cost, schedule, and performance -- can make it difficult to isolate the impact of management actions on schedule. Furthermore, there are many post-contract-award management actions and considerations (e.g., changes in technical requirements, politics, competence of the Program Manager, and cohesion of the acquisition team within the SPO) which could impact schedule performance. These confounds will need to be considered to ensure that the effects of the pre-contract-award management actions are satisfactorily isolated.

Definitions of Terms

The only term which requires a definition is schedule performance, which is defined as the relationship between the planned (i.e., contracted) performance period and the actual performance period.

A list of acronyms used throughout this thesis is given at Appendix A.

Overview of the Thesis

Chapter II of the thesis will discuss current research relevant to this thesis, and will discuss the DoD contractual process from the perspective of schedule management. Chapter III will utilize the overview of the contractual process provided in Chapter II as the basis for determining the data-collection requirements and plan. Furthermore, Chapter III will detail the statistical tests that were used to answer the investigative questions. Chapter IV will present the data analysis and the results from that analysis. Finally, Chapter V will present the conclusions and recommendations, and will identify topics for future research.

Chapter Summary

This chapter introduced the subject area for this research: the relationship between pre-contract-award management actions by the DoD and the resultant schedule performance. To this end, the need for adequate schedule performance was first established and some of the reasons for schedule overruns were provided. Following this, the specific research problem and associated investigative questions were presented. In addition, the scope of, and limitations with, the research were discussed. Finally, an overview of the remainder of the thesis was provided.

II. Literature Review

Introduction

This literature review will describe current research that specifically relates to the authors' area of interest: characterizing the relationship between pre-contract-award management actions by the DoD and the resultant schedule performance. Furthermore, the literature review will provide an understanding of the factors which affect schedule performance throughout the contracting process, as well as an appreciation of the opportunities for improving schedule performance.

The facets of schedule management, which were introduced in the preceding paragraph, will be explored further in the literature review, through a coverage of:

a. the history of schedule-management techniques within the DoD,

b. current research in the area of schedule-performance achievement,

c. existing studies concerning schedule performance for DoD acquisitions,

d. factors under the control of the DoD which have the potential to affect schedule performance,

e. factors under the control of the contractor which have the potential to affect schedule performance, and

f. a summary of the chapter.

The history of schedule-management techniques is an appropriate starting point to set the stage for the current research in the area.

History of Schedule-Management Techniques Within the DoD

During World War I, Henry Laurence Gantt developed what became known as the Gantt (or bar) chart (Fleming, 1988:15). Gantt charts are simple graphical representations of project tasks on a horizontal time-scale. Progress is symbolized by the filling in of the hollow bar (Fleming, 1988:15). A vertical 'time now' line is drawn on the chart to assess current progress, indicating whether individual tasks are ahead of, or behind, schedule (Fleming, 1988:15). Gantt charts are limited in that "they do not explicitly show the relationships among tasks nor the impact of delaying activities or shifting resources" (Nicholas, 1990:270). Despite their limitations, Gantt charts are used widely throughout industry today because of their simplicity. An example of a Gantt chart is given in Figure 2-1.

The earliest significant project control system employed by the DoD, post World War I, amounted simply to the reporting of project progress and status by the contractor (Fleming, 1988:xii). The reporting requirements were foreign to the contractors' management control systems, however, which made an unwelcome orphan of the government requirements (Fleming, 1988:xii). This project control system resulted in the reported information being regarded as inadequate and untimely, precluding effective proactive management action (Fleming, 1988:xii). The actual status of the project, in terms of the true cost for the work performed (termed 'earned value,' which will be discussed later) was not apparent and the reported information provided little assurance that the project was within cost and schedule (Fleming, 1988:xii). Thus, the stage was set for improvement, as the DoD was embarking on many new high-value state-of-the-art projects that could not afford to incur cost and schedule overruns.

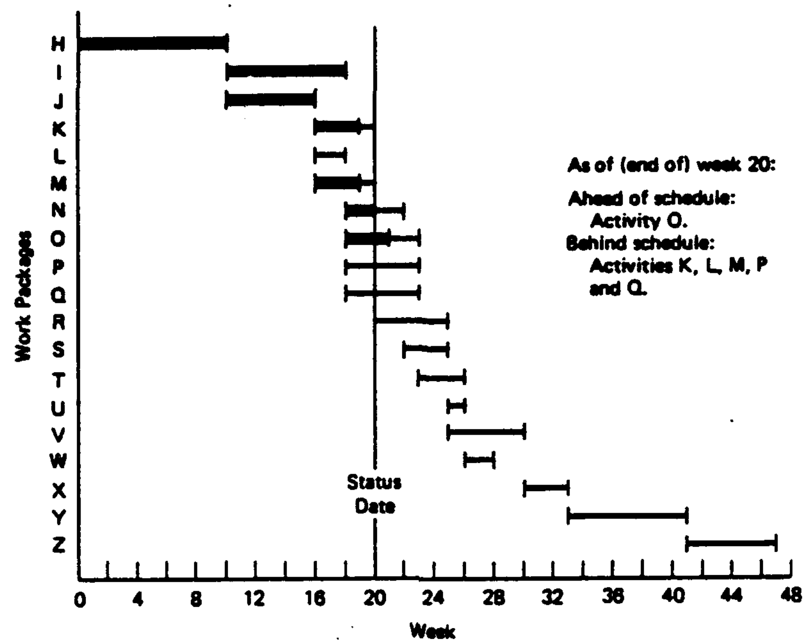

Figure 2-1. Example of a Gantt Chart (Nicholas, 1990:258)

In the late 1950s and early 1960s, the Program Evaluation and Review Technique (PERT) came to the forefront through application in US Navy programs (Slemaker, 1985:6). PERT is a network-based technique that "clearly show[s] interdependencies among activities and enable[s] planning and scheduling functions to be performed separately" (Nicholas, 1990:270). With PERT, managers were able to effectively plan each project through their understanding of how the project would be executed (Fleming, 1988:18; Slemaker, 1985:6). The basic PERT evolved into a number of offspring (although the basics of the technique remained), notably the Critical Path Method (CPM), the Precedence Diagram Method (PDM), the Graphical Evaluation and Review Technique (GERT), and the PERT/Cost method (Fleming, 1988:18-19; Slemaker, 1985:6). Figure 2-2 illustrates the PERT network technique for defining a project. (Note, for detailed descriptions of these techniques, refer to any project-management text, e.g., Nicholas, 1990.) Although the capability to effectively plan a complex project was satisfied by PERT, there still remained the difficulty of relating the budgeted cost of work performed to the budgeted cost of work scheduled (Slemaker, 1985:6-7).

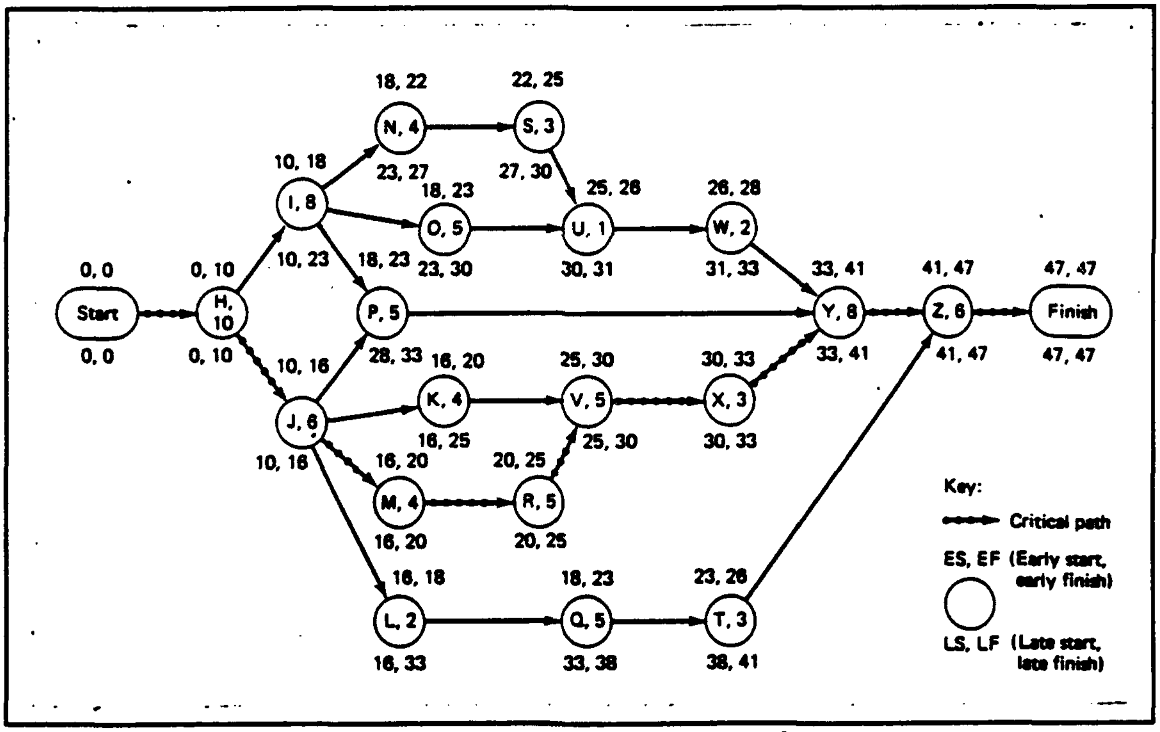

Figure 2-2. Example of a PERT Network (Nicholas, 1990:292)

As highlighted by the preceding paragraph, by the mid 1960s, the DoD had a number of different management control systems in use, which resulted in a lack of standardization in project-management approaches.

In an attempt to standardize, the DoD introduced the Cost/Schedule Control Systems Criteria (C/SCSC). As evidenced from the name, C/SCSC is a set of criteria which provides the basis for determining the acceptability of a contractor's cost and schedule management control system (Grskovich, 1990:26). C/SCSC, therefore, is a philosophy rather than a system (Slemaker, 1985:7; Fleming, 1988:25). When combined with the specified reporting requirements (Cost Performance Reports (CPRs)), the criteria provide an effective management tool for use by the DoD (Grskovich, 1990:31). C/SCSC is an 'earned value' approach to management, in that the contractor's management control system keeps track of funds expended, as well as the percentage of work completed (Nicholas, 1990:28). The DoD also uses another earned value approach: the Cost/Schedule Status Report (C/SSR). The C/SSR approach employs the same cost and schedule measurement techniques as C/SCSC; however, it is used for lower cost acquisitions and the reporting is less stringent (C/SSR Joint Guide, 1978:Ch 1, 4-5).

This brief history reveals the main cost- and schedule-management techniques available to the DoD: Gantt charts, network diagrams, C/SSR, and C/SCSC and CPR. These techniques mainly apply to the monitoring and control phase of the contractual process. The next section will continue the progressive development of schedule-management techniques, introduced in this section, through a discussion of the current research in the area. Specifically, the relationship between project characteristics and the selection of project-management techniques, and the relationship between project inputs and project outcomes will be addressed.

Current Research

Little research has been conducted in the area of schedule performance. There is considerable information concerning the project characteristics that should be considered when addressing the management of projects; however, the relationships between these characteristics and schedule performance have received little attention. Furthermore, the relationship between management actions and schedule performance has not been addressed. This section will present a brief overview of the current research related to schedule management and schedule performance.

Project Characteristics

Schedule-management techniques should be selected for a particular project based upon the specific characteristics of that project. In addition, the project characteristics define which schedule-management techniques can be cost-effectively and efficiently implemented. To obtain a better appreciation of this perspective, a discussion of project characteristics is required.

A review of the project-management literature provided the following list of characteristics which were considered to be of particular relevance when addressing the management of projects:

a. expected cost (i.e., total, and of significant sub-elements);

b. perceived complexity (e.g., number of elements in the work breakdown structure (WBS));

c. expected duration;

d. project type (e.g., research and development, limited design and development, systems integration, etc);

e. degree of uncertainty;

f. planned amount of concurrent activity;

g. planned amount of competition (e.g., sole source or competitively bid);

h. planned contract type (e.g., fixed price or cost plus);

i. pricing arrangement (e.g., incentives and award fees);

j. System Program Office (SPO) organization (i.e., matrix or pure project);

k. resource limitations in the SPO;

l. perceived number of stakeholders; and

m. expected amount of intervention from higher authorities (e.g., Congress) (Bubshait and Selen, 1992:43; Slevin and Pinto, 1986:57-61; Nicholas, 1990:465-471; Cleland, 1986:36).

An assessment of each of these characteristics is needed for each DoD contract to determine the appropriate methods for specifying schedule-management requirements in the RFP or contract, such that the desired schedule performance is achieved.

Project Characteristics and Schedule-Management Approach

In deciding which schedule-management approach to utilize in differing situations, project-management texts provide little guidance. Bubshait and Selen, in their paper on this subject, state:

> Largely absent in project management research are studies of the relationship between specific project characteristics (uncertainty, complexity, high indirect costs, duration, etc) and

the application of project management techniques. (Bubshait and Selen, 1992:43)

The need for such a study was recognized by Webster in 1982: "There is criticism of project management literature in regard to the inability to find guidance as to which tool and which variant to use under what circumstances" (Webster, 1982:13).

Project Inputs and Schedule-Performance Outcomes

A third paper by Merrow and Yarossi discusses the need for the specific research being undertaken:

> [...] we want to identify as many of the possible variables that could affect project performance as possible. [...] we need to analyze project performance to evaluate how the project inputs influence project outcomes. (Merrow and Yarossi, 1990:H.6.3)

Merrow and Yarossi collected data on 2000 variables from 44 projects within the oil, chemical, and minerals industries. Using this data, regression analysis was conducted, in the first instance, to derive a relationship between project characteristics and cost-estimate deviation. Following this, "similar models [were] developed for project schedule, startup, and operational performance" (Merrow and Yarossi, 1990:H.6.5).

These three research examples encapsulate the essence of this research: for DoD acquisitions, what is the effect of the pre-contract-award management actions taken by the DoD on the contracted schedule performance? To place this research in context, an overview is required of the studies that have been conducted with respect to schedule performance within the DoD. A discussion of three studies is presented next.

Existing Studies Pertaining to DoD Acquisition Schedule Performance

Late in the thesis process, three studies were discovered which concerned DoD acquisition schedules. These studies were all conducted by the Rand Corporation at approximately ten year intervals. These studies encapsulate the major emphases that have been utilized to analyze DoD acquisition schedules. The three studies are:

a. System Acquisition Strategies (Perry et al, 1971);

b. An Analysis of Weapon System Acquisition Schedules, Past and Present (Smith and Friedmann, 1980); and

c. An Analysis of Weapon System Acquisition Schedules (Drezner and Smith, 1990).

This section will present a brief overview of each of the studies, the significant and relevant findings, and how the three studies differ from the research being undertaken through this thesis effort.

Overview of the 1971 Study

The 1971 study was mainly concerned with identifying acquisition policies and strategies that contributed to program growth -- cost, schedule, and performance -- and to propose improved procedures for estimating program outcomes (Perry et al, 1971:1). This study collected cost, schedule, and performance data for 24 major systems. The results, with respect to schedule only, are presented in Figure 2-3, which shows an average schedule overrun of approximately 15%, with a range of performance from 0.5 to 2.5 times the planned schedule. One of the main conclusions that was drawn from their analysis was that cost increases seemed to have been accepted in order to meet performance and schedule goals (Perry et al, 1971:9). Furthermore, from their data, the authors

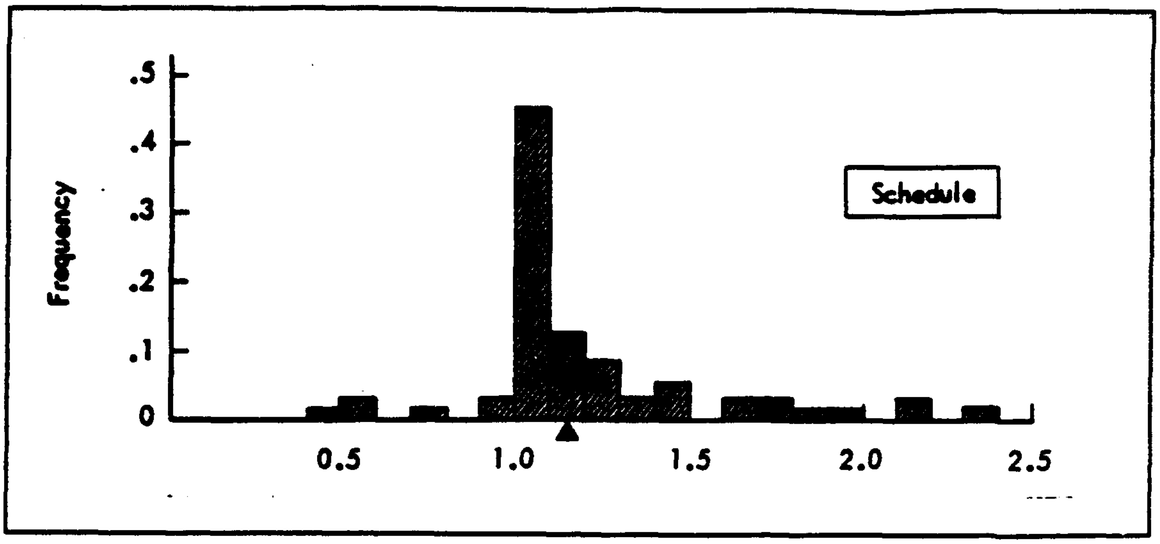

Figure 2-3. Schedule Performance: 1971 Study (Perry et al, 1971:8)

concluded that two main elements were responsible for the majority of the schedule growth: technical uncertainty, and scope changes after the start of the weapon system development (Perry et al, 1971:16). Finally, the authors recommended that two specific acquisition strategies be adopted to reduce the likelihood of program growth: firstly, that acquisition programs be conducted in discrete phases; and secondly, that the number of resources applied to a program be constrained early on in the development process to prevent work being conducted that was not relevant at that stage (Perry et al, 1971:41-47).

Overview of the 1980 Study

The thrust of the 1980 study was to identify whether the acquisition cycle had lengthened over the preceding few decades, whether any changes in the length of the cycle were due to changes in organization or procedures, and whether there were any practical ways to reduce the length of the acquisition cycle without undesirably altering program outcomes (Smith and Friedmann, 1980:v). This study was the least relevant of the three reviewed in this thesis; however, one interesting conclusion was that the "time from beginning of full-scale development to first flight has remained remarkably constant over a period of three decades" (Smith and Friedmann, 1980:v).

Overview of the 1990 Study

The 1990 study was the most relevant of the three in terms of the this thesis effort. The objectives of the study were to:

> [... improve the] understanding of the issues associated with measuring acquisition schedules, evaluating trends in program duration, and identifying the factors affecting that duration. The overall goal was to provide suggestions on how to shorten the time required to complete weapons acquisition programs. (Drezner and Smith, 1990:1-2)

Drezner and Smith identified sixteen factors which were believed, *a priori*, to have the potential to affect the original plan or to cause deviations to the program once underway, or both. These factors were:

a. competition,

b. concurrency,

c. funding adequacy,

d. prototype phase,

e. separate contracting,

f. Service priority,

g. external guidance,

h. joint management,

i. program complexity,

j. technical difficulty,

k. concept stability,

l. contractor performance,

m. external event,

n. funding stability,

o. major requirements stability, and

p. program manager turnover (Drezner and Smith, 1990:21-24).

The authors conducted a non-statistical case-study analysis of ten major programs to determine the extent that the preceding factors affected schedule performance. The case-study approach was chosen for two reasons: firstly, the original schedule plans do not contain justification for the proposed schedule; and secondly, there are a great many factors that can be expected to affect a programs duration, whereas the sample size is typically small (Drezner and Smith, 1990:20-21).

For their model, Drezner and Smith used the following characterization of program duration:

Actual Program Length = Length of Plan + Deviation from Plan

On average, the programs in their sample incurred a schedule slip equal to 33% of the length of the original plans (Drezner and Smith, 1990:44). This number agrees with Augustine's Fantasy Factor, as discussed in Chapter I. Drezner and Smith also concluded that four factors accounted for the largest portion of schedule slip *for the ten programs examined*: external guidance, technical difficulty, funding stability, and external events (Drezner and Smith, 1990:vi-vii). Three of these are external factors, with only one -- technical difficulty -- being under the control of the Program Manager.

The Three Studies in the Context of This Thesis

There are a considerable number of differences between the three studies discussed and the research being undertaken for this thesis effort:

a. The three studies focussed on the overall acquisition process with respect to the program schedule. This research, on the other hand, focusses on contractual performance within the EMD phase of the acquisition cycle.

b. The first and third studies investigated the differences between the target schedule (i.e., before any contracts are awarded) and the actual schedule, whereas this research investigates the differences between the contracted schedule and the actual schedule.

c. The three studies investigated major programs from all three Services, whereas this research investigates smaller-scale programs (i.e., below the C/SCSC threshold) from the USAF only.

d. The three studies investigated schedule performance from the perspective of the influence of external factors and program characteristics. This research investigates schedule performance from the perspective of the influence of management actions, specifically, pre-contract-award management actions.

e. Generally, the three studies did not have sufficient data or sample size to perform statistical analyses; hence, the results presented were qualitative in nature. This research investigates the efficacy of pre-contract-award management actions by the DoD through the use of the appropriate statistical analyses.

The overview of the three studies presented here demonstrates the timeliness and importance of the current research. The inter-relationship between pre-contract-award management actions and the resultant schedule performance has not been investigated. The need for this research, therefore, is readily apparent.

To gain a fuller appreciation of the total contractual process, as it relates to schedule management, the factors under the control of both the DoD and the contractor must be considered. The factors under the control of the DoD will be discussed first.

Factors Under the Control of the DoD

Introduction

Within the DoD, a number of policy directives, instructions, and manuals dictate and restrict the actions available to the SPO throughout the acquisition life-cycle. The major documents involved include:

a. the Office of Management and Budget (OMB) Circular A-109, Major System Acquisitions;

b. the Federal Acquisition Regulations (FAR);

c. the DoD FAR Supplement (DFARS);

d. the Service FAR Supplements (e.g., Air Force FAR Supplement (AFFARS));

e. DoD Directive 5000.1, Defense Acquisition;

f. DoD Instruction 5000.2, Defense Acquisition Management Policies and Procedures; and

g. DoD Manual 5000.2-M, Defense Acquisition Management Documentation and Reports.

OMB Circular A-109 provides broad policy guidance for major system acquisitions. The FAR and associated Defense supplements provide the regulations with respect to contract management. The 5000 series provides specific instructions and procedures for DoD acquisitions.

The DoD acquisition process comprises five phases:

a. Phase 0: Concept Exploration and Demonstration;

b. Phase I: Demonstration and Validation;

c. Phase II: Engineering and Manufacturing Development;

d. Phase III: Production and Deployment; and

e. Phase IV: Operations and Support (DoD Instruction 5000.2, 1991:2-1).

As detailed in Chapter I, the project types of interest are those that include design (or systems integration) and development. As these types of projects are found mainly in Phase II of the acquisition process, the following discussion will be limited to contracts in that phase.

The DoD contracting process, for design and development contracts, can be divided into the following four activity areas:

a. planning the acquisition,

b. specifying the requirement,

c. evaluating the proposals, and

d. monitoring and controlling the resultant contract (Cavendish and Martin, 1987:16).

Each of these activity areas involves specific management actions. Furthermore, the effectiveness of each successive activity is dependent upon how well the preceding activity was done. Within the DoD, many of the actions required for each of these activity areas are completely defined. In this section of the literature review, each of these activity areas will be examined from a schedule-performance perspective. Furthermore, the impact on schedule management and the potential impact on schedule performance of the documents listed in the preceding paragraph, and other military standards, will be addressed. The management act ons identified in this section of the literature review were used to generate the candidate variable list discussed in Chapter III.

Planning the Acquisition

Adequate planning of each acquisition is fundamental to a successful project outcome (Pinto and Slevin, 1988:67; Thamhain & Wilemon, 1986:79; Nicholas, 1990:476). Within the DoD, the requisite management actions during the planning phase are contained in DoD Instruction 5000.2. With respect to schedule performance, Sections A and B of Part 5, Acquisition Planning and Risk Management, and Sections A and B of Part 6, Engineering and Manufacture, are relevant. The considerations presented in the following paragraphs are usually documented in the Acquisition Plan (AP), which is a high-level document used to ensure the effective integration of the acquisition events, documents, and activities required to satisfy the user's needs (ASC/CYX, 1992:24).

Acquisition Strategy. Section A of Part 5 of DoD Instruction 5000.2 relates to acquisition strategy. As stated in that document:

> A primary goal in developing an acquisition strategy is to minimize the time and cost of satisfying an identified, validated need consistent with common sense, sound business practices, and

the basic policies established by DoD Directive 5000.1, "Defense Acquisition". (DoD Instruction 5000.2, 1991:5-A-1)

During the development of the acquisition strategy, consideration is given to a number of factors that have the potential to impact schedule performance, as follows:

a. Consideration is given to streamlining the acquisition process, including the combining or eliminating of phases, the using of concurrent processes, and the streamlining of contractual requirements (DoD Manual 5000.2-M, 1991:4-D-1-2). These aspects, especially concurrency, increase the risks associated with the project, thereby increasing the likelihood that schedule delays will occur (DSMC, 1988: Appendix A, 8-9).

b. Consideration is given to the source of supply, including small disadvantaged businesses and areas where surplus labor exists (DoD Manual 5000.2-M, 1991:4-D-1-2). The choosing of a supplier for reasons other than ability to supply also increases the risk of schedule slippage (DSMC, 1988: Appendix A, 6).

c. Consideration is given to the competitive/noncompetitive aspects of each phase of each acquisition, including how competition will be sought, promoted, and sustained (DoD Manual 5000.2-M, 1991:4-D-1-3). The competitive process leads contractors to underestimate the time required for each task (Bent, 1982:129-131). Unless this effect is analyzed thoroughly at source-selection time, unrealistic acquisition time-scales may result.

d. Consideration is given to the type of contract: fixed-price or cost-plus, and the use of incentives (DoD Manual 5000.2-M, 1991:4-D-1-3 to 4-D-1-4). The type of contract can impact schedule performance; for example, a contractor operating under a fixed-price contract is more likely to produce within schedule. In addition, the DoD may use contract incentives to induce specific schedule performance from the contractor (Nicholas, 1990: 494-499).

Risk Management. Section B of Part 5 of DoD Instruction 5000.2 relates to risk management. As stated in that document:

> A risk management program shall be established for each acquisition program to identify and control performance, cost, and schedule risks [...]. The risk management program will consist of planning, identification, assessment, analysis, and reduction techniques to support sound program management decisions. (DoD Instruction 5000.2, 1991:5-B-1)

The management of risk affects every aspect of acquisition management (DSMC, 1988; DoD 4245.7-M, 1989; NAVSO P-6071, 1986; and CPG No 8 (draft), 1992). Effective planning for, and identification of, high risk areas, therefore, is essential for satisfactory schedule performance. Furthermore, DoD Directive 5000.1 states that "[s]chedule shall be subject to trade-off as a means of keeping risk at acceptable levels" (DoD Directive 5000.1, 1991:1-5). The implication of this directive is that all risks -- technical, cost, schedule, manufacturing, and logistics -- need to be accurately assessed during the planning phase to ensure that realistic schedule trade-offs and performance-requirements are generated. (Note, aspects of risk management will be discussed in more detail under the relevant areas.)

Systems Engineering. Section A of Part 6 of DoD Instruction 5000.2 relates to systems engineering. The systems-engineering-management process involves the integration of all engineering disciplines during the design and development process (DSMC, 1990:Ch 1,2). The more complex the design, the more engineering elements will be involved and the more managerial effort will be required. This will also increase the risk of schedule delays. Furthermore, engineering management of the contractor's design process involves the implementation and tailoring of MIL-STD-1521B, Technical Reviews and Audits for Systems, Equipments, and Computer Programs. MIL-STD-1521B breaks the design process into a number of phases and milestones (e.g., Preliminary Design Review (PDR), Functional Configuration Audit (FCA)). Typically, each milestone has a significant number of data requirements associated with it. The generation of these data requirements is time-consuming and can have a significant impact on schedule performance.

Work Breakdown Structure. Section B of Part 6 of DoD Instruction 5000.2 relates to the development of the work breakdown structure (WBS). In accordance with MIL-STD-881, Work Breakdown Structures for Defense Materiel Items, the SPO will develop a WBS for each applicable acquisition. A WBS is a "product-oriented family tree, composed of hardware, software, services, data and facilities" (MIL-STD-881B (draft), 1992:Sec I,2). Figure 2-3 provides an example of a WBS. The WBS defines all elements of the program, including all system-engineering and project-management elements. The WBS also provides the basis for the contractor to schedule the work to be performed. Furthermore, the WBS provides the basis for the application of earned value management systems (e.g., Cost/Schedule Control Systems Criteria

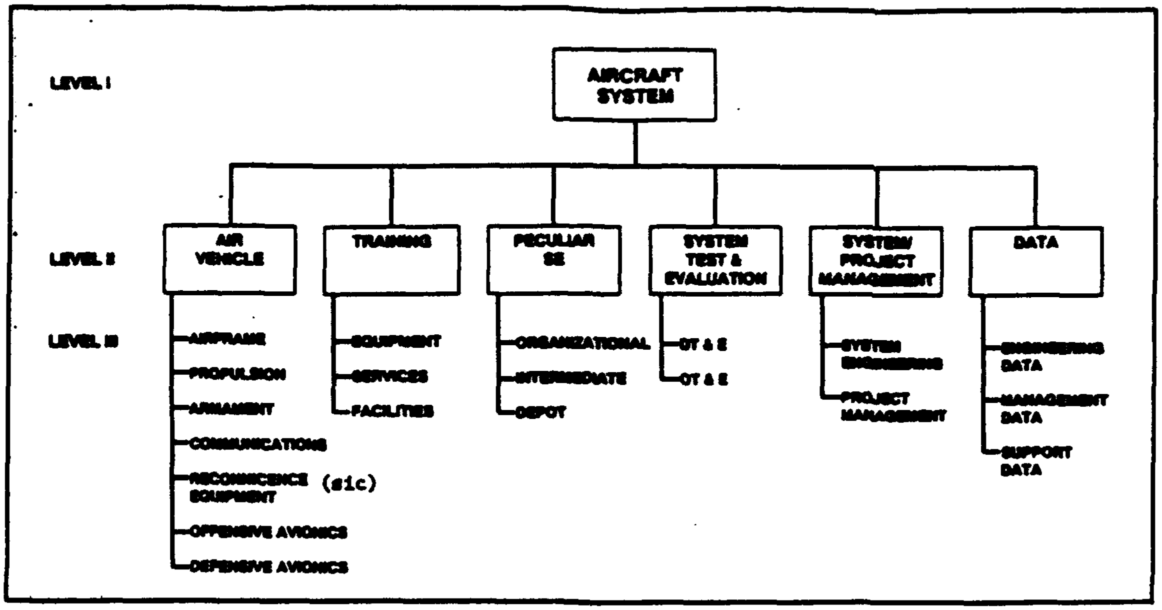

Figure 2-4. Example of a Work Breakdown Structure (Andrews and Adler, 1991:15)

(C/SCSC)). From the perspective of schedule management, therefore, the WBS is perhaps the most important planning document.

Specifying the Requirement

The specifying of a requirement involves a number of documents, including:

a. specifications,

b. a Statement of Work (SOW),

c. a Contract Data Requirements List (CDRL),

d. Data Item Descriptions (DIDs), and

e. other documentation required for a Request For Proposal (RFP) (e.g., Instructions To Offerors (ITO) and Evaluation Criteria) (Beck, 1991:4-7).

With respect to schedule performance, all of these documents are applicable (Beck, 1991:7). Through the application of the SOW, CDRL, and DIDs, the contractual requirements for the contractor's schedule performance (management and reporting) are defined. The correct generation of the SOW and CDRL, and the correct tailoring of DIDs, therefore, is vital for an acquisition to meet its schedule goals. This section of the literature review will discuss each of these document types from the perspective of schedule performance.

Specification. The specification provides the technical definition of the end-items required. Functional requirements are included in the System/Segment Specification (i.e., Type A) and the specific requirements are included in the Prime Item Development Specification (PIDS) (i.e., Type B1) or the Critical Item Development Specification (CIDS) (i.e., Type B2) (DSMC, 1990:10-3). An RFP for a development contract could be issued with either a Type A, Type B1, or Type B2 specification. Furthermore, each of these specifications could be either partially or fully developed. The degree of technical certainty associated with a particular acquisition is provided by the type of specification; that is, a functional specification involves higher technical uncertainty than a PIDS or CIDS, and a draft specification involves higher technical uncertainty than a fully developed specification. As technical uncertainty is known to be a contributing factor to schedule slippage, this aspect should be considered when analyzing schedule performance (Perry et al, 1971:16).

SOW. The SOW specifies the "work to be done [by the contractor] in developing or producing the goods to be delivered" (MIL-HDBK-245C, 1991:4). The content of the SOW is defined by the WBS, in that each element of the WBS is addressed by a section in the SOW (MIL-HDBK-245C, 1991:15). The SOW, therefore, includes all requirements for project management, including schedule performance (Andrews and Adler, 1991:15).

Furthermore, the SOW specifies the need for either C/SCSC or C/SSR (if required). All aspects that relate to schedule management, therefore, must be adequately specified in the SOW, including:

a. contractor's project-management responsibilities,

b. project planning,

c. Contract WBS requirements,

d. C/SCSC or C/SSR requirements,

e. project scheduling,

f. systems engineering management planning,

g. development planning,

h. test and evaluation planning,

i. manufacturing planning, and

i. integrated logistics support planning (DSMC, 1990).

To ascertain whether any recommended SOW clauses or guidance instructions were available to assist in the specifying of these requirements, a review of all the relevant MIL-STDs and MIL-HDBKs, available to the authors, was conducted. This review revealed that almost no standard clauses are available, and few guidance instructions are provided. An automated contractual documentation system, the Computer Generated Acquisition Documents System (CGADS), was found to exist; however, a previous thesis by Zabkar and Zimmerman revealed that this system was considerably out-of-date (Zabkar and Zimmerman, 1985:App. C, 57-58). Since 1985, CGADS has been updated; however, a range of SPO personnel that were questioned on the use of CGADS did not know that the system existed. The implication of this review is that the specifying of the schedule-management requirements is either generated anew for each SOW or copied from an existing SOW.

CDRL and DIDs. The CDRL specifies which data items are required, when and how the data will be accepted, where to look for preparation instructions, and where in the SOW the preparation effort is required (Beck, 1991:6). The DIDs provide the format and content (description) of each data item. In terms of schedule performance, therefore, the CDRL and associated DIDs provide the means to obtain the information which managers require to perform the monitoring and control function. A list of standard DIDs is contained in DoD 5010.12-L, Acquisition Management System and Data Requirements Control List (AMSDL). A review of the AMSDL and existing contracts revealed the following standard DIDs which either have been or could be used to obtain detailed schedule-performance information:

a. DI-A-3007, Program Schedule;

b. DI-A-3009, Program Milestones (Acquisition Phase);

c. DI-A-5004 & 5004A, Project Status Report;

d. DI-F-6000C, Cost Performance Report (CPR);

e. DI-F-6010A, Cost/Schedule Status Report (C/SSR);

f. DI-H-25772B, Progress Report;

g. DI-FNCL-80448, Life Cycle Cost (LCC) and Independent Schedule Assessment (ISA) Report;

h. DI-MGMT-80227, Contractor's Progress, Status and Management Report;

i. DI-MGMT-80368, Status Report;

j. DI-MGMT-80505, Program Evaluation and Review Technique (PERT)/Time Network Diagram;

k. DI-MGMT-80506, Program Evaluation and Review Technique (PERT)/Time Analysis Report; and

1. DI-MISC-81183, Master Integrated Program Schedule (MIPS). While the data items listed here will provide schedule information, care needs to be employed in their utilization to ensure that only the necessary information is provided to the Program Manager in a timely fashion and at the appropriate level of detail. In specifying schedule-management requirements, therefore, the ability to be proactive when managing schedule is dependent upon the particular DIDs selected, the timing for the submission of DIDs, and how the schedule-management information is integrated into a holistic project-management approach.

A current trend, with respect to obtaining schedule-management information, appears to be that the requisite information -- Gantt charts, networks, critical path information, organizational aspects, and resource requirements -- is included as a part of the major planning documents. Some examples of the major planning DIDs, which contain the requirement for detailed schedule information, are as follows:

a. DI-ILSS-80395, Integrated Support Plan (ISP);

b. DI-ILSS-80531, Logistic Support Analysis Plan;

c. DI-ILSS-81070, Training Program Development and Management Plan;

d. DI-MCCR-80030A, Software Development Plan;

e. DI-MGMT-80909, Program Plan;

f. DI-MGMT-81024, System Engineering Management Plan (SEMP); and

g. DI-MISC-80074, Manufacturing Plan.

The timely submission of schedule-management information requires that schedule information be obtained via a specific schedule DID. From this perspective, therefore, the need for detailed schedule information to be provided in each of the preceding plans is questioned. Furthermore, given that many contracts would include all of the preceding planning documents, the complexity of the schedule-management function is increased significantly.

Instructions To Offerors and Evaluation Criteria. The ITO describes to the potential offerors how to layout their proposals and which information is required. From a schedule-performance perspective, therefore, the ITO details to the offerors the information that is required to be delivered with respect to schedule performance to ensure that this aspect can be effectively evaluated during source selection. The evaluation criteria, on the other hand, explain to the potential offerors how the proposals will be evaluated, and which aspects are of importance to the procuring organization.

> Evaluation criteria should be tailored to the characteristics of a particular program and should include only those significant aspects expected to have an impact on the ultimate selection decision. Evaluation criteria consist of three types: cost (price) criterion, specific criteria, and assessment criteria. The cost (price) criterion relates to the evaluation of the offeror's proposed costs (price). The specific criteria relate to program characteristics. The assessment criteria relate to aspects of the offeror's proposal, abilities, and past performance. (AFR 70-15, 1988:14)

These two sections of the RFP, therefore, provide insight to the offerors of the relative importance of schedule with respect to the overall acquisition objectives.

Evaluating the Proposals

Section B of Part 5 of DoD Instruction 5000.2 relates to the selection of contractual sources. Specifically, this instruction states that the source-selection process shall provide for the "impartial, equitable, and comprehensive evaluation of each offeror's proposal" (DoD

Instruction 5000.2, 1991:10-B-1). With respect to the evaluation of schedule, the Instruction states that:

> [...] evaluation factors [in] solicitations typically *may* include [...] an assessment of the offeror's management, financial, technical, manufacturing, and other resources available or planned to develop and produce successfully the proposed system within schedule and resource constraints. [emphasis added to highlight that these evaluation factors are not mandatory] (DoD Instruction 5000.2, 1991:10-B-2)

DoD Instruction 5000.2 also provides a list of evaluation factors and some of the considerations associated with these factors. The requirements of the FAR, with respect to source selection, are implemented via Air Force Regulation (AFR) 70-15, Formal Source Selection for Major Acquisitions, and AFR 70-30, Streamlined Source Selection Procedures, which prescribe the policy and procedures for soliciting and evaluating offerors' proposals for major and non-major defense acquisitions, respectively (AFR 70-15, 1988:1). AFR 70-15 and AFR 70-30 also provide specific guidance on the areas that might be addressed under cost, specific, and assessment criteria. Specific criteria may include "technical, logistics, manufacturing, operational utility, design approach, readiness and support, test and management" (AFR 70-15, 1988:14). Assessment criteria typically include such aspects as "soundness of technical approach, understanding of the requirement, compliance with the requirement, past performance and the impact on schedule" (AFR 70-15, 1988:14). Note that schedule *per se* is not regarded as a specific evaluation criteria in either AFR 70-15 or AFR 70-30.

Within the source-selection-evaluation process, schedule is specifically addressed through risk-assessment procedures which evaluate each proposal with respect to cost, schedule, and performance or technical risks (AFR 70-15, 1988:17). As discussed in Chapter I, source-selection procedures within Aeronautical Systems Center (ASC) are currently undergoing revision to incorporate an analytical schedule-risk assessment into the evaluation process. The current plan is for the Source Selection Evaluation Team (SSET) to perform an analysis of each offeror's proposed schedule to determine the 90% probable completion date (ASC/FMC, 1993:1). Through this revised methodology, more realistic program schedules should result.

Monitoring and Controlling the Resultant Contract

For cost-plus contracts and some fixed-price incentive contracts, the two current methods for monitoring and controlling cost and schedule, as introduced in the history section of this literature review, are C/SCSC (and associated CPR) and C/SSR. Within these two earned value approaches to cost and schedule management, schedule performance is measured by comparing work accomplished against work originally planned, that is, by computation of the schedule variance. A number of authors (Fleming, 1988:179-187; Niemann, 1982:6; Webster, 1988:22) have highlighted that the schedule variance is problematic because it reveals no information about the critical path. As stated in the C/SCSC Joint Implementation Guide (JIG):

> A C/SCSC schedule variance is stated in terms of dollars' worth of work and must be analyzed in conjunction with other schedule information such as provided by networks, Gantt charts, and line-of-balance. By itself, the C/SCSC schedule variance reveals no "critical path" information, and may be misleading because unfavorable accomplishment in some areas may be offset by favorable accomplishment in others. A C/SCSC schedule variance is an "accomplishment variance" that provides an early indicator of *cost problems* when it shows the contractor is not meeting the internal work plan. Further analysis must be performed to determine the effect on contract cost and *schedule*. [emphasis added] (C/SCSC JIG, 1987:vi)

The analysis discussed in the previous paragraph is normally carried out by the contractor when completing either the CPR or the C/SSR. These reports are intended to be submitted to the DoD about 25 days after the close of the contractor's accounting month (C/SCSC JIG, 1987:vii). The CPR and C/SSR, therefore, provide little timely information for use by the SPO. Furthermore, no guidance could be found as to how to appropriately specify the requirements for an integrated schedule-reporting package (i.e., a combination of earned value reports and network analysis).

Summary

This section of the literature review has provided a discussion of a number of the factors, under the control of the DoD, which have the potential to affect schedule performance. A description of each of the factors was provided to show how each one fits into the contractual process from a schedule-performance perspective. Furthermore, some of the problem areas and shortfalls were highlighted. While this is obviously a complex problem, DoD personnel also need an understanding of the contractor's environment. The specifying of requirements in the RFP and the resultant contract must be based on the capability of contractors to meet those requirements; hence the need to understand those factors under the control of the contractor. These factors are discussed in the next section.

Factors Under The Control of The Contractor

Introduction

In the preceding section, the schedule-performance factors under the control of the DoD were discussed. Some of those factors are also under the control of the contractor, though with a somewhat different focus than the DoD. Additionally, there are a number of other factors that are contractor-specific. This section will outline some of the more significant factors under the control of the contractor. Specifically, the following subjects will be addressed:

a. work breakdown structure,

b. schedule-planning method,

c. estimation of activity time,

d. activity-responsibility allocation,

e. resource allocation, and

f. risk assessment.

The discussion of each of these factors will clarify the exact role of each factor in the contractual process, thereby assisting in the identification of candidate variables for the resultant schedule-performance analysis. In the following paragraphs, a brief description of each factor is provided, followed by a description of the contractor's ability to affect schedule performance through that factor.

Work Breakdown Structure (WBS)

Description. The description of the WBS was provided earlier in the section on factors under the control of the DoD. In addition to the uses described in that earlier section, the WBS performs a number of other functions for the contractor. From the contractor's perspective, the WBS provides a common framework for:

a. summing subdivided elements into the total project,

b. providing communication,

c. assigning responsibility,

d. authorizing work,

e. planning,

f. monitoring,

g. controlling, and

h. linking project objectives to company resources in a logical manner (Prentis, 1988:26).

Contractor Control. While the WBS may sometimes be initialized by the DoD in the SOW, the contractor is expected to develop the WBS to a level suitable for management of the contract.

> In general: 1) the greater the project complexity and technical requirements, the greater the number of WBS levels and [Work Packages] WPs; and 2) the greater the project cost and time span of the project, the greater the number of WBS levels and WPs. (Prentis, 1988:27)

The contractor, therefore, has direct control over the effectiveness of project management by the level of the WBS (and the resultant WPs) chosen. This is reinforced by Powers:

> The primacy of the WBS to the network cannot be underestimated. If there are doubts about the necessity of providing structure to the network, remember that a lack of structure is considered "a killer of the network technique". (Powers, 1988:40)

Schedule-Planning Method

Description. In the history section of this literature review, the Gantt chart, the Program Evaluation and Review Technique (PERT), the Critical Path Method (CPM), the Precedence Diagram Method (PDM), and the

Graphical Evaluation and Review Technique (GERT) were introduced as schedule-planning methods. Each method has characteristics that distinguish its usefulness for schedule planning and control, and some methods are generally superior to others. Both the contractor and the DoD must understand the purpose, advantages and disadvantages of each of these scheduling methods (Cori, 1985:82). Further information on the advantages and disadvantages of each method may be found in any project-management text (e.g., Nicholas, 1990).

Contractor Control. The DoD rarely specifies that a contractor utilize a particular schedule-planning method; hence, contractors can select a method that best fits their purpose. Although that degree of flexibility is desired, a contractor's influence on schedule-performance outcomes stems from how well the contractor utilizes the chosen method, and whether or not the chosen method is suitable for the requirements of the project (Bubshait and Selen, 1992:43). There is no doubt that selecting and implementing a suitable schedule-planning method is paramount to project succes; yet many project managers are reluctant to prepare a project plan (Cori, 1985:78; Bitner, 1985:64; Powers, 1988:43; Prentis, 1988:25; McNeil and Hartley, 1986:39). In a paper on the possible use of expert systems in project management, Avots states that:

> [...] one should note the fact that most of the capabilities already available from modern project management systems are not used. A common explanation is that managers do not understand the available techniques and therefore do not support their use. (Avots, 1985:54)

In simplistic terms, "It has been said that 'Failing to plan is planning to fail'" (McNeil and Hartley, 1986:43).

Estimation of Activity Time

Description. The result of the WBS development process is a set of work packages (WP) that form a core from which the total project time and cost estimate are derived. To estimate total project time, the contractor formulates a time estimate for each WP and then utilizes the schedule to aggregate those estimates into an estimated total project time (Nicholas, 1990:249, 282). Care must be taken during the aggregation process due to task dependencies and resource constraints (Nicholas, 1990: Ch 12, Ch 13).

Contractor Control. A time estimate for each WP can be the result of detailed knowledge or high subjectivity, depending on the contractor's previous experience. As projects are usually unique by nature, time estimates tend to be subjective and based on the previous experience of the scheduler, or more ideally on the experience of those best qualified to make the estimates (Cori, 1985:79-80; Nicholas, 1990:299; McNeil and Hartley, 1986:39). Thus, the more subjective the time estimation at the WP level, the more extreme the variance in the total project time estimate. This effect can be modelled for the project by consideration of classical probability theory applied to WP time estimates, where each WP time estimate is assumed to be an independent random variable (Hamburger, 1987:83; Toelle and Witherspoon, 1990:33). From a schedule-performance perspective, the generation of realistic activity-time estimates is fundamental to the achievement of schedule goals.

Activity-Responsibility Allocation

Description. In order to successfully execute the project, the contractor must assign the WPs generated by the WBS to discrete departments, internal managers, and/or subcontractors (if necessary) responsible for those WPs (Nicholas, 1990:238, 248-250; Prentis, 1988:27). Such delineation of responsibility helps to avoid "passing the buck" (Nicholas, 1990:252). The planning of the total project schedule can then involve inputs from the relevant WP managers. Figure 2-5 provides an example of a task responsibility allocation method for a project.

Contractor Control. The allocation of responsibility for each WP has similarities to the contract itself, in that there exists a client and a supplier relationship. Control of that lower level relationship

Responsibility Code

- P Primary responsibility
- S Secondary responsibility
- N Must be notified
- A Must give approval

Persons Responsible: Project Manager; Project Engineer (Design, Drawing, Software, Site Operations); Fabrication Manager (Assembly A, Assembly B)

Project Task or Activity	F.W.	J.M.	S.E.H.	R.L.Q.	P.J.	D.V.R.	R.I.P.	O.E.M.	P.V.P.R.	D.M.N.	R.L.	L.S.F.	L.L.L.	J.R.S.	D.V.Q.	F.W.N.	J.M.M.N.	L.O.T.	A.U.A.	D.A.R.	S.O.B.	E.N.	G.G.F.	R.T.T.	B.V.L.	B.J.	T.T.Y.	H.R.D.	B.V.-Purchasing
			Design				Drawing					Software				Site Operations						Assembly A				Assembly B			
Project coordination	P	S																			S								
Project development	A	P																											
Project design		A	P				A					N				A					N								N
H Basic design	N	A	A	P	S	S	N					N				N													
I Hardware design A			A		P	S																							
J Hardware design B			A	P		S						N																	
K Drawings B							A	S	P												N								
L Software specs		N	A									A	P	S	S														
M Parts purchase B		N																			A								P
N Parts purchase A		N																			A								P
O Drawings A							A			S	P										N								
P Installation drawings							A	P		P						N													
Q Software purchase		N																			A								P
U Assembly A		N																			N	A	P	S	S				
V Assembly B		N																			N					A	P	S	
W Test A		N														N					A	P							
X Test B		N														N					A					P			
Y Final installation		N														A	P	S	S										
Z Final test		N														A		P		S									

Figure 2-5. Example of a Project Task Responsibility Allocation Method (Nicholas, 1990:253)

may well be adequate for the WPs assigned within the contractor's organization; however, when the allocation is made to subcontractors, there may be a reduction in the level of control. Consequently, contractors must guard against the erosion of control when subcontractors are employed.

Resource Allocation

Description. The resources required to execute a project are many and varied, ranging from personnel to materials. As resources are finite, and work packages consume resources, the resources form additional project constraints within the network precedence arrangement (Bubshait and Selen, 1992:45; Cori, 1985:79; Nicholas, 1990:320-325).

Contractor Control. As the DoD does not have 'across the board' visibility of the contractor's allocation of resources, the contractor has the responsibility to ensure that the available resources are not overtaxed (Cori, 1985:79). If resource allocation is a limiting factor, careful analysis must be made of the time-for-resource trade-off, as the relationship may not be linear, may have no effect, or may even be detrimental (Powers, 1988:42-43; Hamburger, 1987:81).

Risk Assessment

Description. The risk associated with a project schedule is related to the probability of completing the project on time (Orczyk and Hancher, 1987:A.7.1). In a network-based approach to schedule-management, the critical path is defined as the longest path through the network (Nicholas, 1990:282). The overall risk, therefore, results from the risk associated with each task that lies on the critical path(s) or on the near-critical path(s); hence, those tasks should receive the majority of the management attention (Toelle and Witherspoon, 1990:34; Nicholas, 1990:297-298).

Different methods currently exist for determining the risk associated with a particular schedule. Each of these methods has advantages and disadvantages. A PERT-based approach to the scheduling of a project, for example, provides an easily calculated, but optimistic estimate for the total project duration (Nicholas, 1990:297). Furthermore, PERT does not enable resource-levelling to be conducted (Nicholas, 1990:313).

Contractor Control. To meet the schedule required by the DoD, the contractor can alter the estimated time for each activity, can change the precedence relationships between activities, or can do both. Precedence relationships can be described as natural, environmental, or preferential (Hamburger, 1987:82). Natural precedence is unalterable, so only environmental and preferential relationships can be altered by the contractor, normally with increased risk (Hamburger, 1987:82; Nicholas, 1990:298; Powers, 1988:43). "If several choices are available, the logic revision involving the least risk should be made" (Powers, 1988:43). Risk must be carefully judged against other project factors:

> To maximize the probability of success, the project planner must first establish a realistic expected completion date -- defined by the project's Critical Path -- with no regard for an arbitrary end date; and then selectively compress this required sequence of tasks by judicious resource management and prudent risk taking. (Hamburger, 1987:79)

As a corollary of the preceding discussion, the positive and negative aspects of the schedule proposed by the contractor should be assessed by the DoD to ensure that the schedule risk is acceptable. The DoD cannot successfully perform this assessment without an understanding of the assumptions, methods, and constraints that were employed by the contractor.

Summary

This section has discussed the factors under the control of the contractor (some of which are related to the DoD factors) that influence the up-front project-schedule estimation. Some of the significant factors are the work breakdown structure, schedule-planning method, estimation of activity time, activity-responsibility allocation, resource allocation, and risk assessment. Each of these factors requires careful consideration by the contractor in order to be able to propose, and then to execute, a project schedule that is as responsive, as responsible, and as accurate as possible. The DoD must also understand these factors to ensure that the generation of the contractual documents, the source-selection evaluation, and the management of the resultant contract are performed in the most efficient and effective manner.

Chapter Summary

This literature review investigated the factors relevant to the pre-contract-award actions by the DoD and the resultant schedule performance. To achieve this, a brief history of schedule management in the DoD was provided. Following this, a review was conducted of current research in the area of improving schedule performance. Finally, the factors under the control of the DoD and the contractor were discussed.

This literature review explained how the factors associated with planning the acquisition, defining the requirement, and evaluating the proposals have the potential to considerably impact on schedule performance. Furthermore, the review has shown that the factors associated with the contractors' schedule-management system -- WBS development, schedule-planning method, activity-time estimation, activity-responsibility allocation, resource allocation, and risk-assessment capability -- need to be understood by the DoD and appropriately addressed throughout the contractual process.

In essence, the factors relevant to the pre-contract-award actions by the DoD are those which are implemented through the Acquisition Plan, the RFP, and the resultant contract. To achieve acceptable schedule performance, therefore, the relevant component documents of the RFP and/or contract -- SOW, CDRL and DIDs, ITO, and Evaluation Criteria -- must clearly delineate requirements that are reasonable, realistic, and have been shown to positively affect schedule performance. To achieve this, the DoD requires an understanding of all the factors that have the potential to affect schedule-performance, their interactions, and the appropriate ways to incorporate those factors into the contractual process.

Chapter III will build on the factors covered in this chapter and will address the methodology employed in this study. Specifically, the population and sample are discussed, and the data-collection instrument and data sources are addressed. Finally, the statistical tests, required to answer the investigative questions, are presented.

III. Methodology

Introduction

The purpose of this study was to describe and characterize the relationship between pre-contract-award management actions by the DoD and the resultant schedule performance. As stated in Chapter I, to achieve this purpose required the identification of the relevant actions, and the measurement of the degree of impact that each of those actions had on schedule performance.

This chapter of the thesis addresses the methodology used for this research and, specifically, covers the following topics:

a. an explanation and justification of the methodology employed,

b. a description of the population and sample,

c. a discussion of the instrument development and testing,

d. a discussion of the data collection,

e. a discussion of the statistical techniques employed,

f. a listing of the operational definitions appropriate to the thesis, and

g. a summary of the chapter.

Explanation and Justification of the Methodology

The methodology employed in addressing the research question followed directly from the research-design classification. Furthermore, the statistical techniques employed followed directly from the investigative questions. Both of these aspects are discussed further in this section.

Research-Design Classification

The research-design classification format presented by Emory and Cooper was used to frame this research (Emory and Cooper, 1991:139-144). Initially, as a research question and associated investigative questions were able to be formulated, the research was classified as a formal study. Furthermore, to address the investigative questions, record analysis of past contracts needed to be conducted; the research, therefore, was further sub-classified as observational and ex post facto in design. Finally, to conduct the study, many contracts over a number of years needed to be examined; hence, the study was also sub-classified as longitudinal in nature.

Statistical Techniques

To satisfactorily answer the investigative questions, the relationship between a number of independent variables (i.e., pre-contract-award planning, scheduling, and evaluating variables) and a single dependent variable (i.e., schedule performance) needed to be analyzed. Furthermore, the thrust of the investigative questions resulted in the need for a predictive model of schedule performance. Many texts provided guidance in selecting appropriate statistical techniques; given the nature of the investigative questions, regression analysis was the recommended technique (Emory and Cooper, 1991:629; Andrews et al, 1981:3-30; Devore, 1991:453-454). Detailed discussion of the actual regression techniques employed in this thesis are presented later in this chapter.

Description of the Population and Sample

Population

The population of interest in this study consisted of all DoD acquisition contracts which were below the threshold where the Cost/ Schedule Control Systems Criteria (C/SCSC) were mandated, and which involved either design and development or systems integration. The population was limited to those contracts below the C/SCSC threshold to avoid many of the confounds that could arise from high-value, politically-sensitive acquisitions. In general, the contracts of interest were those let in Phase II of the DoD Acquisition Cycle: Engineering and Manufacturing Development (EMD) (DoD Instruction 5000.2, 1991:2-1). A population size could not be ascertained, however the population was certainly expected to number many thousands.

Sampling Frame

For economic and convenience reasons, the population was narrowed, via a sampling frame, to only include USAF contracts below the C/SCSC threshold at WPAFB. Furthermore, the sampling frame limited the contracts of interest to those within approximately the last 15 years, as files for acquisitions outside this time-frame were expected to be difficult to locate. This sampling frame was considered to be representative (and, therefore, unbiased) because all Services are mandated to use the same acquisition procedures (e.g., Federal Acquisition Regulations, DoD 5000 series of Directives and Instructions, etc). Furthermore, WPAFB has been the major acquisition center within the USAF; hence, the sampling frame was considered to be representative of DoD acquisition-contracting practice.

Sample Size

Due to the unique and exploratory nature of the research, coupled with the extensive primary data-collection effort required (as there were no secondary data sources in existence with all of the relevant information), the sample-size requirements were not derived using standard statistical guidelines. Instead, the sample size was left open-ended and subject to the vagaries of the data-collection process, as outlined in Chapter I and further described in this chapter.

Neter, Wasserman, and Kutner recommend that, as a general rule of thumb, there should be at least six to ten cases for every independent variable in a regression model (Neter, Wasserman, and Kutner, 1989:435). Under this guidance, therefore, the number of variables that will be able to be fitted in a regression model will be constrained by the actual sample size obtained.

From a statistical standpoint, the larger the sample size, the greater the statistical power, and the more variables that can be fitted in the regression model. With this understanding, the largest sample size obtainable, within the available time, was achieved. A total of 29 contracts were measured; however, schedule-performance information was only able to be obtained for 25 of these contracts. The four contracts, for which schedule-performance information was not able to be obtained, were retained in the database to increase the sample size for any deductions and inferences not related to regression modelling. The sample size of 25 was believed to be small in comparison to the population (i.e., less than 5%). This sample size, however, provides a reasonable ability to fit a small, yet managerially significant, set of variables to a regression model.

Overview of the Contracts Measured

The contracts measured ranged from as early as 1976 through to 1991. Many other potentially-measurable contracts existed in the SPOs; however, contracts more recent than 1990 had not progressed sufficiently for an adequate measure of schedule performance to be obtained. A complete listing of the 29 contracts that were measured is provided at Appendix C.

The majority of the contracts in the sample (15) were obtained from the Training (YT) SPO, while the remainder were obtained from a variety of SPOs and Directorates, including the Subsystems (SM) SPO (7), the Aircraft (SD) SPO (3), the Contracting (PK) Directorate (2), the Electronic Combat and Reconnaissance (EC/Reconn) (RW) SPO (1), and the Short Range Attack Missile II (SRAM II) (YG) SPO (1). The contracts involved a variety of different requirements: development of training systems, software development, aircraft modification, development of missiles, and development of specifications. In a very real sense, therefore, the contracts met the requirement that the sample be representative of DoD contracting practices.

To enable all contracts to be evaluated in an equivalent fashion, it was first necessary to convert the face value of each contract into constant dollars. Price Indexes for Federal Government purchases for each year were obtained and the face values of the contracts were adjusted to 1987 constant dollars (Department of Commerce, 1992:33). The face values of the contracts varied from $2,135,900 to $216,604,100 in constant dollar terms. A histogram showing the range of contract face values in constant dollars is given in Figure 3-1. All reference to contract face value, from this point, will be in terms of 1987 constant dollars.

Seven of the contracts measured required Cost Performance Reports (CPRs) to be submitted in accordance with C/SCSC requirements. While these contracts did not meet the specified project-characteristic criteria, they were included in the sample for a number of reasons. One of the contracts started out as a C/SCSC contract, but was changed to C/SSR via a contract modification. Four of the contracts that required C/SCSC were of relatively low dollar value (i.e., $8,068,600, $9,557,800, $24,883,000, and $25,738,400 in 1987 constant dollars); the utilization of C/SCSC, therefore, was not considered necessary, and the contracts were treated as if C/SSR had been specified. The sixth and

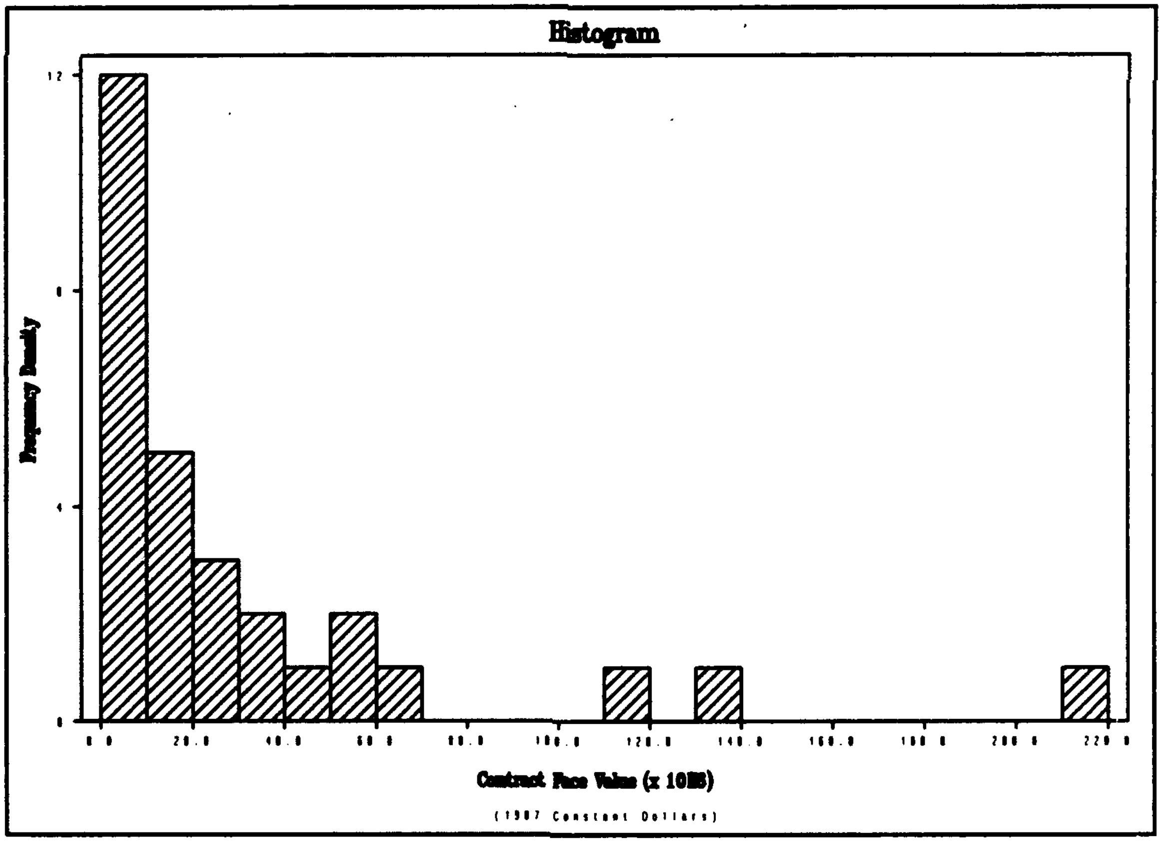

Figure 3-1. Histogram of the Face Value of the Contracts in the Sample

seventh contracts which required C/SCSC were measured in a time of frustration when contracts, which met the requirements and for which all the documents were available, were not forthcoming. Schedule-performance information was not able to be obtained for these two contracts and they were retained in the sample for the reasons provided earlier.

Instrument Development and Testing

The factors that were expected to have an impact on schedule performance were discussed in Chapter II. These factors were converted into a candidate variable list, a copy of which is given at Appendix B. Content validity of the candidate variable list was assessed using personnel from the Source Selection Office, ASC, WPAFB. The factors in the candidate variable list relate to pre-contract-award management actions only; however, to adequately assess schedule performance, other factors must also be considered. Additional factors were selected to address either the direct measurement of schedule performance or the measurement of confound and/or moderator variables (e.g., project characteristics and post-contract-award management actions).

When the list of potential variables was considered to be complete, a standard Data Collection Instrument (DCI) was developed. This DCI was refined during the data-collection process; a (reduced) copy of the final DCI is presented in Figure 3-2. The DCI is laid out, as follows:

a. page 1: contract details and project characteristics;

b. page 2: planning variables;

c. page 3: specifying variables; and

d. page 4: evaluating variables.

The variables being measured within each of these groups are explained in the following paragraphs.

DCI Page One: Contract Details and Project Characteristics

Most elements on the first page are self-explanatory; however, others require some clarification of meaning and intent.

CLIN. Generally, each contract deliverable or group of deliverables is specified via an allocated Contract Line Item Number (CLIN). The developmental item is typically CLIN 0001, while data and other support elements are itemized separately under subsequent CLINs or sub-CLINs. For developmental contracts, production quantities may be specified as either follow-on CLINs or option CLINs (though this is not always the case). For the purposes of this thesis, only the developmental portion of the contract was of interest; therefore, only the CLIN(s) which detailed the developmental item(s) was (were) recorded.

Description. The Description field provided for the name of the contract (i.e., the item(s) being procured).

Dollar Value. The Dollar Value field provided for the cost of the contract when originally let (i.e., face value); typically, the cost of the developmental item and associated support elements. For situations where this was not the case, the cost of the developmental item was separately specified in the designated field.

Number of Units Procured. The Number of Units Procured field included only the quantity of items actually being procured when the

DATA COLLECTION INSTRUMENT

Contract Number: ________-___-_-______; CLIN ______.

Description: ____.

Dollar Value: $___.___.___ (Basic). $___.___.___ (SMP only).

Number of Units Procured: ____.

Contract Type (FFP.FPIF.CPIF.CPFF): _______.

Sole-Source / Competitive (S/C): ___.

Small Business Set-Aside (Y/N): ___.

Development Only / Development & Production (D/D&P): ___.

Options for Production Units (Y/N): ___. Qty: ___.

Contract Start Date: ___ /___ /___.

Planned Finish Date: ___ /___ /___.

Actual Finish Date: ___ /___ /___.

Point in Contract for Above Dates: ______________________.

Number of ECPs/CCPs (at Finish Date): _______.

SPO: ____. Location: Bldg ____.

Contact(s): Rank/Class ______________. Rank/Class ______________.

Name ______________. Name ______________.

Phone ______________. Phone ______________.

[illegible]

DCI - 1

Planning Variables		
Schedule Strategy	Pre-scheduled 0=No, 1=Yes	
	Aggressive 0=No, 1=Yes	
	Concurrency 0=No, 1=Yes	
Sources of Supply	1 = 1 company 2 = 2 companies 3 = more than 2 companies	
Planned Contract Type	FFP = 1 FPIF = 2 CPIF = 3 CPFF = 4	
Schedule Risk	1 = low 2 = low - med 3 = med 4 = med - high 5 = high	
Technical Risk	1 = low 2 = low - med 3 = med 4 = med - high 5 = high	
Complexity	Cost	
	# end items for contractual delivery	
	# pages in SOW	
	# DIDs	
WBS -- measure of planning thoroughness	1 = undeveloped 2 = partially developed 3 = fully developed	
	# elements at lowest level (level 3 max)	
	lowest level developed	
Draft RFP	0 = No 1 = Yes	

DCI - 2

Specifying Variables		
Specification	1= less than draft A spec 2= partially dev'd A spec 3= fully developed A spec 4= partially dev'd B spec 5= fully developed B spec	
Statement of Work		
Develop WBS further	0 = No 1 = Yes	
C/SSR required	0 = nothing	
	1 = C/SSR only	
	2 = C/SSR with integrated schedule network	
Specific schedule management paragraphs 0 = No 1 = Yes	0,1 = Gantt chart	
	0,1 = Definitive network and Critical Path	
	0,1 = Probabilistic network and Critical Path	
	0,1 = Near Critical Paths as well	
	0,1 = Resource Constraint within program	
	0,1 = Resource Constraint between programs	
Frequency of reporting schedule management information	1 = as slippage occurs	
	2 = quarterly or less	
	3 = monthly or with C/SSR	
	4 = as slippage foreseen	
	5 = in combination with 4	
CDRL/DIDs	# DIDs related to project management	

DCI - 3

Evaluating Variables		
Evaluation Criteria	# criteria related to schedule management	
Contractor required to provide info to enable DoD to perform schedule risk assessment 0 = No 1 = Yes	0,1 = descriptive explanation of schedule risks	
	0,1 = Gantt chart	
	0,1 = network with definitive critical path	
	0,1 = network with probabilistic critical path (e.g., PERT)	
	0,1 = network with near critical paths identified	
	0,1 = resource constraints within program identified	
	0,1 = resource constraints between programs identified	
	0,1 = confidence levels for schedule (i.e., contingency)	
	0,1 = program length simulation study	
	0,1 = responsibility allocation	

NOTES:

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DCI - 4

Figure 3-2: Data Collection Instrument

contract was originally let, not including any options. Generally, given that the developmental portion of the contract was the focus of measurement, this field reflected the number of developmental items being procured.

Contract Type. The Contract Type field described whether the contract, when let, was fixed-price or cost-plus, and which type of pricing arrangement (e.g., incentives and award fees) was used. The scale chosen for this field reflected an increasing risk on the DoD, i.e., a fixed-price contract involved acceptance of total risk by the contractor, whereas a cost-plus contract involved total risk acceptance by the DoD. This dichotomy was further moderated by the inclusion of performance incentives.

During the data-collection process, it was discovered that some contracts utilized a mixture of contract types for different portions of the contract. For the developmental portion, however, a single contract type was always able to be identified.

When the DCI was originally developed, the expectation was that four contract types would cover the contracts in the sampling frame:

a. firm fixed-price (FFP),

b. fixed-price-incentive firm target (FPIF),

c. cost-plus-incentive-fee (CPIF), and

d. cost-plus-award-fee (CPAF).

During the data-collection process, however, two other contract types were found: fixed-price-incentive successive targets (FPIS) and cost-plus-fixed-fee (CPFF). To minimize the number of levels for this variable, the FPIS contract was treated as a FPIF contract and the CPFF contract was treated as a CPIF contract.

Sole-source / Competitive. The Sole-source / Competitive field reflected the nature of the procurement process from a competition standpoint. For reasons that are discussed in the following paragraph, this field was not completed.

During the data-collection process, it was discovered that sole-source contracts were not generally let using the standard RFP approach because source-selection evaluation was not required. While the RFP for a sole-source contract generally contained a SOW, a CDRL, DIDs, and a specification, it did not contain a Section M, 'Evaluation Factors for Award,' and, sometimes, it did not contain a Section L, 'Instructions to Offerors.' The sole-source contracts, therefore, did not contain any evaluating variables. To include these contracts in the analysis would have most likely required that a stratification of the sample be made based on competition. This would have resulted in an increase in the sample-size requirements and in the complexity of the analysis. For these reasons, sole-source contracts were not measured, though the spaces on the first and second pages of the DCI were retained where the competitive nature of the contract was intended to be annotated.

Small Business Set-Aside. The Small Business Set-Aside field moderated the previous field to reflect that, even when competitively bid, the bidders were restricted to small businesses. For reasons that are discussed in the following paragraph, this field was not completed.

During the data-collection process, it was discovered that many competitive Small Business Set-Aside contracts were not let using the standard RFP approach. A number of different situations were identified, one of which is described here. Small-business contractors that were interested in a particular contract were assessed, via a site visit, for their capability to meet the requirements of the contract. The contractor that was deemed to be the most suitable was then requested to respond to an RFP. Under this scenario, a Section M was not used and the resultant contract, therefore, was not suitable as a candidate for this research. Due to the difficulties associated with measuring Small Business Set-Aside contracts, it was considered that a representative sample of these contracts would not be obtainable. For these reasons, Small Business Set-Aside contracts were not measured, though the space on the first page of the DCI was retained where the measurement of this aspect was intended to be annotated.

Development Only / Development and Production. The Development Only / Development and Production (D/D&P) field pertained only to the CLIN(s) actually placed on contract when originally let. If the production requirements were included as options, the next field was relevant.

Options for Production Units. The Options for Production Units field provided information on whether or not production options were placed on contract (as option CLINs), and the quantity. This field and the previous one allowed for an assessment of the total estimated production quantity, and of the degree of certainty, to the contractor, of the production quantities.

Contract Start Date. The Contract Start Date field provided the effective date of the contract, as shown on the face page of the contract.

Planned and Actual Finish Dates. The Planned and Actual Finish Date fields generally measured the delivery of the developmental item(s); however, where this point was not reached, the latest measurable point in the contract was used. This tactic was employed to increase the sample size. To provide useful comparisons, contracts which had not reached Critical Design Review (CDR) were not assessed. If a contract met the appropriate criteria (i.e., development, not C/SCSC, and post-CDR) and the delivery date had not been reached, the most recent estimate of the delivery date was used. In all cases, the point of measurement was annotated in the appropriate field.

Number of ECPs/CCPs (at Finish Date). In recognition of the effect that post-contract-award actions may have on schedule performance, a variable was included to capture the number of approved contract modifications (e.g., Engineering Change Proposals (ECPs) and Contract Change Proposals (CCPs)) at the measured completion date. This variable was an attempt to encapsulate, as a surrogate variable, the *effect of all* post-contract-award actions on the resultant schedule performance. For contracts where an estimated completion date was used, the value of the number of ECPs/CCPs variable was scaled, as explained later in this chapter.

DCI Page Two: Planning Variables

The variables measured in this section were mainly gathered from the Acquisition Plan (AP). Very few of the variables, therefore, reflected 'planning' *per se*; instead, they reflected the Project Manager's understanding of the project characteristics and requirements during the planning phase. These variables were selected because the information required to measure the adequacy of planning was not generally available in contract files; to obtain insight into the reasons for selecting a particular acquisition strategy, knowledge of the planning team's thought processes was required. The variables included in this section, however, permitted an assessment of how well the summary measures of a project (e.g., assessment of risk) were related to project schedule performance.

Schedule Strategy. In the Schedule Strategy field, three sub-variables were measured: was the acquisition pre-scheduled, was the schedule considered aggressive, and was concurrency considered to achieve the schedule requirements? Pre-scheduling reflected that a schedule, other than the one that the bidders believed optimum, was forced on the resultant contractor. A schedule that was believed to be aggressive reflected that the resultant contractor would have to 'pull a large number of rabbits out of the proverbial hat' to meet the schedule requirements. Concurrency generally occurs between development and production, and is thought to affect only the production units; however, concurrency also places the contractor under pressure to finalize the prototype design (perhaps before the contractor is ready to do so), and, in the context of this thesis, was measured from this perspective.

Sources of Supply. The Sources of Supply field measured what was planned from a competitive perspective, as opposed to what actually occurred. The limited scale of measurement was chosen because it was believed that a non-competitive bid would contain different schedule-development pressures than a schedule developed under a competitive approach. An RFP aimed at three or more companies was felt to reflect a fully competitive acquisition, whereas an RFP aimed at two companies was felt to reflect an intermediate position. During the data-collection process, this field was not completed for the reasons given under the section pertaining to the Sole-source / Competitive field.

Planned Contract Type. The Planned Contract Type field mirrored the actual Contract Type field described previously. The rationale behind this approach was to detect any differences between the planned and actual contract types.

Schedule Risk. The Schedule Risk field measured the Program Manager's beliefs with respect to the schedule risks associated with the selected acquisition strategy. Theoretically, an acquisition with higher schedule risk should reflect a program that requires more attention to detail with respect to schedule management, and a program that requires more stringent monitoring of schedule performance. The assessment of schedule risk, therefore, should capture both these perspectives.

Technical Risk. Technical uncertainty is known to be a driver of schedule performance (Drezner and Smith, 1990:45; Merrow and Yarossi, 1990:H.6.4). The Technical Risk field, therefore, enabled an assessment of this perspective. Furthermore, the interactive nature of technical risk and schedule risk was able to be addressed through these measures.

Complexity. The Complexity variable, a project-characteristic variable, was included on the expectation that the more complex the acquisition, the greater the likelihood for schedule overruns. Furthermore, management requirements were expected to increase as the complexity increased. The variables chosen to attempt to measure complexity were: cost/unit, number of pages in the SOW, and the number of DIDs.

Work Breakdown Structure. The WBS was considered to be the primary planning document; hence, this variable was used to assess the adequacy of the planning effort. MIL-STD-881 is the document from which a WBS is generated, and the WBS is intended to be tailored as required for each program (especially for small-scale acquisitions). Three sub-variables were measured: the degree of development of the WBS, the number of elements at level three of the WBS, and the lowest level to which the WBS was developed. (Note, a SOW or DID that simply called out MIL-STD-881 as the starting point for the WBS was assessed as undeveloped.) Interestingly, during the data-collection process, the Preliminary WBS was usually found in the section of the ITO pertaining to the cost requirements.

Draft RFP. The Draft RFP field measured whether or not a draft RFP was released to industry for comment. While a 'Yes' response indicated better planning, a draft RFP may also have improved the quality of the requirements-specification; hence, this variable provided *an overlap* between planning and specifying.

DCI Page Three: Specifying Variables

Specification. The Specification field measured the level of specification that was placed on contract; specifically, whether a Type A (functional / system) or a Type B (prime item development) specification was used, and whether the specification was either complete or in draft form.

Develop WBS Further. The Develop WBS Further field captured whether the SOW tasked the contractor with further development of either the Preliminary WBS (supplied by the DoD) or the Contract WBS that was supplied as part of the contractor's proposal.

C/SSR Required. The C/SSR field captured whether a requirement for cost/schedule management, in accordance with C/SSR provisions, was placed on contract and whether the information provided under this requirement was coupled with network information to provide an integrated schedule-management approach. As discussed earlier, the four contracts, for which it was believed that the C/SCSC guidance had been inappropriately applied, were treated as if C/SSR provisions had been specified.

Specific Schedule-Management Paragraphs. The overall management of schedule can only be achieved if the DoD has visibility of the contractor's schedule and how that schedule is updated throughout the contract; hence, the contractor should be tasked, via the CDRL, with providing the necessary schedule information in the appropriate DID format. Six sub-variables were measured: the format of the schedule information (i.e., Gantt chart, deterministic network and associated critical path, or probabilistic network (e.g., PERT) and associated critical path), whether near-critical paths were required to be identified, and whether resource constraints, both within and between programs, were required to be identified and evaluated.

Frequency of Reporting Schedule Management Information. The ability to be proactive with respect to schedule management is dependent upon the frequency with which schedule information is provided to the DoD. This field was divided into five areas on an ordinal scale, in an attempt to assess this ability, as follows:

a. as slippage occurs,

b. quarterly or less,

c. monthly,

d. as slippage is foreseen, or

e. either the second or the third in combination with the fourth.

The first of these measures captures only a reactive approach, whereas the next two capture the possibility of a proactive approach. The fourth measure captures that reporting of schedule-management information only occurs if slippage is foreseen (i.e., proactively), while the fifth measure captures a more conservative approach where regular reporting is combined with the proactive approach.

CDRL/DIDs. The ability to manage an acquisition within schedule depends not only upon the schedule-specific information provided, but also upon the related project-management information provided. This field measured the number of DIDs related to project management; however, only the top-level DIDs were considered. Specifically, the following types of DIDs were included:

a. schedule-specific information,

b. program management plans,

c. contract requirements implementation plans,

d. WBS development information,

e. system engineering management plans,

f. development plans,

g. manufacturing plans,

h. integrated support plans,

i. logistic support analysis plans,

j. system test plans,

k. training development and support plans,

l. quality program plans, and

m. progress/status reports.

A list of DIDs which were considered to be relevant is contained at Appendix D. Note that any DIDs that related to a level of management below that given in the aforementioned list (e.g., support equipment plans, training equipment plans) were excluded.

DCI Page Four: Evaluating Variables

Evaluation Criteria. The Evaluation Criteria field attempted to capture the importance of schedule in the evaluation process, as elucidated to the contractor in the RFP. The expectation associated with this variable was that the number of explicit references to schedule, mentioned in Section M (Evaluation Factors for Award) of the RFP, provides contractors with insight into the relative importance of this performance criteria to the DoD and, hence, the priority that each contractor should place on schedule-management aspects.

Schedule-Risk Assessment Information. The ability of the DoD to perform a schedule-risk assessment is believed to be directly related to the amount and type of schedule information provided by a contractor within the RFP response. This field measured the type and depth of schedule information that was requested by the DoD in Section L (Instructions to Offerors (ITO)) of the RFP. Specifically, ten sub-variables were measured, as follows:

a. Was the contractor requested to provide a descriptive explanation of schedule risks?

b. In which format was the schedule information requested to be provided (i.e., Gantt chart, deterministic network and associated critical path, or probabilistic network (e.g., PERT) and associated critical path)?

c. Were near-critical paths required to be identified?

d. Were resource constraints, both within and between programs, required to be identified and evaluated?

e. Were separate schedules required for a number of different confidence levels (e.g., 50% and 90%)?

f. Was a program length simulation study required?

g. Was the allocation of program-specific responsibilities required to be identified?

These sub-variables measured the extent to which the information requested by the DoD facilitated the performance of a schedule risk assessment.

Summary of Instrument Development and Testing

This section of Chapter III has presented the DCI and the associated planning, scheduling, and evaluating factors that were considered to have the potential to affect schedule performance. The intuitive outcome for each of these factors was also described. The next section will detail the execution of the data collection.

Data Collection

Introduction

The collection of the requisite data proved to be more difficult and time-consuming than was originally envisaged. An overview of the methodology employed to obtain the resultant sample is presented in this section, in the hope that the insights gained through these efforts will be of benefit to future thesis teams.

Obtaining the Sample

Databases. The contracts required for this research were those which involved design and development, and which were below the C/SCSC threshold. The database from which the requisite sample was expected to be obtained was the Acquisition Management Information System (AMIS), a contract-management, as opposed to project-management, database. A second database was considered for obtaining the requisite sample: the Acquisition Planning and Tracking System (APTS) (recently renamed the Contract Management Network (CMN)). This second system is, in the main, a project-management database; however, it is only a few years old, and the contracts resident on the system have not progressed sufficiently to enable an accurate measure of schedule performance to be obtained.

Problems Encountered. Two problems were encountered with obtaining a listing of the requisite contracts from AMIS. In the first instance, AMIS does not have the ability to differentiate as to which phase of the acquisition cycle particular contracts relate; hence, it was not possible (initially) to obtain a listing of only design and development contracts. In the second instance, AMIS does not record whether a contract employs C/SCSC or C/SSR; hence, it was not possible to obtain a listing of contracts which excluded those contracts that employed C/SCSC. The first problem eluded resolution for some time; however, the second problem was addressed immediately.

Solution to the Second Problem. To overcome the second problem, a listing was obtained of contracts below the C/SCSC threshold: currently $60 million for research, development, test, and evaluation (RDT&E) contracts, and $250 million for procurement contracts (in fiscal year 1990 constant dollars) (DoDI 5000.2, 1991:11-B-2). Initially, only contracts having a face value below $60 million dollars were obtained; however, on further investigation, this approach was found to exclude many potentially useful contracts, and a second listing was obtained of contracts having a face value below $200 million.

Solution to the First Problem. A method of overcoming the first difficulty was not discovered until late in the data-collection process. Contracts which involve design and development must utilize RDT&E funding (i.e., '3600 money'). AMIS records the utilization of funding by Appropriation; hence, listings were able to be obtained of contracts which utilized RDT&E funding. While this did not ensure a 100% 'hit rate' on all potential contracts, it did significantly reduce the data-search requirements.

Obtaining Data for the Independent Variables

Data Sources. With the exception of one independent variable (i.e., the number of 'P00000s'), all of the data points for the independent variables were obtained from primary data sources (i.e., the contract files). The data points were extracted from three main contract-management documents, namely:

a. the Acquisition Plan (AP),

b. the Request For Proposal (RFP), and

c. the Contract.

The AP provided the planning variables, while the RFP provided the specifying and evaluating variables. The contract was used to provide the contract details and the project characteristics.

Requisite Sections of the RFP. A number of sections of the RFP were required for the data-collection process, including:

a. Section L - Instructions to Offerors (ITO);

b. Section M - Evaluation Factors for Award;

c. Statement of Work (SOW);

d. Contract Data Requirements List (CDRL); and

e. Specification.

CDRL. The CDRL specifies both standard and modified (tailored) Data Item Descriptions (DIDs). The modifications to the standard DIDs can be considerable. To assess the relevance of the DIDs included in the respective CDRLs, therefore, 121 DIDs were collected and reviewed. Of these 121 DIDs, the DIDs that were considered relevant to the analysis are listed at Appendix D.

Difficulties with Obtaining the Requisite Documents. Surprisingly, for a great number of contracts, one or more of the requisite documents, or sections of the requisite documents, were missing from the contract files. The RFP was the document most often missing and, typically, the same reason was the cause: during source selection, the RFP was stored with the source-selection files, and a copy was not placed in the contract files. Source-selection files are destroyed approximately six years after source selection, while contract files are destroyed approximately six years after the contract has been closed. Obviously, there could be many years difference between these two dates. This practice seems to have occurred most often for contracts prior to 1987; the Source Selection Office has advised that this practice has now ceased. For the purposes of this research, however, if the RFP was not located on the contract file, then it was generally not available and the contract was not able to be measured.

It is estimated that, had the requisite documents been available, the resultant sample size could have been more than doubled.

ECPs/CCPs. After all the data points had been collected for each of the contracts, a listing of the contract modifications (i.e., the 'P00000s') was obtained from AMIS. Initially, the intention was to investigate which 'P00000s' were likely to affect schedule performance (e.g., an ECP to significantly modify the developmental item is likely to affect schedule performance, while a CCP to change the obligation amount is not). To satisfactorily determine which 'P00000s' were significant, however, required that an investigation be made of each contract modification. As this was not possible within the available time, the total number of 'P00000s' was recorded on the DCI, as of the date when schedule performance was measured. For contracts where schedule performance was not able to be measured at the time of delivery of the major developmental item(s), either an earlier milestone date (e.g., Critical Design Review (CDR)) or a projected delivery date was used. In both instances, an assessment of the total number of 'P00000s' that was expected to occur over the total period of the contract was obtained via a linear scaling technique (i.e., if 25 'P00000s' were raised in the first half of the contract, then 50 'P00000s' were assumed to be the number that would be raised for the total contract).

Obtaining Data for the Dependent Variable

Data Sources. As indicated in the preceding paragraph, schedule performance was generally measured at the time of delivery of the major developmental item(s). When more than one major deliverable was involved and the delivery information was available, an average schedule performance was calculated. As delivery information was not available on the contract files, secondary (e.g., AMIS) and other primary data sources (e.g., the Program Manager) were used to obtain this information. A number of difficulties were encountered with attempting to obtain schedule-performance information, particularly from AMIS. These problems are described in the following paragraphs.

Section F of the Contract. Section F of the contract provides a list, in CLIN sequence, of the scheduled delivery dates. In many contracts, the block in which to place this information was annotated: As Required Herein (ASREQ). In the descriptive data section that accompanied each CLIN, however, specific delivery dates were stated. When the schedule information was transferred into AMIS, the ASREQ annotation was transferred, rather than the specific dates or times. In many instances, this precluded using AMIS to obtain the planned-schedule information.

AMIS History Database. After a contract is closed-out, the AMIS records are transferred to the history database. This database only stores the information originally entered into the active database when the contract was let and when each subsequent 'P00000' was raised. Any subsequent contract actions (e.g., delivery of items against a CLIN) are not stored and, hence, this information is lost. In many instances, this precluded using AMIS to obtain actual schedule information.

MOCAS. AMIS is not the database used by the Administrative Contract Officers (ACOs) during administration of the contract. The ACOs use the Mechanization of Contract Administration Services (MOCAS) database, which tracks planned and actual schedule for all items under a contract. MOCAS data is meant to be downloaded into AMIS on a periodic basis; however, with the exception of the Albuquerque Office, the downloading of data appeared to be sporadic. A second difficulty with the use of MOCAS for this research was that, after a contract has been closed-out, the data is deleted from MOCAS. This precluded using MOCAS to obtain the information for closed contracts that was not available on AMIS.

Supplementing AMIS. Due to the difficulties associated with AMIS, schedule-performance information was only able to be obtained from AMIS for approximately half of the sample. For the remaining contracts, schedule-performance information was obtained from the buyer or from the files used by the Program Manager (PM). DD250 forms record when deliverables are accepted by the DoD, and these forms are stored on the files managed by the PM. Due to the age of many of the contracts in the sample, this avenue was only utilized when all other approaches had failed.

Contracts Measured Prior to Delivery. Four of the contracts included in the sample were measured prior to delivery of the developmental item(s). Schedule performance for three of these contracts was assessed using the current estimated completion date. For each of these three contracts, the planned schedule delivery date had been exceeded and greater than 75% of the estimated contract period had elapsed; hence, using the estimated completion date was not perceived to introduce significant errors. The fourth contract, however, was measured at CDR, which occurred at a point only one-third of the way through the contract. To obtain a reasonable measure of schedule performance, the percentage overrun at CDR was calculated, as well as the predicted percentage overrun assuming that the number of months that the contract was currently over-schedule remained constant. An average of these two percentages was taken, and this was used as the measure of schedule performance. In all four cases, the number of 'P00000s' was scaled upwards, as discussed earlier.

Discussion of Error Sources.

Few errors were evident in the primary data sources because the majority of data being obtained was specific factual information (e.g., No/Yes (0,1)) from the documents themselves. Transcription errors may have occurred during the primary data-collection process; however, the likelihood was low due to the simplistic nature of the data. Other errors may have occurred during the data-collection process because of the interpretation involved with some of the independent variables (e.g., ascertaining which DIDs related to project management). To prevent errors when measuring these data points, care was taken when developing the operational definitions and the associated DCI to ensure that reliability issues (especially equivalence) and scoring consistency were adequately addressed. With respect to the secondary data sources, the validity of the data was occasionally questionable. Whenever these concerns arose, the suspect data was checked against the available primary data sources.

Summary of the Data Collection

This section of this chapter has described the actual methods used to obtain the sample, the requisite contractual documents, and the measurement of the independent and dependent variables. Furthermore, a number of difficulties associated with the data collection were addressed, in the hope that, through an explanation of these difficulties, future thesis teams could avoid similar pitfalls and disappointments. The next section of this chapter addresses the statistical techniques to be employed to answer the investigative questions.

General Linear Regression

Introduction

This section of Chapter III provides an overview of general linear regression and its application in this thesis. Specifically, this section provides:

a. an overview of general linear regression,

b. an introduction to the analysis techniques that were used to initially assess the data,

c. a discussion of the single-variable analysis techniques that were used to individually assess each independent variable,

d. a description of the multi-variable analysis techniques that were applied to build the requisite multi-variable regression models, and

e. an overview of the techniques that were used to assess the aptness of the models built in the preceding step.

Overview of Linear Regression

The theory of general linear regression is widely documented. A good reference on this subject is the Neter, Wasserman, and Kutner (1989) text detailed in the bibliography. Much of the background information provided in this section is derived from Neter, Wasserman and Kutner.

A regression model formally expresses the statistical relation between dependent and independent variables. A statistical relation is one in which the observations do not fall on a mathematically defined functional line; that is, the relation is not perfectly defined by a function. The two essential ingredients of a statistical relation are that the dependent variable must vary systematically with the independent variable(s), and that there must be a scattering of points around the statistical curve. Regression models encapsulate those ingredients by postulating that the dependent variable has a probability distribution for each level of the independent variable(s), and that the means of those probability distributions vary in a systematic manner with the independent variable(s).

Regression models with one dependent variable and one independent variable are called simple regression models; within this thesis, the term single-variable analysis is used to describe the analysis of simple regression models. Regression models with more than one independent variable are called multiple regression models; this thesis used multiple regression modeling to analyze the data set. As a number of different regression techniques were utilized, the general term, multi-variable analysis, was used to group these techniques under a single heading. Note that analysis of variance (ANOVA) models are also known as regression models (Neter, Wasserman, and Kutner, 1989:363). No matter how many independent variables may exist, single-variable regression analysis is an important step in gaining an understanding of the potential variable relationships within the data set, and in building a meaningful multiple regression model (Hosmer and Lemeshow, 1989:83).

In all regression modeling, the aim is to find the best-fitting, yet most parsimonious and meaningful, final model that provides an acceptable measure of the relationship between the dependent variable(s) and the independent variables (Neter, Wasserman, and Kutner, 1989:436; Hosmer and Lemeshow, 1989:82-83). Therein lies the challenge of regression modeling, as the aim is often at odds with the statistical ability supported by the data set. Statistical techniques allow the modeler to mathematically analyze the data set to determine the best fitting regression model within stated requirements.

Now that an overview of general linear regression has been provided, the remainder of this section is devoted to addressing the specifics of the analysis methodology for this research.

Initial Data Assessment

The first step in the initial data assessment was to study the data using a range of data-presentation techniques such as histograms, scatter plots, box-and-whisker plots, and frequency distributions, in combination with descriptive statistic values such as mean, median, mode, standard deviation, and skewness were utilized for this assessment. The Statistix 4.0 software was used to perform this first step of the initial data assessment (Analytical Software, 1992). This initial screening enabled some variables to be immediately excluded from further use in the analysis (e.g., where there was little to no variability across the sample or where two variables encapsulated the same information) (Neter, Wasserman, and Kutner, 1989:435). Furthermore, for categorical-level independent variables, the initial screening enabled low and zero cell counts to be identified. Where it made sense to do so, categories were collapsed to remove the low and zero cell counts (Agresti, 1990:247). The initial screening of the data, therefore, enabled a number of independent variables to be eliminated and, for categorical-level variables, enabled the appropriateness of the categorization to be assessed. After this initial assessment had been completed, the reduced set of independent variables was able to be studied further using the single-variable-analysis techniques described in the next section.

Single-variable Analyses

After the initial assessment of the data, a single-variable analysis of each independent variable with respect to the dependent variable was undertaken. Due to the formula used to calculate schedule performance, the dependent variable was a ratio-level measure. The single-variable analyses provided a measure of the relative statistical strength of each independent-variable to dependent-variable relationship, in isolation from other independent variables.

Based on the results of the single-variable analyses, each independent variable was acknowledged as either potentially useful in a multiple regression model, or likely to play no role in a multiple regression model. At this stage of the analysis, however, independent variables were not discarded entirely unless the relationship was blatantly poor, as variable interactions remained to be assessed (Hosmer and Lemeshow, 1989:86). Hosmer and Lemeshow recommend that a broad level of significance (e.g., α=0.25) should be utilized at the single-variable analysis stage to ensure that important variables are not overlooked (Hosmer and Lemeshow, 1989:86). For this research, the recommended level of significance (i.e., α=0.25) was utilized at the single-variable analysis stage.

Different analytical techniques were utilized for each different variable type: continuous or categorical. The following sections discuss those analytical techniques and provide justification for the techniques employed.

Continuous Variables. A simple linear regression (SLR) model was considered to be appropriate for assessing the relationship between a continuous independent variable and the dependent variable (Neter, Wasserman, and Kutner, 1989:52). This model assumes that the error terms are normally distributed with a mean of zero and constant variance, as well as having uncorrelated error terms. Violations of these assumptions was not considered to be of great concern at this single-variable analysis stage, due to the broad level of significance (i.e., α) used to classify the degree of the statistical relationship (Neter, Wasserman, and Kutner, 1989:73, 436). A two-sided t test with an α of 0.25 was used to test the null hypothesis that the estimated coefficient of the independent variable was equal to zero, versus the alternate hypothesis that the estimated coefficient of the independent variable was not equal to zero (Neter, Wasserman, and Kutner, 1989:69-71). The outcome of the test provided guidance as to whether or not each variable was likely to play a role in the multiple regression model-building process.

For each ratio-level independent variable, a poor or non-linear relationship was examined to ascertain whether an improved fit could be obtained by the use of a data transformation, such as a logarithm or an exponent, or through recategorization into an ordinal-level or a binary-level variable (Neter, Wasserman, and Kutner, 1989:435, 377-378). Where the transformation resulted in a categorical variable, the techniques described in the next section were applicable.

Categorical Variables. The categorical variables in this research were either binary-level or ordinal-level (i.e., more than two categories in a hierarchical order). Nonparametric tests were utilized to assess the relationship between the categorical variables and the dependent variable. These tests were employed for the following reasons:

a. Due to the exploratory nature of the research, there was no justification to assume that the population was normally distributed.

b. Also due to the exploratory nature of the research, an assumption of equality of variance between categorized groups of the dependent variable was not able to be justified.

c. Due to the small sample size, cell counts for some of the categorical variables were small. This meant that it was not possible to invoke the Central Limit Theorem (CLT) and assume that the means of the individual cells were normally distributed (Devore, 1990:220).

Generally, nonparametric procedures lose very little efficiency against the corresponding normality t and F tests when the underlying distribution is, in fact, normally distributed (Devore, 1991:594). The specific nonparametric tests that were used for each data type are detailed in the following paragraphs. The Statistix 4.0 software package was used to perform these single-variable analyses (Analytical Software, 1992).

Binary-level Variables. The relationship between each binary-level independent variable and the dependent variable was assessed by the Mann-Whitney (Wilcoxon) Rank-Sum test (Devore, 1991:609-615; Analytical Software, 1992:116-118; BMDP Statistical Software, Inc., 1992:616). The Mann-Whitney (Wilcoxon) Rank-Sum test provides a test for assessing the difference in means between two groups (i.e., the dependent variable categorized by the binary independent variable). An assumption of the Mann-Whitney (Wilcoxon) Rank-Sum test is that the underlying distributions are of the same shape and spread, although in common practice the test is employed without regard to spread (Devore, 1991:610; Analytical Software, 1992:117). The null hypothesis for this test is that the means of the two groups are equal, versus the alternate hypothesis that the means of the two groups are different. This test is applicable even when at least one of the two groups is small and the underlying distributions are quite nonnormal (Devore, 1991:609-610). Interestingly, the Mann-Whitney (Wilcoxon) Rank-Sum test does not suffer from extreme loss of efficiency in comparison to the t test when the underlying distributions are normal, yet it is a distinct improvement on the t test for nonnormality applications (Devore, 1991:615; Analytical Software, 1992:116).

As the Mann-Whitney (Wilcoxon) Rank-Sum test has a discrete probability distribution, an exact level of desired significance cannot always be achieved (Devore, 1991:612). At this stage of the analysis, however, this limitation was not considered to be a problem. As for the continuous-level variables, a significance level of $\alpha = 0.25$ was used in the Mann-Whitney (Wilcoxon) Rank-Sum test to provide guidance as to whether or not each variable was likely to play a role in the multiple regression model-building process.

Ordinal-level Variables. The relationship between each ordinal-level independent variable and the dependent variable was assessed by the one-way Kruskal-Wallis test, a nonparametric ANOVA. The Kruskal-Wallis test is an extension of the Mann-Whitney (Wilcoxon) Rank Sum test for differences in group means when there are more than two groups, and employs the same assumptions (i.e., that the underlying distributions are of the same shape and spread) (Analytical Software, 1992:128; BMDP Statistical Software, Inc., 1992:457, 616). This test is applicable even when at least one of the groups is small and when the underlying distributions are quite nonnormal (Devore, 1991:623-624). The null hypothesis for this test is that the means of all the groups are equal, versus the alternate hypothesis that at least two means are different. The one-way Kruskal-Wallis test statistic is approximately chi-square distributed for a minimum group size of six (when there are only three groups) or of five (when there are more than three groups) (Devore, 1991:624; BMDP Statistical Software, Inc., 1992:616). As for the other types of variables discussed above, a significance level of $\alpha=0.25$ was used in the Kruskal-Wallis test to help provide guidance as to whether or not each variable was likely to play a role in the multiple regression model-building process.

Summary of Single-variable Analyses. This section has addressed the specific single-variable-analysis techniques that were used to assess the relationship between each independent variable and the dependent variable. Different tests were employed commensurate with the data type. A broad level of significance was employed for these tests to ensure that important variables were not overlooked in the multi-variable analyses.

Multi-variable Analyses

The expected small sample size for this research did not allow more than a few variables to be meaningfully fitted in a multiple regression model (Neter, Wasserman, and Kutner, 1989:435). In essence, the steps leading up to this part of the multiple regression model-building strategy were necessary to enable the examination of possible multi-variable models with the most relevant, most statistically powerful, yet most parsimonious set of independent variables supported by the data set (Neter, Wasserman, and Kutner, 1989:436).

The goal of this research is to identify the factors which affect schedule performance, not to develop the 'one best model.' For this research, therefore, best subsets regression was considered to be the most appropriate analysis technique to answer the investigative questions. "With this procedure a number of models containing one, two, three, and so on, variables are examined which are considered the 'best' according to some specified criteria" (e.g., R^2, adjusted R^2, or Mallows' C_p) (Hosmer and Lemeshow, 1989:87). The results from the best subsets regression would provide a number of models of approximately equal explanatory power, but containing different variable combinations. The software available to perform the best subsets regression (BMDP and Statistix 4.0), however, would not execute with the full variable set. This difficulty precluded using best subsets regression as the primary analysis technique. Instead, a stepwise regression approach was employed in the first instance, and best subsets regression was used to supplement the information obtained through the stepwise approach.

The small sample size and large number of independent variables precluded the use of any backward stepwise multiple regression technique (Neter, Wasserman, and Kutner, 1989:437, 453; Hosmer and Lemeshow, 1989:106). Forward stepwise with backward elimination multiple regression, therefore, was the method selected to perform the multiple regression modeling. The forward stepwise method is a widely practiced model building approach, and is well documented (Neter, Wasserman, and Kutner, 1989:453-458; Devore, 1991:548-550).

The forward stepwise with backward elimination multiple regression method employs a step procedure to examine sequential regression models, commencing with a model containing only an intercept term (Step 0). At each successive step, an independent variable is added to, or deleted from, the model. Variable addition or deletion occurs in accordance with user-defined levels of a specific criterion (commonly termed the enter and remove limits). The specific criterion is usually the error sum of squares reduction, the coefficient of partial correlation, or the F^* statistic for the partial F test. The F^* statistic for the partial F test is probably the most commonly used criterion in the stepwise model-building approach, and was the criterion used for this research (Neter, Wasserman, and Kutner, 1989:241,453).

The partial F test is an application of the general linear test (Neter, Wasserman, and Kutner, 1989:95, 241, 283). The null hypothesis being tested is that the coefficient of the variable being added to or excluded from the model is equal to zero, while the alternate hypothesis is that the coefficient is not equal to zero (Neter, Wasserman, and

Kutner, 1989:283). A value of the test statistic, F*, that is greater than a user-defined critical F value (obtained from the F distribution for the appropriate degrees of freedom and the desired level of significance (i.e., α)) leads to the rejection of the null hypothesis; hence, the variable is included in the model (Neter, Wasserman, and Kutner, 1989:283).

As the relationships being studied have not been well researched, liberal enter and remove limits were employed for the multiple regression model-building process (Hosmer and Lemeshow, 1989:106, 108). A significance level of $\alpha=0.05$ was considered to be too restrictive for the partial F test; therefore, an $\alpha=0.1$ was used to obtain a balance between over-fitting and under-fitting the multiple regression model (Neter, Wasserman, and Kutner, 1989:453). With the sample size of 25, an $\alpha=0.1$ approximately relates to a critical F value of three, as shown in Appendix G. The liberal enter and remove limits allowed for the likelihood that weak, yet significant and meaningful relationships, were considered in the model-building process.

Treatment of Ordinal-level Variables. In a regression model, ordinal-level variables can be treated in one of two ways: firstly, the ordinal scale can be assumed to be based on a known underlying interval scale; and secondly, the ordinal scale can be assumed to not be based on a known underlying interval scale (Neter, Wasserman, and Kutner, 1989:376-377). In the first case, the ordinal-level variables are treated as if they are interval-level variables (with the appropriate scaling), while in the second case, the ordinal-level variables are modelled using dummy (binary) variables (Neter, Wasserman, and Kutner, 1989:349-350). For the analyses conducted for this research, all ordinal-level variables were recoded into dummy variables. This decision was taken because an underlying interval-scale could not reasonably be assumed, given the exploratory nature of the research.

When an ordinal-level variable is coded using dummy variables, the result is to create one less variable than there are categories in the ordinal scale of the variable (Neter, Wasserman, and Kutner, 1989:360). The dummy variables that are created through this process must be treated as a set; that is, all of the dummy variables must be entered in, or removed from, a regression model together (Hosmer and Lemeshow, 1989:32). The requirement to treat the dummy variables as sets was a limiting factor when considering the choice of statistical software.

Statistical Analysis Tools. Statistix 4.0 Analytical Software (running on a home personal computer) and the BMDP Release 7 Statistical Software (running on the AFIT Hercules mainframe computer system) were the two software packages used to perform all the statistical analyses. Two limitations of the Statistix 4.0 stepwise regression procedure are that:

a. the software cannot model dummy variables as sets; and

b. the software does not allow the user to exercise control over the multicollinearity exclusion-criterion level (Analytical Software, 1992:143-144).

The BMDP program 2R for performing stepwise regression, on the other hand, does not exhibit these limitations; hence, this software program was used to conduct the stepwise model-building procedure (BMDP Statistical Software, Inc., 1992:387-425). After a model had been obtained from the stepwise procedure, Statistix 4.0 was used to obtain diagnostics and graphical plots.

Multicollinearity. Multicollinearity is the condition which exists when there is correlation between independent variables in a multiple regression model (Neter, Wasserman, and Kutner, 1989:296; Devore, 1991:552). Several undesirable effects occur within the model if the independent variables display multicollinearity; however, a good multiple regression model can be obtained if multicollinearity is identified and accounted for, either in the model-building process or in the use of the model (Neter, Wasserman, and Kutner, 1989:300-305, 411; Devore, 1991:552-553). A model-building regression procedure must, therefore, allow for the possibility of variable multicollinearity at each stage of the analysis, so that potential multicollinear relationships can be identified and that remedial measures can be taken.

The variance inflation factor (VIF) is a widely used method for detecting the presence of multicollinearity (Neter, Wasserman, and Kutner, 1989:408). The VIF "measure[s] how much the variances of the estimated regression coefficients are inflated as compared to when the independent variables are not linearly related" (Neter, Wasserman, and Kutner, 1989:408). A VIF value in excess of 10 is commonly used as an indication that multicollinearity is having an adverse effect on the regression model (Neter, Wasserman, and Kutner, 1989:409; Analytical Software, 1992:145; Devore, 1991:552-553). To preclude multicollinear variable relationships from the final model, this research employed a VIF of 10 for the model-building process. Within the BMDP 2R program, the tolerance command (TOL=[value]) is used to set the VIF level; a TOL=0.1 command equates to a VIF of 10 (BMDP Statistical Software, Inc., 1992:610).

The approach exercised by the BMDP 2R program, through the tolerance level command, is that of excluding independent variables from entering a stepwise model whenever the VIF level is exceeded (BMDP Statistical Software, Inc., 1992:610-611). Neter, Wasserman, and Kutner acknowledge that there are some limitations with this approach; however, the relative advantages and disadvantages, in comparison with other approaches, were not regarded as severe for this research (Neter, Wasserman, and Kutner, 1989:411).

Interaction of Variables. Interaction is the term used to describe the effect, in a multiple regression model, where an expected change in the dependent variable, resulting from a change in one independent variable, depends on the value of another independent variable (Devore, 1991:528; Neter, Wasserman, and Kutner, 1989:232). To include interaction terms in the model-building process, the cross product of the independent variables is obtained, thereby creating a new variable (Neter, Wasserman, and Kutner, 1989:355-356). For ordinal-level variables, the interaction terms were created from the raw data, and the resultant variables were then recategorized into dummy variables, as explained earlier. Within this research, the large number of independent variables precluded an effective study of all possible two-way or three-way interaction terms. Due to the exploratory nature of this research, the interaction terms that were included in the model-building process were derived using logical considerations only.

Several methods exist for including interaction terms in the model-building process. The first method, termed hierarchical modelling, assumes that, for an interaction term to be included in the model, all the main effect terms must also be in the model (Agresti, 1990:144). The second method, termed non-hierarchical modelling, assumes that the inclusion or exclusion of an interaction term is independent of the main effect terms (Agresti, 1990:216). Due to the small sample size, this research used a non-hierarchical model-building approach. This decision was considered reasonable for a number of reasons, which were that:

a. the interaction terms included in the model-building process were able to be interpreted from a stand-alone perspective,

b. a larger number of interaction terms were able to be studied, and

c. a larger number of interaction terms were able to be included in the final model.

For these reasons, a non-hierarchical model-building approach was believed to result in a final model that was more representative of the real world, where management actions are known to be interdependent.

Assessment of Model Aptness. Analysis of the possible relationships under study did not end with the regression model resulting from the stepwise model-building process. Firstly, the resultant model was assessed to determine whether there were any important departures from the assumptions associated with the normal-error regression model. Secondly, diagnostics were used to assess whether there were any individual cases which were having a significant influence on the coefficients of the resultant model. The following sections will describe the specific techniques used to achieve these objectives.

Departures from the Assumptions. To assess any departures from the assumptions associated with the normal-error regression model, the following features were studied:

a. nonlinearity in the regression function;

b. nonconstant variance of the error terms;

c. nonindependence of the error terms;

d. good model fit, except for a few outliers;

e. nonnormality of the error terms; and

f. omission of some important independent variables from the model (Neter, Wasserman, and Kutner, 1989:116).

These features are described in the following sections.

Nonlinearity of the Regression Function. A plot of the residuals against the fitted values was used to assess for nonlinearity of the regression function. This plot reveals whether the residuals display a systematic pattern around the fitted regression line; a good regression model does not display any significant pattern (Neter, Wasserman, and Kutner, 1989:118, 247).

Nonconstancy of Error Variance. The residual plot generated for the previous assessment was also used to subjectively assess for any indications of nonconstant error variance (Neter, Wasserman, and Kutner, 1989:247). This 'visual' approach provided only a coarse measure for this assessment; however, this was considered to be satisfactory given the nature of this research.

Nonindependence of Error Terms. Autocorrelation is the term used to describe the situation where the error terms in a regression model display a time-dependent basis. This situation normally arises when one or more key variables have been omitted from the model (Neter, Wasserman, and Kutner, 1989:484). For this research, autocorrelation was not expected to be significant as it was highly unlikely that the contracts measured showed time-dependency: there was no reason to propose that the particular contracts measured were dependent in any way. Even though autocorrelation was not expected, the Durbin-Watson test was performed to ensure that the assumption of independence of the error terms was supported.

The Durbin-Watson test for autocorrelation relies on the calculation of a test statistic value, D, based on the time-series order of the error terms (Neter, Wasserman, and Kutner, 1989:491-492). This was easily accommodated within the final regression model, as the contracts measured were arranged in contract-number sequence (a de-facto time-series arrangement by definition of contract number). For this test, the null hypothesis is that the autocorrelation parameter is equal to zero, whereas the alternate hypothesis is that the autocorrelation parameter is not equal to zero. When there is no autocorrelation, the Durbin-Watson test statistic will be close to two; however, when positive autocorrelation is present, the value of the test statistic will be close to zero, and when negative autocorrelation is present, the value of the test statistic will be close to four (Analytical Software, 1992:146). A significance level of $\alpha=0.05$ was used for this test.

Presence of Outliers. A plot of the standardized residuals against the fitted values was used to assess for the presence of outliers of the dependent variable (Neter, Wasserman, and Kutner, 1989:121, 247). Cases where the standardized residuals were more than three standard deviations from the fitted regression line were flagged as potential outliers. A simple probability test, utilizing the prediction interval, was used to assess the potential outliers. To perform this test, a new regression model was fitted without the outlier(s) in the sample. A 99.0% prediction interval, associated with each outlier, was then obtained. If the measured value for the outlier was outside the 99.0% prediction interval, then this result was considered to support a hypothesis that the outlier had come from a different population to the rest of the sample (Neter, Wasserman, and Kutner, 1989:130). Outliers were not excluded from the sample on this basis alone; instead, this result was considered in combination with the result from the influence assessment before an exclusion decision was made.

Nonnormality of Error Terms. A normal probability plot of the residuals, the Wilk-Shapiro Rankit Plot, was used to assess for nonnormality of the error terms For the sample sizes of 25 and 23, and at a level of significance of $\alpha=0.05$, the critical Wilk-Shapiro test statistic lower limits of 0.918 and 0.914, respectively, were appropriate to accept or reject the assumption of normality for the distribution of the error terms (Conover, 1980:468).

Omission of Important Independent Variables. Due to the sample size limitations, the complexity of schedule management, and the significant number of variables involved in the analysis, it was highly likely that important independent variables were overlooked at some stage of the methodology, and also highly unlikely that these omissions were detected. The single-variable analyses and the stepwise model-building procedure, employed in executing this research, was expected to identify all important variables from those identified for the study.

Identification Of Influential Cases. A number of measures are available to assess the possible influence of cases in the model: a leverage measure, a residual measure, and a combined measure. The leverage measure assesses the influence of a case in determining the regression coefficients; however, this measure only considers the effects of the independent variables (Neter, Wasserman, and Kutner, 1989:392-397). The residual measure assesses the influence of each observed value in determining the regression residuals; however, this measure only considers the effects of the dependent variable (Neter, Wasserman, and Kutner, 1989:398-400). A combined measure considers the effects of both the dependent and independent variables (Neter, Wasserman, and Kutner, 1989:401-406). Given the goals of this study -- to identify factors that influence schedule performance -- a combined measure was considered to be the most relevant diagnostic, of the three discussed here, for assessing outliers (BMDP Statistical Software, Inc., 1992:402; Neter, Wasserman, and Kutner, 1989:403-404).

The combined measure that was used to assess the influence of each case on the estimated regression coefficients was Cook's distance (Neter, Wasserman, and Kutner, 1989:403-404; BMDP Statistical Software, Inc., 1992:403). While this measure is not F distributed, a comparison of the measure to the corresponding F distribution percentile-value is useful for interpreting the degree of influence of each case in the model (Neter, Wasserman, and Kutner, 1989:403-404). Neter, Wasserman, and Kutner state that a Cook's distance with a corresponding F distribution percentile-value of "less than about 10 or 20 percent" has little apparent influence on the regression coefficients, while percentile-values "near 50 percent or more" imply that the case has significant influence on the regression coefficients (Neter, Wasserman, and Kutner, 1989:403). Based on this recommendation, a Cook's distance percentile-value in excess of 20 percent was considered to be an outlier which required further assessment. Note that this measure is not a test statistic; hence, there is not a significance level (i.e., α) associated with it.

Statistix 4.0 was used to provide data and a plot, as necessary, of a transformation of the Cook's distance associated with each case. This transformation takes into account the sample size and the number of independent variables in the model, in that Statistix 4.0 calculates a value equal to one minus the corresponding F distribution percentile-value (Analytical Software, 1992:152-153). The implication of this calculation is that outliers are identified when the transformed Cook's distance is less than 0.8.

As stated by Neter, Wasserman, and Kutner:

> [...] an outlying influential case should not be automatically discarded, because it may be entirely correct and simply represents an unlikely event. [...]. If, on the other hand, the circumstances surrounding the data provide an explanation of the unusual case which indicates an exceptional situation not to be covered by the model, the discarding of the case may be appropriate. (Neter, Wasserman, and Kutner, 1989:405-406)

Using this logic, the final decision to exclude a contract from the sample was based on a subjective assessment of that contract, and whether the contract represented an unusual case.

Summary of Model Aptness Assessment. As described in this section, the model that resulted from the stepwise model-building procedure was subjected to a wide range of aptness assessments, ranging from an investigation of any departures from the assumptions of the normal-error regression model, to the identification and the study of influential cases in the model. Aptness assessment was a vital step in verifying, and adjusting, the model to ensure that only statistically supported factors, that influence schedule performance, were identified.

Best Subsets Regression. As discussed earlier in this chapter, the small sample size precluded using best subsets regression as the primary analysis technique. This situation arose because the software programs (i.e., BMDP 9R and Statistix 4.0) were unable to execute correctly with the small sample size and the number of independent variables under investigation. Best subsets regression, however, was able to be used to supplement the information obtained through the stepwise regression approach. A number of difficulties with the execution of best subsets regression still remained, however, and these difficulties are discussed in the following paragraphs.

The first difficulty with the best subsets approach was that neither software program would allow the ordinal-level variables, that had been recoded into dummy variables, to be entered into the model as sets. Due to this difficulty, all the ordinal-level variables were recoded into binary-level variables.

The recoding of the ordinal-level variables into binary-level variables still did not allow BMDP 9R to execute correctly. Despite considerable assistance from BMDP Technical Support Staff, the difficulties with this software program could not be overcome. Statistix 4.0, therefore, was used to conduct the best subsets regression. This software has some additional restrictions which are explained in the following paragraphs.

Statistix 4.0 will only allow 20 unforced variables and 20 forced variables to be used with the best subsets regression program

(Analytical Software, 1992:164). Furthermore, this program is restricted to reporting a maximum of 150 best subsets (Analytical Software, 1992:163). Due to these two restrictions, the program can only produce a limited number of best subsets for each subset size. For the number of variables involved in this analysis, these restrictions meant that only the seven best subsets could be obtained at each subset size for any one run.

To overcome the restrictions concerning the number of forced and unforced variables, the variable set was reduced. Firstly, a decision was made to model the main effects only. Secondly, a number of variables were combined as interaction terms (i.e., the cross product was obtained). Finally, variables which were found to have little significance during the stepwise regression analyses were dropped from the best subsets analyses. Using these techniques, which are explained in more detail in Chapter IV, the number of variables used for these analyses was reduced to 20 unforced variables in all cases. This restriction, however, did not prove to be a limitation, as the results obtained showed that further best subsets would not contribute to the goals of the analysis.

The best subsets algorithm in Statistix 4.0 analyzes the variable set to determine the best subsets based on the adjusted R^2 for each model. This approach, however, may result in a number of models which include variables which are not significant. To ascertain whether this situation had occurred, each of the best subsets were analyzed further using the linear regression program in Statistix 4.0 (Analytical Software, 1992:143-162). The p-value associated with the t test for each of the variables in each of the models and the p-value associated with the overall F test for each of the models were obtained. These results were then analyzed to determine whether the variables and the models were significant ($\alpha=0.1$). A study of aptness was not conducted for each of these models, because this degree of rigor was not considered to be necessary given the limitations of the best subsets approach.

The best subsets regression approach enabled a number of factors to be identified which had not been identified through the stepwise regression approach. Despite the software limitations, the use of the best subsets technique was considered to be beneficial and to provide significant additional insights into the nature of schedule performance and schedule management.

Summary of General Linear Regression

This section of Chapter III has provided an overview of general linear regression and its application in this thesis. Firstly, the techniques that were used to initially assess the data were described. Secondly, the single-variable analysis techniques, for assessing the relationship between each of the independent variables and the dependent variable, were discussed. Following this, the multi-variable analysis techniques -- stepwise regression and best subsets regression -- were discussed. Finally, the techniques that were used to assess the aptness of the models were addressed.

Operational Definitions

The following list provides the operational definitions for the terms used in this research:

a. Acquisition Contract. An acquisition contract was defined as a contract which was executed within the context of the DoD acquisition process (i.e., using phased design and development).

b. Schedule Performance. For the purposes of this research, schedule performance was defined as the percentage overrun of a contract from its target period of performance. In mathematical terms, schedule performance was calculated as follows:

$$SP = \frac{PP_A - PP_C}{PP_C} * 100\%$$

where:

PP_A = Performance Period (Actual)

PP_C = Performance Period (Contracted)

Note that schedule performance can be negative if the contract finishes ahead of time.

Chapter Summary

This chapter has described the methodology that was employed to address the investigative questions. The population, sampling frame, and sample were described. Furthermore, justification for the representativeness of the sample was also provided. Next, the data-collection instrument and its implementation were described, along with the data collection methodology and the associated problems. A description of, and justification for, the statistical techniques followed, including details of the specific tests that were employed and the required level of significance for each test. The stage has now been set for Chapter IV to detail the data analysis and results, and for Chapter V to detail the research findings and conclusions.

IV. Findings and Analysis

Introduction

The relationships between the measured pre-contract-award management actions by the DoD and the resultant schedule performance were assessed using the analysis techniques described in the previous chapter. This chapter will present the results obtained through the analyses, thereby setting the stage for the conclusions and recommendations.

To present the data and results obtained, this chapter will address the following topics:

a. a detailed presentation of the single-variable analyses;

b. a detailed presentation of the multi-variable analyses; and

c. a discussion of the results.

With respect to the presentation of analyses, it is typical for these analyses to be presented from the perspective of each of the research questions. Given the nature of this research, however, it was felt more appropriate to first describe the results for each of the analyses and then to address the results in terms of the specific research questions.

Single-variable Analyses

Introduction

This section of Chapter IV will address the single-variable analyses for all of the independent variables. As discussed in Chapter III, different single-variable-analysis techniques will be conducted for each variable type: continuous and categorical. Specifically, this section will present:

a. an introduction to the variables involved,

b. a discussion of the dependent variable, and

c. a detailed description of each of the single-variable analyses for each of the independent variables.

Introduction to the Variables

Forty-one variables were entered into a data set after the data-collection process was completed. These variables are listed at Appendix E along with the raw data associated with each of these variables. Not all of these variables are relevant to the analysis: contract number (CNO) is not an independent variable, and the face-value variables (FVALUE1 and FVALUE2), the gross domestic product deflator (GDPDEFL) variable, the adjusted face-value variables (FV87CDOL1 and FV87CDOL2), and the number of units procured (NOUNITS) variable are all intermediate variables used to obtain the unit cost in constant dollars (UCOSTCD) variable.

Dependent Variable

SCHEDPER and SCHEDMOD. The schedule performance variable was abbreviated as SCHEDPER. Schedule performance was measured as the percentage overrun; hence, a negative result indicated that delivery was achieved ahead of schedule. Schedule performance information was only able to be obtained for 25 of the 29 contracts measured. A histogram and box-and-whisker plot for schedule performance is presented in Figure 4-1. This Figure shows that there are two outliers: 263% and 334%. SCHEDPER was modified to remove the two outliers and was renamed

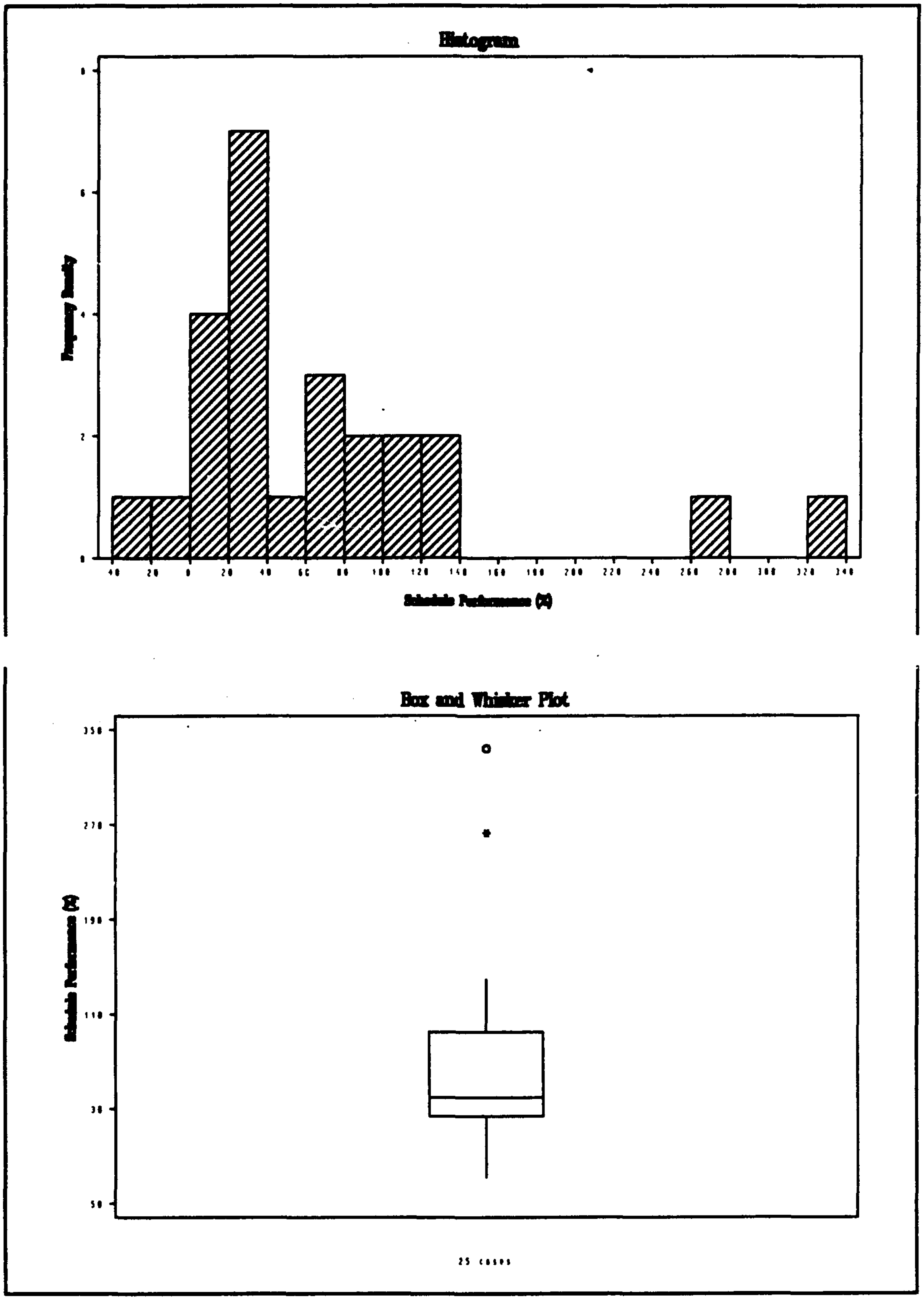


Figure 4-1. Histogram and Box-and-Whisker Plot of Schedule Performance

SCHEDMOD to reflect this. This modification was done to more fully investigate the effects of the outliers, and to ensure that the statistical analyses were not biased due to the inclusion of cases that were potentially from a different population. To facilitate these goals, both the single-variable and the multi-variable assessments of the independent variables were conducted using both SCHEDPER and SCHEDMOD. (Note, the specific characteristics associated with the two outliers are discussed in more detail later in this chapter.)

Descriptive Statistics for SCHEDPER and SCHEDMOD. The descriptive statistics for SCHEDPER and SCHEDMOD are provided in Table 4-1. These descriptive statistics show that, as expected, the two outliers have a significant impact on the mean, standard deviation, and standard error. As the data is highly skewed, the median is, perhaps, a better measure

Table 4-1. Descriptive Statistics for SCHEDPER and SCHEDMOD

STATISTIC	SCHEDPER	SCHEDMOD
Sample Size	25	23
Mean	70.768	50.965
Median	39.4	35.3
Standard Deviation	81.811	45.413
Standard Error	16.362	9.469
Minimum	-27.9	-27.9
Maximum	334.0	139.7
Skewness	1.8218	0.4912

of central tendency (Devore, 1991:18). The median values for both SCHEDPER and SCHEDMOD -- 39.4% and 35.3%, respectively -- are not significantly different from the 33% mean schedule slippage obtained in the most recent RAND study (Drezner and Smith, 1990:44). On the other hand, the mean values for SCHEDPER and SCHEDMOD -- 70.77% and 50.97%, respectively -- are considerably different from the findings in that study.

Assessment of Normality for SCHEDPER and SCHEDMOD. The box-and-whisker plot of SCHEDPER in Figure 4-2 indicated that an assessment of normality for the underlying population of schedule performance could not be made. To test this hypothesis further, Wilk-Shapiro / Rankit Plots of both SCHEDPER and SCHEDMOD were obtained from Statistix 4.0. These plots are given in Figure 4-2. "Systematic departure from a linear trend indicates non-normality, as does a small value for the Wilk-Shapiro statistic" (Analytical Software, 1992:247). The Wilk-Shapiro statistic of 0.7901 for SCHEDPER showed that an assessment of normality for the underlying population could not be made (α=0.05) (Conover, 1980:468). If it were assumed, however, that the two outliers removed to obtain SCHEDMOD were atypical, then the Wilk-Shapiro statistic of 0.9465 for that variable meant that an assessment of normality could be made (α=0.05) (Conover, 1980:468). Given that the majority of the independent variables in this study were categorical, and the single-variable analyses associated with these variables were conducted using nonparametric techniques, further assessment of normality at this stage was not required.

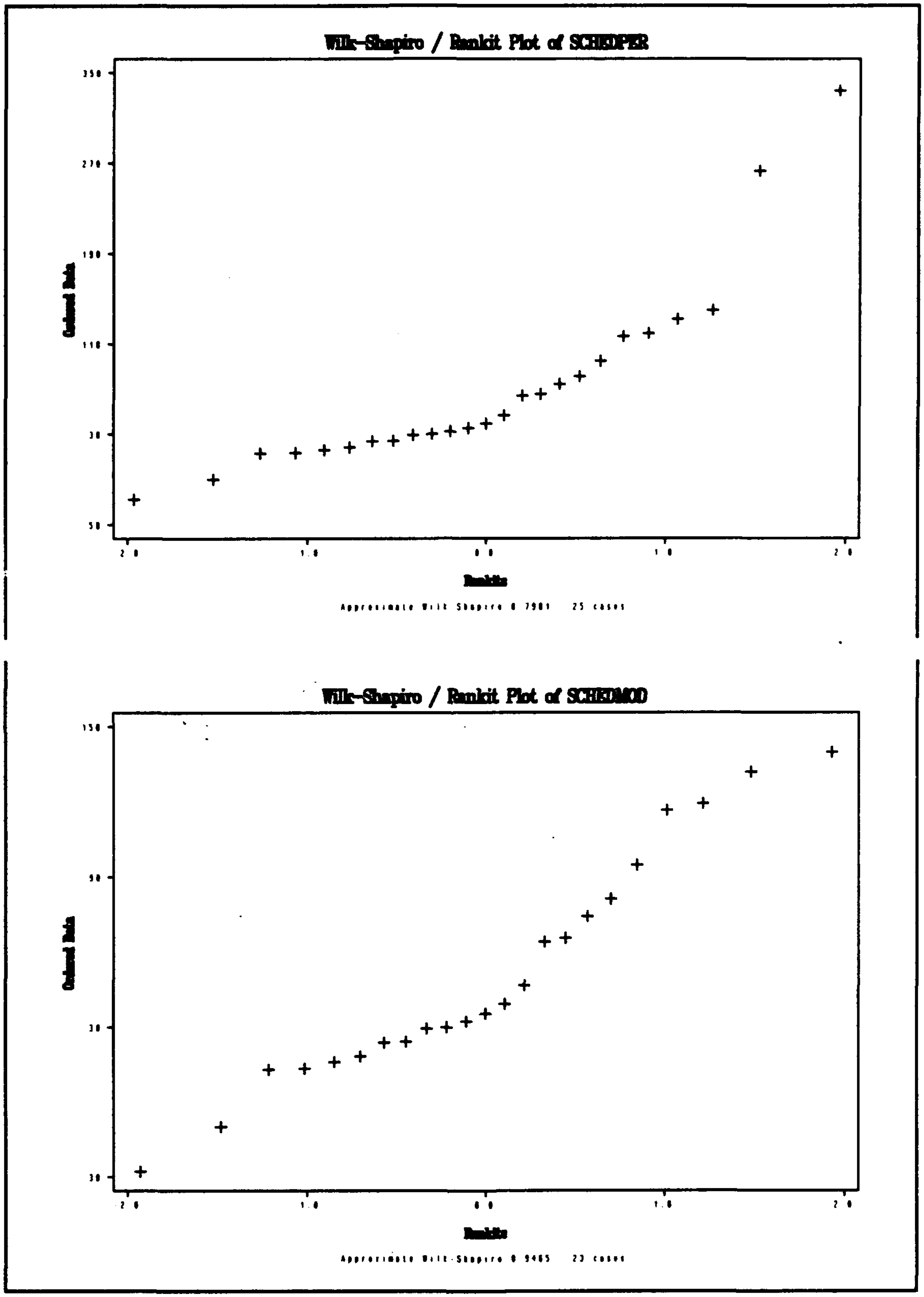


Figure 4-2. Wilk-Shapiro / Rankit Plots of SCHEDPER and SCHEDMOD

Independent Variables

Introduction. In this section, the independent variables are discussed in the order in which they appear in the Data Collection Instrument (DCI). Frequency distributions for each categorical variable are reported and these were used for the elimination of any categorical variables that displayed little to no variation, and for the scaling of ordinal-level variables. Following this initial assessment, results from the different analyses are reported and an assessment was made as to whether or not a relationship existed between the independent and dependent variables. As discussed in Chapter III, the following tests were conducted:

a. ratio-level data: scatter plots and simple linear regressions (SLRs);

b. ordinal-level data: Kruskal-Wallis one-way analysis of variance (ANOVA); and

c. binary-level data: Mann-Whitney (Wilcoxon) Rank-Sum Test.

The results of the nonparametric tests for the ordinal-level and binary-level variables are given in Table 4-2. The scatter plots for the ratio-level variables are given at Appendix F, while the results from the SLRs are given in Table 4-3.

Contract Type (CTYPE). The Contract Type (CTYPE) variable was initially scaled as an ordinal-level variable, having four levels: FFP, FPIF, CPIF, and CPFF. This project-characteristic variable was included in the analysis to moderate for the different degrees of risk being shared between the DoD and the contractor. A frequency distribution of the 25 contracts, for which schedule-performance information was obtained, revealed that 16 of the contracts measured were FFP, while

Table 4-2. Results of the Nonparametric Tests

Variable Name and Type (Binary, Ordinal)		SCHEDPER		SCHEDMOD	
		Kruskal-Wallis One-Way ANOVA p-value	Mann-Whitney (Wilcoxon) Rank-Sum p-value	Kruskal-Wallis One-Way ANOVA p-value	Mann-Whitney (Wilcoxon) Rank-Sum p-value
CTYPE	Bin	N/A	0.4447	N/A	0.7768
D_DP	Bin	N/A	0.2391	N/A	0.3815
PRODOPT	Bin	N/A	0.2330	N/A	0.4757
PLPRESCH	Bin	N/A	0.0096	N/A	0.0386
PLAGGR	Bin	N/A	0.6332	N/A	0.9110
PLCONC	Bin	N/A	0.9782	N/A	0.9753
PLSRISK	Ord	0.2222	N/A	0.3223	N/A
PLTRISK	Ord	0.3421	N/A	0.8963	N/A
COMPLEX	Ord	0.6994	N/A	0.1578	N/A
PLWBSDEV	Bin	N/A	0.9746	N/A	0.1558
PLWBSL3M	Ord	0.2718	N/A	0.0781	N/A
PLDRRFP	Bin	N/A	0.1104	N/A	0.2087
TECHDEFN	Ord	0.9518	N/A	0.7676	N/A
SOWDWBS	Bin	N/A	0.7598	N/A	0.1647
SOWCSSR	Bin	N/A	0.7184	N/A	0.8768
SOWSDISP	Bin	N/A	0.2147	N/A	0.8522
SOWRCWP	Bin	N/A	0.5886	N/A	0.8522
SOWRCBP	Bin	N/A	0.6034	N/A	0.7226
SOWFRSI	Bin	N/A	0.6456	N/A	0.8195
EVSDISP	Bin	N/A	0.1627	N/A	0.0881
EVRCWP	Bin	N/A	0.9188	N/A	0.4410
EVRCBP	Bin	N/A	0.6304	N/A	0.4197

eight were FPIF, one was CPIF, and one was CPFF. The latter two types did not contain a sufficient number of samples to warrant retaining them as separate entities; hence, the FPIF, CPIF, and CPFF categories were combined into a single class. CTYPE, therefore, was rescaled as a dichotomous variable with 'FFP' scaled as '0', and 'Other Than FFP' scaled as '1'.

The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test, as reported in Table 4-2, showed that CTYPE was not significantly related to either SCHEDPER or SCHEDMOD (α=0.25). From these results, CTYPE was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable potential interactions to be assessed.

Development / Development and Production (D_DP). The Development / Development and Production (D_DP) variable was a project-characteristic variable which was included in the analysis to moderate for contracts which included a production element. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution revealed that only six of the contracts required that production items be manufactured after the development item(s) had been completed, while 19 did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test, however, showed that D_DP was slightly related to SCHEDPER but not to SCHEDMOD (α=0.25). From these results D_DP was considered to be a significant enough variable for inclusion in the multi-variable analyses.

Production Option (PRODOPT). The Production Option (PRODOPT) variable was a project-characteristic variable which was included in the analysis to moderate the previous variable (D_DP) for contracts which included production requirements as an option. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution for the Production Option (PRODOPT) variable revealed that 15 contracts in the sample included a production option, while 11 did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that PRODOPT was slightly related to SCHEDPER but not to SCHEDMOD (α=0.25). From these results, however, PRODOPT was considered to be a significant enough variable to be included in the multi-variable analyses.

Number of Contract Modifications (N PS). The Number of Contract Modifications (NOECPS) variable was included in the analysis as a surrogate variable for all the post-contract-award management actions which may impact schedule performance. As this variable is a ratio-level variable, the first step was to assess the relationships between this variable and SCHEDPER / SCHEDMOD through the use of scatter plots (refer Appendix F). The results from these analyses showed that there was a definite relationship between NOECPS and both SCHEDPER and SCHEDMOD. Following this, SLRs were conducted to obtain the degree of significance of the 'visual' relationships. The results from these tests are presented in Table 4-3, and, from these results, this variable was considered to be a definite candidate for the multi-variable analyses (α=0.25).

Pre-scheduled (PLPRESCH). The Pre-scheduled (PLPRESCH) variable was included in the analysis to capture whether or not the SPO had mandated a schedule requirement in the RFP. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution for the this variable revealed that 20 of the contracts in

Table 4-3. Results of Simple Linear Regressions

Variable Name	SCHEDPER	SCHEDMOD
	Simple Linear Regression p-value	Simple Linear Regression p-value
NOECPS	0.0517	0.0000
UCOSTCD	0.6913	0.0651
PAGESSOW	0.2968	0.4846
NODIDS	0.4692	0.8154
NOPMDIDS	0.9267	0.2557
NOEVCRIT	0.8038	0.6415

the sample were pre-scheduled by the SPO, while five were not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that PLPRESCH was very significantly related to both SCHEDPER and SCHEDMOD (α=0.25). From these results, PLPRESCH was considered to be a significant variable for inclusion in the multi-variable analyses.

Aggressive (PLAGGR). The Aggressive (PLAGGR) variable was included in the analysis to capture whether or not the SPO considered the schedule to be aggressive. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution for this variable revealed that only six of the contracts in the sample were considered by the SPO to involve an aggressive schedule, while 19 were not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that PLAGGR was not significantly related to either SCHEDPER or to SCHEDMOD (α=0.25). From these results, PLAGGR was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable potential interactions to be assessed.

Concurrency (PLCONC). The Concurrency (PLCONC) variable was included in the analysis to capture whether or not a schedule involved concurrency. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution for this variable revealed that 11 contracts in the sample involved some degree of concurrency, while 14 did not. Contrary to expectations, however, the results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that PLCONC was not significantly related to either SCHEDPER or to SCHEDMOD (α=0.25). From these results, PLCONC was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable potential interactions to be assessed.

Sources of Supply. For the reasons given in Chapter III, the Sources of Supply variable was deleted from the research effort shortly after the data-collection was begun.

Planned Contract Type. A comparison between what was planned for the contract type and what was actually done (CTYPE) revealed that there was no difference between the planned and actual contract types; hence, this variable was dropped from the analysis.

Schedule Risk (PLSRISK). The Schedule Risk (PLSRISK) variable was included in the analysis to capture the Program Manager's assessment of the schedule risk associated with the selected acquisition strategy. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution of this variable revealed that eight contracts were rated as having low schedule risk, three as having low-medium risk, 13 as having moderate risk, zero as having medium-high risk, and one as having as high risk. (Note, one contract, for which schedule-performance information was not able to be obtained was rated as having a medium-high schedule risk.) Due to these sample limitations, the 'medium-high' and 'high' categories were combined with the 'medium' category. Under this recategorization, the frequency distribution for PLSRISK was:

a. low schedule risk (category '1'): 8;

b. low-medium schedule risk (category '2'): 3; and

c. higher than low-medium schedule risk (category '3'): 14.

The results from the Kruskal-Wallis One-Way ANOVA Test showed that PLSRISK was slightly related to SCHEDPER but not to SCHEDMOD (α=0.25). From these results, PLSRISK was considered to be a significant enough variable for inclusion in the multi-variable analyses.

Technical Risk (PLTRISK). The Technical Risk (PLTRISK) variable was included in the analysis to capture the Program Manager's assessment of the technical risk associated with a particular acquisition. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution of this variable revealed that nine contracts were rated as having low technical risk, four as having low-medium risk, 12 as having moderate risk, zero as having medium-high risk, and zero as having as high risk. The frequency distribution for the three levels of PLTRISK was:

a. low technical risk (category '1'): 9;

b. low-medium technical risk (category '2'): 4; and

c. medium technical risk (category '3'): 12.

The results from the Kruskal-Wallis One-Way ANOVA Test showed that PLTRISK was not significantly related to either SCHEDPER or to SCHEDMOD (α=0.25). From these results, PLTRISK was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable potential interactions to be assessed (e.g., PLTRISK and PLSRISK).

Unit Cost in Constant Dollars (UCOSTCD) and Complexity (COMPLEX). Three sub-variables were measured in an attempt to obtain a measure of complexity (COMPLEX): Unit Cost in Constant Dollars (UCOSTCD), Number of Pages in the SOW (PAGESSOW), and total Number of DIDs (NODIDS). The complexity variable was included in the analysis as a moderator variable to capture the potential impact of increasing complexity on schedule performance. The intention behind measuring these three sub-variables was to combine them into a single measure of complexity. During data collection, however, only UCOSTCD appeared to bear any resemblance to a subjective assessment of the complexity of individual contracts. With respect to the other two variables -- PAGESSOW and NODIDS -- a scatter plot revealed that, as expected, a relationship existed between the length of the SOW and the number of DIDs (refer Appendix F). Any relationship to the subjective assessment of complexity, however, did not exist. Possible explanations for this result were that any potential relationships were nullified over time due to turnover of SPO personnel, different emphases within individual SPOs, and/or the many changes that have been made to acquisition policies and procedures in the period from 1976 to 1991.

With regard to UCOSTCD, a histogram showing the spread of unit costs is presented in Figure 4-3. From this histogram and from a

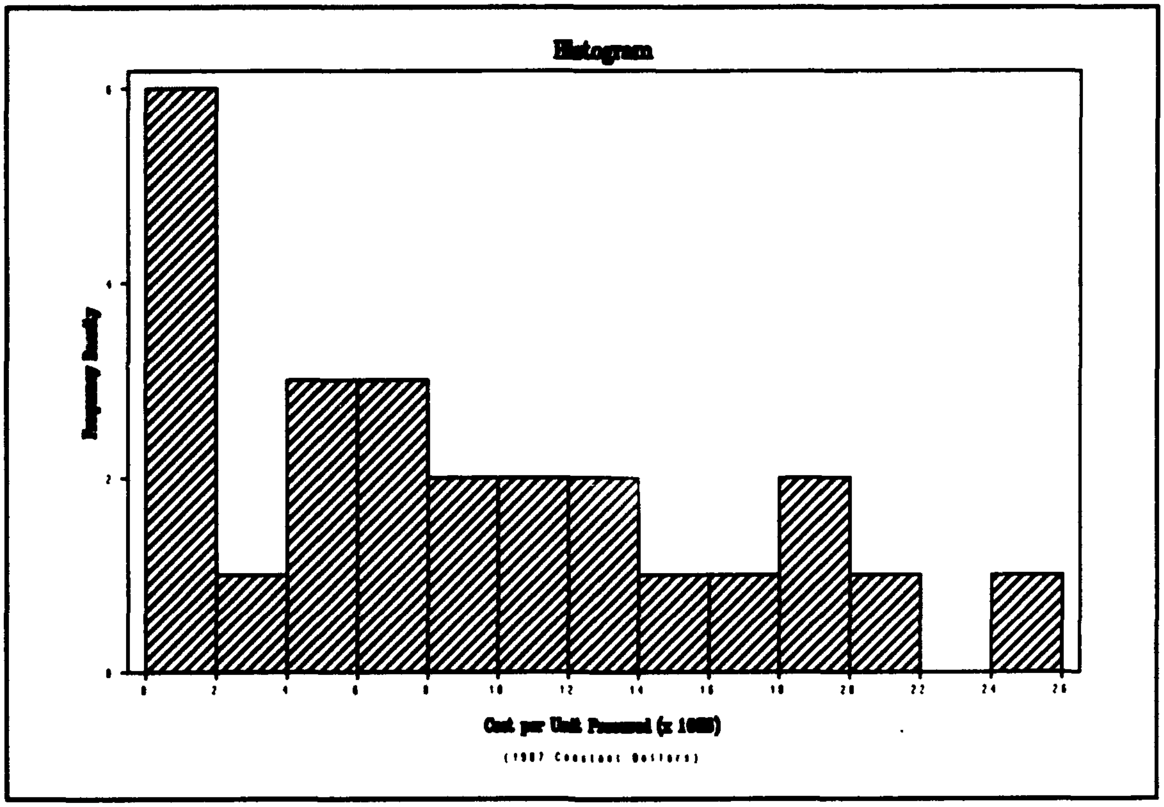


Figure 4-3. Histogram of UCOSTCD

subjective evaluation of the contracts in the sample, the following decision rule was used to convert UCOSTCD into a three-level ordinal variable (COMPLEX):

a. UCOSTCD <= $4,000,000: COMPLEX = 1;

b. UCOSTCD > $4,000,000 but <= $14,000,000: COMPLEX = 2;

c. UCOSTCD > $14,000,000: COMPLEX = 3.

Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution for COMPLEX revealed that seven contracts were rated as being of low complexity, 12 as being of moderate complexity, and six as being of high complexity.

The scatter plots for UCOSTCD (refer Appendix F) revealed that there was almost no relationship between UCOSTCD and SCHEDPER; however, a slight relationship existed between UCOSTCD and SCHEDMOD. The p-values from the SLRs, as presented in Table 4-3, confirmed this 'visual' evaluation (α=0.25). The same relationships were obtained for COMPLEX using the Kruskal-Wallis One-Way ANOVA test (α=0.25). From these results, both UCOSTCD and COMPLEX were considered to be significant enough variables for inclusion in the multi-variable analyses (though not together).

With respect to the other two variables under the heading of complexity -- PAGESSOW and NODIDS -- these two variables were analyzed with respect to SCHEDPER and SCHEDMOD to ascertain whether a relationship might exist. The scatter plots in Appendix F, and the results from the SLRs in Table 4-3, revealed that no relationships existed between PAGESSOW and either SCHEDPER or SCHEDMOD, nor between NODIDS and either SCHEDPER or SCHEDMOD (α=0.25). From these results, neither PAGESSOW nor NODIDS were expected to be significant variables in the multi-variable analyses; however, they were retained in the data-set to enable potential interactions to be assessed.

Work Breakdown Structure (WBS). Three sub-variables were measured with respect to the preliminary WBS in an attempt to measure the degree of planning thoroughness for each contract: Preliminary WBS Developed (PLWBSDEV), Number of Elements at Level Three of the WBS (PLWBSL3), and the Lowest Level Developed of the WBS (PLWBSLL). The intention, at the time that the DCI was formulated, was to combine these three sub-variables into an overall measure of planning thoroughness. Having collected the data, however, a reasonable method for achieving this overall measure could not be readily determined; therefore, the three variables were assessed individually.

A difficulty with assessing these three variables was caused by structural zeros (Agresti, 1990:244). For contracts where a preliminary WBS had not been developed (i.e., PLWBSDEV = 0), PLWBSL3 and PLWBSLL could only be scored with a zero. This result occurred for six of the 25 contracts for which schedule-performance information had been obtained. The other 19 contracts in the sample had developed a preliminary WBS. As a result of the structural zeros, however, the information contained in PLWBSDEV was also contained in PLWBSLL; PLWBSDEV, therefore, was eliminated from the analysis. (Note, the information provided by PLWBSDEV was not also contained in PLWBSL3 because a WBS that had only been developed to level two would cause PLWBSL3 to be scored with a zero.)

PLWBSL3. The scatter plots for the Number of Elements at Level Three of the WBS (PLWBSL3) variable (refer Appendix F) showed that only a very slight relationship existed between PLWBSL3 and both SCHEDPER and SCHEDMOD. Schedule overrun did appear to be reduced as the number of elements at level three was increased; however, the outliers in both scatter plots appeared to be highly influential. In an attempt to overcome this, a number of transformations of PLWBSL3 were investigated. The only transformation which resulted in an appreciable improvement in the statistical relationship was obtained by converting PLWBSL3 to a four-level ordinal variable (PLWBSL3M) based on its quartiles: 0, 10, and 16. The results from the Kruskal-Wallis One-Way ANOVA Test showed that PLWBSL3M was significantly related to SCHEDMOD but not to SCHEDPER (α=0.25). From these results, the transformed variable, PLWBSL3M, was considered to be a significant enough variable for inclusion in the multi-variable analyses.

PLWBSLL. The scatter plots for the Lowest Level Developed of the WBS (PLWBSLL) variable showed that only a very slight relationship existed between PLWBSLL and both SCHEDPER and SCHEDMOD. Furthermore, these scatter plots indicated that transforming PLWBSLL from a ratio-level variable to an ordinal-level variable may be more appropriate. A number of different transformations were attempted, including transforming to four-level, three-level, and binary-level variables. Only one transformation produced a significant result from either the Kruskal-Wallis One-Way ANOVA Test or the Mann-Whitney (Wilcoxon) Rank-Sum Test (α=0.25). Interestingly, this transformation resulted in a binary-level variable that was structurally identical to the Preliminary WBS Developed (PLWBSDEV) variable (i.e., contracts that were scored with either a '0' or a '1' under the transformation had the identical score under PLWBSDEV). For this reason, the previous decision to eliminate PLWBSDEV was reversed, and PLWBSLL was eliminated from the multi-variable analyses. For PLWBSDEV, the results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that this variable was not significantly related to SCHEDPER but was related to SCHEDMOD (α=0.25). From these results, PLWBSDEV was considered to be a significant enough variable for inclusion in the multi-variable analyses.

Draft RFP (PLDRRFP). The Draft RFP (PLDRRFP) variable was included in the analysis to capture whether or not a draft RFP had been issued. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution for this variable revealed that five contracts in the sample had not issued a draft RFP prior to formal solicitation, whereas 20 had. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that PLDRRFP was significantly related to both SCHEDPER and SCHEDMOD (α=0.25). From these results, PLDRRFP was considered to be a significant variable for inclusion in the multi-variable analyses.

Degree of Technical Definition (TECHDEFN). The Degree of Technical Definition (TECHDEFN) variable was included in the analysis to capture the type of specification that was used and whether or not the specification was complete at the time of solicitation. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution of this variable revealed that none of the contracts in the sample utilized a specification that was less than a draft A specification. As a result of this, TECHDEFN was rescaled, as follows (the numbers in brackets represent the frequency of each category in the sample):

a. 'Partially Developed A Spec' = 1 (5);

b. 'Fully Developed A Spec' = 2 (6);

c. 'Partially Developed B Spec' = 3 (6); and

d. 'Fully Developed B Spec' = 4 (8).

The results from the Kruskal-Wallis One-Way ANOVA Test showed that TECHDEFN was not significantly related to either SCHEDPER or to SCHEDMOD (α=0.25). From these results, TECHDEFN was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable potential interactions to be assessed.

Develop WBS Further (SOWDWBS). The Develop WBS Further (SOWDWBS) variable was included in the analysis to capture whether or not the SOW specified that the contractor was to further develop the preliminary WBS. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution of this variable revealed that five of the contracts from the sample did not require that the preliminary WBS be developed further, while 20 did.

The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test for SOWDWBS showed that this variable was not significantly related to SCHEDPER but was related to SCHEDMOD (α=0.25). From these results, SOWDWBS was considered to be a significant enough variable for inclusion in the multi-variable analyses.

When examining all of the 29 contracts that were measured, some interesting insights into the use of WBSs in the contractual process were obtained. Of the five contracts for which it was not required to further develop the preliminary WBS, three contracts had not developed a preliminary WBS in the first place, while the other two contracts reflected that the SOW had not required the preliminary WBS to be developed further. Interestingly, of the remaining 24 contracts, three contracts required the contractor to develop a WBS for contract management and reporting purposes even though a preliminary WBS had not been developed in the first place.

C/SSR Required (SOWCSSR). The C/SSR Required (SOWCSSR) variable was included in the analysis to capture whether or not C/SSR reporting was specified in the SOW, and whether or not this reporting was integrated with schedule-network information. Interestingly, none of the contracts in the sample required that C/SSR information be integrated with schedule-network information, and this category, therefore, was eliminated. Of the 25 contracts for which schedule-performance information was obtained, the frequency distribution of this variable revealed that 10 of the contracts required cost and schedule reporting in accordance with the C/SSR (or C/SCSC) requirements, while 15 did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that SOWCSSR was not significantly related to either SCHEDPER or SCHEDMOD (α=0.25). From these results, SOWCSSR was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable potential interactions to be assessed.

Schedule Management Paragraphs (SOWSDISP), (SOWRCWP), and (SOWRCBP). When the DCI was created, the schedule-management paragraphs in the SOW were to be assessed using six variables. The intention was to obtain data that reflected increasing quantity and depth of schedule-management information, from Gantt charts, through different aspects of network information, to the examination of resource constraints. When the contracts were measured, however, the expectations concerning schedule-management paragraphs in the SOW were not realized. Instead, the following characteristics were revealed:

a. All contracts required, as a minimum, some form of Gantt chart to obtain schedule-management information. Even contracts which specified some form of network also required that the schedule-management information be provided in Gantt-chart format. For this reason, the first two variables were combined into a single binary-level variable ('0' = Gantt chart, '1' = network diagram). This single variable was named, SOW Schedule Display (SOWSDISP).

b. Only one of the contracts in the sample required that some form of probabilistic network (e.g., PERT) be used; hence, this variable was dropped from the analysis.

c. None of the contracts in the sample required that near-critical paths be identified; hence, this variable was also dropped from the analysis.

d. Only a few of the contracts in the sample required that resource constraints (either within or between programs) be addressed as an explicit part of the schedule-management-information requirements. Generally, this information was required as part of one or more DIDs (e.g., System Engineering Management Plan (SEMP), Training and Training Equipment Plan, Manufacturing Plan, Software Development Plan, System Test Plan). For the purposes of measurement, if resource constraints were addressed either explicitly or in one or more of the relevant DIDs, the contracts were scored with a '1'. (Note that tailored or modified DIDs were examined to ascertain whether or not the relevant paragraphs in the DIDs had been modified or deleted.)

As an outcome of the preceding discussion, three variables were selected to measure how schedule-management information was addressed in the SOW: SOW Schedule Display (SOWSDISP), SOW Resource Constraints Within a Program (SOWRCWP), and SOW Resource Constraints Between Programs (SOWRCBP).

· SOWSDISP. The frequency distribution of the SOW Schedule Display (SOWSDISP) variable revealed that 18 contracts, of the 25 in the sample, required that the schedule-management information be presented in a network format, while the other seven required a Gantt chart format. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that SOWSDISP was significantly related to SCHEDPER but not to

SCHEDMOD (α=0.25). From these results, SOWSDISP was considered to be a significant enough variable for inclusion in the multi-variable analyses.

SOWRCWP. The frequency distribution of the SOW Resource Constraints Within a Program (SOWRCWP) variable revealed that 19 contracts, of the 25 in the sample, required that resource constraints within a program be identified, while six did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that SOWRCWP was not significantly related to either SCHEDPER or SCHEDMOD (α=0.25). From these results, SOWRCWP was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable assessment of potential interactions.

SOWRCBP. The frequency distribution of SOW Resource Constraints Between Programs (SOWRCBP) variable revealed that 16 contracts, of the 25 in the sample, required that resource constraints between programs be identified, while nine did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that SOWRCBP was not significantly related to either SCHEDPER or SCHEDMOD (α=0.25). From these results, SOWRCBP was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable assessment of potential interactions.

Frequency of Reporting Schedule-Management Information (SOWFRSI). When the DCI was created, the intention was to measure, on a five-point scale, whether schedule-management information was required proactively, on a periodic basis, or reactively. Interestingly, only one contract in the sample required that schedule-management information be provided proactively (i.e., the SOW required that any problems that were likely to cause schedule delays were to be reported). Furthermore, the frequency distribution of the Frequency of Reporting Schedule-Management Information (SOWFRSI) variable revealed that 21 contracts, of the 25 in the sample, required reporting on a monthly basis. The other three required reporting on a quarterly or less basis. From these results, a decision was made to convert SOWFRSI into a binary-level variable, as follows:

a. reporting less often than monthly = '0', and

b. reporting monthly or more proactively = '1'.

The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that SOWFRSI was not significantly related to either SCHEDPER or SCHEDMOD (α=0.25). From these results, SOWFRSI was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable assessment of potential interactions.

Number of Project-management DIDs (NOPMDIDS). The Number of Project-management DIDs (NOPMDIDS) variable was included in the analysis to capture the amount of project-management information that was required to be delivered by the contractor in accordance with the CDRL. As this variable is a ratio-level variable, the first step was to assess the relationships between this variable and SCHEDPER / SCHEDMOD through the use of scatter plots (refer Appendix F). Following this, SLRs were conducted to obtain the degree of significance of the 'visual' relationships, and the results obtained are presented in Table 4-3. The results from these analyses showed that there was no definite relationship between NOPMDIDS and either SCHEDPER or SCHEDMOD (α=0.25). Furthermore, a number of different scaling techniques did not improve upon this result. NOPMDIDS, therefore, was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable assessment of potential interactions.

Number of Evaluation Criteria (NOEVCRIT). The Number of Evaluation Criteria (NOEVCRIT) variable was included in the analysis to capture the relative importance of schedule performance, as elucidated to the contractor in the RFP (i.e., the number of explicit references to schedule in Section M of the RFP). As this variable is a ratio-level variable, the first step was to assess the relationships between this variable and SCHEDPER / SCHEDMOD through the use of scatter plots (refer Appendix F). Following this, SLRs were conducted to obtain the degree of significance of the 'visual' relationships, and the results obtained are presented in Table 4-3. The results from these analyses showed that there was no definite relationship between NOEVCRIT and either SCHEDPER or SCHEDMOD (α=0.25). Furthermore, a number of different scaling techniques did not improve upon this result. NOEVCRIT, therefore, was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable assessment of potential interactions.

Schedule-Risk Assessment (EVSDISP), (EVRCWP), and (EVRCBP). When the DCI was created, the schedule-risk-assessment paragraphs in the Instructions to Offerors (ITO) were to be assessed using ten variables. The intention was to obtain data that reflected increasing quantity and depth of information -- from Gantt charts, through different aspects of network information, to the examination of resource constraints and responsibility allocation -- to obtain a measure of the level of schedule-risk assessment that was able to be performed as part of the source-selection evaluation. When the contracts were measured, however, these expectations were not realized. Instead, the following characteristics were revealed:

a. All contracts in the sample, except two, required that a descriptive assessment of schedule risks be conducted by the contractor. For this reason, this variable was dropped from the analysis.

b. All contracts required, as a minimum, some form of Gantt chart for the presentation of schedule information. Even contracts which specified some form of network also required that the schedule information be provided in Gantt-chart format. For this reason, the second two variables were combined into a single binary-level variable ('0' = Gantt chart, '1' = network diagram). This single variable was named Evaluation Schedule Display (EVSDISP). (Note that, interestingly, some contracts that required Gantt charts in the offeror's proposal, separately specified network diagrams in the SOW (and vice-versa).)

c. None of the contracts in the sample required that the schedule information be derived from some form of probabilistic network approach (e.g., PERT). Furthermore, none of the contracts required that near-critical paths be identified. For these reasons, both these variables were dropped from the analysis.

d. None of the contracts in the sample required that the offeror present a number of different proposed schedules at various confidence levels. Furthermore, none of the contracts in the sample required that the offeror undertake a program length simulation study to identify critical and near-critical paths. For these reasons, these two variables were dropped from the analysis.

e. All of the contracts in the sample, except two, required that the offeror provide information concerning the allocation of responsibilities for the proposal. For this reason, this variable was dropped from the analysis.

As an outcome of the preceding discussion, three variables were selected to measure how schedule-risk-assessment information was addressed in the ITO: Evaluation Schedule Display (EVSDISP), Evaluation Resource Constraints Within a Program (EVRCWP), and Evaluation Resource Constraints Between Programs (EVRCBP).

EVSDISP. The frequency distribution of the Evaluation Schedule Display (EVSDISP) variable revealed that 14 contracts in the sample required that schedule-risk-assessment information be presented in network format (as opposed to 18 for SOWSDISP), while 11 did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that EVSDISP was significantly related to both SCHEDPER and SCHEDMOD ($\alpha=0.25$). From these results, EVSDISP was considered to be a significant variable for inclusion in the multi-variable analyses.

EVRCWP. The frequency distribution of the Evaluation Resource Constraints Within a Program (EVRCWP) variable revealed that 20 contracts in the sample required that resource constraints within a program be identified (as opposed to 19 for SOWRCWP), while five did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that EVRCWP was not significantly related to either SCHEDPER or SCHEDMOD ($\alpha=0.25$). From these results, EVRCWP was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable assessment of potential interactions.

EVRCBP. The frequency distribution of the Evaluation Resource Constraints Between Programs (EVRCBP) variable revealed that 16 contracts in the sample required that resource constraints between programs be identified (the same number as SOWRCBP, but not the same contracts), while nine did not. The results from the Mann-Whitney (Wilcoxon) Rank-Sum Test showed that EVRCBP was not significantly related to either SCHEDPER or SCHEDMOD (α=0.25). From these results, EVRCBP was not expected to be a significant variable in the multi-variable analyses; however, it was retained in the data-set to enable assessment of potential interactions.

Summary of the Single-variable Analysis Results

This section of Chapter IV has introduced all of the variables that were measured during the data-collection process. The dependent variable, schedule performance (SCHEDPER), was addressed first. From the raw data, two outliers were discovered and these were removed to form a second dependent variable (SCHEDMOD). Following this, each of the independent variables was addressed, and eliminated if insufficient variability existed. In addition, appropriate scaling was performed, and single-variable analyses were conducted to ascertain whether any simple relationships existed with the dependent variables, SCHEDPER and SCHEDMOD.

The single-variable analyses demonstrated that certain variables (e.g., NOECPS) exhibited a definite relationship with one or both of the dependent variables, and that it made sense to proceed to the multi-variable analyses. Note that the significance level used for the single-variable analyses was set at α=0.25 to ensure that any potential relationships would be identified. A variable that was considered to be significant at this level would not necessarily be significant in the multi-variable analyses, and vice-versa; however, the single-variable analyses have provided considerable insight into the nature of schedule performance and schedule management. The multi-variable analyses are the subject of the next section.

Multi-variable Analyses

This section of Chapter IV will present the multi-variable analyses that were conducted to address the research questions. Specifically, this section will present:

a. a brief discussion of the pre-analysis manipulation of the variables;

b. the results of the stepwise regressions (i.e., with both SCHEDPER and SCHEDMOD) using the full variable set;

c. the results of the stepwise regressions with interaction terms included; and

d. the results from the best subsets regressions.

Pre-analysis Manipulation of Variables

Prior to conducting the stepwise analyses, the following ordinal-level variables were recategorized into sets of dummy variables: PLSRISK, PLTRISK, COMPLEX, TECHDEFN, and PLWBSL3M. This recategorization was necessary to ensure that the regression did not treat the ordinal-level variables as interval-level variables, as explained in Chapter III. The dummy variables for each ordinal-level variable were then entered into, or removed from, the stepwise regression model in sets (BMDP Statistical Software, Inc., 1992:408, 416).

Full Variable Set Stepwise Regressions without Interactions

The BMDP 2R program was used to conduct two stepwise regression analyses, one for SCHEDPER and one for SCHEDMOD. For these regression analyses, a p-value-to-enter of 0.1 and a p-value-to-remove of 0.11 were used. The edited data outputs from these regression analyses are contained at Appendix H and Appendix I, respectively. Each of these regression analyses will be discussed separately.

SCHEDPER without Interactions. Six variables were entered into the stepwise regression model for SCHEDPER, as follows: PLTRISK (as a set of two dummy variables), *NOECPS*, *PLCONC*, and *PLSRISK (as a set of* two dummy variables). The value of the F statistic and the associated p-value, for the overall F test, for this model were 6.32 and 0.0010, respectively. The adjusted R^2 for this model was 0.5709, which indicated that approximately half of the variability had been explained by the model. Plots of the standardized residuals and the Wilk-Shapiro Rankit Plot are given in Figure 4-4. The plot of the standardized residuals did not indicate that there were any systematic deviations around the fitted regression line. The plot did indicate, however, that the assumption of constancy of error variance may have been violated. For this model, the variance appeared to increase as schedule performance increased. The Wilk-Shapiro statistic of 0.9051 indicated that the assumption of normality for the distribution of the residuals

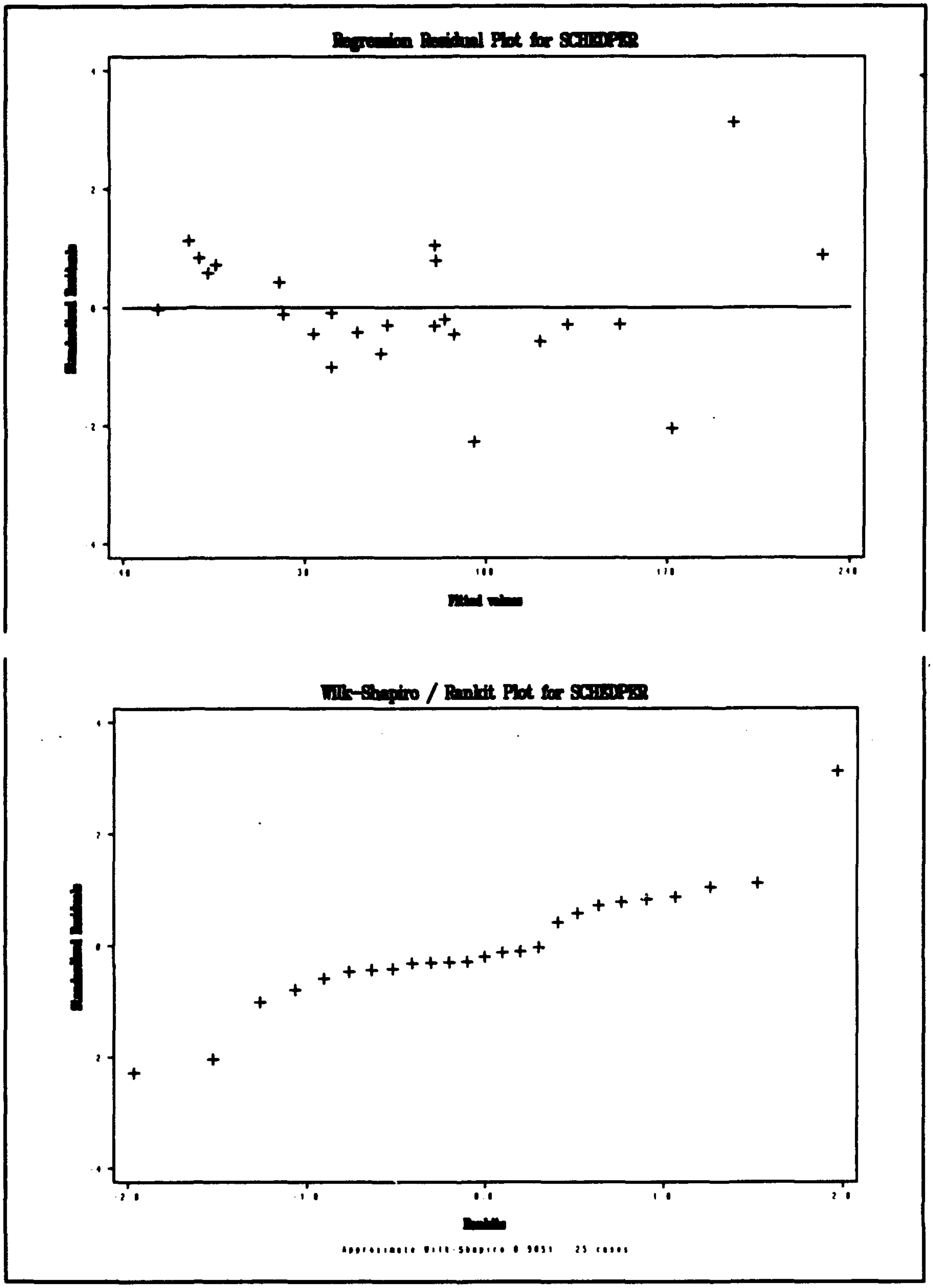


Figure 4-4. Standardized Residuals and Normality Assessment for SCHEDPER (without Interactions)

could not reasonably be made (α=0.05) (Conover, 1980:468). Remedial measures were not considered at this stage, as this model was an intermediate step in the model-building process.

This initial analysis suggested that the fitting of a model for SCHEDPER would be problematic; however, this initial model-building step identified that a number of variables were significant (α=0.1), and that it made sense to proceed with further model-building. Before continuing with the identification of interaction terms, however, a multi-variable analysis for SCHEDMOD was conducted and the results are presented in the next section.

SCHEDMOD without Interactions. Six variables were entered into the stepwise regression model for SCHEDMOD, as follows: NOECPS, PLPRESCH, TECHDEFN (as a set of three dummy variables), and NODIDS. Interestingly, these variables are different from those brought into the model for SCHEDPER. The value of the F statistic and the associated p-value, for the overall F test, for this model were 42.38 and 0.0000, respectively. The adjusted R^2 for this model was 0.9186, which indicated that the majority of the variability had been explained by the model. Plots of the standardized residuals and the Wilk-Shapiro Rankit Plot are given in Figure 4-5. The plot of the standardized residuals did not indicate that there were any systematic deviations around the fitted regression line. Contrary to the same plot as for SCHEDPER, this plot indicated that the assumption of constancy of error variance may be upheld. The Wilk-Shapiro statistic of 0.9551 indicated that the assumption of normality for the distribution of the residuals could now reasonably be made (α=0.05) (Conover, 1980:468). Remedial measures were

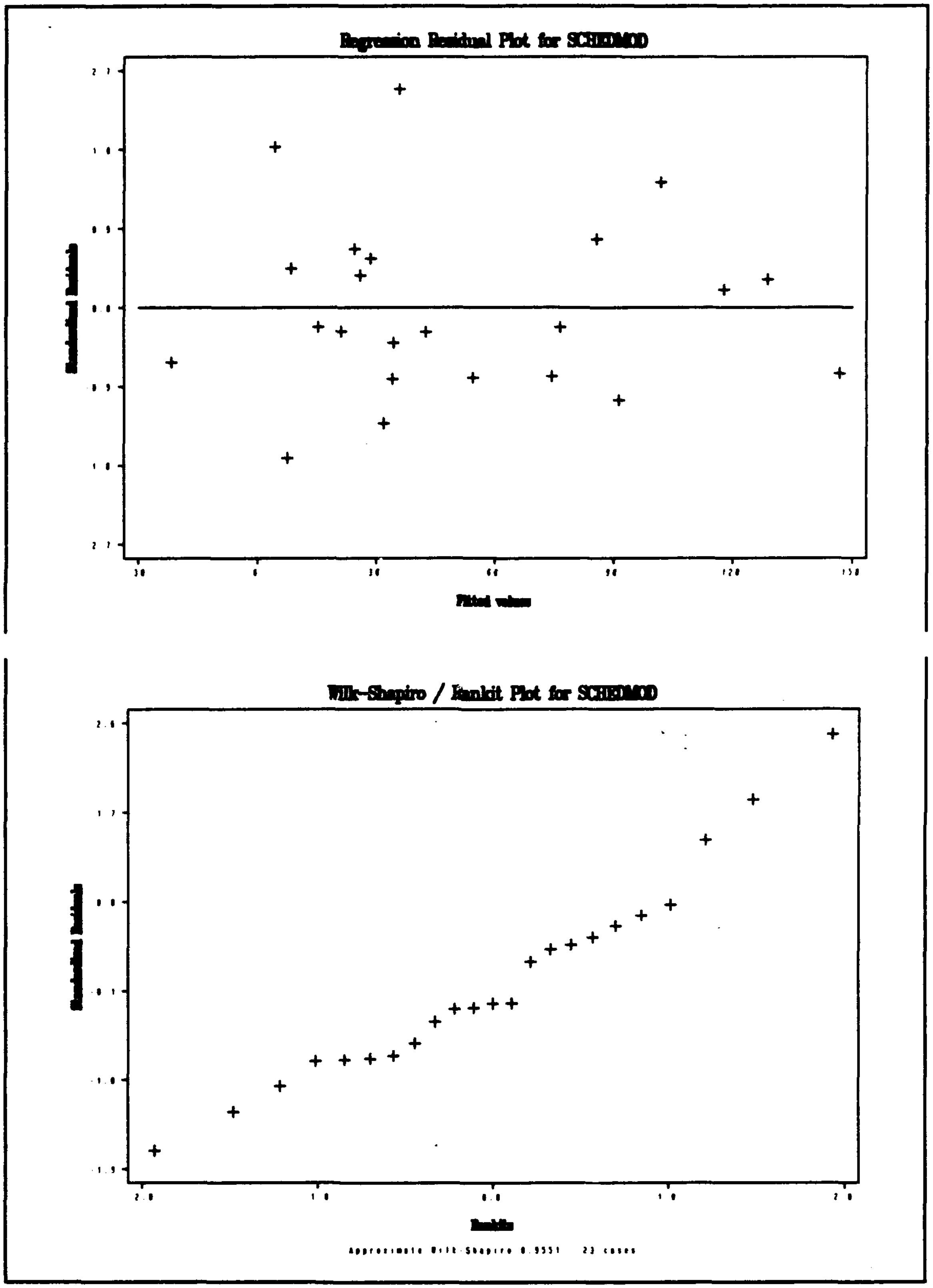


Figure 4-5. Standardized Residuals and Normality Assessment for SCHEDMOD (without Interactions)

not considered at this stage, as this model was an intermediate step in the model-building process.

This initial analysis suggested that a model for SCHEDMOD would be easier to develop than for SCHEDPER, due to the improved fit of the model. The model-building process will continue at this stage with the identification of interaction terms.

Full Variable Set Stepwise Regressions with Interactions

Identification of Interaction Terms. As explained in Chapter III, potential two-way and three-way interaction terms were identified through logical considerations. The final list of interaction terms which were incorporated into the model-building process comprised 22 interaction terms, as follows:

a. MPTRISK1 = PLTRISK*NOECPS,
b. MPTRISK2 = PLTRISK*PLWBSDEV,
c. MPTRISK3 = PLTRISK*SOWDWBS,
d. MPTRISK4 = PLTRISK*PLSRISK,
e. MNOECPS1 = NOECPS*PLCONC,
f. MNOECPS2 = NOECPS*PLDRRFP,
g. MNOECPS3 = NOECPS*EVSDISP,
h. MNOECPS4 = NOECPS*TECHDEFN,
i. MNOECPS5 = NOECPS*UCOSTCD,
j. MNOECPS6 = NOECPS*COMPLEX,
k. MPSRISK1 = PLSRISK*PLPRESCH,
l. MPSRISK3 = PLSRISK*COMPLEX,
m. MPRESCH1 = PLPRESCH*PLCONC,
n. MPRESCH2 = PLPRESCH*PLDRRFP,
o. MPRESCH3 = PLPRESCH*SOWRCWP,
p. MPRESCH4 = PLPRESCH*EVRCWP,
q. MPLAGGR = PLAGGR*SOWSDISP,
r. MSOWRC = SOWRCBP*SOWRCWP,
s. MPLCONC3 = PLCONC*PLSRISK,
t. MPRESCH6 = PLPRESCH*PLAGGR*PLCONC,
u. MSOWSINT = SOWSDISP*SOWRCWP*SOWRCBP, and
v. MEVSINT = EVSDISP*EVRCWP*EVRCBP.

The two previous stepwise regressions (i.e., one for SCHEDPER and one for SCHEDMOD) were re-run, with these interaction terms included in the BMDP 2R command files, to ascertain whether the models would change as a result of the inclusion of the interaction terms. The results of these runs are discussed next, for both SCHEDPER and SCHEDMOD.

SCHEDPER with Interactions. The stepwise regression for SCHEDPER, the results of which are contained in Appendix J, ran for thirteen steps: steps 1 to 9 brought in MPRESCH3, SOWSDISP, NOECPS, MSOWSINT, PAGESSOW, TECHDEFN (as a set of three dummy variables), EVRCWP, MEVSINT, and PLTRISK1 (PLTRISK2, the other dummy variable in the PLTRISK set, was not included due to collinearity problems); step 10 removed PAGESSOW and entered PLTRISK2 (although the summary table and edited data output in Appendix J does not show this); step 11 removed SOWSDISP; and finally, steps 12 and 13 brought in SOWCSSR and MPRESCH2. The value of the F statistic and the associated p-value, for the overall F test, for this model were 44.68 and 0.0000, respectively. The final model had an adjusted R^2 of 0.9562, which indicated that the majority of the variability had been explained by the model.

A number of problems were noted with this model, however, and these are explained as follows:

a. The final model contained 13 variables, which, given the sample size of 25, was considered to be an 'over-fit.'

b. At step nine, only one of the dummy variables (PLTRISK1) for the technical risk (PLTRISK) set was entered into the model, which did not make sense.

To overcome these problems, a reduced set of variables was fitted in the model. As explained in Chapter III, Neter, Wasserman, and Kutner recommend that, as a minimum, six to ten cases are required per variable in the model (Neter, Wasserman, and Kutner, 1989:435). For SCHEDPER, therefore, only the first four variables could be fitted in the model.

Interestingly, this limitation corresponded to the point in the model-building process where a p-value-to-enter of 0.05, and a p-value-to-remove of 0.051, applied, in lieu of the 0.1 level that was utilized in the BMDP program execution. Further detailed analysis of the SCHEDPER model with this reduced variable-set was conducted using Statistix 4.0.

The Model. The four variables that were defined in the regression model for SCHEDPER were as follows: MPRESCH3 (PLPRESCH* SOWRCWP), SOWSDISP, NOECPS, and MSOWSINT (SOWSDISP*SOWRCWP*SOWRCBP). The regression results for this model are contained in Appendix L. These variables resulted in the following model:

$$\text{SCHEDPER} = 150.08 + -109.64*\text{MPRESCH3} + -120.30*\text{SOWSDISP} + 1.28*\text{NOECPS} + 73.09*\text{MSOWSINT}$$

The value of the F statistic and the associated p-value for the overall F test, for this model, were 8.88 and 0.0003, respectively. The adjusted R^2 for this model was 0.5678, which indicated that approximately half of the variability had been explained by the model. The p-values associated with the t tests for the parameter estimates were as follows:

a. Constant (150.08): $p = 0.0001$;

b. MPRESCH3 (-109.64): $p = 0.0005$;

c. SOWSDISP (-120.30): $p = 0.0009$;

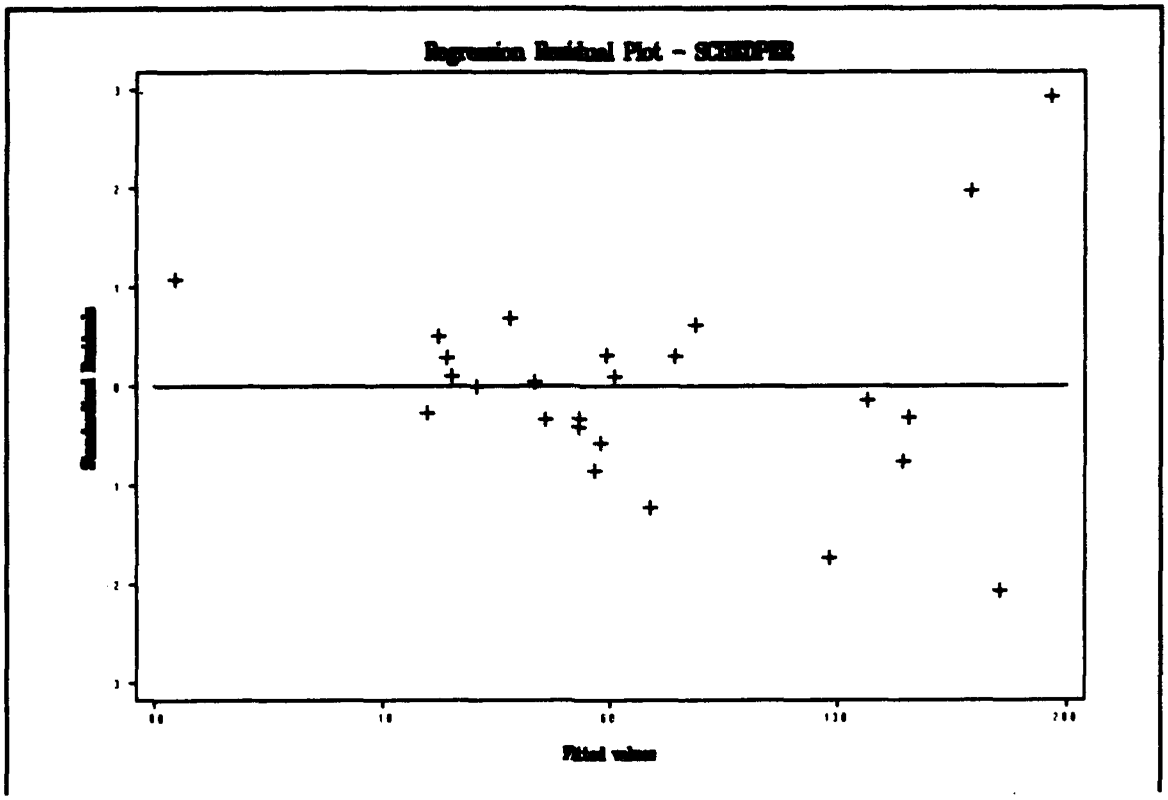
d. NOECPS (1.28): $p = 0.0154$; and

e. MSOWSINT (73.09): $p = 0.0313$.

These p-values showed that all of the variables were significant at the $\alpha=0.05$ level. One puzzling aspect of this model was the contradiction in sign for the coefficients for the related variables, SOWSDISP and MSOWSINT. This will be discussed after the remedial measures have been addressed.

Assessment of Model Aptness. Plots of the standardized residuals and the Wilk-Shapiro Rankit Plot are given in Figure 4-6. The plot of the standardized residuals indicated that there was only one outlier of any significance (i.e., greater than three sigma): Case #24. Furthermore, the plot indicated that the assumption of constancy of error variance may not hold for this model: error variance appeared to increase as schedule performance increased. The Wilk-Shapiro statistic of 0.9262, however, indicated that the assumption of normality for the distribution of the residuals could be made (α=0.05) (Conover, 1980:468). The time series plot of the regression residuals is given in Figure 4-7. This plot indicated that the error terms were not correlated over time. This 'visual' result was confirmed by the Durbin-Watson statistic for autocorrelation of 2.3027, which indicated that the error terms were independent (α=0.05) (Analytical Software, 1992:146-147).

Assessment of Influence. From Statistix 4.0, the plot of the transformed Cook's distance was obtained, and is reproduced in Figure 4-7. As explained in Chapter III, an F distribution percentile-value of 20 percent was used to assess which cases were exerting at least moderate influence on the values of the coefficients (i.e., in the plot presented in Figure 4-7, any case with a transformed Cook's distance less than 0.8). Using this criterion, one case was identified as influential, with a moderate influence value of 0.7800: Case #24 (SCHEDPER=334.0%, MPRESCH3=0, SOWSDISP=0, NOECPS=35, MSOWSINT=0).



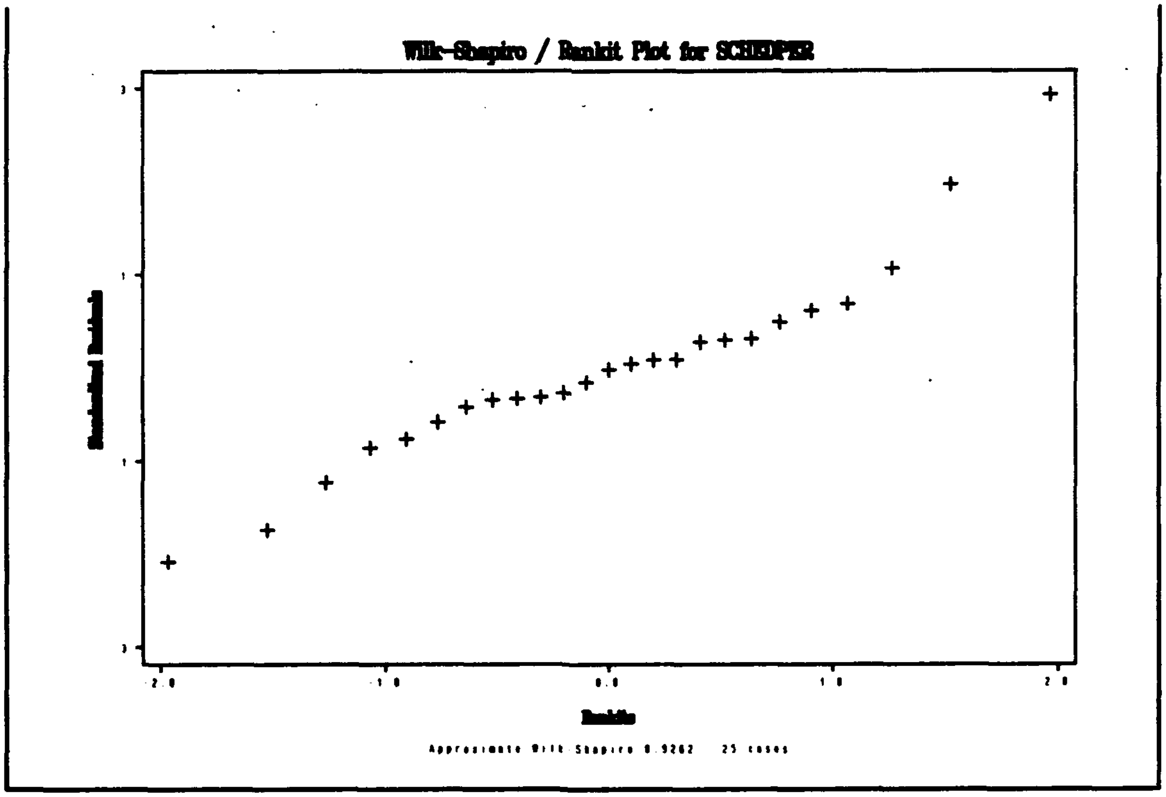


Figure 4-6. Standardized Residuals and Normality Assessment for SCHEDPER (with Interactions)

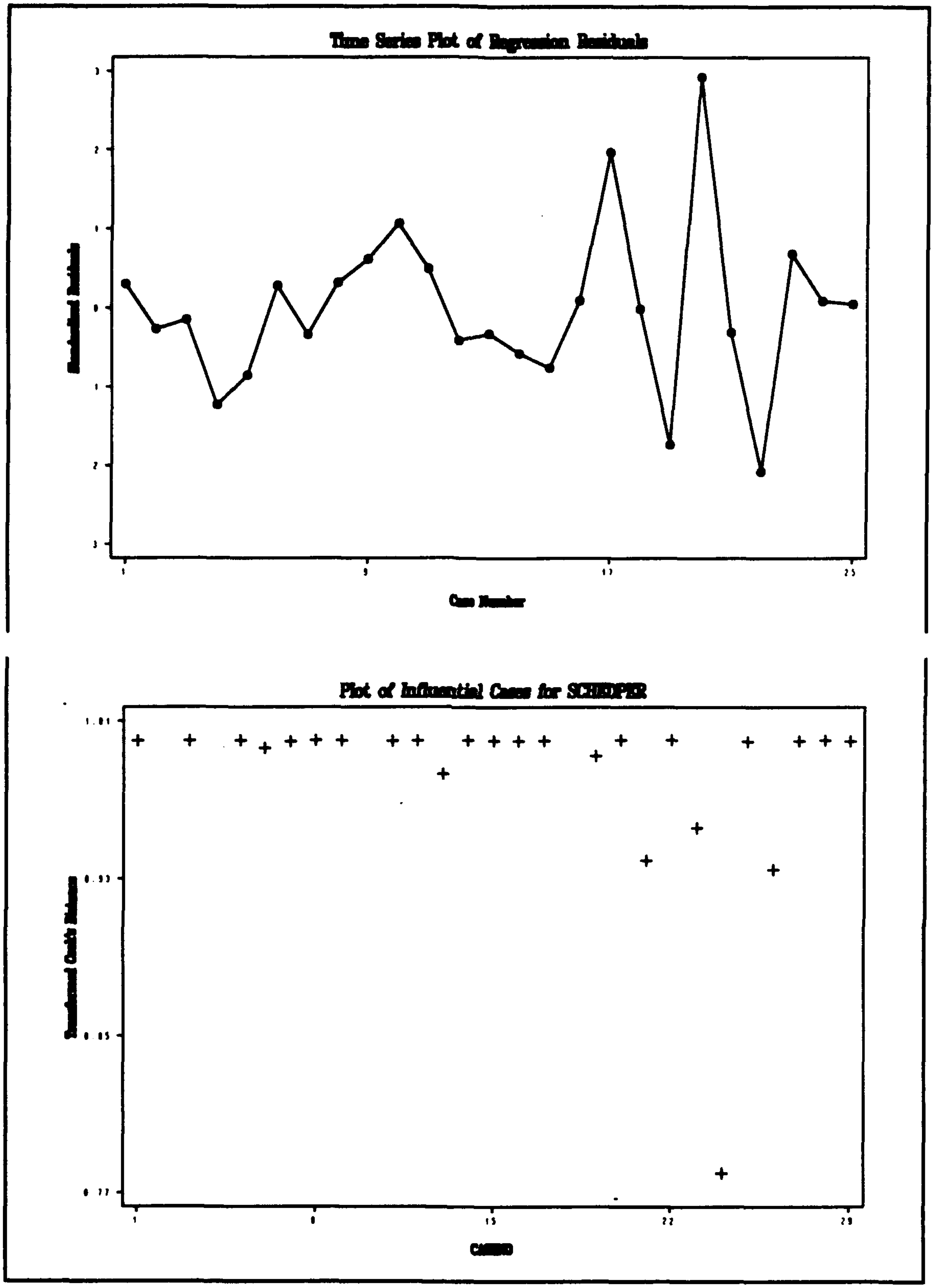


Figure 4-7. Time Series Plot and Transformed Cook's Distance for SCHEDPER (with Interactions)

Interestingly, Case #24 was the case that was identified as an outlier from the plot of the standardized residuals.

Model with Case #24 Deleted. To assess the significance of Case #24, the regression model was refitted with this case deleted. The regression results for this revised model are contained in Appendix L. The value of the F statistic and the associated p-value for the overall F test, for this model, were 7.97 and 0.0006, respectively, as compared with 8.88 and 0.0003 for the model with Case #24 included. Furthermore, the adjusted R^2 for the revised model decreased from 0.5678 to 0.5479 after Case #24 was removed, which indicated that less of the variability had been explained by this model. The reason that a model was obtained that did not fit as well was able to be readily identified from the plot of the standardized residuals and from the Wilk-Shapiro Rankit Plot: the revised model contained an outlier at almost four standard deviations from the regression line. The plot of the transformed Cook's Distance identified the outlier as Case #21 (SCHEDPER=263.0%, MPRESCH3=0, SOWSDISP=0, NOECPS=16, MSOWSINT=0), which had a significant influence value of 0.3529.

The majority of the regression coefficients changed significantly from the model with Case #24 included. The new values for the coefficients and the p-values for the associated t tests were obtained, and are given in the following list. (Note, the numbers in parentheses are the previous values for the coefficients.)

a. Constant = 112.66 (150.08): p = 0.0002,

b. MPRESCH3 = -85.54 (-109.64): p = 0.0007,

c. SOWSDISP = -84.25 (-120.30): p = 0.0040,

d. NOECPS = 1.22 (1.28): p = 0.0043, and

e. MSOWSINT = 56.36 (73.09): p = 0.0353.

As explained in Chapter III, a 99% prediction interval for schedule performance was obtained for Case #24 from the model for SCHEDPER with Case #24 excluded. The lower bound of this prediction interval for schedule performance was 20.2%, while the upper bound was 290.6%. This result supported the hypothesis that Case #24, with an actual schedule performance of 334.0%, may be from a different population to that of the rest of the sample. Further discussion of whether or not Case #24 should be excluded from the sample will be reserved until the remedial diagnostics for the model for SCHEDPER are completed.

Model with Case #21 and Case #24 Deleted. To assess the significance of Case #21, the regression model was refitted with this case deleted (i.e., now both Cases #21 and #24 have been deleted from the model). The regression results for this second revised model are contained in Appendix L. The value of the F statistic and the associated p-value for the overall F test, for this model, were 19.02 and 0.0000, respectively, as compared with 8.88 and 0.0003 for the model with Case #21 and Case #24 included. Furthermore, the adjusted R^2 for this second revised model increased from the previous models to 0.7661, which showed that approximately three quarters of the variability had been explained by the model. Plots of the standardized residuals and the Wilk-Shapiro Rankit Plot are given in Figure 4-8. The plot of the standardized residuals did not indicate that there were any outliers, nor that there were any systematic deviations around the fitted regression line. Furthermore, the plot of the standardized residuals indicated that the assumption of constancy of error variance may hold

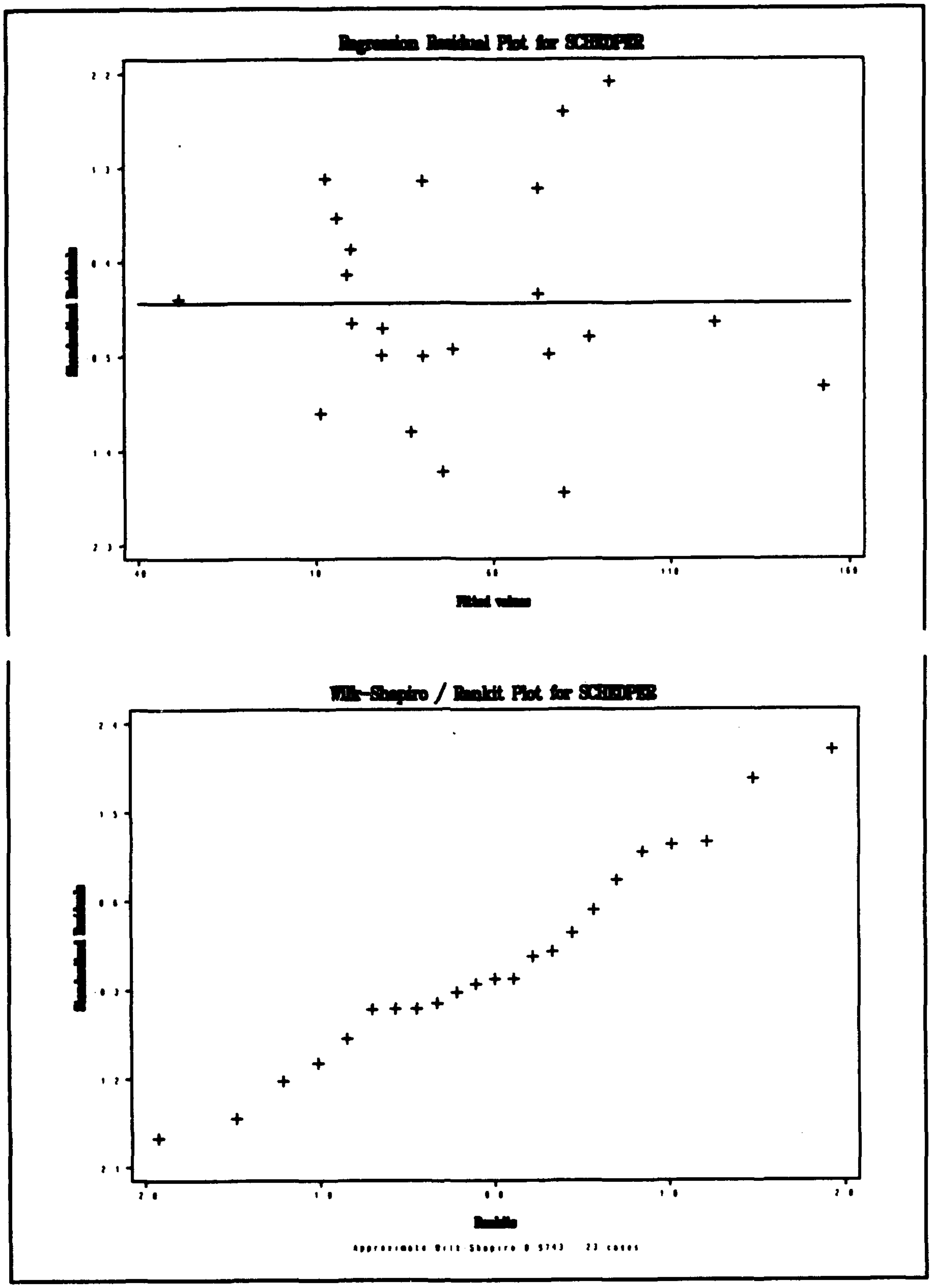


Figure 4-8. Standardized Residuals and Normality Assessment, SCHEDPER (with Interactions), Cases #21 and #24 Excluded

for this model. The Wilk-Shapiro statistic of 0.9743 indicated that the assumption of normality for the distribution of the residuals could be made (α=0.05) (Conover, 1980:468). From the influence measure (transformed Cook's distance) obtained from Statistix 4.0, none of the remaining cases were significant from an influence perspective. From these diagnostics, therefore, this second revised model appeared to be valid and to meet the assumptions of the normal-error regression model.

The regression coefficients changed significantly once again. The new values for the coefficients and the p-values for the associated t tests were obtained, and are given in the following list. (Note, the numbers in parentheses are the previous values from the model with Case #24 deleted, and from the original model, respectively.)

a. Constant = 54.04 (112.66, 150.08): p = 0.0026,

b. MPRESCH3 = -52.79 (-85.84, -109.64): p = 0.0004,

c. SOWSDISP = -36.90 (-84.25, -120.30): p = 0.0253,

d. NOECPS = 1.42 (1.22, 1.28): p = 0.0000, and

e. MSOWSINT = 35.68 (56.36, 73.09): p = 0.0160.

As explained in Chapter III, a 99% prediction interval for schedule performance was obtained for Case #21 from the model for SCHEDPER with Case #21 and Case #24 excluded. The lower bound of this prediction interval for schedule performance was 1.4%, while the upper bound was 152.2%. This result supported the hypothesis that Case #21, with an actual schedule performance of 263.0%, may be from a different population than the rest of the sample. Furthermore, the prediction interval for schedule performance from this model for Case #24, with an actual schedule performance of 334.0%, ranged from 29.2% to 178.5%. Further discussion of whether or not Case #21 and/or Case #24 should be excluded from the sample will be reserved until the remedial diagnostics for the model for SCHEDPER are completed.

Interestingly, the two cases that were removed from the SCHEDPER model using the regression-diagnostics (Case #21 and Case #24) were the same two cases that were removed from SCHEDPER earlier in this chapter to obtain SCHEDMOD. The results obtained through the regression-modelling approach confirmed that the two cases were indeed outliers. The assessment of whether or not these two cases should be excluded from the sample was now able to be made.

Discussion of Case #24. Case #24 was Contract Number F33657-88-C-0091, Contingency Airfield Lighting System (CALS). Discussions with the buyer responsible for this contract indicated that this particular acquisition had been subject to significant disruption as a result of the Gulf War. The actual schedule performance, therefore, was deemed to be unrepresentative of programs having similar attributes. This did not mean, however, that the case was from a different population; rather, the most likely conclusion was that the case represented a situation where other important, but not measured, independent variables would provide the necessary explanatory power. (Note, another explanation could be that, with a larger sample size, more variables would be able to be validly included in the model, and these additional variables would increase the explanatory power.) On this basis, the decision to exclude this case from the sample was justified.

Discussion of Case #21. Case #21 was Contract Number F33657-87-C-2092, Aircrew Eye/Respiratory Protection (AERP) Systems. This particular contract was the only contract in the sample that was rated as high for schedule risk. The SPO, therefore, knew when the contract was let that the contracted schedule was unrealistic and, perhaps, unreasonable. As this contract was the only case with a high schedule risk assessment, this attribute was unable to be adequately modeled. This did not mean, however, that the case was from a different population; rather, that sufficient explanatory power was unable to be obtained to model this single occurrence. (Note, another explanation could be that, with a larger sample size that contained more cases with schedule risk rated above medium, more variables would be able to be validly included in the model, and these additional variables would increase the explanatory power.) On this basis, the decision to exclude this case from the sample was also justified.

Interpretation of the Coefficients. The final model for SCHEDPER, with Case #21 and Case #24 excluded, was as follows:

$$SCHEDPER = 54.04 + -52.79*MPRESCH3 + -36.90*SOWSDISP + 1.42*NOECPS + 35.68*MSOWSINT$$

The interpretation of the coefficients of this model are as discussed in the following sub-paragraphs.

Interpretation of b_0. The y-intercept for the regression model is equal to 54.04 percentage units. While this point is an extrapolation beyond the data, an interpretation for this coefficient could be that, if, for a particular contract, there were no contract modifications, the contract was not pre-scheduled or the SOW did not require resource constraints within a program to be evaluated, and the SOW did not require schedule-management information in a network format (which removes the effect of both the SOWSDISP and MSOWSINT variables), then the point estimator for schedule performance for that contract would be 54.04 percentage units.

Interpretation of b_1. If a particular contract were pre-scheduled and the SOW tasked the contractor to evaluate resource constraints within a program, then the resultant schedule performance would improve by 52.79 percentage units compared with a contract that did not incorporate both of these attributes (for the same number of contract modifications).

Interpretation of b_2. If a particular contract tasked a contractor, via the SOW, to generate schedule-management information in a network format, then the resultant schedule performance would improve by 36.9 percentage units compared with a contract that did not incorporate this attribute (for the same number of contract modifications).

Interpretation of b_3. For a particular contract, as the number of contract modifications increases, schedule performance worsens at the rate of 1.42 percentage units per contract modification.

Interpretation of b_4. If a particular contract tasked a contractor, via the SOW, to generate schedule-management information in a network format and to evaluate resource constraints within a program and between programs, then the resultant schedule performance would worsen by 35.68 percentage units compared with a contract that did not incorporate these attributes (for the same number of contract modifications).

Discussion of the Coefficients. With the exception of the coefficient for the MSOWSINT (SOWSDISP*SOWRCWP*SOWRCBP) variable (b_4), the coefficients for the other variables in the model were consistent with intuition. The coefficient for the MSOWSINT variable is counter-intuitive, in that the sign is opposite to that of the coefficient for the related variables, MPRESCH3 and SOWSDISP. This counter-intuitive result probably occurred due to an artifact of the sample and, for this reason, the significance of the MSOWSINT variable is in question.

Further analysis of the revised SCHEDPER model, developed through the model-building approach discussed in this section, was not required because the dependent variable, with Case #21 and Case #24 excluded, was equivalent to SCHEDMOD. The model-building process for SCHEDPER, however, has resulted in a statistically significant model and has enabled a number of independent variables to be identified. To build on this knowledge, a more significant model, using different variables, was obtained using the stepwise model-building approach with SCHEDMOD as the dependent variable. This model is discussed in the next section.

SCHEDMOD with Interactions. The stepwise regression for SCHEDMOD, the results of which are contained in Appendix K, ran for five steps and included seven variables: steps 1-5 brought in NOECPS, PLPRESCH, MNOECPS1 (NOECPS*PLCONC), TECHDEFN (as a set of three dummy variables), and NODIDS. As explained earlier in this chapter, this stepwise approach resulted in a model that was 'over-fitted.' For SCHEDMOD, therefore, only the first three variables could be fitted in the model because TECHDEFN, comprised of three dummy variables, added too many variables in the fourth step. Further detailed analysis of the SCHEDMOD model with this reduced variable-set was conducted using Statistix 4.0, and the results are contained in Appendix L.

The Model. The three variables that were defined in the regression model for SCHEDMOD were as follows: NOECPS, PLPRESCH and MNOECPS1. These variables resulted in the following model:

SCHEDMOD = 35.02 + 1.59*NOECPS + -46.72*PLPRESCH + 1.19*MNOECPS1

The value of the F statistic and the associated p-value for the overall F test, for this model, were 51.66 and 0.0000, respectively. The adjusted R^2 for this model was 0.8736, which indicated that the majority of the variability had been explained by the model. The p-values associated with the t test for the parameter estimates were as follows:

a. Constant (35.02): p = 0.0025;

b. NOECPS (1.59): p = 0.0000;

c. PLPRESCH (-46.72): p = 0.0001; and

d. MNOECPS1 (1.19): p = 0.0013.

These p-values showed that all of the variables were significant at the α=0.05 level.

Assessment of Model Aptness. Plots of the standardized residuals and the Wilk-Shapiro Rankit Plot are given in Figure 4-9. The plot of the standardized residuals indicated that there were no outliers of any significance (i.e., greater than three sigma); however, one outlier was close to being significant: Case #23 (-2.97 sigma). The plot of the standardized residuals also indicated that the assumption of constancy of error variance may only tentatively hold for this model. The Wilk-Shapiro statistic of 0.9257 indicated that an assumption of normality for the distribution of the residuals could be made (α=0.05) (Conover, 1980:468). The time series plot of the regression residuals is given in Figure 4-10. This plot indicated that the error terms were

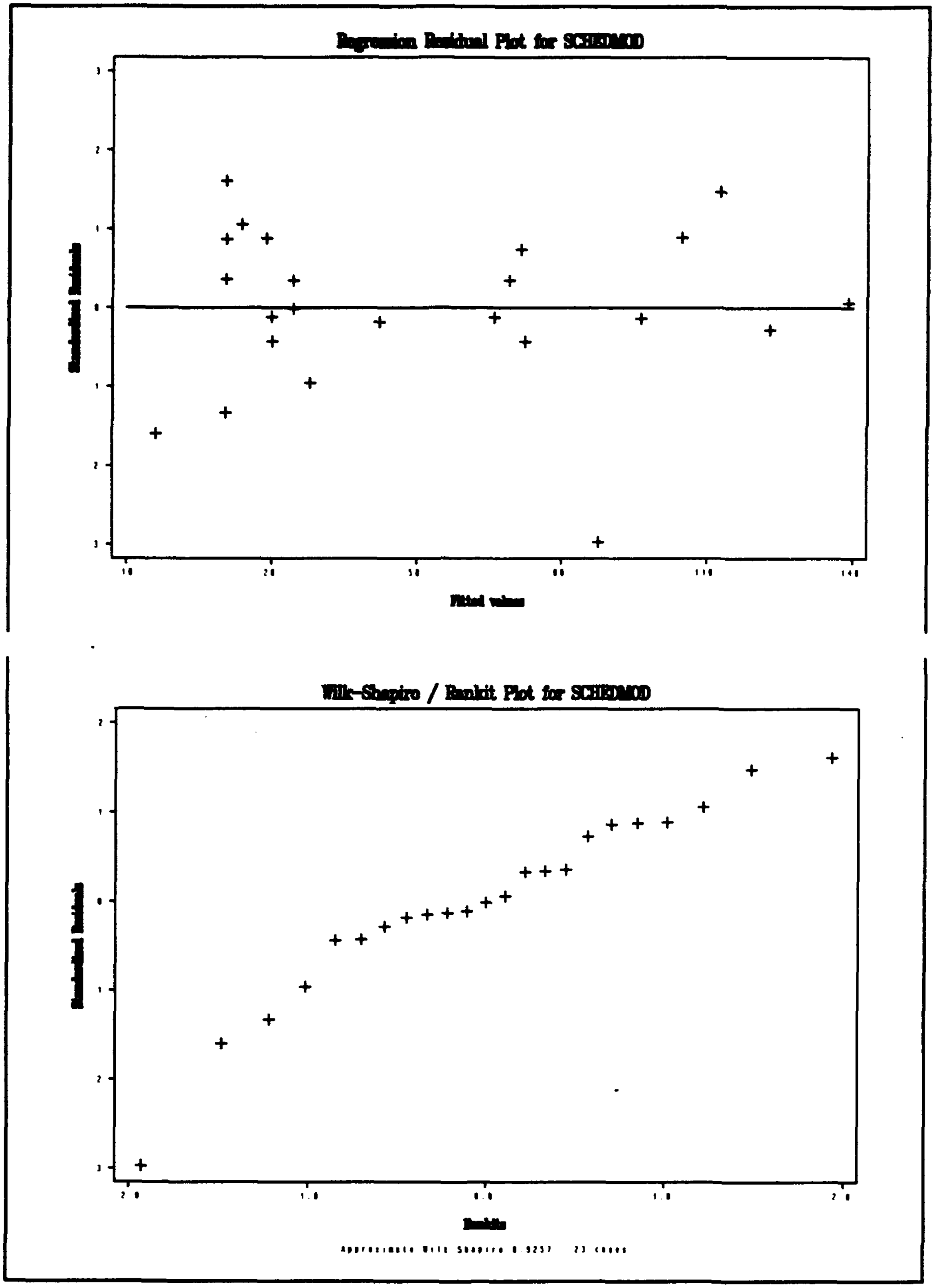


Figure 4-9. Standardized Residuals and Normality Assessment for SCHEDMOD (with Interactions)

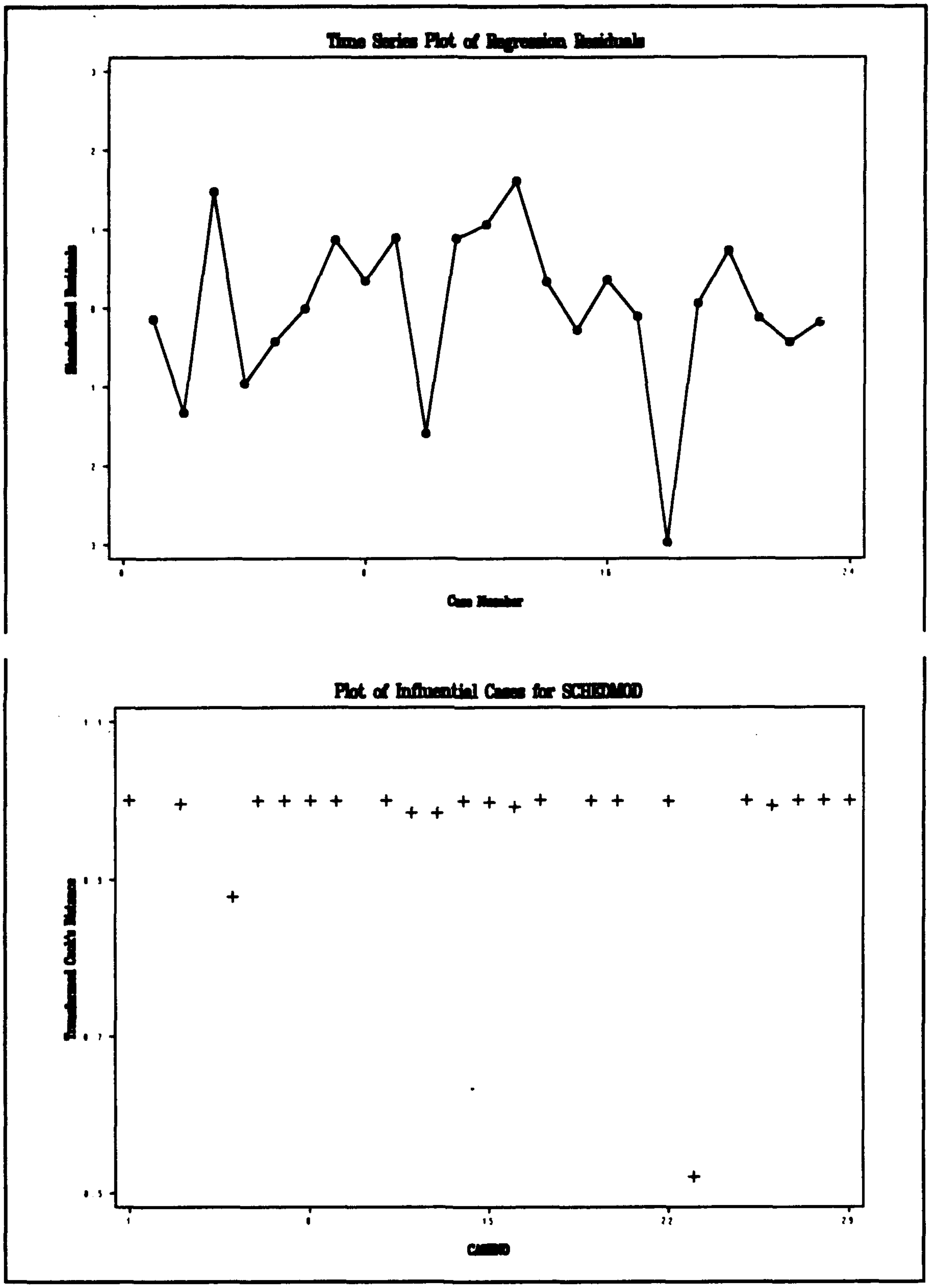


Figure 4-10. Time Series Residuals and Transformed Cook's Distance for SCHEDMOD (with Interactions)

not correlated over time. This 'visual' result was confirmed by the Durbin-Watson statistic for autocorrelation of 2.1056, which indicated that the error terms were independent (α=0.05) (Analytical Software, 1992:146-147).

Assessment of Influence. From Statistix 4.0, the plot of the transformed Cook's distance was obtained, and is given in Figure 4-10. From this plot, one case was identified as influential, with a moderate influence value of 0.5208: Case #23 (SCHEDMOD=46.8%, NOECPS=19, PLPRESCH=0, and MNOECPS1=19). As expected, this was the case which was assessed as being almost an outlier from the plot of the standardized residuals.

Model with Case #23 Deleted. To assess the significance of Case #23, the regression model was refitted with this case deleted. The regression results for this revised model are contained in Appendix L. The value of the F statistic and the associated p-value for the overall F test, for this model, were 96.75 and 0.0000, respectively. The adjusted R^2 for this new model increased from 0.8736 to 0.9319, which indicated that a greater amount of the variability had been explained by this model. The Wilk-Shapiro statistic also increased to 0.9678, which indicated that an assumption of normality for the distribution of the residuals could reasonably be made (α=0.05) (Conover, 1980:468). A new plot of the transformed Cook's distance further revealed that there were no additional outliers.

The regression coefficients changed moderately from the model with Case #23 included. The new values for the coefficients and the p-values for the associated t tests were obtained, and are given in the following list. (Note, the numbers in parentheses are the previous values for the coefficients.)

a. Constant = 48.39 (35.02): p = 0.0000;

b. NOECPS = 1.55 (1.59): p = 0.0000;

c. PLPRESCH = -60.10 (-46.72): p = 0.0000; and

d. MNOECPS1 = 1.33 (1.19): p = 0.0000.

As explained in Chapter III, a 99% prediction interval for schedule performance was obtained for Case #23 from the model for SCHEDMOD with Case #23 excluded. The lower bound of this prediction interval for schedule performance was 62.2%, while the upper bound was 144.1%. This result supported the hypothesis that Case #23, with an actual schedule performance of 46.8%, may be from a different population to that of the rest of the sample. Further discussion of whether or not Case #23 should be excluded from the sample will be reserved until the remedial diagnostics for the model for SCHEDMOD are completed.

Discussion of Case #23. Case #23 was contract number F33657-88-C-0029, C-17 Aircrew Training System (ATS). While the exclusion of Case #23 resulted in an improved model, there was no justifiable reason to remove the case; it simply represented a configuration of covariates that was entirely plausible but with an unusual outcome (i.e., schedule performance better than the 99% predicted value). For this reason, Case #23 was not excluded from the final model. Potentially, with increased sample size, this case may no longer be an outlier; this is further justification for retaining the case in the sample.

Interpretation of the Coefficients. The final model for SCHEDMOD was as follows:

SCHEDMOD = 35.02 + 1.59*NOECPS + -46.72*PLPRESCH + 1.19*MNOECPS1

The interpretation of the coefficients of this model are as discussed in the following sub-paragraphs.

Interpretation of b_0. The y-intercept for the regression model is equal to 35.02 percentage units. While this point is an extrapolation beyond the data, an interpretation for this coefficient could be that, if, for a particular contract, there were no contract modifications and the contract was not pre-scheduled, then the point estimator for schedule performance for that contract would be 35.02 percentage units.

Interpretation of b_1. For a particular contract, as the number of contract modifications increases, schedule performance worsens at the rate of 1.59 percentage units per contract modification.

Interpretation of b_2. If a particular contract were pre-scheduled, then the resultant schedule performance would improve by 46.72 percentage units compared with a contract that did not incorporate this attribute (for the same number of contract modifications).

Interpretation of b_3. If a particular contract were to involve concurrency, then, as the number of contract modifications increases, schedule performance worsens at an increased rate of 2.78 (i.e., 1.59 + 1.19) percentage units per contract modification.

Discussion of the Coefficients. The coefficients for all the variables in the model were consistent with intuition. With respect to b_3, the effect of this interaction term was to increase the slope of the regression function when concurrency was present in the program.

Plot of the Final SCHEDMOD Regression Model. A plot of the final regression model developed from SCHEDMOD is given in Figure 4-11. This plot was generated using Mathcad 4.0 and graphically shows the limitations of the regression model. The single most important limitation demonstrated by this plot was that the regression function had a limited number of data points beyond approximately 50 contract

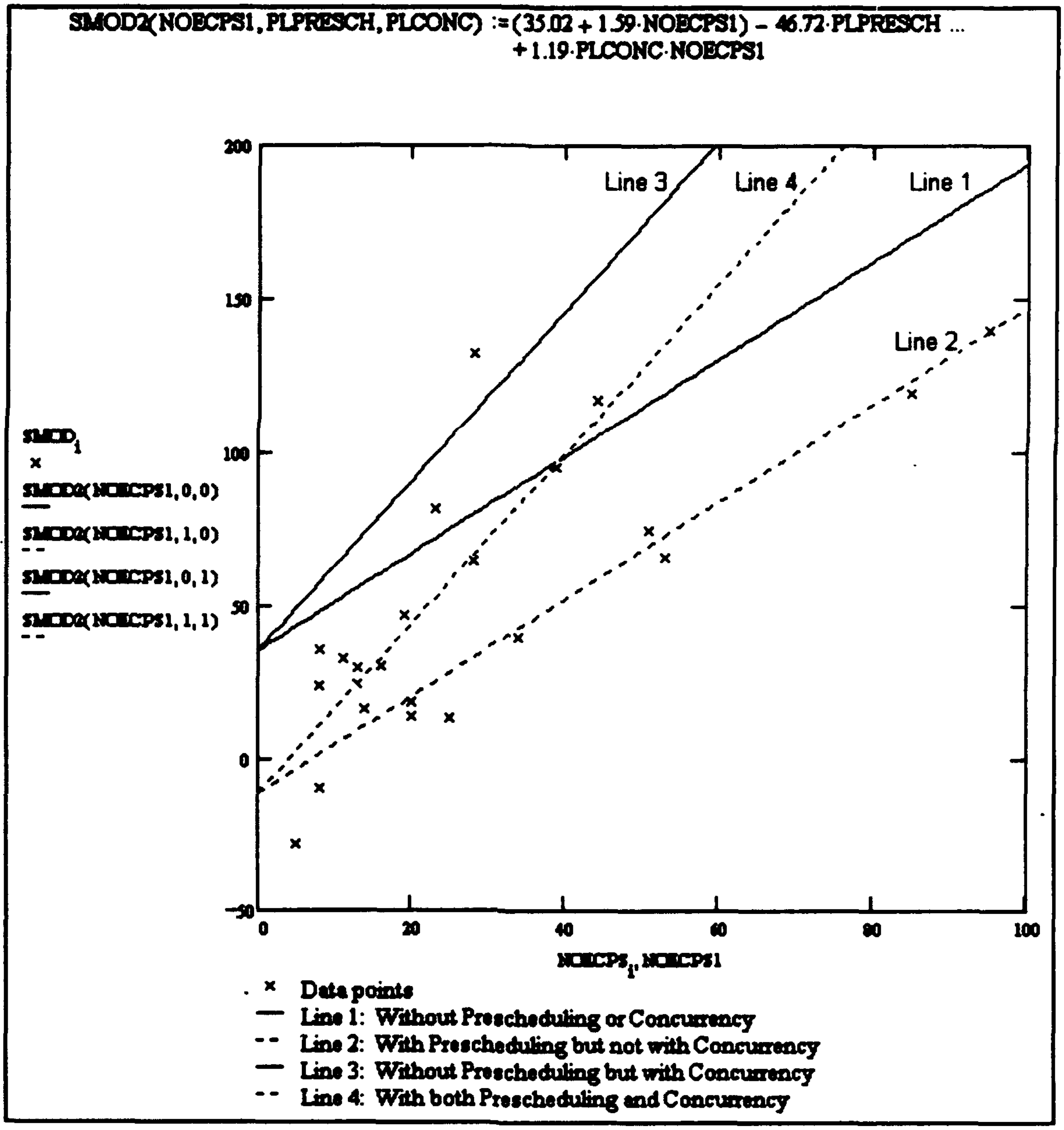


Figure 4-11. Plot of the Final Regression Model for SCHEDMOD

modifications. This limitation suggested that inferences beyond this point were of questionable value. The plot also demonstrated the effect of both the binary-level variable, PLPRESCH, and the interaction variable, MNOECPS1 (i.e., PLCONC*NOECPS).

Summary of the Stepwise Regression Results

This section of Chapter IV has presented the results of the stepwise multi-variable analyses. Initially, stepwise regression techniques were utilized, with models containing no interaction terms, to ascertain whether or not it made sense to proceed with obtaining a multi-variable model. Secondly, potential interaction terms were identified through logical considerations. Following this, a regression model for SCHEDPER was obtained. Analysis of this model indicated that there were two significant outliers, which, when removed, considerably improved the fit of the model. These two outliers were the two cases that were identified when schedule performance was initially reviewed earlier in this chapter. Removal of these two outliers resulted in a model which effectively employed SCHEDMOD as the dependent variable; hence, further analysis of the model developed from SCHEDPER was not required.

The model that was obtained for SCHEDMOD contained three variables. Analysis of this model revealed a well-fitting model which met the assumptions of the normal-error regression model. Having completed the stepwise model-building process, the next step is to supplement the information obtained from this process by examining the results obtained from the best subsets regression models.

Best Subsets Regression

Introduction. As discussed in Chapter III, best subsets regression was used to supplement the information gained from the stepwise regression analyses. This section will discuss the best subsets regression results by addressing:

a. the pre-analysis manipulation of the variables, and

b. the results from the best subsets regressions for SCHEDPER and for SCHEDMOD.

Pre-Analysis Manipulation of Variables. Prior to conducting the best subsets regressions, the following ordinal-level variables were recategorized into binary-level variables: PLSRISK, PLTRISK, TECHDEFN, and PLWBSL3M. These four variables were renamed, respectively: PLSRM, PLTRM, TDEFM, and PLWL3M. This recategorization was necessary because the software used to perform the best subsets regressions could not handle ordinal-level variables recoded into dummy variable sets.

After the ordinal-level variables were recoded the variable set was reduced by combining the following variables into interaction variables: SOWSDISP, SOWRCWP, and SOWRCBP were combined into the variable MSOWSINT; and EVSDISP, EVRCWP, and EVRCBP were combined into the variable MEVSINT. The combining of variables through this approach enabled the effect of each of the individual variables to be included (albeit to a lesser extent), while reducing the number of variables in the variable set. These two interaction variables had been included in the stepwise regression analyses, and were found to be significant (α=0.1) (refer Appendix J).

After the interaction terms were generated, the variable set was still too large; hence, it was necessary to drop a number of variables from the analysis. A decision was taken to drop the following variables: D_DP, PRODOPT, and COMPLEX. These three variables were all project-characteristic variables which had been included in the variable set to act as moderators. The first two variables were found to be of little significance in the stepwise analyses, and the third variable, COMPLEX, was a transformation of UCOSTCD; hence, the same information was effectively contained in the variable set twice.

After the variable set was reduced, the final step was to rename a number of variables to enable the full complement of 20 unforced variables to fit in the appropriate data field in Statistix 4.0. The new names appear in Appendix M; however, the discussion of the results utilizes the original names.

Discussion of the Results. The results for the individual regression runs are given in Appendix M, and these results are summarized in Table 4-4 for the analyses which utilized SCHEDPER as the dependent variable, and in Table 4-5 for the analyses which utilized SCHEDMOD as the dependent variable. Note that each model reported in the two tables had a significant value for the overall F test (α=0.05), yet within each model the p-value for the t test for each variable was not always significant (α=0.10). This second distinction is the focus of the discussion to follow.

The best subsets regressions identified the following variables as significant (α=0.10):

a. NOECPS,
b. PLPRESCH,
c. PLCONC,
d. TDEFM,
e. PLWBSDEV,
f. NODIDS,
g. NOPMDIDS,

i. CTYPE, and

h. PLWL3M.

Of these variables, TDEFM, PLWBSDEV, PLWL3M, NOPMDIDS, NODIDS, and CTYPE were not identified as significant in the stepwise regression analyses. Furthermore, the appearance of NOECPS, PLPRESCH, and PLCONC variables in the best subsets models provided significant support for the results obtained from the stepwise regression analyses. Each of these variables will be discussed in the following paragraphs.

NOECPS. The results of the best subsets regressions lent considerable support to the previous result that the number of contract modifications was the most significant variable in this analysis. Interestingly, this variable appeared in all of the best subsets models.

PLPRESCH. As for NOECPS, the results of the best subsets regressions lent considerable support to the previous result that the pre-scheduling of a contract was a very significant variable in this analysis. Interestingly, this variable appeared in the majority of the best subsets models.

PLCONC. While not discussed as a significant variable during the stepwise regression analyses, PLCONC was entered into the model for SCHEDPER (without interactions) at Step #3 (refer Appendix H), and was included in the final model for SCHEDMOD (with interactions) as an interaction term with NOECPS (refer Appendices K and L). The results of the best subsets regressions, therefore, revealed that concurrency in a program was a significant variable for defining schedule performance. The average coefficient for this variable was approximately 23, which indicated that a program that involved concurrency would result in approximately 23 percentage units worse schedule performance than a

Table 4-4. Results of Best Subsets Regressions for SCHEDPER

Model No	Var #1 (p-val)	Var #2 (p-val)	Var #3 (p-val)	Var #4 (p-val)	Adj R^2	F value	p-value
1	NOECPS (.0074)	PLPRESCH (.0060)	TDEFM (.0345)		.3959	6.24	.0034
2	NOECPS (.0143)	PLPRESCH (.0365)	PLWBSDEV (.0500)		.3771	5.84	.0046
3	NOECPS (.0020)	PLCONC (.0399)	PLWBSDEV (.0039)		.3724	5.75	.0049
4	NOECPS (.0035)	PLWBSDEV (.0116)	TDEFM (.0508)		.3599	5.50	.0060
5	NOECPS (.0142)	PLPRESCH (.0174)	UCOSTCD (.1430)		.3234	4.82	.0104
6	NOECPS (.1199)	PLPRESCH (.0170)	PLDRRFP (.1506)		.3208	4.78	.0108
7	NOECPS (.0074)	PLWBSDEV (.0086)	NOPMDIDS (.1297)		.3107	4.61	.0125
8	NOECPS (.0307)	PLPRESCH (.0241)	PLTRM (.2040)		.3056	4.52	.0135
9	NOECPS (.0520)	PLPRESCH (.0211)	MSOWSINT (.2223)		.3014	4.45	.0143
10	NOECPS (.0645)	PLPRESCH (.0110)	PLAGGR (.2290)		.3000	4.43	.0146
11	NOECPS (.0011)	PLPRESCH (.0081)	PLWBSDEV (.0153)	TDEFM (.0109)	.5307	7.78	.0006
12	NOECPS (.0015)	PLPRESCH (.0321)	PLCONC (.0349)	PLWBSDEV (.0067)	.4793	6.52	.0016
13	NOECPS (.0072)	PLPRESCH (.0117)	PLWL3M (.0965)	TDEFM (.0132)	.4494	5.90	.0026
14	NOECPS (.0046)	PLPRESCH (.0064)	PLTRM (.1280)	TDEFM (.0248)	.4367	5.65	.0033
15	NOECPS (.0117)	PLPRESCH (.0024)	PLAGGR (.1404)	TDEFM (.0246)	.4326	5.57	.0035
16	NOECPS (.0028)	PLPRESCH (.0051)	UCOSTCD (.1417)	TDEFM (.0365)	.4322	5.57	.0035
17	NOECPS (.0153)	PLPRESCH (.0301)	PLWBSDEV (.0449)	PLDRRFP (.1266)	.4197	5.34	.0043

Table 4-5. Results of Best Subsets Regressions for SCHEDMOD

Model No	Var #1 (p-val)	Var #2 (p-val)	Var #3 (p-val)	Var #4 (p-val)	Adj R^2	F value	p-value
1	NOECPS (.0000)	PLPRESCH (.0000)	PLCONC (.0052)		.8550	44.25	.0000
2	NOECPS (.0000)	PLPRESCH (.0000)	TDEFM (.0095)		.8464	41.42	.0000
3	NOECPS (.0000)	PLPRESCH (.0015)	NOPMDIDS (.0491)		.8208	34.60	.0000
4	NOECPS (.0000)	PLPRESCH (.0001)	NODIDS (.0496)		.8207	34.56	.0000
5	NOECPS (.0000)	PLPRESCH (.0001)	CTYPE (.0941)		.8102	32.30	.0000
6	NOECPS (.0000)	PLPRESCH (.0002)	SOWCSSR (.1131)		.8072	31.70	.0000
7	NOECPS (.0000)	PLPRESCH (.0002)	PAGESSOW (.1966)		.7982	30.00	.0000
8	NOECPS (.0000)	PLPRESCH (.0000)	PLCONC (.0447)	TDEFM (.0821)	.8712	38.21	.0000
9	NOECPS (.0000)	PLPRESCH (.0001)	PLCONC (.0032)	NOEVCRIT (.1805)	.8619	35.32	.0000
10	NOECPS (.0000)	PLPRESCH (.0000)	CTYPE (.1069)	TDEFM (.0120)	.8603	34.86	.0000
11	NOECPS (.0000)	PLPRESCH (.0000)	TDEFM (.0104)	SOWCSSR (.1081)	.8601	34.82	.0000
12	NOECPS (.0000)	PLPRESCH (.0000)	PLCONC (.0104)	SOWCSSR (.2110)	.8601	34.80	.0000
13	NOECPS (.0000)	PLPRESCH (.0003)	PLCONC (.0224)	NOPMDIDS (.2203)	.8596	34.66	.0000
14	NOECPS (.0000)	PLPRESCH (.0002)	TDEFM (.0236)	NOPMDIDS (.1195)	.8588	34.46	.0000

program that did not involve concurrency.

TDEFM. While not discussed as a significant variable during the stepwise regression analyses, the ordinal-level version of TDEFM (TECHDEFN) was entered into the model for SCHEDMOD (without interactions) at Step #3 (refer Appendix I), was entered into the model for SCHEDPER (with interactions) at Step #6 (refer Appendix J), and was included in the model for SCHEDMOD (with interactions) at Step #4 (refer Appendix K). Interestingly, TDEFM appeared in almost half of the best subsets models. The results of the best subsets regressions, therefore, revealed that the degree of technical definition was a significant variable for defining schedule performance. The average coefficient for this variable was approximately 20, which indicated that a program that utilized a Type B specification (either draft or full) would result in approximately 20 percentage units worse schedule performance than for a program that utilized a Type A specification (either draft or full).

PLWBSDEV. Interestingly, during the stepwise analyses, PLWBSDEV was not entered into any of the stepwise regression models for SCHEDPER nor for SCHEDMOD. With respect to the best subsets regressions, on the other hand, PLWBSDEV appeared in almost half the models obtained for SCHEDPER, though did not appear in any of the models for SCHEDMOD. The results of the best subsets regressions, therefore, revealed that the development of a preliminary WBS was a marginally significant variable for defining schedule performance. The average coefficient for this variable was approximately -86; however, with a standard error of approximately 30, the magnitude of this coefficient should be treated with caution. The sign of the coefficient, however, indicated that the development of a preliminary WBS would improve schedule performance.

NODIDS. While not discussed as a significant variable during the stepwise regression analyses, NODIDS was entered into the model for SCHEDMOD (without interactions) at Step #4 (refer Appendix I), and was entered into the model for SCHEDMOD (with interactions) at Step #5 (refer Appendix K). With respect to the best subsets regressions, however, NODIDS appeared in only one of the models obtained for SCHEDMOD. In all of the three cases mentioned here, the coefficient for this variable was approximately 0.4, which indicated that as the number of DIDS for a program were increased, schedule performance would worsen at the rate of 0.4 percentage units per DID. Given that this variable only appeared in one of the best subsets, however, this result should be treated with caution.

NOPMDIDS. During the stepwise analyses, NOPMDIDS was not entered into any of the stepwise regression models for SCHEDPER or for SCHEDMOD. Furthermore, with respect to the best subsets regressions, NOPMDIDS appeared as a significant variable in only one of the models obtained for SCHEDMOD (α=0.1). The variable did appear in a number of other models; however, the associated p-value was greater than 0.1. The variability explained by NOPMDIDS, therefore, was better explained by other variables in the variable set. On this basis, NOPMDIDS was not considered to be significantly related to schedule performance, in comparison with the already identified significant variables.

CTYPE. During the stepwise analyses, CTYPE was not entered into any of the stepwise regression models for SCHEDPER nor for SCHEDMOD. Furthermore, with respect to the best subsets regressions, CTYPE appeared in only one of the models obtained for SCHEDMOD. In that model, CTYPE had a p-value of 0.0941, which was very close to $\alpha=0.1$. For these reasons, CTYPE was not considered to be a variable which meaningfully contributed to the explanation of schedule performance.

PLWL3M. During the stepwise analyses, the ordinal-level version of PLWL3M (PLWBSL3) was not entered into any of the stepwise regression models for SCHEDPER or for SCHEDMOD. Furthermore, with respect to the best subsets regressions, PLWL3M appeared in only one of the models obtained for SCHEDPER. In that model, PLWL3M had a p-value of 0.0965, which was very close to $\alpha=0.1$. For these reasons, PLWL3M was not considered to be a variable which meaningfully contributed to the explanation of schedule performance.

Summary of Best Subsets Regression. Best subsets regression was utilized to aid in the identification of important pre-contract-award management actions which may affect schedule performance. A number of additional actions were identified by best subsets regression which had not been identified in the stepwise regression analyses, and the relevance of these actions was discussed. The use of best subsets regression, therefore, enabled the nature of schedule performance and schedule management to be better understood.

Discussion of the Results

Introduction

Chapter I of the thesis outlined the specific problem addressed by this research effort and presented the associated investigative questions. This section of Chapter IV will discuss the results of the analyses in relation to the investigative questions. Specifically, this section will address, as appropriate:

a. the variables which were found to be significant from the single-variable analyses,

b. the variables which were found to be significant from the multi-variable analyses,

c. some observations associated with the variables which were found to be significant, and

d. some observations associated with the variables which were found not to be significant.

For reasons that will become immediately obvious, a brief discussion of the results of the analyses for the variables not covered under any of the investigative questions is required before the investigative questions are addressed.

Significant Results Outside the Scope of the Investigative Questions

A number of the variables included in the analyses were not addressed by the investigative questions. These variables included a number of project-characteristic variables (i.e., Contract Type (CTYPE), Development / Development and Production (D_DP), Production Option (PRODOPT), Unit Cost in Constant Dollars (UCOSTCD), and Complexity (COMPLEX)) and a moderator variable to address the post-contract-award management actions: Number of Contract Modifications (NOECPS). Of the project-characteristic variables, D_DP, PRODOPT, UCOSTCD, and COMPLEX demonstrated a significant relationship with schedule performance at the single-variable-analysis level (α=0.25). At the multi-variable-analysis level, however, none of these variables were found to be significant (α=0.1). NOECPS, on the other hand, was arguably the most significant main effect and interacting variable at all levels of the analysis. This result was not unexpected, and reinforces the commonly-held belief that post-contract-award actions are the main drivers of schedule performance. Furthermore, this result is arguably the most important contribution of this research effort to an understanding of schedule performance; hence, a study of the relationship between pre-contract-award management actions and the resultant number of contract changes is worthy of some endeavor. This additional study, however, was outside of the scope of the research effort.

Investigative Question One

The first investigative question was as follows: Which management actions, with the potential to affect schedule performance, may occur prior to contract award? This investigative question was addressed through the literature review in Chapter II of the thesis. A review of current DoD policies and procedures resulted in the candidate variable list, attached at Appendix B, which was refined to obtain the DCI.

Investigative Question Two

The second investigative question was as follows: Which DoD management actions, during the planning phase, influence schedule performance? The results from both the single-variable and the multi-variable analyses showed that a number of planning actions have the potential to affect schedule performance. From the single-variable analyses, the following variables were found to have at least some relationship to schedule performance, at the broad level of significance chosen (α=0.25): Pre-scheduled (PLPRESCH), Schedule Risk (PLSRISK), Preliminary WBS Developed (PLWBSDEV), Number of Elements at Level Three of the WBS (PLWBSL3), and Draft RFP (PLDRRFP). The multi-variable analyses revealed that the following planning variables were significant (α=0.1): Pre-scheduled (PLPRESCH), Concurrency (PLCONC), and Preliminary WBS Developed (PLWBSDEV).

As expected, the planning variables that were found to be significant at the single-variable-analysis level were not necessarily found to be significant at the multi-variable-analysis level. In part, this was due to the less stringent level of significance utilized at the single-variable-analysis level, and that collinearities and potential interactions were not considered at that level. Furthermore, this result was an artifact of the model-building process itself, in that only a maximum of four variables could be meaningfully employed in any multiple regression model.

Of the three planning variables identified at the multi-variable-analysis level, Pre-scheduled (PLPRESCH) and Concurrency (PLCONC) were found to be the most significant variables. Interestingly and perhaps counter-intuitively, Pre-scheduled (PLPRESCH) was discovered to have a beneficial effect on schedule performance; that is, a contract that was pre-scheduled by the DoD resulted in a better schedule performance. Concurrency, on the other hand, appealed to intuitive sense in that it was found to have a detrimental effect on schedule performance; that is, the existence of concurrency resulted in a worse schedule performance. With respect to Preliminary WBS Developed (PLWBSDEV), a tentative result, based on the sign of the associated coefficient, was that, the development of a preliminary WBS would have a beneficial effect on schedule performance.

Two of the variables that were found to be significant at the single-variable analysis stage (α=0.25) but were not found to be significant at the multi-variable stage (α=0.1) require further discussion: Schedule Risk (PLSRISK) and Draft RFP (PLDRRFP). The fact that Schedule Risk (PLSRISK) was not found to be significant at the multi-variable analysis stage is important because this result highlights the difficulties associated with the *a priori* assessment of schedule risk. With regard to Draft RFP (PLDRRFP), the lack of a very significant relationship between whether or not a draft RFP was issued and schedule performance is important because this result is counter-intuitive. These results, however, do not provide definitive proof that these variables are not related to schedule performance; the lack of a very significant relationship could be due to the sample size and to artifacts of the sample.

The study of the relationship between pre-contract-award management actions and the resultant schedule performance would not be complete without addressing which actions did not result in a significant relationship at any analysis level. With respect to the planning variables, the following variables did not exhibit a significant relationship with schedule performance: Aggressive (PLAGGR) and Technical Risk (PLTRISK). Within the limitations of this thesis, the lack of a relationship between these variables and schedule performance is surprising: PLAGGR because, intuitively, an admittedly aggressive schedule would be expected to result in a schedule overrun (unless additional schedule-management actions were to counteract the overrun potential); and PLTRISK because previous studies (e.g., the 1990 RAND study) have linked technical uncertainty with schedule overrun.

Investigative Question Three

The third investigative question was as follows: Which DoD management actions, during the specification-of-requirements phase, influence schedule performance? The results from both the single-variable and the multi-variable analyses showed that a number of specifying actions have the potential to affect schedule performance. From the single-variable analyses, the following variables were found to have at least some relationship to schedule performance at the broad level of significance chosen (α=0.25): Degree of Technical Definition (TECHDEFN), Develop WBS Further (SOWDWBS), and SOW Schedule Display (SOWSDISP). The multi-variable analyses revealed that the following specifying variables were significant (α=0.1): Technical Definition (TDEFM) (i.e., TECHDEFN recoded as a binary variable); SOW Schedule Display (SOWSDISP); Number of DIDs (NODIDS), SOW Resource Constraints Within a Program (SOWRCWP) (as an interacting variable with Pre-scheduled (PLPRESCH)); and, as a three-way interaction variable: SOW Schedule Display (SOWSDISP), SOW Resource Constraints Within a Program (SOWRCWP), and SOW Resource Constraints Between Programs (SOWRCBP).

Of the five specifying variables identified at the multi-variable-analysis level, Technical Definition (TDEFM), SOW Schedule Display

(SOWSDISP), and Number of DIDs (NODIDS) were found to be the most significant variables. The degree of technical definition was found to have a detrimental effect on schedule performance, in that, as the specification changed from a functional specification (i.e., Type A) to a Prime Item Development Specification (PIDS) (i.e., Type B), schedule performance worsened. The format in which the schedule-performance information was requested in the SOW was found to have a beneficial effect on schedule performance, in that, a program that requested information in a network format had improved schedule performance compared with a program that requested information in a Gantt chart format. The number of DIDs was found to have a detrimental effect on schedule performance, in that, as the number of DIDs for a program increased, schedule performance worsened.

The other two variables also found to be significant at the multi-variable-analysis level, SOWRCWP and SOWRCBP, were only significant as interaction variables. With respect to the interaction variable involving SOWRCWP and PLPRESCH, this variable demonstrated that if a contract were pre-scheduled and if the SOW required that resource constraints within a program be evaluated, then these two actions, together, would have a beneficial effect on schedule performance. As discussed earlier in this Chapter, the significance of the three-way interaction term, MSOWSINT (SOWSDISP*SOWRCWP*SOWRCBP), was believed to be due to an artifact of the sample. For this reason, the significance of MSOWSINT and, therefore, SOWRCBP, are questionable. The inclusion of the interaction terms in that multiple regression model reinforces the need to evaluate real-world scenarios from a multi-variable perspective.

The study of the relationship between pre-contract-award management actions and the resultant schedule performance would not be complete without addressing which actions did not result in a significant relationship at any stage of the analysis. With respect to the specifying variables, the following variables did not exhibit a significant relationship with schedule performance: Number of Pages in the SOW (PAGESSOW), Develop WBS Further (SOWDWBS), C/SSR Required (SOWCSSR), Frequency of Reporting Schedule-Management Information (SOWFRSI), and Number of Project-Management DIDs (NOPMDIDS). Within the limitations of this thesis, the lack of a relationship between the last four (which are the intuitively significant variables) and schedule performance was surprising and, potentially, of considerable import.

Investigative Question Four

The fourth investigative question was as follows: Which DoD management actions, during the evaluation phase, influence schedule performance? The results from both the single-variable and the multi-variable analyses showed that, within the constraints of the sample size, evaluating actions were not related to schedule performance. From the single-variable analyses, one variable was found to have a minor relationship to schedule performance at the broad level of significance chosen (α=0.25): Evaluation Schedule Display (EVSDISP). The multi-variable analyses, however, revealed that none of the evaluating variables were significant (α=0.1).

As a corollary to the preceding discussion, the following evaluating variables did not exhibit a relationship with schedule performance: Number of Evaluation Criteria (NOEVCRIT), Evaluation

Resource Constraints Within a Program (EVRCWP), and Evaluation Resource Constraints Between Programs (EVRCBP). Within the limitations of this thesis, the fact that evaluating variables were found to have little significance in defining schedule performance appears to be counter-intuitive and extremely relevant.

Investigative Question Five

The fifth investigative question was as follows: Of the DoD management actions which positively influence schedule performance, which can be cost-effectively implemented (commensurate with the selected project characteristics)? Due to the small sample-size, the ability of regression techniques to comprehensively evaluate the large number of variables involved was limited. From this perspective, therefore, the ability to address this investigative question was also limited. The results obtained under investigative questions two, three, and four provide some tentative guidance as to the focus of management attention. The management actions identified under those investigative questions are all able to be implemented with little effort and for little cost by both the DoD and the contractor; hence, these actions are considered to be cost-effective.

Other Observations Related to Schedule Management

A number of observations were made during the data-collection process and during the initial data analysis which highlight some important issues with respect to schedule management. These observations imply that the management of schedule, via the contractual process, is not well understood within the SPO. The specific observations which support this conclusion are discussed in the following paragraphs.

Schedule-Management Information. The information that was required for the assessment of schedule during source selection (i.e., in the ITO) often differed from the information that was required for the management of schedule throughout the contractual period (i.e., in the SOW and the CDRL). For example, 12 of the 29 contracts in the database differed from the ITO to the SOW/CDRL with respect to the format in which the schedule-management information was required to be presented (i.e., Gantt chart or network). Furthermore, 12 of the 29 contracts differed from the ITO to the SOW/CDRL as to whether or not resource constraints within a program were to be evaluated, and 13 of the 29 contracts differed from the ITO to the SOW/CDRL as to whether or not resource constraints between programs were to be evaluated.

The information that was required for the management of schedule throughout the contractual period was rarely found to be specified in a coherent and integrated manner. In a significant number of contracts, the schedule-presentation information, the evaluation of resource constraints, and the allocation of responsibility were all specified in different sections of the contract. Furthermore, many of the project-management DIDs imposed unique schedule-management requirements that were not necessarily compatible with each other nor with the major schedule-management requirements for a particular contract.

Significance of the Work Breakdown Structure. For a number of contracts in the database, the manner in which the WBS was specified implied that the WBS was not being effectively utilized for the management of schedule. In many contracts examined during the data-collection process, the SOW required that the WBS be periodically updated throughout the life of the contract without tying the requirement for a WBS to any other requirement in the contract. Furthermore, three of the RFPs which did not include a preliminary WBS required that the resultant contractor utilize a WBS for contract-management purposes. Moreover, two of the RFPs which required that the offeror update the preliminary WBS with his/her proposal did not require that the WBS be used for contract-management purposes. Finally, the preliminary WBS was often 'hidden' in the cost-requirements section of the ITO, which implied that the WBS was considered by the SPO to be more relevant for cost-accounting purposes than for the management of schedule. These practices suggest that the effectiveness of the WBS as a schedule-management tool may not be well understood.

Integration of C/SCSC or C/SSR with Network Information. None of the contracts in the database attempted to integrate C/SSR or C/SCSC requirements with network information. Furthermore, the guidance concerning the use of C/SCSC, in comparison with C/SSR, appeared to be inappropriately applied at times (i.e., C/SCSC was specified for some contracts with a face value (or potential worth) significantly below the mandated threshold). The potential gains of an integrated approach to cost and schedule management, therefore, were not realized.

Schedule Risk. A significant observation from the contracts in the database was that only one of the contracts had a schedule-risk assessment of high and only one of the contracts had a schedule-risk assessment of medium-high, while the rest of the contracts had a schedule risk assessment of medium or lower. Given that 23 of the 25 contracts in the sample experienced a schedule overrun, the implication of this result is that the assessment of schedule risk by the SPOs does not reflect an adequate understanding of the factors that affect schedule performance.

Reactive Nature of Schedule Management. For the 29 contracts in the database, only one of the contracts required that the schedule-management information be provided proactively (i.e., as schedule slippage was foreseen). For the remaining 28 contracts, the schedule-management information was provided either on a regular basis (e.g., monthly) or as slippage occurred; hence, the management of schedule was only able to be conducted reactively.

Use of Schedule-management Techniques. A significant number of schedule-management techniques exist, some of which were outlined in Chapter II. For the contracts in the database, however, only limited use was made of the most basic techniques. The potential benefits of the more sophisticated techniques such as PERT, simulation studies, and contingency schedules, therefore, were not able to be realized.

Generation of Schedule-management Requirements. The generation of contractual documentation is a task of considerable magnitude; hence, during the data-collection process, it was not surprising to discover that a degree of copying from previous contracts had occurred. The specification of the schedule-management requirements should be based upon the characteristics of each contract. With respect to the contracts in the database, therefore, the copying of requirements from previous contracts had sometimes led to the inappropriate specification of schedule-management requirements within the contractual documentation.

Summary

This section of Chapter IV has summarized the results of the analyses and addressed the investigative questions. The Number of Contract Modifications (NOECPS) variable was found to be the most significant variable in terms of defining schedule performance. With respect to the planning, specifying, and evaluating phases of the contractual process, the variables which were found to be significant in these areas were discussed. Furthermore, and equally important, the variables which were found not to be significant were also discussed. Finally, some observations related to schedule-management practices within the SPOs were highlighted which have some important implications for the management of schedule.

The ability to generalize these results was limited by the thesis constraints; that is, by the choice of project characteristics to define the sample, and by the small sample-size. Some tentative conclusions may be drawn, however, and the significance of these will be discussed in Chapter V.

Chapter Summary

This chapter has presented the detailed analysis of the data. The analysis results discussed in the chapter provided considerable insight into the relationships between the pre-contract-award management actions and schedule performance. The single-variable analyses showed that a number of variables were related to schedule performance and that proceeding with a multiple regression model-building stage was appropriate. The results from the multi-variable analyses revealed that the Number of Contract Modifications (NOECPS) variable was the most significant variable in terms of defining schedule performance; however, a number of other variables were also significant: Pre-scheduled (PLPRESCH), Concurrency (PLCONC), Preliminary WBS Developed (PLWBSDEV), Degree of Technical Definition (TDEFM), SOW Schedule Display (SOWSDISP), and Number of DIDs (NODIDS). The results from the multi-variable analyses also revealed that a number of variables did not play a direct role in defining schedule performance; instead, these variables become significant when interacting with other variables. Furthermore, the variables that did not show a significant relationship with schedule performance were also addressed. Finally, some observations related to schedule-management practices within the SPOs were discussed. Chapter V will present a summary of the thesis so far, will discuss the significance of the findings, and will present some opportunities for follow-on research.

V. Conclusions and Recommendations

Introduction

The first four chapters of this thesis have presented the research question and associated investigative questions, a summary of the relevant literature, the development of the methodology, and the results and findings for the data collected. This chapter will continue the presentation of the research by summarizing what has occurred so far, and by addressing the conclusions that may be drawn. Specifically, this chapter will present:

a. a summary of the first three chapters,

b. a summary of the findings in Chapter IV,

c. a discussion of the significance of the findings and the practical implications of the research, and

d. a discussion of possible follow-on research.

Summary of the First Three Chapters

Each acquisition contract has a three-dimensional goal: to accomplish the requisite work within specified cost, schedule, and performance requirements. Within the DoD, however, the typical acquisition contract is characterized as being "behind schedule and over budget" (Christensen, 1993:37). While there has been some effort to examine the reasons for cost overruns, there has been little research into the causes of schedule overruns. This study aimed to contribute to the body of knowledge in this area through an examination of certain elements of DoD contracting practices. Specifically, the goal of this research was to assess the relationship between pre-contract-award management actions by the DoD and the resultant schedule performance. More particularly, this research analyzed those DoD pre-contract-award management actions which were believed to affect the contracted schedule performance.

Congress, through the Federal Acquisition Regulations (FAR), and the DoD, through numerous directives and instructions, mandate the policies and procedures which will be followed throughout the acquisition process. Little research, however, has been conducted to ascertain the efficiency and effectiveness of these procedures. This thesis is a step towards a better understanding of the interactive nature of these processes and, from this perspective alone, is considered to be a worthwhile endeavor.

Schedule performance for the purposes of this research was defined as the percentage schedule overrun; that is, the difference between the actual schedule and the contracted schedule, expressed as a percentage of the actual schedule. (By this definition, therefore, a schedule underrun results in a negative schedule performance.) Schedule performance was measured as of the date that delivery of the major developmental item(s), under the primary Contract Line Item Number(s) (CLIN(s)), occurred.

To address the multitude of issues presented by this research, the contractual process was divided into four activity areas, namely:

a. planning the acquisition,

b. specifying the requirement,

c. evaluating the proposal, and

d. monitoring and controlling the resultant contract.

While the last of these activities does not involve pre-contract-award management actions, the ability to adequately monitor and control a contract was believed to be highly dependent upon consideration of the relevant issues during the planning, specifying, and evaluating phases.

Each of the four activity areas involved specific schedule management actions which had the potential to affect schedule performance. To address the specific problem from the perspective of each of these activity areas, therefore, a series of investigative questions were developed. These investigative questions are listed, as follows:

a. Which management actions, with the potential to affect schedule performance, may occur prior to contract award?

b. Which DoD management actions, during the planning phase, influence schedule performance?

c. Which DoD management actions, during the specification-of-requirements phase, influence schedule performance?

d. Which DoD management actions, during the evaluation phase, influence schedule performance?

e. Of the DoD management actions which positively influence schedule performance, which can be cost-effectively implemented (commensurate with the selected project characteristics)?

The population of interest for this research was selected as all DoD acquisition contracts which did not employ C/SCSC, but which did involve either design and development or systems integration. Generally, the contracts of interest were those let in Phase II of the DoD Acquisition Cycle: Engineering and Manufacturing Development (EMD).

The sample was selected from available contracts at WPAFB. While this decision limited the research to a sub-set of USAF contracts only, this was believed to be representative of DoD acquisition-contracting practice for two reasons: firstly, all Services are mandated to use the same acquisition procedures; and secondly, WPAFB has been a major acquisition center within the USAF.

To address the investigative questions, a review of the literature relevant to this research was conducted. There is a significant body of knowledge concerning the management of projects within an organization; however, there has been little research into the management of schedule via the contractual process. The literature did provide some insight into which project characteristics were relevant to schedule performance; however, little else was gleaned.

Three studies conducted by the RAND corporation in 1971, 1980, and 1990 investigated several different aspects of the DoD acquisition process. The 1971 study found that, for the 24 systems investigated, the average schedule overrun was 15%. The 1990 study found that, for the ten systems investigated, the average schedule overrun was 33%. The studies conducted by the RAND corporation and this research effort are distinctly different. Firstly, the RAND studies focused on the overall acquisition process with respect to program schedule for major programs. This research, on the other hand, focuses on the contracted schedule performance for small-scale programs. Secondly, the RAND studies investigated schedule performance from the perspective of external factors and program characteristics, whereas this research investigates schedule performance from the perspective of the influence of management actions. Finally, the results from the RAND studies were qualitative in nature, whereas the results from this research have been supported by rigorous statistical analyses. This overview of the differences between these three studies and the current research demonstrates the timeliness and the importance of this research effort. The relationship between pre-contract-award management actions and the resultant schedule performance has not previously been investigated.

To identify the management actions that may have the potential to impact schedule performance, a review of the applicable policy directives, instructions, and manuals was undertaken. From this review, a candidate variable list was generated, a copy of which is attached at Appendix B. This list was further refined to produce the Data Collection Instrument (DCI), a copy of which is presented in Figure 3-2.

The contract-management database, the Acquisition Management Information System (AMIS), was used, in conjunction with SPO personnel, to obtain the requisite sample. Measures of the independent variables of interest were obtained directly from the contract files, and were recorded on the DCI. Measures of the dependent variable -- schedule performance -- were obtained from a number of different sources, specifically the AMIS database, the Mechanization of Contract Administration Services (MOCAS) database, the Buyer, or the PM. When a sufficiently representative sample had been obtained, statistical methods were utilized to analyze the data. This is the subject of the next section.

Summary of the Findings in Chapter IV

Data for 29 contracts were obtained, though schedule performance was only able to be assessed for 25 of them. For those 25 contracts, the average schedule performance was found to be 70.77%, with a range from -27.9% to 334.0%. This average measure was significantly higher than that found in the two previous RAND studies; however, the distribution of schedule performance was quite skewed, as evidenced by the median which was only 39.4%. When the two outliers were removed, the average schedule performance decreased to 50.97%, which is still considerably higher than in the two previous studies.

From the analyses that were conducted, a number of factors were found to be significantly related to schedule performance. Furthermore, these factors were interpretable in a management context. Specifically, the number of contract modifications was shown to be the most significant contributing factor to schedule performance. The point estimate for the deterioration in schedule performance was found to be 1.59 percentage units per contract modification. The number of contract modifications was measured as a surrogate variable to encapsulate the effects of all the post-contract-award factors on schedule performance.

The specific management factors which were identified as having a significant influence on schedule performance were:

a. whether or not the contract was pre-scheduled (i.e., was the contracted schedule performance dictated to the contractor);

b. whether or not the contract involved concurrency;

c. whether or not a preliminary WBS had been developed;

d. whether or not the contract utilized a Functional Specification or a Prime Item Development Specification (PIDS) (i.e., a Type A or a Type B specification);

e. whether or not the contract required the schedule information to be presented in a network format; and

f. the number of DIDs that were required by the CDRL.

Each of these factors can be directly influenced by the Program Manager; hence, placing emphasis on these actions may reap considerable benefit.

The pre-scheduling of a contract by the DoD was found to have a beneficial effect on schedule performance. The point estimate for the improvement in schedule performance that resulted from the implementation of this management action was found to be 47 percentage units. Concurrency, on the other hand, was found to have a detrimental effect on schedule performance, with a point estimate for the deterioration of schedule performance of 23 percentage units. The development of a WBS was found to have a beneficial effect on schedule performance; however, the magnitude of the effect was unable to be determined. The use of a Type A specification was found to be beneficial with respect to schedule performance, in comparison with the use of a Type B specification. The point estimate for the improvement in schedule performance associated with the use of a Type A specification was found to be 20 percentage units. The presentation of schedule-management information in a network format was found to promote better schedule performance, in comparison with a lower-level presentation (e.g., Gantt charts). The point estimate for the improvement in schedule performance associated with the use of a network format was found to be 37 percentage units. Finally, the number of DIDs required by the CDRL was found to have a detrimental effect on schedule performance, in that, as the number of DIDs increased, the schedule performance worsened by 0.4 percentage units per DID.

From the analyses that were conducted, a large number of factors were not found to be significantly related to schedule performance. The intuitively significant variables that were not found to be related to schedule performance included:

a. the contract type,

b. the aggressiveness of the schedule,

c. the assessment of technical risk,

d. the development of the WBS (SOW requirement),

e. the requirement for C/SSR,

f. the frequency of reporting schedule-management information,

g. the number of project-management DIDs,

h. the number of evaluation criteria related to schedule management, and

i. the evaluation of schedule-management information during source selection.

The small sample size precluded a complete assessment of these factors that, *a priori*, were believed to influence schedule performance. Further research is required to more thoroughly assess these factors. It is important to note at this stage, however, that these factors were not found to be significant within the limitations of this thesis.

Significance of the Findings

Introduction

The findings associated with this research effort are believed to be very significant, especially with respect to the implications for schedule management. This section will discuss the significance of these findings, including the limitations of the results, and the implications for schedule management and for future research in this area.

Implications for Small-scale Programs

This study found that the average schedule overrun for small-scale, design and development contracts at WPAFB was 70.77%. While this result is not conclusive (due to sample-size limitations), this finding is considerably at odds with previous research (even when the outliers are removed from the sample). Given that all previous studies have examined major programs, the implication of this research is that schedule performance for small-scale programs is considerably poorer than for large-scale programs. Furthermore, given that the sample was considered to be representative of DoD contracting practices, a second implication of this result is that the poor schedule performance for small-scale programs is widespread. Finally, a third implication of this result is that the factors that affect schedule performance in small-scale programs are either not well understood, or the current DoD directives and instructions (i.e., the DoD 5000 series), which are tailored to large-scale programs, are not applicable to small-scale programs. Further research is required to assess whether or not this last point is valid; research that could have significant implications for the management of schedule in small-scale programs.

Implications for Schedule Management

From the analyses that were conducted, the number of contract modifications was found to be the most significant contributing factor to schedule performance. This result is in accord with the currently held belief that post-contract-award factors are the major driver of schedule performance. The implication of this research, therefore, is that further research needs to be conducted to determine which pre-contract-award actions have an influence on the number of contract modifications.

A number of pre-contract-award management actions were found to positively influence schedule performance. The implication of these results to Program Managers is that these 'known' factors *can now be* explicitly incorporated into the acquisition strategy, and the resulting contractual documentation. Potentially, the recognition of these factors as known contributors to schedule performance could have significant benefits for the management of schedule.

To adequately implement the factors which have been demonstrated to be significantly related to schedule performance, the limitations of the analysis need to be addressed. A difficulty in applying these results is that many of the factors were measured on a coarse scale; that is, the factor was identified as either being present or not being present. To clarify this point, the situation with respect to concurrency will be discussed in greater depth. When the existence of concurrency was observed in a contract, the *degree* of that concurrency was not investigated. The applicability of this result, therefore, is somewhat limited. Furthermore, due to the way that schedule performance was measured, there was no ability, based on the results of this research, to ascertain whether the worse schedule performance that resulted from the use of concurrency, was negated by the concurrency itself. These comments do not detract from the findings; rather, they point out that the results obtained should be treated with caution. Furthermore, these comments highlight the need for further research to obtain a fuller appreciation of the relationships between the identified management actions and the resultant schedule performance.

Management of Schedule within the SPOs

As a general comment, the management of schedule is not well understood within the SPOs. This comment is supported by the following observations that were noted during the data-collection process:

a. Different schedule-management information was required for the source-selection evaluation than was required to manage the contract (e.g., a Gantt chart was requested for the source-selection evaluation, whereas a network diagram was required for the management of the contract (and vice-versa)).

b. A considerable amount of schedule-management information was found to be 'buried' within a wide array of DIDs (e.g., resource constraints were required to be evaluated in many planning DIDs). In many situations, the equivalent information was not required to be delivered with the source-selection documentation. The groundwork, therefore, to enable effective and proactive management of schedule, as required by the DIDs, was not being established.

c. In the majority of contracts examined during the data-collection process, the schedule-management requirements were rarely specified in a coherent and integrated manner (e.g., schedule-presentation information was separated from the evaluation of resource constraints and from the allocation of responsibility). Many modern software packages allow for the explicit consideration of resource constraints as a part of the development of the program schedule; hence, an integrated approach to schedule development would enable the abilities of these software packages to be more fully exploited.

d. In the majority of RFPs examined during the data-collection process, the WBS (perhaps the major schedule-planning document) was found 'hidden' in the cost-requirements section of the ITO. The implication of this finding is that the WBS is seen by the SPO to be a more effective tool for managing cost than it is for managing schedule.

e. In many contracts examined during the data-collection process, the SOW required that the WBS be periodically updated throughout the life of the contract without tying the requirement for a WBS to any other requirement in the contract. Furthermore, a number of RFPs which required that the offeror update the preliminary WBS with his/her proposal did not require that the WBS be used for contract-management purposes. Moreover, a number of RFPs which did not include a preliminary WBS required that the resultant contractor utilize a WBS for contract-management purposes.

f. None of the contracts in the sample attempted to integrate C/SSR or C/SCSC with network information. Furthermore, the guidance concerning the use of C/SCSC, in comparison with C/SSR, appeared to be inappropriately applied at times (i.e., C/SCSC was specified for some contracts with a face value (or potential worth) significantly below the mandated threshold).

g. Almost none of the contracts in the sample were assessed as having a schedule risk of higher than medium, yet 23 of the 25 contracts in the sample were not completed within the requisite time period.

h. Schedule-management requirements, as stated in the SOW and CDRL, were rarely proactive.

i. Only a limited number of techniques were specified in the SOW and the ITO for the management of schedule (e.g., the use of PERT, simulation studies, and contingency schedules were rarely, if ever, seen).

j. From a subjective evaluation of the contracts examined, the schedule-management requirements in many of the contracts appeared to be constructed via the 'copied-from' principle within each SPO. That practice led to the inclusion of inappropriate schedule-management techniques in some contracts.

These observations highlight that the range and use of schedule-management techniques are not well understood within the SPOs. This lack of understanding implies that realistic and effective schedule-management requirements will rarely be included in contractual documentation. Furthermore, the ability to exploit the available technologies for the management of schedule will be limited. To overcome these observed shortfalls, a training program could be instigated which addresses the requisite schedule-management procedures, or a set of guidance instructions could be generated which assists in the specification of schedule-management requirements. On a positive note, however, some of these difficulties may be overcome with the introduction of the revised schedule-risk-assessment procedures currently being introduced in ASC (as discussed in Chapter II).

Data Collection

The difficulties associated with obtaining the data for this research highlight that, unless steps are taken in the near future to start collecting the relevant data, the ability to assess the efficiency and effectiveness of contract-management actions will continue to be virtually non-existent. This data-collection effort is not a small task; however, the relatively small efforts that would be required up front would, in all probability, reap considerable benefits in the longer term. (Note that, the relatively new project-management database, the Contract Management Network (CMN) (refer Chapter III), may partially meet the needs of this data-collection requirement.)

As a corollary to the preceding comment, better house-keeping of contractual documents and the existing contract management databases -- AMIS and MOCAS -- is required. The fact that a number of the major contractual documents were missing from a significant number of files is difficult to understand. Furthermore, the current problems with the schedule information which is input into AMIS (in particular) should be resolved in the near future to enable this vehicle to be effectively utilized for schedule management and for future schedule-performance analyses.

Possible Follow-on Research

Validation of the Research Findings

The investigation of the relationships between management actions and schedule performance has not been undertaken previously. Furthermore, this research effort addressed a broad range of DoD contract-management practices. Considerable effort was required, therefore, to ascertain which variables should be included in the analyses. As a result of this, only a small group of individuals were involved in validating the DCI. Follow-on research, therefore, could focus on a number of aspects related to validation of the research findings. These aspects are addressed in the following paragraphs.

DCI Validation. As only a small number of individuals were involved in validating the DCI, there is no clear indication that all of the relevant variables have been considered. A thorough 're-scrubbing' of the relevant DoD instructions, directives, and manuals (including the FAR) could be used to validate the variable list, and to generate other potential factors. Another approach could be to survey SPO personnel to obtain a wider perspective of the relevant factors.

Variable Evaluation Measures. Are there better measures for evaluating the relevant factors than the ones used in the DCI? For example, difficulties were experienced obtaining adequate measures for assessing planning performance. Once again, a survey of SPO personnel could be used to obtain better measures for this aspect.

Narrower Focus. Future thesis efforts could focus in more depth on one of the four activity areas associated with the contractual process (i.e., planning, specifying, evaluating, and monitoring and controlling) to examine the relationship between the actions in those activity areas and contractual objectives (i.e., cost, schedule, or performance).

Expansion of the Model. The research conducted under this thesis effort did not evaluate any variables related to actual source selection. The model developed here could be expanded to include the variables associated with the source-selection evaluation process (though this would require access to source-selection sensitive information).

Model Validation/Expansion. To validate the model constructed from the statistical analyses, a new data-set could be obtained. These additional data-points could be either added to the model or predictions from the model could be obtained and compared to actual contract outcomes. Furthermore, data for contracts outside the scope of the research (e.g., C/SCSC contracts) could be obtained to broaden the applicability of the model.

Related Research

The preceding research ideas have focused on the model obtained through this thesis effort. A number of other potential research topics present themselves as an outcome of this research. These are explained in the following paragraphs.

Pre-contract-award Actions. This research identified a number of pre-contract-award management actions that were found to be related to schedule performance for small-scale programs. Many of these management actions were measured on a coarse scale; that is, the factor was identified as either being present or not being present. More in-depth analysis is required to gain a fuller appreciation of the underlying factors associated with the relationship between the identified management actions and schedule performance.

Post-contract-award Actions. Given that the number of contract modifications was found to be the main variable which contributed to schedule performance, a line of research could be followed which parallels the efforts undertaken through this research effort. For example, an investigation could be made into which pre-contract-award management actions are drivers of post-contract-award changes.

Source-selection Variables. The variables analyzed under this research effort were limited to those which were not source-selection sensitive. An interesting research proposal could be to analyze whether a relationship exists between the information provided to the offerors in Section L (Instructions to Offerors (ITO)) and Section M (Evaluation Factors for Award) of the RFP and the actions that are undertaken during the source-selection process. This could be used to ascertain whether or not the current procedures for specifying Section L and Section M of the RFP are adequate and effective.

Data Collection Related to Project Outcomes. Two of the major difficulties associated with this research were determining which variables to measure and where to obtain the requisite data. If the DoD were serious about improving the acquisition process, then the effectiveness of the mandated procedures and associated management actions should be assessed. To enable the necessary analyses to be performed, significant quantities of data need to be stored and analyzed. As stated by Merrow and Yarossi, "[...] little progress can be expected in the state of our knowledge of projects without systematic and detailed data collection" (Merrow and Yarossi, 1990:H.6.3). A research project could analyze which data would be required to determine which variables affect project outcomes. This would be a major research undertaking, but the end result would be of considerable import.

Chapter Summary

This chapter has summarized the first four chapters of the thesis. An overview of the requirement for this research, the scope of the research, and the investigative questions associated with this research were presented. Following this, a brief discussion of the findings, relevant to the investigative questions, was presented. The significance of the findings was also discussed, especially with respect to the implications for schedule management. Finally, a number of potential areas for follow-on research were presented.

The findings from this research effort have considerable import for schedule management. Firstly, a number of factors were identified which were significantly related to schedule performance. The incorporation of these known factors into the relevant contractual documentation could have significant benefits for schedule management.

Secondly, a number of observations concerning the specification of schedule-management requirements highlighted that the management of schedule did not appear to be well understood within the SPOs. Training programs on this subject, therefore, could be of considerable benefit. Finally, the problems associated with the contract files and the contract-management databases were highlighted, in the hope that future research teams could benefit from the lessons learned through this research effort.

Appendix A: List of Acronyms

ACO	Administration Contract Officer
AERP	Aircrew Eye/Respiratory Protection
AFFARS	Air Force FAR Supplement
AFIT	Air Force Institute of Technology
AFR	Air Force Regulation
AMIS	Acquisition Management Information System
AMSDL	Acquisition Management System and Data Requirements Control List
ANOVA	Analysis of Variance
AP	Acquisition Plan
ASC	Aeronautical System Center
ASREQ	As Required Herein
ATS	Aircrew Training System
CALS	Contingency Airfield Lighting System
CCP	Contract Change Proposal
CDRL	Contract Data Requirements List
CDR	Critical Design Review
CGADS	Computer Generated Acquisition Documents System
CIDS	Critical Item Development Specification
CLIN	Contract Line Item Number
CMN	Contract Management Network
CPAF	Cost-Plus-Award-Fee
CPFF	Cost-Plus-Fixed-Fee
CPIF	Cost-Plus-Incentive-Fee
CPM	Critical Path Method
C/SCSC	Cost/Schedule Control Systems Criteria
C/SSR	Cost/Schedule Status Report
CPR	Cost Performance Report
DCI	Data Collection Instrument
DFARS	DoD FAR Supplement
DID	Data Item Description
DoD	Department of Defense
ECP	Engineering Change Proposal
EMD	Engineering and Manufacturing Development
FAR	Federal Acquisition Regulations
FCA	Functional Configuration Audit
FFP	Firm Fixed-Price
FPIF	Fixed-Price-Incentive Firm Target
FPIS	Fixed-Price-Incentive Successive Targets
GERT	Graphical Evaluation and Review Technique
ITO	Instructions to Offerors
JIG	Joint Implementation Guide
MOCAS	Mechanization of Contract Administration Services
PDM	Precedence Diagram Method
PDR	Preliminary Design Review
PERT	Program Evaluation and Review Technique
PIDS	Prime Item Development Specification
PM	Program Manager
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute

RDT&E	Research, Development, Test, and Evaluation
RFP	Request for Proposal
SEMP	System Engineering Management Plan
SLR	Simple Linear Regression
SOW	Statement of Work
SP	Schedule Performance
SPO	System Program Office
SSET	Source Selection Evaluation Team
SSO	Source Selection Office
USAF	United States Air Force
VIF	Variance Inflation Factor
WBS	Work Breakdown Structure
WP	Work Package
WPAFB	Wright-Patterson Air Force Base

Appendix B: Management Actions -- Candidate Variables

Planning the Acquisition

Acquisition Strategy

May be able to "factor up" the acquisition strategy variables with the PR package variables to give the answer to two questions, which then become the variables of interest to the model:

(1) How well is the acquisition strategy transferred into the PR package, score on a 1 - 10 scale.

(2) How effective are the planning aspects (by a measure such as the sum of the lower level measures divided by the total max score possible?), score on a scale of 1 - 10.

a. Streamlining Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Question and answer checklist:	In the acquisition plan.	0/1 then ORD
Is the schedule considered aggressive? 0/1		
Is concurrency considered -- early, middle, late? 1-3		
Were phases combined/eliminated? 0/1		
Were design reviews/audits combined/eliminated? 0/1		
Was pre-scheduling performed? 0/1		
Was it used in the RFP and source selection criteria? 0/1		
Was contingency planning allowed for? 0/1		
Result -- total up the 0/1 scores.		

b. Source of Supply Variable

Questions to Answer/Measures	*Where to Find*	*Type*
# firms on source selection list.	Acquisition plan.	INT
# responses to interest statement.	Interest statement.	

# RFPs mailed.	Evaluation report.	
# offers received.		
(How to factor-in competitive/non-competitive?)		
Utilize some type of metric combining these, some divided by others.		

c. Contract Type Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Arranged in the appropriate order, then scored on a 1-4 scale: FFP, FPIF, CPIF, CPFF	RFP Acq. Plan	ORD 1-4
Need to work-in the schedule incentive vs fixed-fee type of trade-offs in this measure.	Contract	

Risk Management

a. Schedule Risk Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Were risks identified in the schedule, i.e., were there major risks seen in the program? 0/1	Acq. plan RFP	0/1 then ORD 1->
Were the risks analyzed and assessed for their possible effect on completion time of the project? 0/1	Source - Selection	
Were the risks then managed appropriately i.e., did the RFP and/or source selection take the identified risk into account, or was it disregarded? 0/1		
Result -- combine into one variable by the scoresheet approach.		

Systems Engineering

a. Complexity Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Need to get a metric of this, perhaps with an individual measure or combinations of:	Acq. plan	INT

# activities/# precedence relationships total $/total end item quantity	Contract schedule
# pages in spec., SOW	SOW
# referenced documents	Cost reports
# referenced texts	
# engineering disciplines required	
# hardware items	
% R&D dollars	
% design or design development dollars	

Work Breakdown Structure

a. WBS Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Was WBS specified? 0/1	Acq plan.	0/1 ORD
Was WBS mandated? 0/1	SOW	
What level of WBS was initially provided for the respondents to work with? 0->3	Contract.	
# elements at level (lowest, or 3)? 0->	Contract reports.	
Thoroughness measure -- how well was the up-front WBS breakdown done i.e., compare up-front to finalized WBS. 0->10		
# elements/scope, where scope = dollars or direct labor hours or similar.		
Result -- roll all this into one value by the score sheet approach.		

Specifying the Requirement

Specification

a. Specification Definition Variable

Questions to Answer/Measures	*Where to Find*	*Type*
# pages in the spec	SOW/Spec	INT ORD
# individual specs	Acq. Plan	
# reference documents		
How well specified, i.e., functional only or detailed (how do we quantify this aspect?).		
Possibly this is a complexity measure too.		

Statement Of Work

a. SOW Completeness Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Checklist: Does the SOW task the contractor to:	SOW	ORD
- define, monitor and report on project-management responsibilities		
- perform project planning		
- increase the WBS to lower levels		
- CSSR		
- integration of CSSR and schedule network?		
- if not CSSR, then another technique?		
- schedule variance thresholds -- considered for both the CP and near CP over the whole project? 0/1		
- Is the monitoring and control information integrated with the network? 0/1		
- show a schedule and to actively manage to/report on that schedule		

- frequency of reporting?

- show a systems engineering management plan

- show test and evaluation planning

- show technical review and audit plan

- show ILS plan

CDRL and DID

a. CDRL Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Is scheduling information required -- CP, near CP, probability? 0/1 (Does this relate to some of the other measures we got before?)	SOW Contract	ORD
To what level is the scheduling information required? 1-4		
How often is the scheduling information required? 1-4		

b. DID Varaible

Questions to Answer/Measures	*Where to Find*	*Type*
Is a schedule risk assessment required? 0/1	?	?
Are DID requirements too specific, or not specific enough? (How to measure?)		

Purchase Request Package

a. PR Package Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Contract type, same as in the Acquisition Strategy variable on 1->4 scale.	PR Package Source - Selection	ORD
Was schedule a stated evaluation criteria (this is in the risk management area too?) 0/1		
Was the method of evaluation stated? (risk) 0/1		

How thorough an evaluation? (risk)

RFP data list -- detailed "one to one" response against the SOW? 0/1

Evaluating the Proposal

a. Schedule Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Were contractors told that schedule would be an evaluation criteria? 0/1	Source - Selection.	0/1
Were the evaluation criteria specific enough to enable the contractor to know how important the schedule was considered to be? 0/1	RFP package.	
How was the schedule evaluated -- thoroughness, activity times etc.? (scale 1->)		
Was there a data list in the RFP that outlined the RFP data requirements, and was it realistic vs the actual CDRL? 0/1		

b. WBS Variable

Questions to Answer/Measures	*Where to Find*	*Type*
How well was it done? 1->	Contractor response	ORD
Thoroughness measure? 1->		
Activity Time Variable		
Were activity times estimated? 0/1	Contractors response	0/1

c. Activity Responsibility Allocation Variable

Questions to Answer/Measures	*Where to Find*	*Type*
Was an activity responsibility allocation done? 0/1	Contractors response	0/1
Was the allocation appropriate? 0/1		

d. <u>Resource Allocation Variable</u>

Questions to Answer/Measures	*Where to Find*	*Type*
Requested within the project? 0/1	SOW	0/1
Requested between projects? 0/1	Contractors response	
Are there contingency resources? 0/1		

e. <u>Risk Assessment Variable</u>

Questions to Answer/Measures	*Where to Find*	*Type*
Were the CP and near CP identified? 0/1	SOW Contractors response	0/1
Was a probabilistic approach used to evaluate schedule time? 0/1		

f. <u>Concurrent Engineering Variable</u>

Questions to Answer/Measures	*Where to Find*	*Type*
Is the contractor doing concurrent engineering? 0/1	Contractors response	0/1

Appendix C: Contract List

F33657-76-C-0103	A-10 Trainer Flight Simulator
F33657-76-C-0792	Compass Cope Development Program
F33657-81-C-2041	F-16 Digital Radar Land Mass Simulator (DRLMS)
F33657-81-C-2107	MATE System and Supporting Tasks
F33657-83-C-2141	C-5A/C-141B Air Refuelling Part Task Trainer (ARPTT)
F33657-83-C-2217	Ground Power Generator
F33657-84-C-0117	Sonobuoy Missile Impact Location System (SMILS) Aircraft Modification and Support Segment (AMSS)
F33657-85-C-0020	KC-135 OFT Refurbishment
F33657-85-C-0153	Advanced Range Instrumentation Aircraft (ARIA) Optics System
F33657-86-C-0012	Short Range Attack Missile (SRAM II) (AGM-131A)
F33657-86-C-0039	Air Force One (AF-1)
F33657-86-C-0103	C-130 Aircrew Training System (ATS)
F33657-86-C-0149	Modular Simulator Project, Phase III, Part I
F33657-86-C-0158	F-15E LANTIRN Part Task Trainer (PTT)
F33657-86-C-0182	Project 2851 Standard DoD Simulator Database / CTPD, Phase A
F33657-86-C-2121	GBU-15 Part Task Trainer (PTT)
F33657-86-C-2141	F-16 and A-10 LANTIRN Core Simulator
F33657-87-C-0001	MATE System Integration Contract
F33657-87-C-0103	Advanced Tactical Air Reconnaissance System (ATARS) Full Scale Development (FSD)
F33657-87-C-0168	F-16 Improved Electronic Warfare Training Devices (IEWTDs)
F33657-87-C-2092	Aircrew Eye/Respiratory Protection (AERP) Systems
F33657-88-C-0008	Global Positioning System (GPS) Digital-Analog-Converter (DAC)
F33657-88-C-0029	C-17 Aircrew Training System (ATS)
F33657-88-C-0091	Contingency Airfield Lighting System (CALS)
F33657-88-C-0122	EC-18D Cruise Missile Mission Control Aircraft (CMMCA) Systems
F33657-89-C-0014	Advanced X-Ray System (AXES)
F33657-89-C-0018	C-17 Maintenance Trainers Development (MTDs)
F33657-89-C-0039	C-141 Aircrew Training System (ATS)
F33657-91-C-0062	Simulator for Electronic Combat Training (SECT)

Appendix D: Project Management Data Item Descriptions

OT-AF62045	System Engineering Master Schedule (SEMS)
DI-A-1021	Program Plan
DI-A-3002	R&D Status Report
DI-A-3002A	R&D Status Report
DI-A-3007	Program Schedule
DI-A-3009	Program Milestones (Acquisition Phase)
DI-A-3023	Contract Work Breakdown Structure
DI-P-3460A	Manufacturing Plan
DI-S-3618	System Engineering Management Plan (SEMP)
DI-T-3701A	System Test Plan
DI-T-3703A	Computer Program Configuration Item (CPCI) Test Plans/Procedures
DI-T-3707A	General Test Plan/Procedures
UDI-E-3935	Firmware Development Plan (FDP)
DI-F-4802	Quality Assurance Program Plan Requirements
DI-A-5004	Project Status Report
DI-A-5004A	Project Status Report
DI-A-5009A	Progress Report
DI-A-5239B	Management Plan
DI-E-5529	Software Quality Assurance Plan
DI-F-6000C	Cost Performance Report (CPR)
DI-F-6010A	Cost/Schedule Status Report
DI-L-6138	Integrated Support Plan (ISP)
DI-P-6162	DD Form 610 "GFE Requirement Schedule"
DI-S-7017	Logistic Support Analysis (LSA) Plan
DI-L-7017A	Logistic Support Analysis Plan
DI-H-7066	Training and Training Equipment Plan
DI-E-7144	Simulator System Engineering Management Plan (SEMP)
DI-H-25711B	Training Development and Support Plan Report
DI-H-25772B	Progress Report
DI-L-30317	Logistic Support Analysis (LSA) Plan
DI-L-30318	Integrated Support Plan (ISP)
DI-M-30417	Engineering Management Report
DI-P-30465	Manufacturing Plan
DI-R-30510	Quality Program Plan
DI-S-30567A	Computer Program Development Plan (CPDP) Quality Assurance Plan (QAP)
DI-S-30595	Detailed Research Plan
DI-T-30714	Master Test Plan/Program Test Plan
DI-T-30715	Computer Program Test Plan
DI-FNCL-80448	Life Cycle Cost (LCC) and Independent Schedule Assessment (ISA) Report
DI-FNCL-81116	Manhour Estimate, Technical Cost Proposals
DI-ILSS-80395	Integrated Support Plan (ISP)
DI-ILSS-80531	Logistic Support Analysis Plan
DI-ILSS-81070	Training Program Development and Management Plan
DI-MCCR-80014A	Software Test Plan
DI-MCCR-80030A	Software Development Plan
DI-MGMT-80004	Management Plan
DI-MGMT-80096	Management Plan

DI-MGMT-80227	Contractor's Progress, Status and Management Report
DI-MGMT-80368	Status Report
DI-MGMT-80475	Contract Requirements Implementation Plan
DI-MGMT-80476	Training Development and Support Plan
DI-MGMT-80505	Program Evaluation and Review Technique (PERT) / Time Network Diagram
DI-MGMT-80506	Program Evaluation and Review Technique (PERT) / Time Analysis Report
DI-MGMT-80507A	Project Planning Chart
DI-MGMT-80555	Program Progress Report
DI-MGMT-80615	Technical Progress Report
DI-MGMT-80909	Program Plan
DI-MGMT-81024	System Engineering Management Plan (SEMP)
DI-MGMT-81117	Technical and Management Work Plan
DI-MISC-80074	Manufacturing Plan
DI-MISC-80167A	Contract Data Status and Schedule Report
DI-MISC-81183	Master Integrated Program Schedule (MIPS)
DI-NDTI-80808	Test Plans/Procedures

Appendix E: Variable List and Raw Data

CNO	Contract Number
FVALUE1	Face Value of the Contracts
FVALUE2	Face Value of the Contracts, Adjusted for Contract Number 86-C-0039
GDPDFL	Gross Domestic Product Deflator
FV87CDOL1	FVALUE1 Converted to 1987 Constant Dollars
FV87CDOL2	FVALUE2 Converted to 1987 Constant Dollars
NOUNITS	Number of Developmental Units Procured
UCOSTCD	Unit Cost in 1987 Constant Dollars
CTYPE	Contract Type
D_DP	Development / Development and Production
PRODOPT	Production Options
SCHEDPER	Schedule Performance
SCHEDMOD	Schedule Performance (Modified)
SCHEDPLR	Schedule Performance Converted to a Binary Variable
NOECPS	Number of Contract Modifications
PLPRESCH	Pre-scheduled
PLAGGR	Aggressive
PLCONC	Concurrency
PLSRISK	Schedule Risk
PLTRISK	Technical Risk
COMPLEX	Complexity
PAGESSOW	Number of Pages in the SOW
NODIDS	Number of DIDs
PLWBSDEV	Preliminary WBS Developed
PLWBSL3	Number of Elements at Level Three of the WBS
PLWBSLL	Lowest Level Developed of the WBS
PLDRRFP	Draft RFP
TECHDEFN	Degree of Technical Definition
SOWDWBS	Develop WBS Further
SOWCSSR	C/SSR Required
SOWSDISP	SOW Schedule Display
SOWRCWP	SOW Resource Constraints Within a Program
SOWRCBP	SOW Resource Constraints Between Programs
SOWFRSI	Frequency of Reporting Schedule-Management Information
NOPMDIDS	Number of Project-management DIDs
NOEVCRIT	Number of Evaluation Criteria
EVRISKS	Evaluation of Schedule Risks
EVSDISP	Evaluation Schedule Display
EVRCWP	Evaluation Resource Constraints Within a Program
EVRCBP	Evaluation Resource Constraints Between Programs
EVRESP	Evaluation Responsibility Allocation

CASE	CNO	FVALUE1	FVALUE2	GDPDEFL	FV87CDOL1	FV87CDOL2
1	760103	6961.0	6961.0	0.5730	12.148	12.148
2	760792	77246.9	77246.9	0.5730	134.81	134.81
3	812041	6640.4	6640.4	0.8230	8.0686	8.0686
4	812107	54806.6	54806.6	0.8230	66.594	66.594
5	832141	8812.3	8812.3	0.9220	9.5578	9.5578
6	832217	12900.0	12900.0	0.9220	13.991	13.991
7	840117	6643.0	6643.0	0.9560	6.9488	6.9488
8	850020	17114.8	17114.8	0.9790	17.482	17.482
9	850153	7808.0	7808.0	0.9790	7.6440	7.6440
10	860012	214438.0	214438.0	0.9900	216.60	216.60
11	860039	249815.0	38000.0	0.9900	252.34	38.384
12	860103	31442.6	31442.6	0.9900	31.760	31.760
13	860149	2830.6	2830.6	0.9900	2.8591	2.8591
14	860158	6696.6	6696.6	0.9900	6.7642	6.7642
15	860182	5198.7	5198.7	0.9900	5.2512	5.2512
16	862121	11196.0	11196.0	0.9900	11.309	11.309
17	862141	25481.0	25481.0	0.9900	25.738	25.738
18	870001	24883.0	24883.0	1.0000	24.883	24.883
19	870103	118624.1	118624.1	1.0000	118.62	118.62
20	870168	9899.3	9899.3	1.0000	9.8993	9.8993
21	872092	10573.0	10573.0	1.0000	10.573	10.573
22	88000β	4838.6	4838.6	1.0280	4.7069	4.7069
23	880029	57489.9	57489.9	1.0280	55.924	55.924
24	880091	3156.8	3156.8	1.0280	3.0708	3.0708
25	880122	42662.9	42662.9	1.0280	41.501	41.501
26	890014	2287.5	2287.5	1.0710	2.1359	2.1359
27	890018	54808.4	54808.4	1.0710	51.175	51.175
28	890039	27958.5	27958.5	1.0710	26.105	26.105
29	910062	8612.3	8612.3	1.1670	7.3798	7.3798

CASE	NOUNITS	UCOSTCD	CTYPE	D_DP	PRODOPT	SCHEDPER
1	1	12.148	2	0	1	94.8
2	3	44.937	3	0	0	M
3	1	8.0686	2	0	1	-10.0
4	2	33.297	2	0	1	M
5	1	9.5578	2	0	1	131.9
6	3	4.6638	1	0	0	13.0
7	1	6.9488	1	1	1	13.4
8	1	17.482	1	0	0	24.2
9	4	1.9110	1	1	0	23.8
10	30	7.2201	2	0	1	M
11	2	19.192	1	1	0	74.4
12	2	15.880	1	1	0	116.7
13	1	2.8591	2	0	0	-27.9
14	1	6.7642	1	0	1	32.4
15	1	5.2512	4	0	0	30.0
16	1	11.309	2	0	1	35.3
17	1	25.738	2	0	1	29.5
18	1	24.883	4	0	0	M
19	11	10.784	1	0	1	119.3
20	17	0.5823	1	1	1	16.0
21	104	0.1017	1	0	1	263.0
22	26	0.1810	1	1	0	18.3
23	3	18.641	1	0	1	46.8
24	2	1.5354	1	0	1	334.0
25	2	20.750	1	0	0	139.7
26	6	0.3560	1	0	1	81.3
27	12	4.2646	2	0	1	64.2
28	2	13.053	1	0	1	65.7
29	1	7.3798	3	0	0	39.4

CASE	SCHEDMOD	SCHEDPLR	NOECPS	PLPRESCH	PLAGGR	PLCONC
1	94.8	1	39	1	0	1
2	M	M	M	1	0	0
3	-10.0	0	8	1	1	1
4	M	M	M	1	1	1
5	131.9	1	28	0	0	1
6	13.0	0	25	1	0	0
7	13.4	0	20	1	0	0
8	24.2	0	13	1	0	1
9	23.8	0	8	1	0	1
10	M	M	M	1	1	1
11	74.4	1	51	1	1	0
12	116.7	1	44	0	0	0
13	-27.9	0	5	1	0	0
14	32.4	0	11	1	0	1
15	30.0	0	16	1	0	0
16	35.3	1	8	1	0	1
17	29.5	0	13	1	0	1
18	M	M	M	1	0	0
19	119.3	1	85	1	0	0
20	16.0	0	14	1	1	0
21	M	1	16	1	1	1
22	18.3	0	20	1	0	0
23	46.8	1	19	0	0	1
24	M	1	35	0	0	0
25	139.7	1	95	1	1	0
26	81.3	1	23	0	0	0
27	64.2	1	28	1	1	1
28	65.7	1	53	1	0	0
29	39.4	1	34	1	0	0

CASE	PLSRISK	PLTRISK	COMPLEX	PAGESSOW	NODIDS	PLWBSDEV
1	1	1	2	30	76	1
2	2	2	3	36	101	1
3	3	3	2	45	100	1
4	4	3	3	30	58	1
5	3	3	2	62	88	1
6	2	2	2	30	57	0
7	3	1	2	68	62	0
8	2	1	3	42	68	1
9	1	1	1	70	92	1
10	3	3	2	77	140	1
11	1	1	3	21	86	1
12	3	1	3	39	41	1
13	3	3	1	17	25	1
14	2	1	2	43	55	1
15	3	3	2	25	37	1
16	3	3	2	49	77	1
17	3	3	3	56	69	1
18	3	3	3	25	37	1
19	3	3	2	87	25	1
20	3	1	1	34	59	0
21	5	2	1	16	50	0
22	1	3	1	39	80	1
23	3	3	3	25	39	1
24	1	2	1	19	51	0
25	3	3	3	25	59	1
26	1	2	1	40	73	0
27	3	3	2	40	58	1
28	1	1	2	26	40	1
29	1	3	2	25	48	1

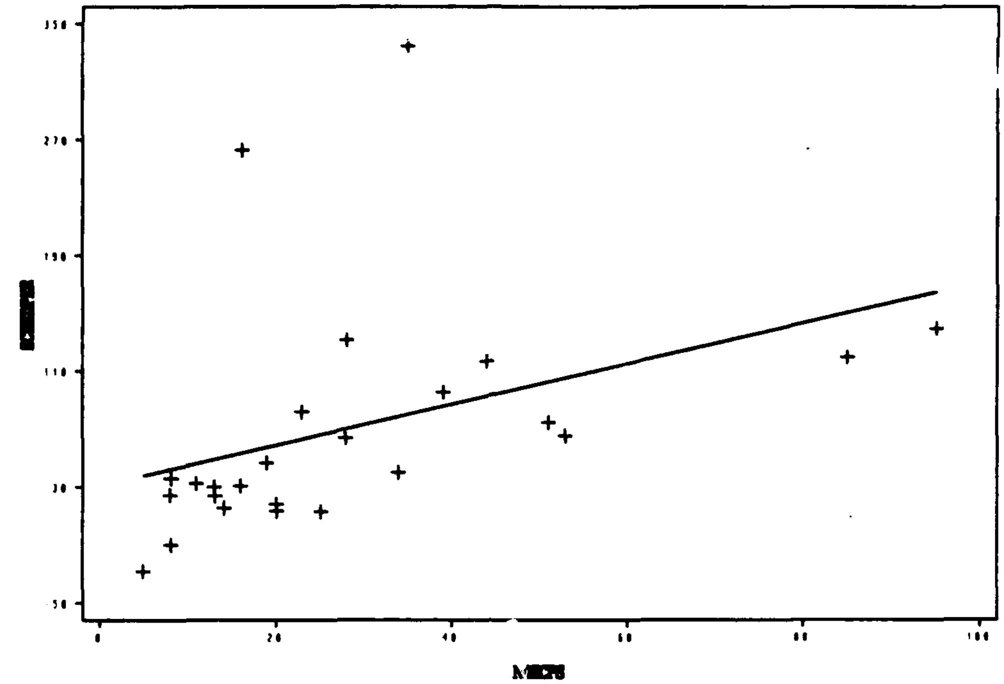
CASE	PLWBSL3	PLWBSLL	PLDRRFP	TECHDEFN	SOWDWBS	SOWCSSR
1	7	4	0	4	1	1
2	21	4	0	2	1	1
3	17	3	1	3	1	1
4	11	4	0	2	1	1
5	36	3	1	4	1	1
6	0	0	1	2	0	0
7	0	0	1	2	1	0
8	12	3	1	4	0	0
9	17	4	0	3	1	0
10	35	3	1	2	1	1
11	12	5	0	2	1	0
12	6	4	1	2	1	1
13	17	4	1	1	1	1
14	11	4	1	4	1	0
15	0	2	1	4	1	1
16	15	4	1	4	1	1
17	14	4	1	4	1	1
18	19	6	0	1	1	1
19	44	5	0	3	1	0
20	0	0	1	4	1	0
21	0	0	1	3	1	0
22	70	5	1	3	0	0
23	10	5	1	2	1	0
24	0	0	0	3	0	0
25	4	4	1	2	1	0
26	0	0	1	1	0	0
27	8	4	1	1	1	1
28	9	5	1	1	1	0
29	12	3	1	1	1	1

CASE	SOWSDISP	SOWRCWP	SOWRCBP	SOWFRSI	NOPMDIDS	NOEVCRIT
1	1	0	0	3	5	3
2	1	0	0	1	5	3
3	1	1	1	3	9	2
4	1	0	0	3	10	9
5	1	1	1	3	11	5
6	0	1	1	5	4	4
7	1	0	0	3	3	3
8	1	1	1	3	7	6
9	1	0	0	3	7	4
10	1	0	0	3	16	12
11	1	1	1	2	8	2
12	1	1	0	3	12	3
13	1	1	0	3	4	1
14	1	1	1	3	8	10
15	1	0	0	2	6	5
16	0	1	1	3	11	2
17	0	1	1	3	9	2
18	0	0	0	1	4	3
19	0	1	1	3	5	4
20	1	1	1	3	7	11
21	0	0	0	3	6	5
22	1	1	1	2	9	3
23	1	1	1	3	8	3
24	0	1	1	3	6	2
25	1	0	0	3	6	2
26	0	1	0	3	7	7
27	1	1	1	3	10	2
28	1	1	1	3	7	3
29	1	1	1	3	9	5

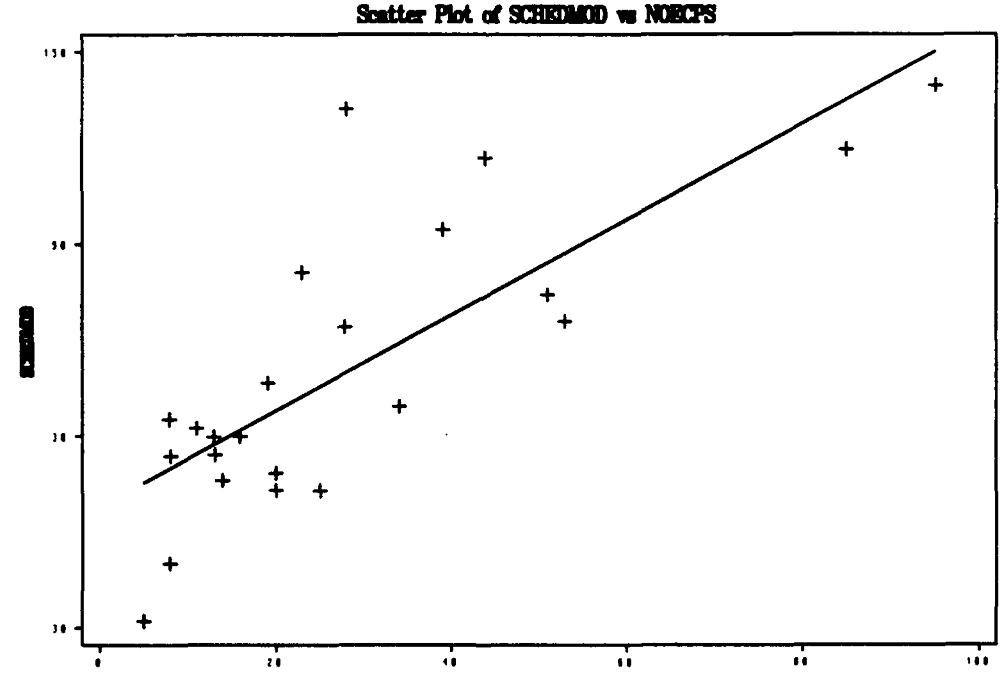
CASE	EVRISKS	EVSDISP	EVRCWP	EVRCBP	EVRESP
1	1	0	1	1	1
2	1	1	0	0	0
3	1	0	1	0	1
4	1	1	1	1	1
5	1	0	1	1	1
6	1	0	1	1	1
7	1	0	0	0	1
8	1	1	1	1	1
9	1	0	1	0	1
10	1	1	1	0	1
11	1	1	0	0	1
12	1	1	1	1	1
13	1	0	0	1	1
14	1	1	1	1	1
15	1	0	1	0	1
16	1	1	1	1	1
17	1	1	1	1	1
18	0	0	1	0	1
19	1	1	1	0	1
20	1	1	1	1	1
21	1	1	1	1	1
22	1	0	1	0	1
23	1	1	1	1	1
24	0	0	0	0	0
25	1	1	1	1	1
26	1	0	1	1	1
27	1	1	1	1	1
28	1	1	0	0	1
29	1	1	1	1	1

Appendix F: Scatter Plots for Single-variable Analyses

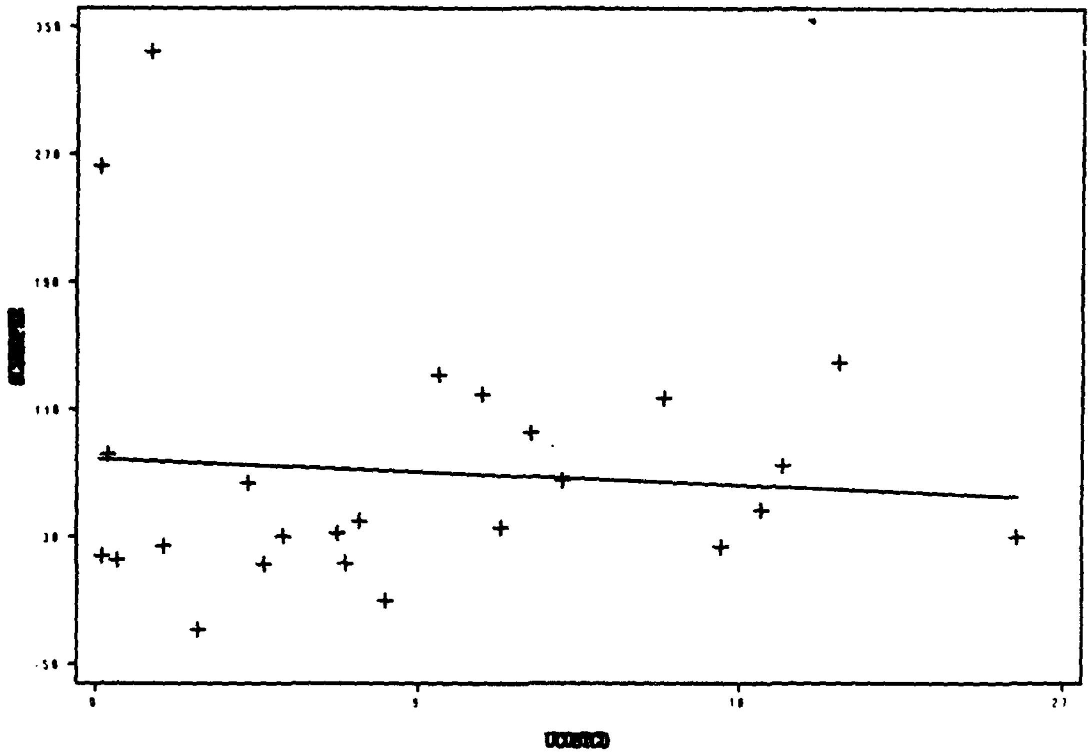
Scatter Plot of SCHEDPER vs NOECPS



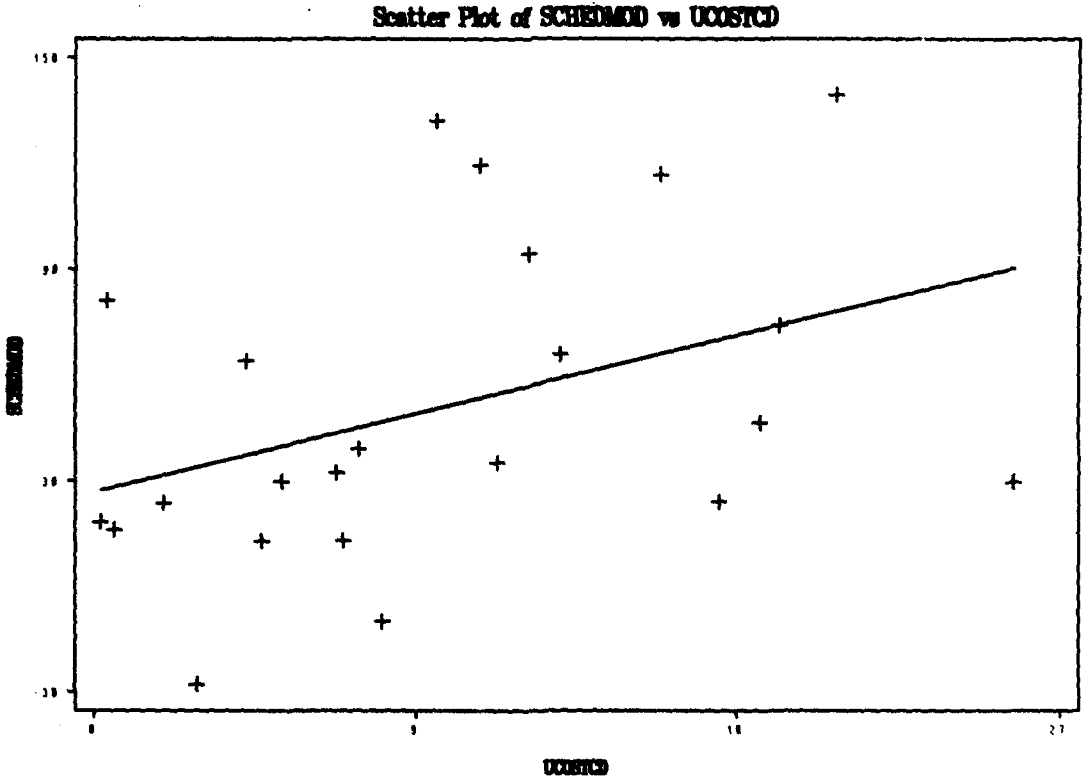
Scatter Plot of SCHEDMOD vs NOECPS



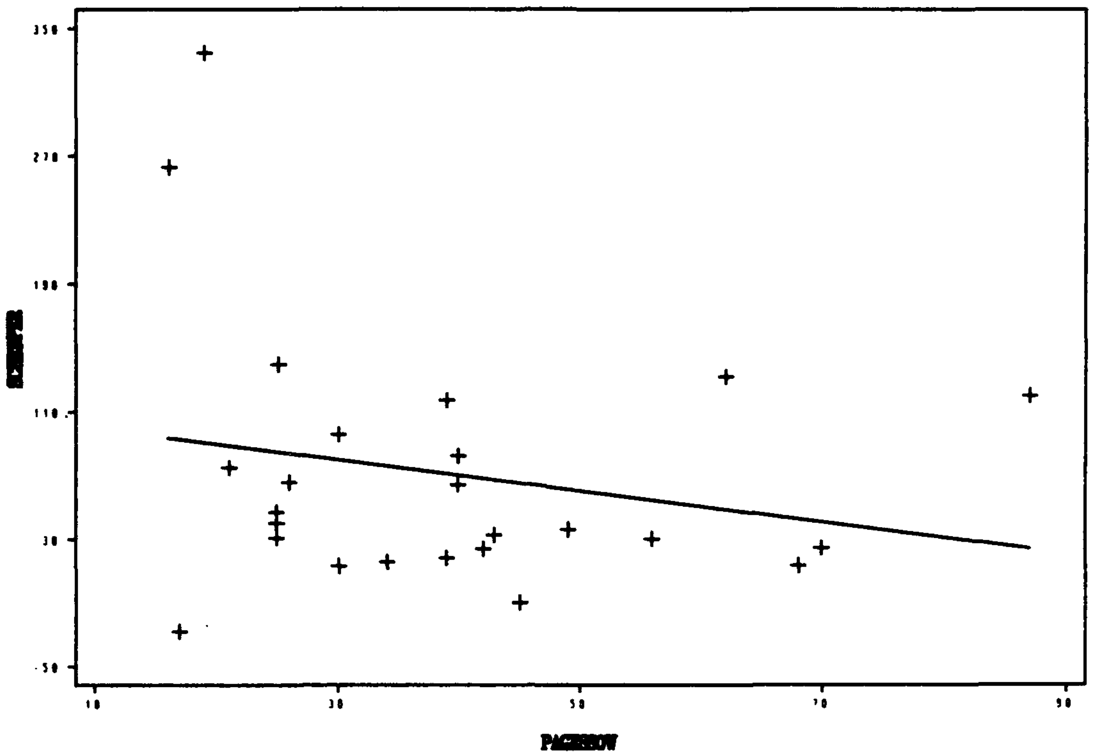
Scatter Plot of SCHEDPER vs UCOSTCD



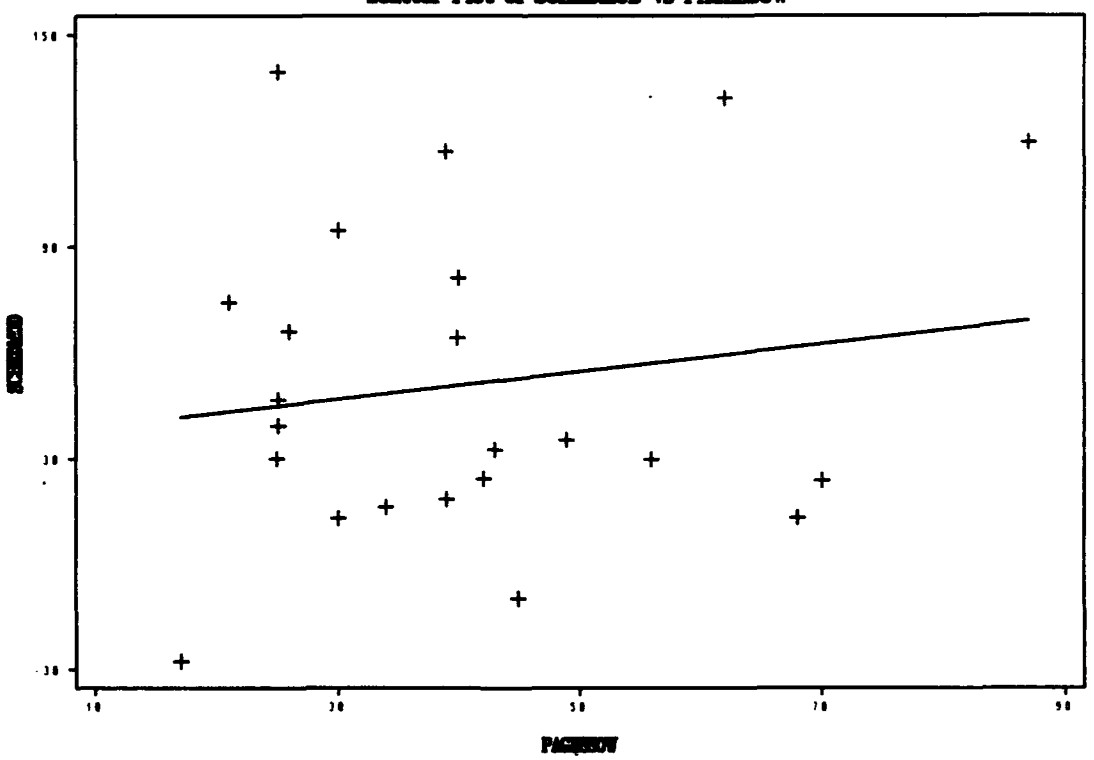
Scatter Plot of SCHEDMOD vs UCOSTCD



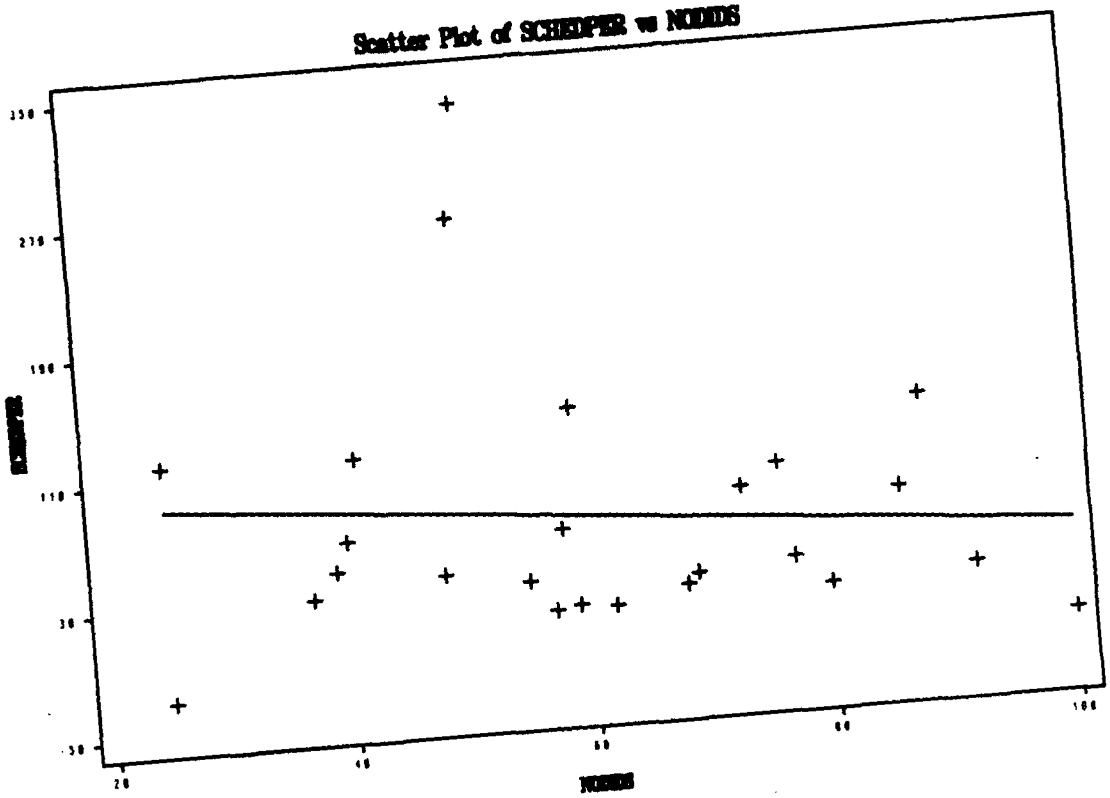
Scatter Plot of SCHEDPER vs PAGESSOW



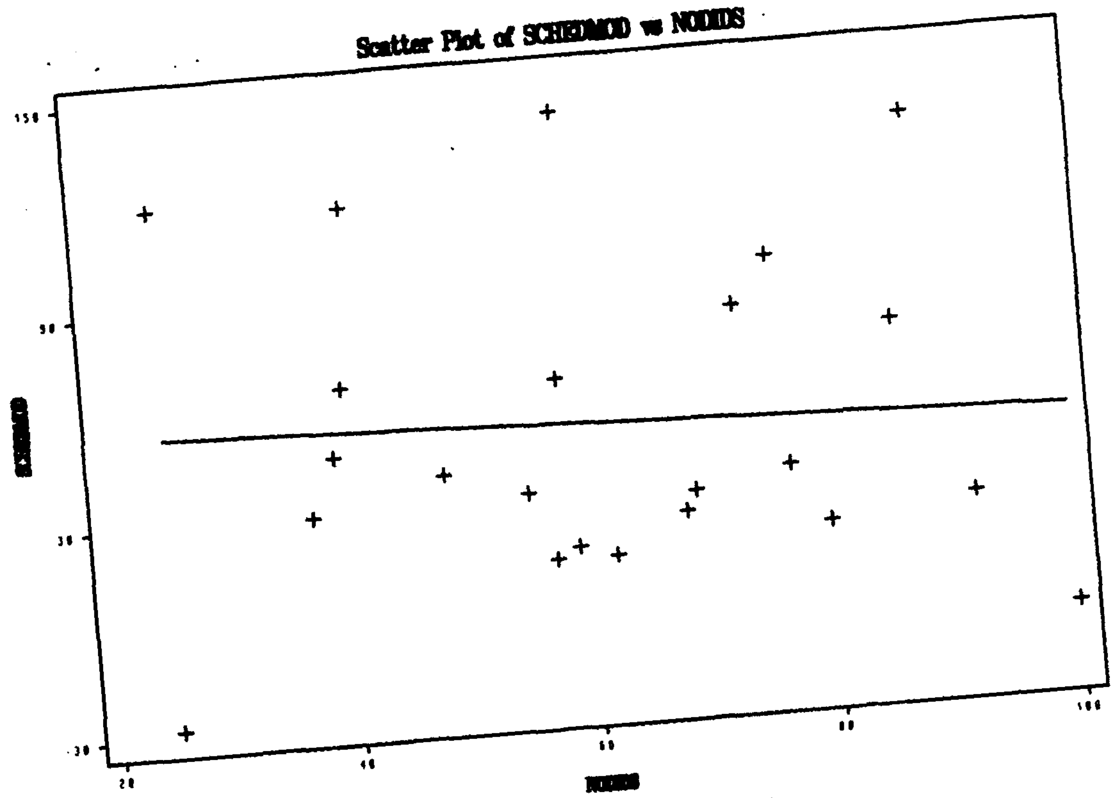
Scatter Plot of SCHEDMOD vs PAGESSOW



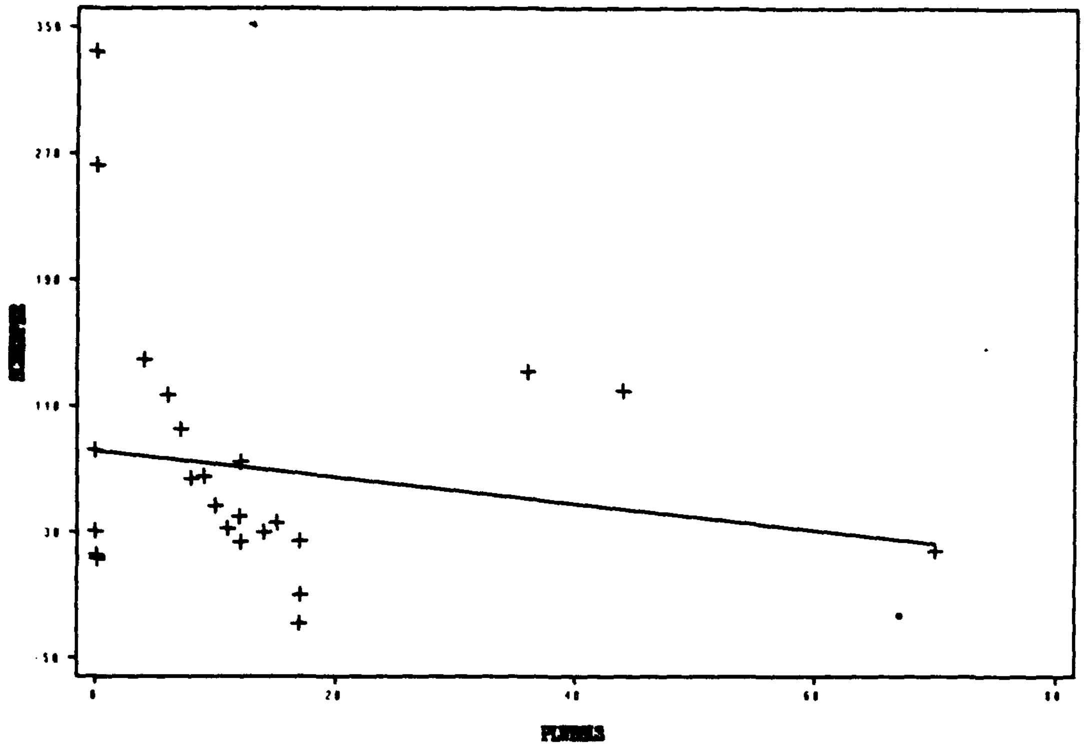
Scatter Plot of SCHEDPER vs NODIDS



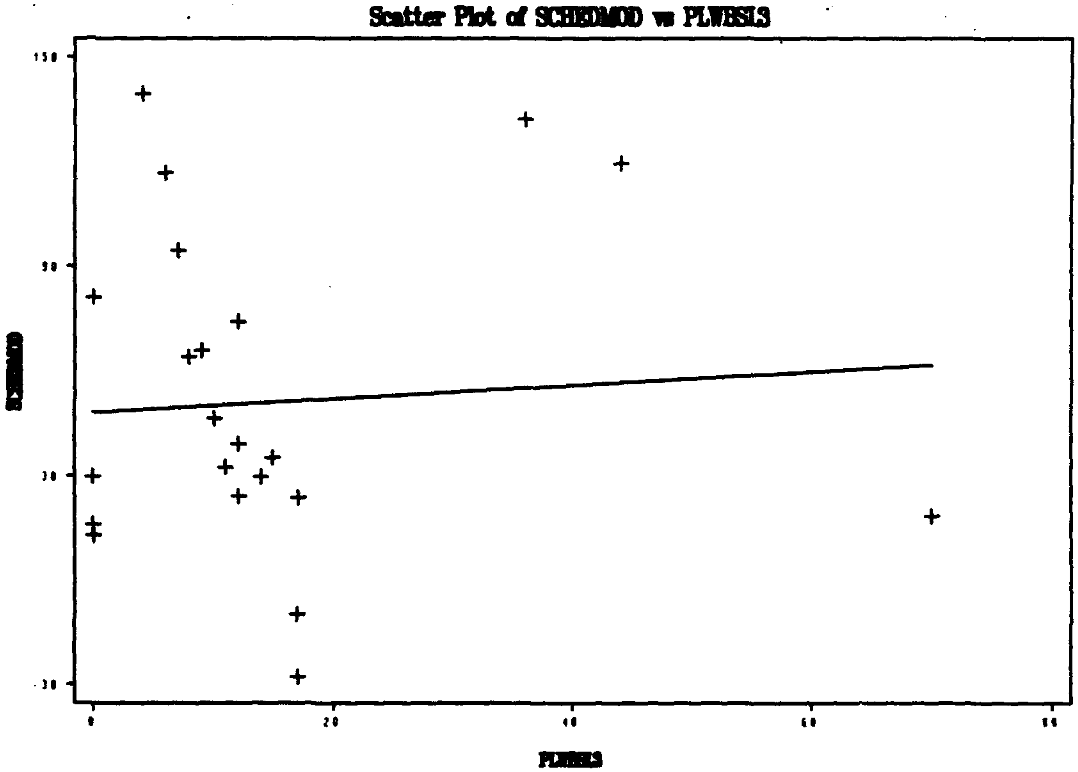
Scatter Plot of SCHEDMOD vs NODIDS



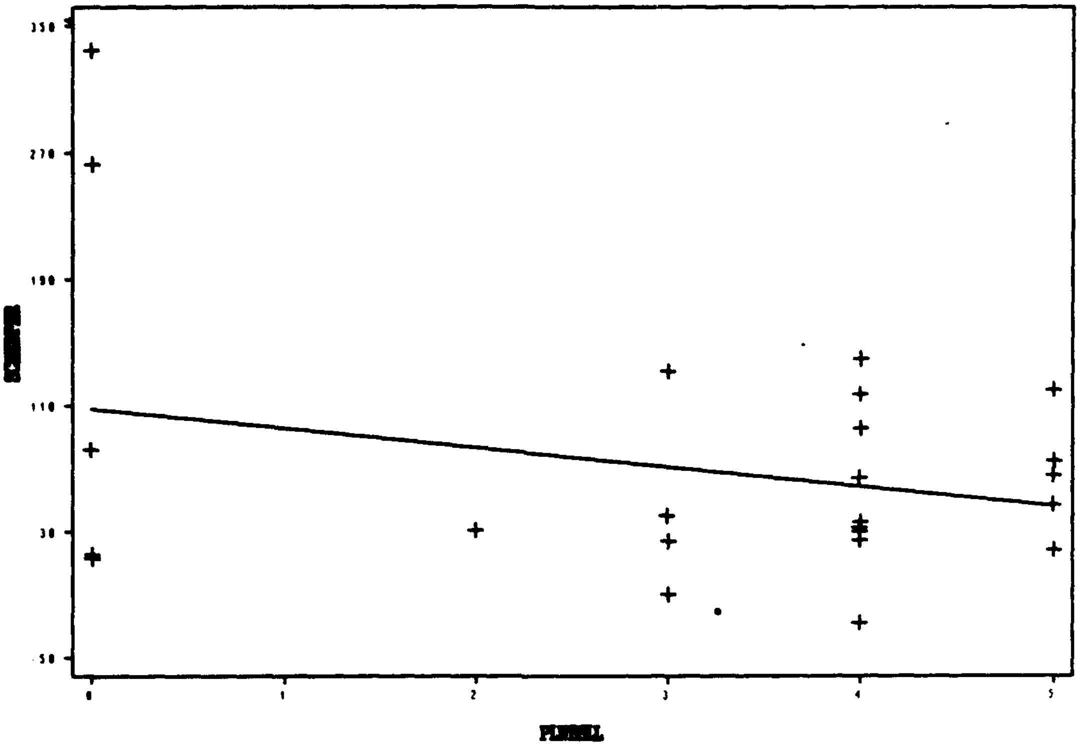
Scatter Plot of SCHEDPER vs PLWBSL3



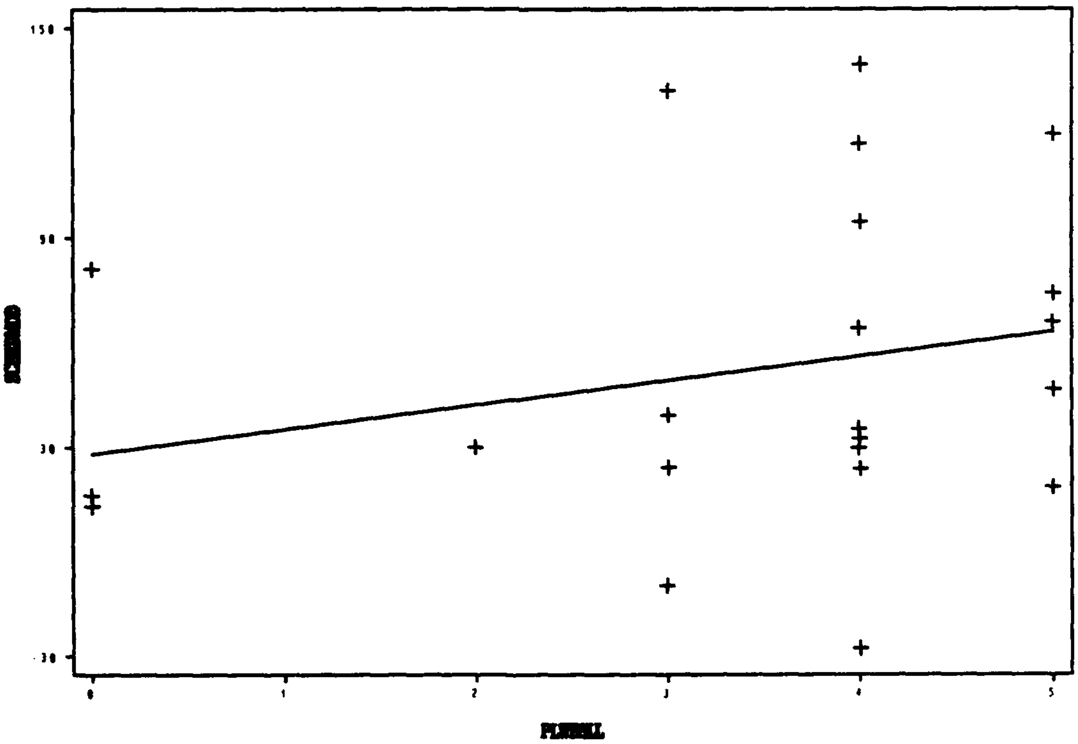
Scatter Plot of SCHEDMOD vs PLWBSL3



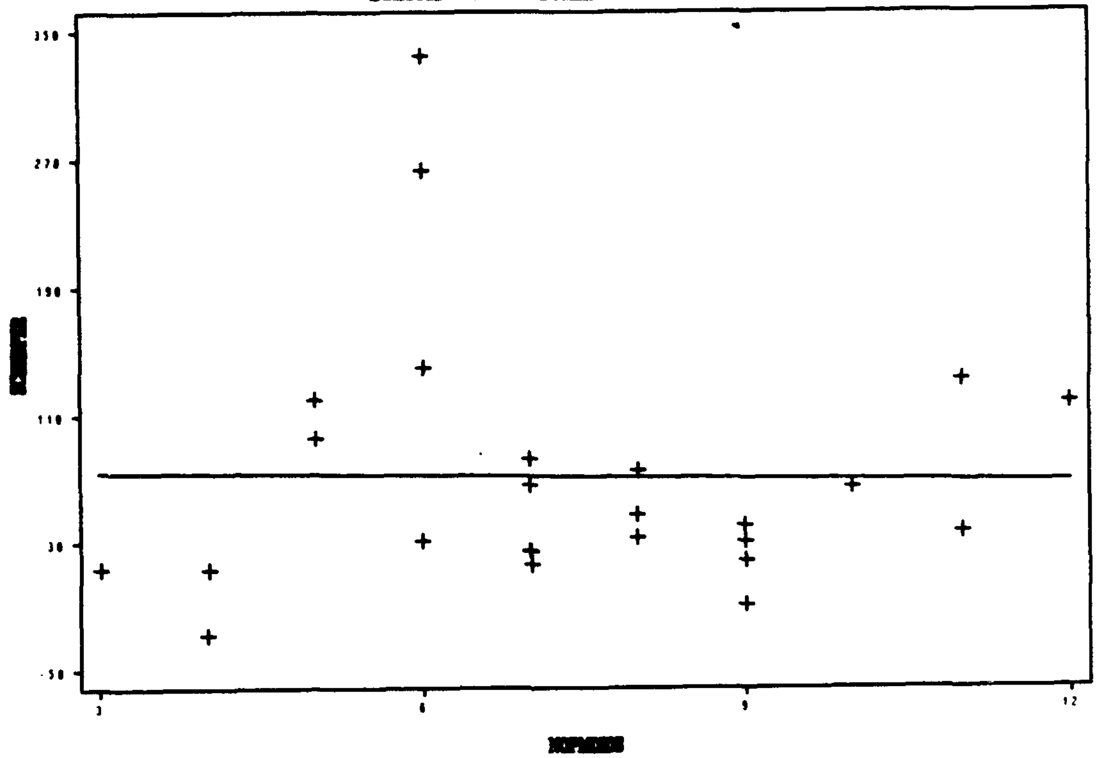
Scatter Plot of SCHEDPER vs PLWBSLL



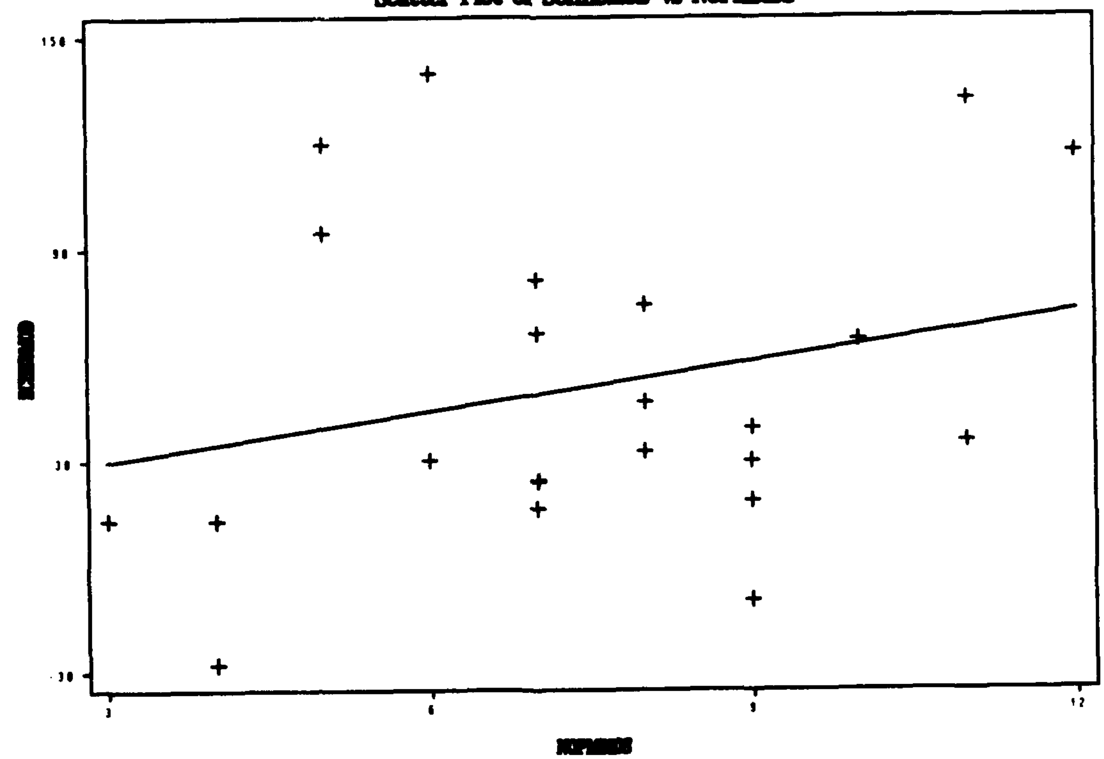
Scatter Plot of SCHEDMOD vs PLWBSLL



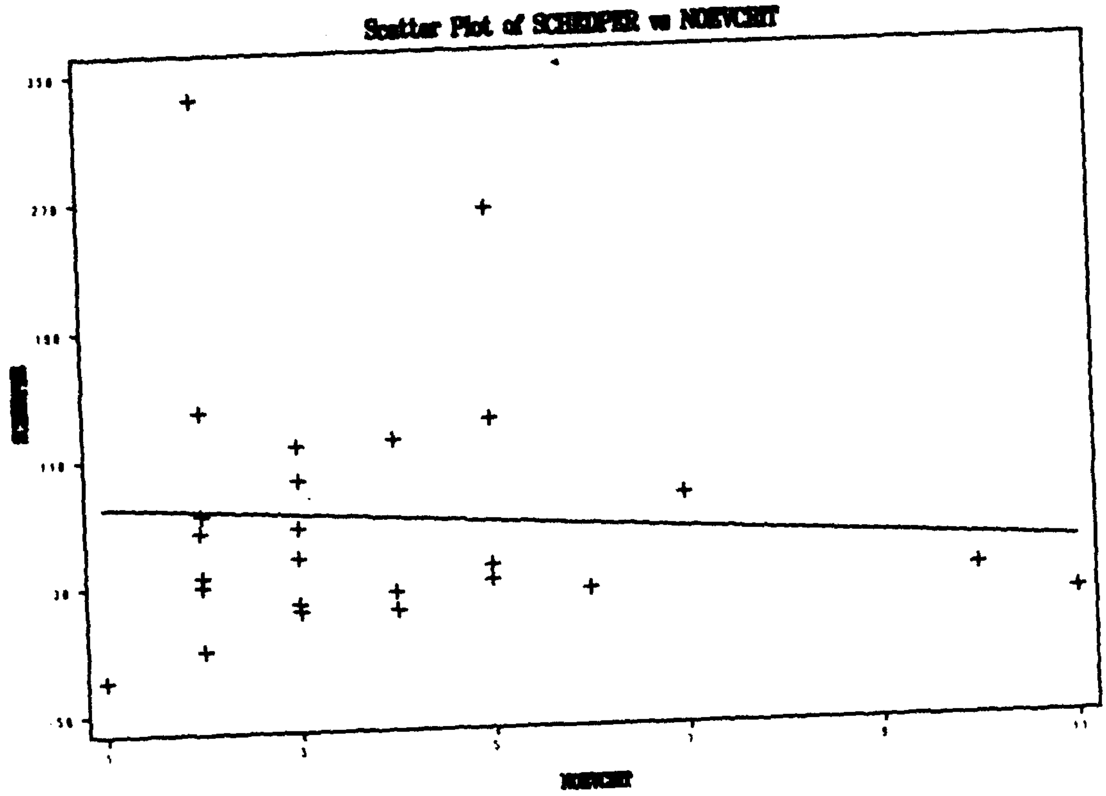
Scatter Plot of SCHEDPER vs NOPMDIDS



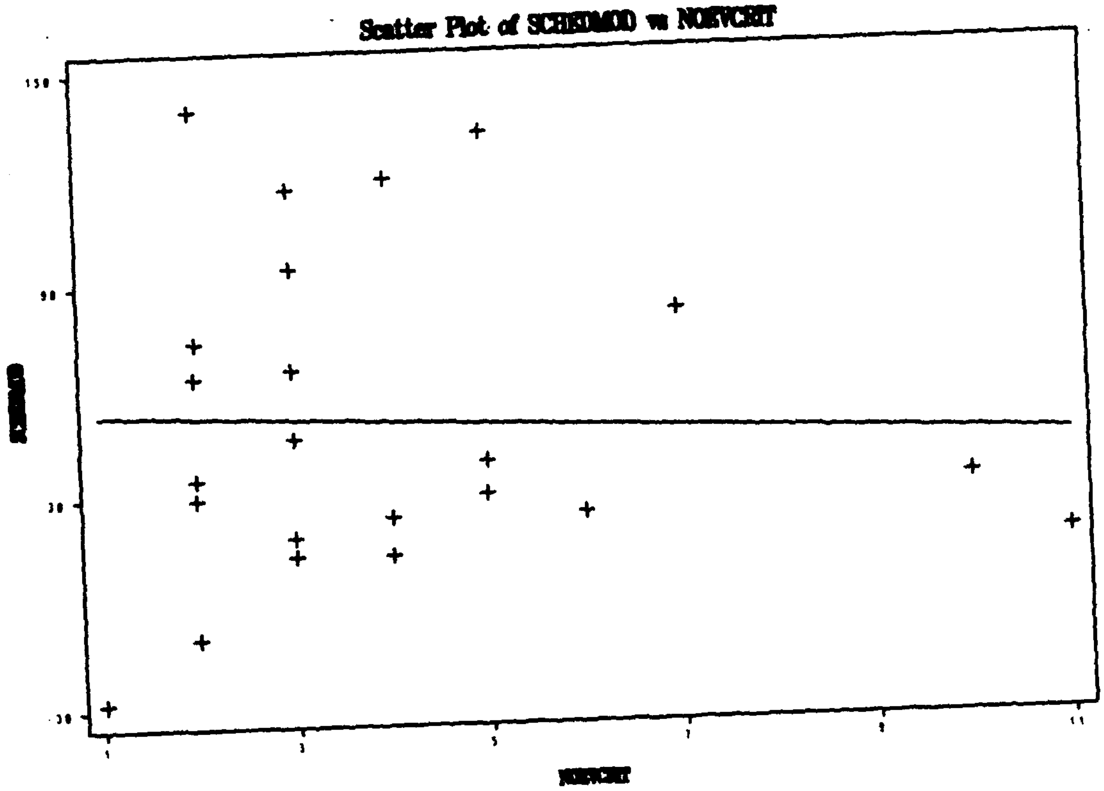
Scatter Plot of SCHEDMOD vs NOPMDIDS

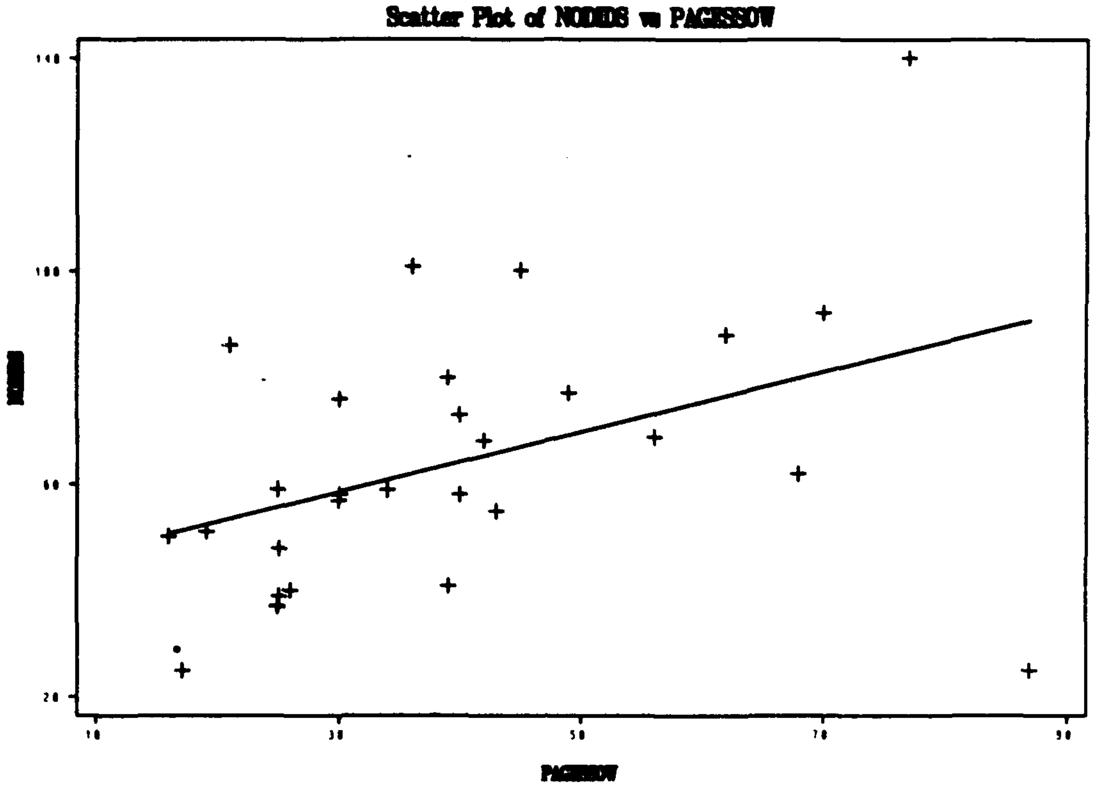


Scatter Plot of SCHEDPER vs NOEVCRIT



Scatter Plot of SCHEDMOD vs NOEVCRIT





Scatter Plot of NODEDS vs PAGESSOW
140
100
60
20
10
30
50
70
90
PAGESSOW

Appendix G: Selected F-Distribution Values for the Forward Stepwise with Backward Elimination Multiple Regression Model, Sample Size of 25

For the partial F test, at each step of the stepwise model-building process, the F distribution has 1 degree of freedom for the numerator and (n-p-1) degrees of freedom for the denominator, where n is the sample size and p is the number of variables in the full model at the relevant step. (Note that an ordinal variable, when decomposed into a set of dummy variables for a regression model, changes both the numerator and denominator degrees-of-freedom for the F test by the number of dummy variables in the set.) For the sample size of 25 in this research, n = 25 and p changes as variables enter or leave the model. At the first step, p = 0 so the degrees of freedom for the denominator is (25-0-1) = 24. The degrees of freedom for the denominator is reduced by one for each variable added to the model.

The following results, obtained from the Statistix 4.0 statistical software package, study the change in the F distribution F value and p value with change in the denominator degrees of freedom (Analytical Software, 1992:302).

An F-value of 3 to Enter or Remove Variables.

FPROB (3, 1, 24)	0.09610
FPROB (3, 1, 23)	0.09666
FPROB (3, 1, 22)	0.09726
FPROB (3, 1, 21)	0.09793
FPROB (3, 1, 20)	0.09866
FPROB (3, 1, 19)	0.09947
FPROB (3, 1, 18)	0.10037
FPROB (3, 1, 17)	0.10137

A p-value of 0.1 to Enter or Remove Variables.

FINVERSE (0.9, 1, 24)	2.93
FINVERSE (0.9, 1, 23)	2.94
FINVERSE (0.9, 1, 22)	2.95
FINVERSE (0.9, 1, 21)	2.96
FINVERSE (0.9, 1, 20)	2.97
FINVERSE (0.9, 1, 19)	2.99
FINVERSE (0.9, 1, 18)	3.01
FINVERSE (0.9, 1, 17)	3.03

With the sample size of 25 and the expected range of the number of variables to be fitted for a meaningful model, the preceding results demonstrate that an F value of 3 and a p value of 0.1 are approximately equivalent.

Appendix H: BMDP 2R Stepwise Regression on SCHEDPER, Full Variable Set, No Interaction Terms (Edited Data Output)

PROGRAM INSTRUCTIONS

```
/INPUT      FILE='THESIS.ASC'.
            VARIABLES=33.
            FORMAT=FREE.

/VARIABLE   NAMES=CNO, SCHEDPER, SCHEDMOD, SCHEDPLR, UCOSTCD,
            CTYPE, D_DP, PRODOPT, NOECPS, PLPRESCH, PLAGGR, PLCONC,
            PLSRISK, PLTRISK, COMPLEX, PAGESSOW, NODIDS, PLWBSDEV,
            PLWBSL3, PLWBSLL, PLDRRFP, TECHDEFN, SOWDWBS, SOWCSSR,
            SOWSDISP, SOWRCWP, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT,
            EVSDISP, EVRCWP, EVRCBP.

            USE=SCHEDPER, UCOSTCD, CTYPE, D_DP, PRODOPT, NOECPS,
            PLPRESCH, PLAGGR, PLCONC, PLSRISK, PLTRISK, COMPLEX,
            PAGESSOW, NODIDS, PLWBSDEV, PLWBSL3, PLDRRFP, TECHDEFN,
            SOWDWBS, SOWCSSR, SOWSDISP, SOWRCWP, SOWRCBP, SOWFRSI,
            NOPMDIDS, NOEVCRIT, EVSDISP, EVRCWP, EVRCBP, PLSRISK1,
            PLSRISK2, PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, TECHDEF1,
            TECHDEF2, TECHDEF3, PLWBSL31, PLWBSL32, PLWBSL33.

/TRANSFORM  IF(PLSRISK EQ 1) THEN(PLSRISK1=0. PLSRISK2=0.).
            IF(PLSRISK EQ 2) THEN(PLSRISK1=1. PLSRISK2=0.).
            IF(PLSRISK EQ 3) THEN(PLSRISK1=0. PLSRISK2=1.).

            IF(PLTRISK EQ 1) THEN(PLTRISK1=0. PLTRISK2=0.).
            IF(PLTRISK EQ 2) THEN(PLTRISK1=1. PLTRISK2=0.).
            IF(PLTRISK EQ 3) THEN(PLTRISK1=0. PLTRISK2=1.).

            IF(COMPLEX EQ 1) THEN(COMPLEX1=0. COMPLEX2=0.).
            IF(COMPLEX EQ 2) THEN(COMPLEX1=1. COMPLEX2=0.).
            IF(COMPLEX EQ 3) THEN(COMPLEX1=0. COMPLEX2=1.).

            IF(TECHDEFN EQ 1) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=0.).
            IF(TECHDEFN EQ 2) THEN(TECHDEF1=1. TECHDEF2=0. TECHDEF3=0.).
            IF(TECHDEFN EQ 3) THEN(TECHDEF1=0. TECHDEF2=1. TECHDEF3=0.).
            IF(TECHDEFN EQ 4) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=1.).

            IF(PLWBSL3 EQ 0) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=0.).
            IF(PLWBSL3 GT 0 AND PLWBSL3 LE 10) THEN(PLWBSL31=1. PLWBSL32=0. PLWBSL33=0.).
            IF(PLWBSL3 GT 10 AND PLWBSL3 LE 16) THEN(PLWBSL31=0. PLWBSL32=1. PLWBSL33=0.).
            IF(PLWBSL3 GT 16) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=1.).

/GROUP      CODES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
            SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
            SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
            PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
            PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3)=1,0.

            NAMES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
            SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
            SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
            PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
            PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3)=YES, NO.

            CODES(PLSRISK, PLTRISK, COMPLEX)=1, 2, 3.
            NAMES(PLSRISK, PLTRISK)=LOW, LOW_MED, OTHER.
            NAMES(COMPLEX)=LOW, MED, HI.

            CODES(TECHDEFN)=1, 2, 3, 4.
            NAMES(TECHDEFN)=DRAFT_A, FULL_A, DRAFT_B, FULL_B.

            NAMES(PLWBSL3)='UNDER_2', '2_11', '11_17', 'OVER_17'.
```

```
/REGRESS    DEPEND=SCHEDPER.
            SETNAMES=SPLSRISK, SPLTRISK, SCOMPLEX, STECHDEF, SPLWBSL3.
            SPLSRISK=PLSRISK1, PLSRISK2.
            SPLTRISK=PLTRISK1, PLTRISK2.
            SCOMPLEX=COMPLEX1, COMPLEX2.
            STECHDEF=TECHDEF1, TECHDEF2, TECHDEF3.
            SPLWBSL3=PLWBSL31, PLWBSL32, PLWBSL33.
            INPVAL=0.1, 0.1.
            OUTPVAL=0.11, 0.11.
            INDEPEND=CTYPE, PLAGGR, PLCONC, PAGESSOW, NODIDS, PLDRRFP,
            SOWCSSR, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVRCWP, EVRCBP,
            UCOSTCD, D_DP, PRODOPT, NOECPS, PLPRESCH, PLWBSDEV, SOWDWBS,
            SOWSDISP, SOWRCWP, EVSDISP, SPLSRISK, SPLTRISK, SCOMPLEX,
            STECHDEF, SPLWBSL3.
            TOL=0.1.

/PRINT      LEVEL=MINIMAL.
            NO DATA.
            NO CORRELATION.
            STEP.
            ANOVA.
            NO COVA.
            NO PART.
            NO COEFF.
            NO FRATIO.
            NO RREG.
            CASE=0.
            DIAGNOSTICS=ALL.
            LINESIZE=80.

/PLOT       RESIDUALS.
            DNORMAL.
            SIZE=60, 25.
            CASEPLOTS.
            XVAR=UCOSTCD.
            YVAR=COOK.
            STEP=ALL.
            NO DATA.

/END

NUMBER OF CASES READ. . . . . . . . . . . . . . .        29
   CASES WITH DATA MISSING OR BEYOND LIMITS . .           4
      REMAINING NUMBER OF CASES . . . . . . . . .        25
```

DESCRIPTIVE STATISTICS OF DATA
----------- ---------- -- ----

VARIABLE NO.	NAME	TOTAL FREQ.	MEAN	STANDARD DEV.	SKEW-NESS	KURTOSIS	SMALLEST VALUE	SMALLEST Z-SCR	LARGEST VALUE	LARGEST Z-SCR
2	SCHEDPER	25	70.768	81.812	1.714	2.723	-27.900	-1.21	334.00	3.22
5	UCOSTCD	25	9.0161	7.3135	0.548	-0.825	.10166	-1.22	25.738	2.29
6	CTYPE	25	.36000	.48990	0.549	-1.765	0.0000	-0.73	1.0000	1.31
7	D_DP	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
8	PRODOPT	25	.60000	.50000	-0.384	-1.925	0.0000	-1.20	1.0000	0.80
9	NOECPS	25	28.440	22.862	1.497	1.641	5.0000	-1.03	95.000	2.91
10	PLPRESCH	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
11	PLAGGR	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
12	PLCONC	25	.44000	.50662	0.227	-2.025	0.0000	-0.87	1.0000	1.11
13	PLSRISK	25	2.2400	.92556	-0.462	-1.714	1.0000	-1.34	3.0000	0.82
14	PLTRISK	25	2.1200	.92736	-0.224	-1.845	1.0000	-1.21	3.0000	0.95
15	COMPLEX	25	1.9600	.73485	0.056	-1.222	1.0000	-1.31	3.0000	1.42
16	PAGESSOW	25	38.920	18.216	0.885	0.027	16.000	-1.26	87.000	2.64
17	NODIDS	25	60.600	20.294	0.064	-0.930	25.000	-1.75	100.00	1.94
18	PLWBSDEV	25	.76000	.43589	-1.145	-0.712	0.0000	-1.74	1.0000	0.55
19	PLWBSL3	25	12.840	16.069	2.057	4.263	0.0000	-0.80	70.000	3.56
21	PLDRRFP	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
22	TECHDEFN	25	2.6800	1.1446	-0.187	-1.474	1.0000	-1.47	4.0000	1.15
23	SOWDWBS	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
24	SOWCSSR	25	.40000	.50000	0.384	-1.925	0.0000	-0.80	1.0000	1.20
25	SOWSDISP	25	.72000	.45826	-0.922	-1.193	0.0000	-1.57	1.0000	0.61
26	SOWRCWP	25	.76000	.43589	-1.145	-0.712	0.0000	-1.74	1.0000	0.55
27	SOWRCBP	25	.64000	.48990	-0.549	-1.765	0.0000	-1.31	1.0000	0.73
28	SOWFRSI	25	.88000	.33166	-2.200	2.962	0.0000	-2.65	1.0000	0.36
29	NOPMDIDS	25	7.3600	2.3072	0.123	-0.763	3.0000	-1.89	12.000	2.01
30	NOEVCRIT	25	3.9600	2.4576	1.418	1.473	1.0000	-1.20	11.000	2.86
31	EVSDISP	25	.56000	.50662	-0.227	-2.025	0.0000	-1.11	1.0000	0.87
32	EVRCWP	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
33	EVRCBP	25	.64000	.48990	-0.549	-1.765	0.0000	-1.31	1.0000	0.73
34	PLSRISK1	25	.12000	.33166	2.200	2.962	0.0000	-0.36	1.0000	2.65
35	PLSRISK2	25	.56000	.50662	-0.227	-2.025	0.0000	-1.11	1.0000	0.87
36	PLTRISK1	25	.16000	.37417	1.745	1.092	0.0000	-0.43	1.0000	2.24
37	PLTRISK2	25	.48000	.50990	0.075	-2.072	0.0000	-0.94	1.0000	1.02
38	COMPLEX1	25	.48000	.50990	0.075	-2.072	0.0000	-0.94	1.0000	1.02
39	COMPLEX2	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
40	TECHDEF1	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
41	TECHDEF2	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
42	TECHDEF3	25	.32000	.47610	0.726	-1.530	0.0000	-0.67	1.0000	1.43
43	PLWBSL31	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
44	PLWBSL32	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
45	PLWBSL33	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74

*** N O T E *** KURTOSIS VALUES GREATER THAN ZERO INDICATE A DISTRIBUTION WITH HEAVIER TAILS THAN NORMAL DISTRIBUTION.

STEP NO. 0

STD. ERROR OF EST. 81.8118

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE
RESIDUAL	160636.20	24	6693.175

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	70.7680)			

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
UCOSTCD	-0.0836	1.0000	0.16(1)
CTYPE	-0.2596	1.0000	1.66(1)
D_DP	-0.1893	1.0000	0.85(1)
PRODOPT	0.2608	1.0000	1.68(1)
NOECPS	0.3935	1.0000	4.21(1)
PLPRESCH	-0.4452	1.0000	5.69(1)
PLAGGR	0.1434	1.0000	0.48(1)
PLCONC	-0.0428	1.0000	0.04(1)
PLSRISK	-0.1037	1.0000	0.25(0)
PLTRISK	-0.0314	1.0000	0.02(0)
COMPLEX	-0.1431	1.0000	0.48(0)
PAGESSOW	-0.2173	1.0000	1.14(1)
NODIDS	-0.1517	1.0000	0.54(1)
PLWBSDEV	-0.3460	1.0000	3.13(1)
PLWBSL3	-0.1657	1.0000	0.65(0)
PLDRRFP	-0.3649	1.0000	3.53(1)
TECHDEFN	0.0493	1.0000	0.06(0)
SOWDWBS	-0.1459	1.0000	0.50(1)
SOWCSSR	-0.2076	1.0000	1.04(1)
SOWSDISP	-0.4224	1.0000	4.99(1)
SOWRCWP	-0.1637	1.0000	0.63(1)
SOWRCBP	-0.1018	1.0000	0.24(1)
SOWFRSI	0.1376	1.0000	0.44(1)
NOPMDIDS	-0.0194	1.0000	0.01(1)
NOEVCRIT	-0.0979	1.0000	0.22(1)
EVSDISP	0.0762	1.0000	0.13(1)
EVRCWP	-0.1319	1.0000	0.41(1)
EVRCBP	-0.0333	1.0000	0.03(1)
		F=	0.75
SET SPLSRISK		P=	0.48413(1)
PLSRISK1	-0.2191	1.0000	(1)
PLSRISK2	-0.0230	1.0000	(1)
		F=	4.91
SET SPLTRISK		P=	0.01721(1)
PLTRISK1	0.5557	1.0000	(1)
PLTRISK2	-0.2324	1.0000	(1)
		F=	0.77
SET SCOMPLEX		P=	0.47461(1)
COMPLEX1	-0.2196	1.0000	(1)
COMPLEX2	0.0078	1.0000	(1)
		F=	1.27
SET STECHDEF		P=	0.31000(1)
TECHDEF1	-0.0241	1.0000	(1)
TECHDEF2	0.3783	1.0000	(1)
TECHDEF3	-0.1840	1.0000	(1)
		F=	1.10
SET SPLWBSL3		P=	0.37055(1)
PLWBSL31	0.1207	1.0000	(1)
PLWBSL32	-0.2213	1.0000	(1)
PLWBSL33	-0.1977	1.0000	(1)

```
STEP NO.    1
---------------
VARIABLE ENTERED  SET SPLTRISK
                   36 PLTRISK1
                   37 PLTRISK2

MULTIPLE R              0.5557
MULTIPLE R-SQUARE       0.3088
ADJUSTED R-SQUARE       0.2459
STD. ERROR OF EST.     71.0435

ANALYSIS OF VARIANCE
                     SUM OF SQUARES     DF     MEAN SQUARE       F RATIO
        REGRESSION   49598.297           2    24799.15            4.91
        RESIDUAL     111037.91          22    5047.178
```

```
       VARIABLES IN EQUATION
-------------------------------------------
                      STD.ERR         F AND P
VARIABLE    COEFF.   OF COEFF  TOL.  REMOVE(L)
-------------------------------------------
(CONSTANT   51.2667)
                                F=    4.91
SET SPLTRISK                    P=0.01721(1)
PLTRISK1  121.5583    42.692 0.8242       (1)
PLTRISK2    0.1083   31.3272 0.8242       (1)
```

```
     VARIABLES NOT IN EQUATION
-------------------------------
            PARTIAL        F AND P
VARIABLE    CORR.    TOL.  ENTER(L)
-------------------------------
UCOSTCD   0.2223 0.7995(0.308)(1)

CTYPE    -0.1195 0.6173     0.30(1)
D_DP     -0.0764 0.6884     0.12(1)
PRODOPT   0.2265 0.9815     1.14(1)
NOECPS    0.5230 0.9935     7.91(1)
PLPRESCH-0.3359 0.8889      2.67(1)
PLAGGR    0.1657 0.9990     0.59(1)
PLCONC    0.0611 0.9695     0.08(1)
PLSRISK   0.0366 0.7931     0.03(0)
PLTRISK  -0.0001 0.0000     0.00(0)
COMPLEX   0.1281 0.8145     0.35(0)
PAGESSOW-0.0571 0.9040      0.07(1)
NODIDS   -0.1420 0.9799     0.43(1)
PLWBSDEV 0.1760 0.3411      0.67(1)
PLWBSL3   0.0444 0.7465     0.04(0)
PLDRRFP  -0.4205 0.9167     4.51(1)
TECHDEFN 0.1744 0.9639      0.66(0)
SOWDWBS   0.2822 0.6389     1.82(1)
SOWCSSR  -0.0141 0.7037     0.00(1)
SOWSDISP-0.0600 0.4464      0.08(1)
SOWRCWP  -0.1932 0.9686     0.81(1)
SOWRCBP  -0.0384 0.9500     0.03(1)
SOWFRSI   0.0588 0.9680     0.07(1)
NOPMDIDS 0.1981 0.8653      0.86(1)
NOEVCRIT-0.1985 0.8485      0.86(1)
EVSDISP   0.2856 0.9199     1.87(1)
EVRCWP   -0.1279 0.9167     0.35(1)
EVRCBP   -0.1081 0.9790     0.25(1)
                        F=    2.05
SET SPLSRISK            P=0.15512(1)
PLSRISK1-0.4067 0.8733          (1)
PLSRISK2 0.1821 0.7170          (1)
                        F=    0.34
SET SCOMPLEX            P=0.71413(1)
COMPLEX1-0.1337 0.9437          (1)
COMPLEX2 0.1796 0.9320          (1)
                        F=    0.75
SET STECHDEF            P=0.53418(1)
TECHDEF1-0.0362 0.9686          (1)
TECHDEF2 0.2911 0.9077          (1)
TECHDEF3-0.0223 0.8987          (1)
                        F=    0.80
SET SPLWBSL3            P=0.51159(1)
PLWBSL31 0.3202 0.9320          (1)
PLWBSL32-0.1059 0.9320          (1)
PLWBSL33-0.0811 0.8346          (1)
```

STEP NO. 2

VARIABLE ENTERED 9 NOECPS

MULTIPLE R	0.7056
MULTIPLE R-SQUARE	0.4978
ADJUSTED R-SQUARE	0.4261

STD. ERROR OF EST. 61.9781

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	79969.141	3	26656.38	6.94
RESIDUAL	80667.063	21	3841.289	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	7.3830)			
NOECPS	1.5611	0.5552	0.9935	7.91(1)
				F= 7.17
SET SPLTRISK				P=0.00423(1)
PLTRISK1	126.8053	37.291	0.8221	(1)
PLTRISK2	-2.7103	27.3482	0.8231	(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
UCOSTCD	0.0188	0.6735	0.01(1)
CTYPE	0.1296	0.5083	(0.565)(1)
D_DP	-0.0480	0.6852	0.05(1)
PRODOPT	0.3219	0.9736	2.31(1)
PLPRESCH	-0.3609	0.8862	3.00(1)
PLAGGR	0.0894	0.9690	0.16(1)
PLCONC	0.3993	0.7637	3.79(1)
PLSRISK	0.1124	0.7831	0.26(0)
PLTRISK	-0.0002	0.0000	0.00(0)
COMPLEX	-0.0751	0.7095	0.11(0)
PAGESSOW	-0.0763	0.9038	0.12(1)
NODIDS	0.0016	0.9063	0.00(1)
PLWBSDEV	0.1099	0.3324	0.24(1)
PLWBSL3	0.0164	0.7440	0.01(0)
PLDRRFP	-0.2869	0.7915	1.79(1)
TECHDEFN	0.3969	0.8849	3.74(0)
SOWDWBS	0.2763	0.6336	1.65(1)
SOWCSSR	0.1872	0.6333	0.73(1)
SOWSDISP	-0.0109	0.4422	0.00(1)
SOWRCWP	-0.1620	0.9575	0.54(1)
SOWRCBP	-0.0115	0.9472	0.00(1)
SOWFRSI	0.0657	0.9680	0.09(1)
NOPMDIDS	0.3386	0.8416	2.59(1)
NOEVCRIT	-0.0984	0.8062	0.20(1)
EVSDISP	0.1551	0.8341	0.49(1)
EVRCWP	-0.0788	0.9041	0.13(1)
EVRCBP	-0.0366	0.9576	0.03(1)
			F= 1.72
SET SPLSRISK			P=0.20583(1)
PLSRISK1	-0.3680	0.8422	(1)
PLSRISK2	0.2380	0.7159	(1)
			F= 0.38
SET SCOMPLEX			P=0.69209(1)
COMPLEX1	-0.1760	0.9428	(1)
COMPLEX2	0.0501	0.8667	(1)
			F= 1.75
SET STECHDEF			P=0.19183(1)
TECHDEF1	-0.2844	0.8412	(1)
TECHDEF2	0.3291	0.9073	(1)
TECHDEF3	0.2124	0.7789	(1)
			F= 0.10
SET SPLWBSL3			P=0.95870(1)
PLWBSL31	0.1105	0.7420	(1)
PLWBSL32	-0.0068	0.8978	(1)
PLWBSL33	-0.0286	0.8247	(1)

```
STEP NO.    3
---------------
VARIABLE ENTERED   12 PLCONC

MULTIPLE R              0.7602
MULTIPLE R-SQUARE       0.5779
ADJUSTED R-SQUARE       0.4935

STD. ERROR OF EST.     58.2263

ANALYSIS OF VARIANCE
                     SUM OF SQUARES     DF    MEAN SQUARE      F RATIO
         REGRESSION  92830.211           4   23207.55            6.85
         RESIDUAL    67806.000          20   3390.300

       VARIABLES IN EQUATION                   VARIABLES NOT IN EQUATION
-----------------------------------------    ---------------------------------
                    STD.ERR        F AND P               PARTIAL          F AND P
VARIABLE   COEFF.   OF COEFF  TOL.  REMOVE(L) VARIABLE  CORR.    TOL.  ENTER(L)
-----------------------------------------    ---------------------------------
(CONSTANT -30.6792)
NOECPS      2.0884   0.5877 0.7826   12.63(1) UCOSTCD -0.1589 0.5742     0.49(1)
PLCONC     52.2856  26.8449 0.7637    3.79(1) CTYPE    0.0646 0.4921     0.08(1)
                                   F=    9.53
SET SPLTRISK                       P=0.00124(1)
PLTRISK1 138.7444   35.566 0.7977        (1) D_DP     0.1815 0.5242(0.431)(1)
PLTRISK2  -6.5672  25.7688 0.8182        (1)
                                              PRODOPT  0.1793 0.7889     0.63(1)
                                              PLPRESCH-0.3756 0.8846     3.12(1)
                                              PLAGGR   0.0236 0.9409     0.01(1)
                                              PLSRISK  0.0639 0.7686     0.08(0)
                                              PLTRISK -0.0002 0.0000     0.00(0)
                                              COMPLEX -0.2347 0.6358     1.11(0)
                                              PAGESSOW-0.1820 0.8612     0.65(1)
                                              NODIDS  -0.1666 0.7884     0.54(1)
                                              PLWBSDEV-0.0678 0.2747     0.09(1)
                                              PLWBSL3  0.0324 0.7432     0.02(0)
                                              PLDRRFP -0.2365 0.7644     1.13(1)
                                              TECHDEFN 0.2870 0.7528     1.71(0)
                                              SOWDWBS  0.1993 0.5944     0.79(1)
                                              SOWCSSR  0.1658 0.6282     0.54(1)
                                              SOWSDISP 0.0791 0.4236     0.12(1)
                                              SOWRCWP -0.1136 0.9366     0.25(1)
                                              SOWRCBP -0.0675 0.9324     0.09(1)
                                              SOWFRSI -0.1222 0.7978     0.29(1)
                                              NOPMDIDS 0.2569 0.7746     1.34(1)
                                              NOEVCRIT-0.0835 0.8038     0.13(1)
                                              EVSDISP  0.0469 0.7663     0.04(1)
                                              EVRCWP  -0.3117 0.7259     2.04(1)
                                              EVRCBP  -0.1895 0.8592     0.71(1)
                                                                  F=    2.80
                                              SET SPLSRISK        P=0.08709(1)
                                              PLSRISK1-0.4806 0.8189         (1)
                                              PLSRISK2 0.2293 0.7123         (1)
                                                                  F=    1.27
                                              SET SCOMPLEX        P=0.30578(1)
                                              COMPLEX1-0.2394 0.9323         (1)
                                              COMPLEX2-0.0247 0.8383         (1)
                                                                  F=    1.03
                                              SET STECHDEF        P=0.40274(1)
                                              TECHDEF1-0.2394 0.8167         (1)
                                              TECHDEF2 0.3023 0.8904         (1)
                                              TECHDEF3 0.1084 0.7115         (1)
                                                                  F=    0.15
                                              SET SPLWBSL3        P=0.92588(1)
                                              PLWBSL31-0.0126 0.6732         (1)
                                              PLWBSL32-0.0802 0.8735         (1)
                                              PLWBSL33-0.0122 0.8231         (1)
```

STEP NO. 4

VARIABLE ENTERED SET SPLSRISK
34 PLSRISK1
35 PLSRISK2

MULTIPLE R	0.8235
MULTIPLE R-SQUARE	0.6782
ADJUSTED R-SQUARE	0.5709
STD. ERROR OF EST.	53.5928

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	108936.75	6	18156.13	6.32
RESIDUAL	51699.457	18	2872.192	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	-16.9594)			
NOECPS	1.9756	0.5437	0.7747	13.21(1)
PLCONC	60.7526	25.2687	0.7302	5.78(1)
			F=	2.80
SET SPLSRISK				P=0.08709(1)
PLSRISK1	-80.3200	38.437	0.7364	(1)
PLSRISK2	10.6097	26.9803	0.6405	(1)
			F=	12.88
SET SPLTRISK				P=0.00034(1)
PLTRISK1	143.1269	32.805	0.7943	(1)
PLTRISK2	-29.9876	27.2668	0.6191	(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
UCOSTCD	-0.0959	0.5475	0.16(1)
CTYPE	-0.0341	0.4646	0.02(1)
D_DP	-0.0263	0.4338(0.915)	(1)
PRODOPT	-0.0232	0.6351(0.925)	(1)
PLPRESCH	-0.2944	0.8240	1.61(1)
PLAGGR	-0.1336	0.8069	0.31(1)
PLSRISK	0.0001	0.0000	0.00(0)
PLTRISK	-0.0003	0.0000	0.00(0)
COMPLEX	-0.0873	0.5109	0.13(0)
PAGESSOW	-0.2161	0.8442	0.83(1)
NODIDS	-0.2768	0.6500	1.41(1)
PLWBSDEV	0.1227	0.1772	0.26(1)
PLWBSL3	0.1326	0.6139	0.30(0)
PLDRRFP	-0.1619	0.5610	0.46(1)
TECHDEFN	0.4015	0.7209	3.27(0)
SOWDWBS	-0.1018	0.3379	0.18(1)
SOWCSSR	0.0548	0.5898	0.05(1)
SOWSDISP	0.1152	0.4133	0.23(1)
SOWRCWP	0.0559	0.8266	0.05(1)
SOWRCBP	0.1706	0.7435	0.51(1)
SOWFRSI	-0.1635	0.7147	0.47(1)
NOPMDIDS	0.2277	0.7448	0.93(1)
NOEVCRIT	0.0682	0.7140	0.08(1)
EVSDISP	0.1153	0.7012	0.23(1)
EVRCWP	-0.2303	0.6743	0.95(1)
EVRCBP	-0.1056	0.7428	0.19(1)
		F=	0.30
SET SCOMPLEX			P=0.74178(1)
COMPLEX1	-0.1496	0.8823	(1)
COMPLEX2	0.0332	0.7969	(1)
		F=	1.13
SET STECHDEF			P=0.37003(1)
TECHDEF1	-0.2518	0.6973	(1)
TECHDEF2	0.2302	0.7997	(1)
TECHDEF3	0.2617	0.6543	(1)
		F=	0.18
SET SPLWBSL3			P=0.90559(1)
PLWBSL31	-0.1398	0.6403	(1)
PLWBSL32	0.1662	0.6789	(1)
PLWBSL33	-0.0505	0.7945	(1)

***** P-VALUES(0.100, 0.110) OR TOLERANCE INSUFFICIENT FOR FURTHER STEPPING

SUMMARY TABLE

STEP NO.	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	MULTIPLE RSQ	CHANGE IN RSQ	P-VALUE ENTER	P-VALUE REMOVE	NO.OF VAR. INCLUDED
1	SET SPLTRISK 36 PLTRISK1 37 PLTRISK2		0.5557	0.3088	0.3088	0.02		2
2	9 NOECPS		0.7056	0.4978	0.1891	0.01		3
3	12 PLCONC		0.7602	0.5779	0.0801	0.07		4
4	SET SPLSRISK 34 PLSRISK1 35 PLSRISK2		0.8235	0.6782	0.1003	0.09		6

SERIAL CORRELATION -0.1016
DURBIN-WATSON STATISTIC 2.1809 BASED ON 25 CASES

```
CASE PLOTS           RESIDUALS             LEVERAGE             INFLUENCE

CASE  LABEL           STRESID              -LOG P(H)             MODCOOK
NO.          -4   -2    0    2    4  0    1    2    3    4  0  1  2  3  4  5  6
              +....+....+....+....+  +....+....+....+....+  +..+..+..+..+..+..+
    1         .        **         .  ****                .  ***               .
    2-        .         M         .  M                   .  M                 .
    3         .      ****         .  **                  .  ***               .
    4-        .         M         .  M                   .  M                 .
    5         .         ****      .  *                   .  ***               .
    6         .   *******         .  ***********         .  ***************   .
    7         .        **         .  ***                 .  **                .
    8         .         ***       .  ******              .  ****              .
    9         .       ***         .  ***                 .  ***               .
   10-        .         M         .  M                   .  M                 .
   11         .         *         .  **                  .  *                 .
   12         .         ***       .  ***                 .  ***               .
   13         .         *         .  ***                 .  *                 .
   14         .         ****      .  ******              .  *****             .
   15         .         ***       .  **                  .  ***               .
   16         .         *         .  **                  .  *                 .
   17         .        **         .  *                   .  **                .
   18-        .         M         .  M                   .  M                 .
   19         .        **         .  *****               .  **                .
   20         .         *         .  ****                .  *                 .
   21         .         ***       .  ********            .  *****             .
   22         .         **        .  ****                .  ***               .
   23         .        **         .  *                   .  **                .
   24         .         ********* .  ****                .  ***************   .
   25         .        **         .  ********            .  **                .
   26         .    ******         .  ****                .  ********          .
   27         .        **         .  *                   .  **                .
   28         .        **         .  **                  .  **                .
   29         .         **        .  ***                 .  **                .
              +....+....+....+....+  +....+....+....+....+  +..+..+..+..+..+..+
             -4   -2    0    2    4  0    1    2    3    4  0  1  2  3  4  5  6
```

P(H) IS AN APPROXIMATE TAIL PROBABILITY FOR HATDIAG.

```
       .+......+......+......+......+......+......+......+......+.....
       -                                                             -
   .9  +          1                                                  +
       -                                                             -
       -                                                             -
       -                                                             -
       -                                                             -
       -                                                             -
C      -                                                             -
O      -    1                                                        -
O  .6  +                                                             +
K      -                                                             -
       -                                                             -
       -                                                             -
       -                                                             -
       -                                                             -
       -                                                             -
       -                                                             -
5  .3  +                                                             +
9      - 1                                                           -
       -                                                             -
       -                                                             -
       -                                                             -
       -1             1                                              -
       -                                        1                    -
       -1   1              1  1     1        1                       -
   0.  + 1     1  1 1   11      11  1              1 1  1           1+
       .+......+......+......+......+......+......+......+......+.....
               3.           9.           15           21
        0.           6.           12           18           24

                                UCOSTCD     5
```

EXTREME CASES --

CASE NO.	COOK	CASE NO.	UCOSTCD
6	0.8985	17	25.7384
24	0.6218	25	20.7504

EXTREME CASES IN THE PLOTS --

STATISTICS	EXTREME VALUE	NO.	CASE LABEL	WEIGHT	2 SCHEDPER	9 NOECPS
COOK	0.8985	6		1.0000	13.0000	25.0000
COOK	0.6218	24		1.0000	334.0000	35.0000

CASE NO.	LABEL	12 PLCONC	34 PLSRISK1	35 PLSRISK2	36 PLTRISK1
6		0.0000	1.0000	0.0000	1.0000
24		0.0000	0.0000	0.0000	1.0000

CASE NO.	LABEL	37 PLTRISK2
6		0.0000
24		0.0000

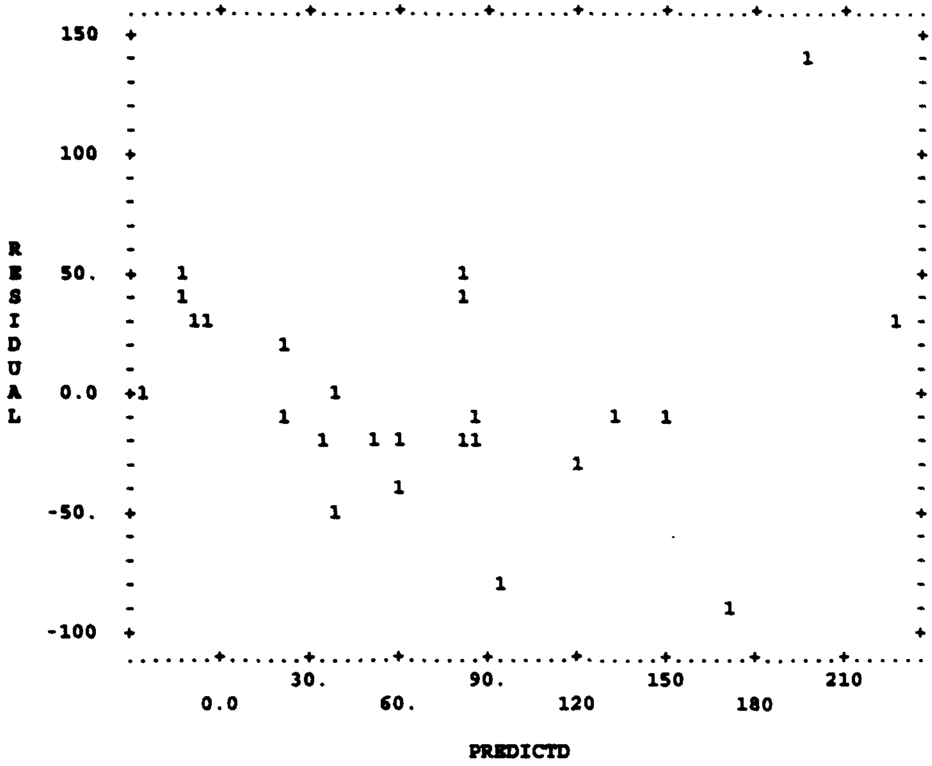
LIST OF PREDICTED VALUES, RESIDUALS, AND VARIABLES
- CASES WITH MISSING VALUES ARE MARKED WITH A MINUS SIGN BETWEEN THE CASE NUMBER AND CASE LABEL.
- ASTERISKS (UP TO 3) TO THE RIGHT OF A RESIDUAL INDICATE THAT THE RESIDUAL DEVIATES FROM THE MEAN BY MORE THAN THAT NUMBER OF STANDARD DEVIATIONS.
- MISSING VALUES AND VALUES OUT OF RANGE ARE DENOTED BY VALUES GREATER THAN OR EQUAL TO 2.12676E+37 IN ABSOLUTE VALUE.

CASE NO.	LABEL	PREDICTED	RESIDUAL	WEIGHT	2 SCHEDPER	48 WRESID	49 STRESID
1		120.8429	-26.0429	1.000	94.8000	-26.0429	-0.5851
2-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
3		40.2203	-50.2203	1.000	-10.0000	-50.2203	-1.0129
4-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
5		79.7330	52.1670	1.000	131.9000	52.1670	1.0479
6		95.2383	-82.2383*	1.000	13.0000	-82.2383	-2.2807
7		33.1629	-19.7629	1.000	13.4000	-19.7629	-0.4365
8		-10.8436	35.0436	1.000	24.2000	35.0436	0.8351
9		59.5983	-35.7983	1.000	23.8000	-35.7983	-0.7887
10-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
11		83.7979	-9.3979	1.000	74.4000	-9.3979	-0.1967
12		80.5781	36.1219	1.000	116.7000	36.1219	0.7833
13		-26.4592	-1.4408	1.000	-27.9000	-1.4408	-0.0313
14		-14.7948	47.1948	1.000	32.4000	47.1948	1.1247
15		-4.7273	34.7273	1.000	30.0000	34.7273	0.7239
16		40.2203	-4.9203	1.000	35.3000	-4.9203	-0.0992
17		50.0985	-20.5985	1.000	29.5000	-20.5985	-0.4132
18-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
19		131.5914	-12.2914	1.000	119.3000	-12.2914	-0.2853
20		21.3091	-5.3091	1.000	16.0000	-5.3091	-0.1194
21		229.1399	33.8601	1.000	263.0000	33.8601	0.8756
22		-7.4344	25.7344	1.000	18.3000	25.7344	0.5835
23		61.9523	-15.1523	1.000	46.8000	-15.1523	-0.3031
24		195.3147	138.6853**	1.000	334.0000	138.6853	3.1147
25		151.3477	-11.6477	1.000	139.7000	-11.6477	-0.2950
26		171.6071	-90.3071*	1.000	81.3000	-90.3071	-2.0389
27		79.7330	-15.5330	1.000	64.2000	-15.5330	-0.3120
28		87.7491	-22.0491	1.000	65.7000	-22.0491	-0.4631
29		20.2245	19.1755	1.000	39.4000	19.1755	0.4221

CASE NO.	LABEL	50 DELRESID	51 DSTRESID	52 AP1	53 Q1	54 U	55 HATDIAG
1		-37.7564	-0.5741	0.9810	983.2856	0.3280	0.3102
2		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
3		-58.6773	-1.0137	0.9430	2946.7939	1.2196	0.1441
4		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
5		60.4626	1.0510	0.9390	3154.1523	1.3160	0.1372
6		-181.6709	-2.6286	0.7110	14940.3145	3.2704	0.5473
7		-27.6913	-0.4265	0.9894	547.2610	0.1889	0.2863
8		57.1594	0.8278	0.9613	2003.0673	0.5938	0.3869
9		-49.9126	-0.7801	0.9654	1786.7860	0.6197	0.2828
10		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
11		-11.8282	-0.1914	0.9978	111.1596	0.0427	0.2055
12		48.7869	0.7745	0.9659	1762.2755	0.6310	0.2596
13		-1.9589	-0.0305	0.9999	2.8224	0.0010	0.2645
14		76.9839	1.1336	0.9297	3633.2412	1.0771	0.3870
15		43.3368	0.7139	0.9709	1504.9689	0.5832	0.1987
16		-5.7489	-0.0965	0.9995	28.2863	0.0117	0.1441
17		-23.8044	-0.4035	0.9905	490.3345	0.2052	0.1347
18		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
19		-19.0164	-0.2779	0.9955	233.7377	0.0731	0.3536
20		-7.7113	-0.1161	0.9992	40.9401	0.0136	0.3115
21		65.0378	0.8697	0.9574	2202.1860	0.5544	0.4794
22		37.9994	0.5725	0.9811	977.8911	0.3202	0.3228
23		-17.4190	-0.2954	0.9949	263.9377	0.1110	0.1301
24		200.9108	4.4578**	0.4611	27863.3828	9.3007	0.3097
25		-21.4663	-0.2874	0.9952	250.0338	0.0656	0.4574
26		-132.2099	-2.2594	0.7691	11939.4844	3.9436	0.3169
27		-18.0030	-0.3041	0.9946	279.6400	0.1167	0.1372
28		-27.9378	-0.4528	0.9881	616.0039	0.2351	0.2108
29		26.6931	0.4123	0.9901	511.8537	0.1778	0.2816

CASE NO.	LABEL	56 RHAT	57 AP2	58 MAHAL	59 COOK	60 MODCOOK	61 DFFITS
1		0.4498	0.6898	6.4857	0.0220	0.6174	-0.3850
2		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
3		0.1684	0.8559	2.4991	0.0247	0.6670	-0.4160
4		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
5		0.1590	0.8628	2.3328	0.0249	0.6721	0.4191
6		1.2091	0.4527	12.1757	0.8985	4.6349	-2.8903
7		0.4012	0.7137	5.9115	0.0109	0.4332	-0.2701
8		0.6311	0.6131	8.3260	0.0629	1.0545	0.6576
9		0.3943	0.7172	5.8267	0.0350	0.7855	-0.4898
10		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
11		0.2586	0.7945	3.9712	0.0014	0.1561	-0.0973
12		0.3506	0.7404	5.2704	0.0307	0.7355	0.4586
13		0.3596	0.7355	5.3883	0.0001	0.0293	-0.0183
14		0.6312	0.6130	8.3269	0.1141	1.4442	0.9006
15		0.2479	0.8013	3.8080	0.0186	0.5700	0.3555
16		0.1684	0.8559	2.4991	0.0002	0.0635	-0.0396
17		0.1556	0.8653	2.2723	0.0038	0.2552	-0.1592
18		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37
19		0.5471	0.6464	7.5274	0.0064	0.3296	-0.2055
20		0.4525	0.6885	6.5164	0.0009	0.1252	-0.0781
21		0.9208	0.5206	10.5451	0.1009	1.3382	0.8345
22		0.4766	0.6772	6.7865	0.0232	0.6338	0.3952
23		0.1496	0.8699	2.1631	0.0020	0.1832	-0.1142
24		0.4487	0.6903	6.4732	0.6218	4.7883	2.9860
25		0.8430	0.5426	10.0175	0.0105	0.4232	-0.2639
26		0.4640	0.6831	6.6466	0.2755	2.4680	-1.5391
27		0.1590	0.8628	2.3328	0.0022	0.1944	-0.1213
28		0.2671	0.7892	4.0987	0.0082	0.3752	-0.2340
29		0.3920	0.7184	5.7991	0.0100	0.4140	0.2582

CASE NO.	LABEL	62 AP	63 STRES**2	64 AP2*PRED	65 XRESIDUL	66 YRESIDUL
1		0.6766	0.3423	83.3528	-0.4933	-31.2764
2		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	-31.2764
3		0.8071	1.0260	34.4234	0.0914	-49.2510
4		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	-49.2510
5		0.8102	1.0982	68.7935	0.1051	53.2821
6		0.3219	5.2017	43.1122	0.1194	-80.9717
7		0.7061	0.1905	23.6679	0.6142	-13.2467
8		0.5893	0.6974	-6.6480	-0.0590	34.4175
9		0.6924	0.6221	42.7450	-0.5146	-41.2576
10		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	-41.2576
11		0.7928	0.0387	66.5801	-0.3645	-13.2654
12		0.7152	0.6136	59.6602	0.6307	42.8130
13		0.7354	0.0010	-19.4604	0.2098	0.7852
14		0.5700	1.2650	-9.0699	-0.0604	46.5542
15		0.7780	0.5240	-3.7881	0.2174	37.0334
16		0.8554	0.0098	34.4234	0.0914	-3.9510
17		0.8571	0.1707	43.3513	0.0948	-19.5927
18		2.1268E+37	2.1268E+37	2.1268E+37	2.1268E+37	-19.5927
19		0.6434	0.0814	85.0553	0.2647	-9.4825
20		0.6879	0.0143	14.6710	0.6101	1.1634
21		0.4984	0.7667	119.2951	0.5406	39.5955
22		0.6644	0.3405	-5.0348	-0.7799	17.4600
23		0.8654	0.0919	53.8904	0.0989	-14.1028
24		0.3183	9.7011	134.8224	-0.3259	135.2280
25		0.5400	0.0871	82.1221	0.2716	-8.7660
26		0.5253	4.1569	117.2177	-0.3341	-93.8518
27		0.8581	0.0974	68.7935	0.1051	-14.4179
28		0.7798	0.2145	69.2536	-0.3632	-25.9021
29		0.7113	0.1782	14.5287	-0.7703	11.0031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-100
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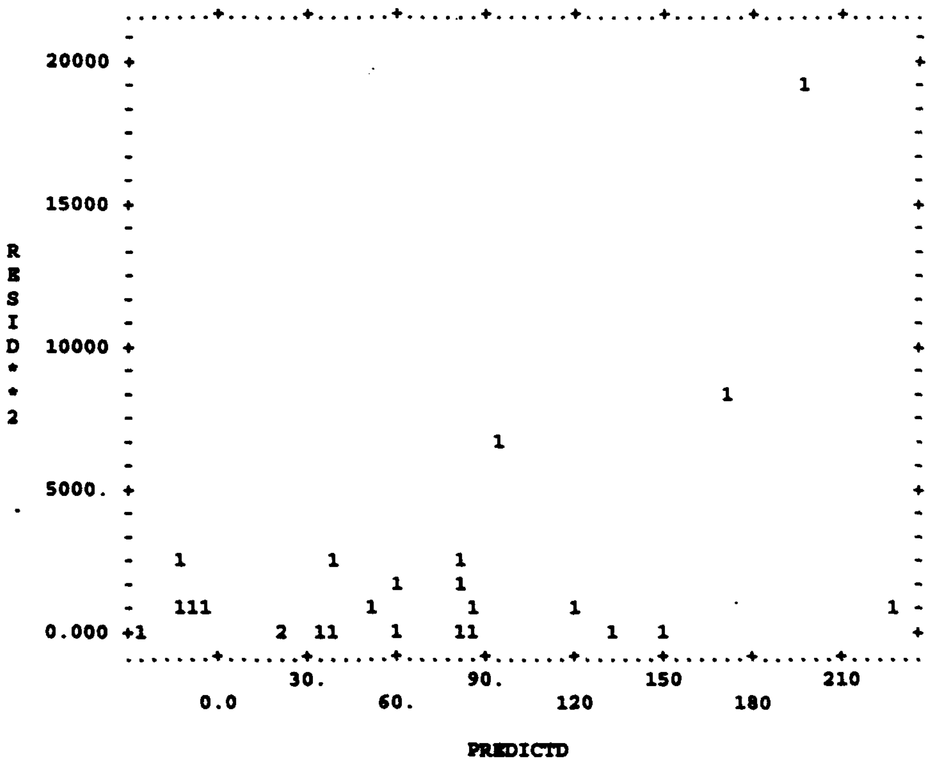
PREDICTD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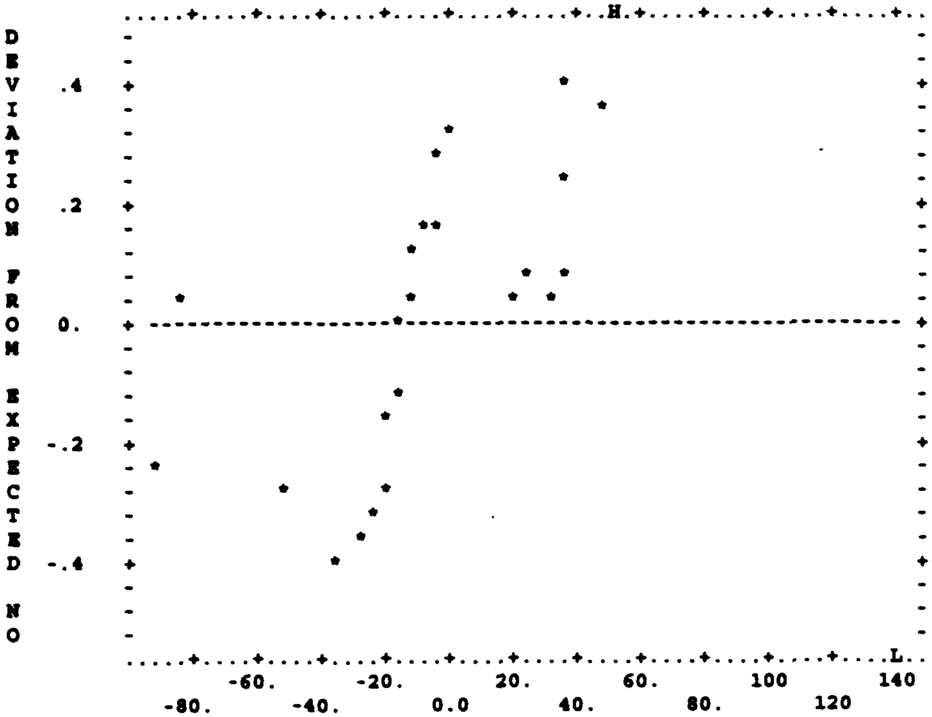
PREDICTD

DETRENDED NORMAL PROBABILITY PLOT OF UNWEIGHTED RESIDUALS



VALUES FROM NORMAL DISTRIBUTION WOULD LIE
ON THE LINE INDICATED BY THE SYMBOL - .

END OF INSTRUCTIONS

PROGRAM TERMINATED

Appendix I: BMDP 2R Stepwise Regression on SCHEDMOD, Full Variable Set, No Interaction Terms (Edited Data Output)

```
PROGRAM INSTRUCTIONS

/INPUT      FILE='THESIS.ASC'.
            VARIABLES=33.
            FORMAT=FREE.

/VARIABLE   NAMES=CNO, SCHEDPER, SCHEDMOD, SCHEDPLR, UCOSTCD,
            CTYPE, D_DP, PRODOPT, NOECPS, PLPRESCH, PLAGGR, PLCONC,
            PLSRISK, PLTRISK, COMPLEX, PAGESSOW, NODIDS, PLWBSDEV,
            PLWBSL3, PLWBSLL, PLDRRFP, TECHDEFN, SOWDWBS, SOWCSSR,
            SOWSDISP, SOWRCWP, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT,
            EVSDISP, EVRCWP, EVRCBP.

            USE=SCHEDMOD, UCOSTCD, CTYPE, D_DP, PRODOPT, NOECPS,
            PLPRESCH, PLAGGR, PLCONC, PLSRISK, PLTRISK, COMPLEX,
            PAGESSOW, NODIDS, PLWBSDEV, PLWBSL3, PLDRRFP, TECHDEFN,
            SOWDWBS, SOWCSSR, SOWSDISP, SOWRCWP, SOWRCBP, SOWFRSI,
            NOPMDIDS, NOEVCRIT, EVSDISP, EVRCWP, EVRCBP, PLSRISK1,
            PLSRISK2, PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, TECHDEF1,
            TECHDEF2, TECHDEF3, PLWBSL31, PLWBSL32, PLWBSL33.

/TRANSFORM  IF(PLSRISK EQ 1) THEN(PLSRISK1=0. PLSRISK2=0.).
            IF(PLSRISK EQ 2) THEN(PLSRISK1=1. PLSRISK2=0.).
            IF(PLSRISK EQ 3) THEN(PLSRISK1=0. PLSRISK2=1.).

            IF(PLTRISK EQ 1) THEN(PLTRISK1=0. PLTRISK2=0.).
            IF(PLTRISK EQ 2) THEN(PLTRISK1=1. PLTRISK2=0.).
            IF(PLTRISK EQ 3) THEN(PLTRISK1=0. PLTRISK2=1.).

            IF(COMPLEX EQ 1) THEN(COMPLEX1=0. COMPLEX2=0.).
            IF(COMPLEX EQ 2) THEN(COMPLEX1=1. COMPLEX2=0.).
            IF(COMPLEX EQ 3) THEN(COMPLEX1=0. COMPLEX2=1.).

            IF(TECHDEFN EQ 1) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=0.).
            IF(TECHDEFN EQ 2) THEN(TECHDEF1=1. TECHDEF2=0. TECHDEF3=0.).
            IF(TECHDEFN EQ 3) THEN(TECHDEF1=0. TECHDEF2=1. TECHDEF3=0.).
            IF(TECHDEFN EQ 4) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=1.).

            IF(PLWBSL3 EQ 0) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=0.).
            IF(PLWBSL3 GT 0 AND PLWBSL3 LE 10) THEN(PLWBSL31=1. PLWBSL32=0. PLWBSL33=0.).
            IF(PLWBSL3 GT 10 AND PLWBSL3 LE 16) THEN(PLWBSL31=0. PLWBSL32=1. PLWBSL33=0.).
            IF(PLWBSL3 GT 16) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=1.).

/GROUP      CODES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
            SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
            SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
            PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
            PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3)=1,0.

            NAMES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
            SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
            SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
            PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
            PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3)=YES, NO.

            CODES(PLSRISK, PLTRISK, COMPLEX)=1, 2, 3.
            NAMES(PLSRISK, PLTRISK)=LOW, LOW_MED, OTHER.
            NAMES(COMPLEX)=LOW, MED, HI.

            CODES(TECHDEFN)=1, 2, 3, 4.
            NAMES(TECHDEFN)=DRAFT_A, FULL_A, DRAFT_B, FULL_B.

            NAMES(PLWBSL3)='UNDER_2', '2_11', '11_17', 'OVER_17'.
```

```
/REGRESS    DEPEND=SCHEDMOD.
            SETNAMES=SPLSRISK, SPLTRISK, SCOMPLEX, STECHDEF, SPLWBSL3.
            SPLSRISK=PLSRISK1, PLSRISK2.
            SPLTRISK=PLTRISK1, PLTRISK2.
            SCOMPLEX=COMPLEX1, COMPLEX2.
            STECHDEF=TECHDEF1, TECHDEF2, TECHDEF3.
            SPLWBSL3=PLWBSL31, PLWBSL32, PLWBSL33.
            INPVAL=0.1, 0.1.
            OUTPVAL=0.11, 0.11.
            INDEPEND=CTYPE, PLAGGR, PLCONC, PAGESSOW, NODIDS, PLDRRFP,
            SOWCSSR, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVRCWP, EVRCBP,
            UCOSTCD, D_DP, PRODOPT, NOECPS, PLPRESCH, PLWBSDEV, SOWDWBS,
            SOWSDISP, SOWRCWP, EVSDISP, SPLSRISK, SPLTRISK, SCOMPLEX,
            STECHDEF, SPLWBSL3.
            TOL=0.1.

/PRINT      LEVEL=MINIMAL.
            NO DATA.
            NO CORRELATION.
            STEP.
            ANOVA.
            NO COVA.
            NO PART.
            NO COEFF.
            NO FRATIO.
            NO RREG.
            CASE=0.
            DIAGNOSTICS=DSTRESID, HATDIAG, COOK.
            LINESIZE=80.

/PLOT       RESIDUALS.
            DNORMAL.
            SIZE=60,25.
            CASEPLOTS.
            STEP=ALL.
            XVAR=UCOSTCD.
            YVAR=COOK.
            NO DATA.

/END

NUMBER OF CASES READ. . . . . . . . . . . . . . .        29
   CASES WITH DATA MISSING OR BEYOND LIMITS . .           6
      REMAINING NUMBER OF CASES . . . . . . . . .        23
```

DESCRIPTIVE STATISTICS OF DATA
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VARIABLE NO.	NAME	TOTAL FREQ.	MEAN	STANDARD DEV.	SKEW-NESS	KURTOSIS	SMALLEST VALUE	SMALLEST Z-SCR	LARGEST VALUE	LARGEST Z-SCR
3	SCHEDMOD	23	50.965	45.414	0.460	-0.842	-27.900	-1.74	139.70	1.95
5	UCOSTCD	23	9.7290	7.1877	0.473	-0.864	.18103	-1.33	25.738	2.23
6	CTYPE	23	.39130	.49901	0.417	-1.904	0.0000	-0.78	1.0000	1.22
7	D_DP	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
8	PRODOPT	23	.56522	.50687	-0.246	-2.022	0.0000	-1.12	1.0000	0.86
9	NOECPS	23	28.696	23.688	1.437	1.311	5.0000	-1.00	95.000	2.80
10	PLPRESCH	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
11	PLAGGR	23	.21739	.42174	1.282	-0.367	0.0000	-0.52	1.0000	1.86
12	PLCONC	23	.43478	.50687	0.246	-2.022	0.0000	-0.86	1.0000	1.12
13	PLSRISK	23	2.2609	.91539	-0.501	-1.663	1.0000	-1.38	3.0000	0.81
14	PLTRISK	23	2.1304	.96786	-0.245	-1.932	1.0000	-1.17	3.0000	0.90
15	COMPLEX	23	2.0435	.70571	-0.053	-1.080	1.0000	-1.48	3.0000	1.36
16	PAGESSON	23	40.783	17.789	0.885	-0.004	17.000	-1.34	87.000	2.60
17	NODIDS	23	61.478	20.956	-0.048	-1.028	25.000	-1.74	100.00	1.84
18	PLWBSDEV	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
19	PLWBSL3	23	13.957	16.291	1.992	3.866	0.0000	-0.86	70.000	3.44
21	PLDRRFP	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
22	TECHDEFN	23	2.6522	1.1912	-0.115	-1.601	1.0000	-1.39	4.0000	1.13
23	SOWDWBS	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
24	SOWCSSR	23	.43478	.50687	0.246	-2.022	0.0000	-0.86	1.0000	1.12
25	SOWSDISP	23	.78261	.42174	-1.282	-0.367	0.0000	-1.86	1.0000	0.52
26	SOWRCWP	23	.78261	.42174	-1.282	-0.367	0.0000	-1.86	1.0000	0.52
27	SOWRCBP	23	.65217	.48698	-0.598	-1.711	0.0000	-1.34	1.0000	0.71
28	SOWFRSI	23	.86957	.34435	-2.053	2.322	0.0000	-2.53	1.0000	0.38
29	NOPMDIDS	23	7.4783	2.3716	-0.003	-0.845	3.0000	-1.89	12.000	1.91
30	NOEVCRIT	23	4.0000	2.5226	1.398	1.273	1.0000	-1.19	11.000	2.77
31	EVSDISP	23	.56522	.50687	-0.246	-2.022	0.0000	-1.12	1.0000	0.86
32	EVRCWP	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
33	EVRCBP	23	.65217	.48698	-0.598	-1.711	0.0000	-1.34	1.0000	0.71
34	PLSRISK1	23	.13043	.34435	2.053	2.322	0.0000	-0.38	1.0000	2.53
35	PLSRISK2	23	.56522	.50687	-0.246	-2.022	0.0000	-1.12	1.0000	0.86
36	PLTRISK1	23	.08696	.28810	2.743	5.779	0.0000	-0.30	1.0000	3.17
37	PLTRISK2	23	.52174	.51075	-0.081	-2.078	0.0000	-1.02	1.0000	0.94
38	COMPLEX1	23	.52174	.51075	-0.081	-2.078	0.0000	-1.02	1.0000	0.94
39	COMPLEX2	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
40	TECHDEF1	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
41	TECHDEF2	23	.17391	.38755	1.610	0.624	0.0000	-0.45	1.0000	2.13
42	TECHDEF3	23	.34783	.48698	0.598	-1.711	0.0000	-0.71	1.0000	1.34
43	PLWBSL31	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
44	PLWBSL32	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
45	PLWBSL33	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65

*** N O T E *** KURTOSIS VALUES GREATER THAN ZERO INDICATE A DISTRIBUTION WITH HEAVIER TAILS THAN NORMAL DISTRIBUTION.

STEP NO. 0

STD. ERROR OF EST. 45.4135

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE
RESIDUAL	45372.512	22	2062.387

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	50.9652)			

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
UCOSTCD	0.3910	1.0000	3.79(1)
CTYPE	-0.1434	1.0000	0.44(1)
D_DP	-0.0963	1.0000	0.20(1)
PRODOPT	0.1146	1.0000	0.28(1)
NOECPS	0.7793	1.0000	32.48(1)
PLPRESCH	-0.4464	1.0000	5.23(1)
PLAGGR	0.0699	1.0000	0.10(1)
PLCONC	-0.0726	1.0000	0.11(1)
PLSRISK	0.0015	1.0000	0.00(0)
PLTRISK	0.0023	1.0000	0.00(0)
COMPLEX	0.3813	1.0000	3.57(0)
PAGESSOW	0.1534	1.0000	0.51(1)
NODIDS	-0.0515	1.0000	0.06(1)
PLWBSDEV	0.2070	1.0000	0.94(1)
PLWBSL3	0.0694	1.0000	0.10(0)
PLDRRFP	-0.2801	1.0000	1.79(1)
TECHDEFN	-0.0400	1.0000	0.03(0)
SOWDWBS	0.1732	1.0000	0.65(1)
SOWCSSR	-0.0114	1.0000	0.00(1)
SOWSDISP	-0.0559	1.0000	0.07(1)
SOWRCWP	-0.1112	1.0000	0.26(1)
SOWRCBP	-0.1317	1.0000	0.37(1)
SOWFRSI	0.0878	1.0000	0.16(1)
NOPMDIDS	0.2471	1.0000	1.37(1)
NOEVCRIT	-0.0548	1.0000	0.06(1)
EVSDISP	0.2785	1.0000	1.77(1)
EVRCWP	0.2021	1.0000	0.89(1)
EVRCBP	0.1497	1.0000	0.48(1)
		F=	0.63
SET SPLSRISK			P=0.54269(1)
PLSRISK1	-0.2421	1.0000	(1)
PLSRISK2	0.0836	1.0000	(1)
		F=	0.01
SET SPLTRISK			P=0.99298(1)
PLTRISK1	-0.0265	1.0000	(1)
PLTRISK2	0.0096	1.0000	(1)
		F=	1.75
SET SCOMPLEX			P=0.19921(1)
COMPLEX1	0.0349	1.0000	(1)
COMPLEX2	0.2798	1.0000	(1)
		F=	0.37
SET STECHDEF			P=0.77325(1)
TECHDEF1	0.2189	1.0000	(1)
TECHDEF2	-0.1355	1.0000	(1)
TECHDEF3	-0.0280	1.0000	(1)
		F=	2.16
SET SPLWBSL3			P=0.12686(1)
PLWBSL31	0.4951	1.0000	(1)
PLWBSL32	-0.1574	1.0000	(1)
PLWBSL33	-0.1123	1.0000	(1)

STEP NO. 1

VARIABLE ENTERED 9 NOECPS

MULTIPLE R 0.7793
MULTIPLE R-SQUARE 0.6073
ADJUSTED R-SQUARE 0.5886

STD. ERROR OF EST. 29.1276

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	27555.752	1	27555.75	32.48
RESIDUAL	17816.762	21	848.4172	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	8.0927)			
NOECPS	1.4940	0.2622	1.0000	32.48(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
UCOSTCD	0.1434	0.8434	0.42(1)
CTYPE	0.1577	0.9071	0.51(1)
D_DP	-0.0732	0.9958	0.11(1)
PRODOPT	0.2974	0.9917	1.94(1)
PLPRESCH	-0.7172	1.0000	21.18(1)
PLAGGR	-0.1911	0.9429	0.76(1)
PLCONC	0.4541	0.8204	5.20(1)
PLSRISK	0.0473	0.9987	0.04(0)
PLTRISK	-0.0455	0.9984	0.04(0)
COMPLEX	0.1589	0.8626	0.52(0)
PAGESSOW	0.2181	0.9995	1.00(1)
NODIDS	0.2806	0.9202	1.71(1)
PLWBSDEV	0.1302	0.9737	0.35(1)
PLWBSL3	0.0081	0.9932	0.00(0)
PLDRRFP	-0.0285	0.8859	0.02(1)
TECHDEFN	0.2843	0.9264	1.76(0)
SOWDWBS	0.0693	0.9720	0.10(1)
SOWCSSR	0.2917	0.9414	1.86(1)
SOWSDISP	-0.0298	0.9977	0.02(1)
SOWRCWP	0.0180	0.9753	0.01(1)
SOWRCBP	-0.1104	0.9935	0.25(1)
SOWFRSI	0.1464	1.0000	0.44(1)
NOPMDIDS	0.5661	0.9820	9.43(1)
NOEVCRIT	0.1805	0.9550	0.67(1)
EVSDISP	-0.0028	0.8708	0.00(1)
EVRCWP	0.4111	0.9950	4.07(1)
EVRCBP	0.3959	0.9847	3.72(1)
		F=	0.18
SET SPLSRISK			P=0.83783(1)
PLSRISK1	-0.1322	0.9573	(1)
PLSRISK2	0.0866	0.9986	(1)
		F=	0.03
SET SPLTRISK			P=0.96992(1)
PLTRISK1	0.0356	0.9961	(1)
PLTRISK2	-0.0532	0.9970	(1)
		F=	0.25
SET SCOMPLEX			P=0.78141(1)
COMPLEX1	0.0060	0.9984	(1)
COMPLEX2	0.1169	0.9279	(1)
		F=	1.34
SET STECHDEF			P=0.29357(1)
TECHDEF1	-0.0913	0.8777	(1)
TECHDEF2	-0.2546	0.9991	(1)
TECHDEF3	0.4096	0.8810	(1)
		F=	0.45
SET SPLWBSL3			P=0.71825(1)
PLWBSL31	0.2553	0.7954	(1)
PLWBSL32	-0.0274	0.9675	(1)
PLWBSL33	-0.0829	0.9940	(1)

STEP NO. 2

VARIABLE ENTERED 10 PLPRESCH

MULTIPLE R 0.8996
MULTIPLE R-SQUARE 0.8093
ADJUSTED R-SQUARE 0.7902

STD. ERROR OF EST. 20.8006

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	36719.246	2	18359.62	42.43
RESIDUAL	8653.2676	20	432.6634	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	51.4996)			
NOECPS	1.4974	0.1872	1.0000	63.97(1)
PLPRESCH	-52.6612	11.4429	1.0000	21.18(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
UCOSTCD	0.1037	0.8350	0.21(1)
CTYPE	0.3749	0.8891	3.11(1)
D_DP	-0.0930	0.9957	0.17(1)
PRODOPT	0.2541	0.9626	1.31(1)
PLAGGR	-0.0195	0.8849	0.01(1)
PLCONC	0.5861	0.8169	9.94(1)
PLSRISK	-0.0587	0.9837	0.07(0)
PLTRISK	-0.1253	0.9951	0.30(0)
COMPLEX	0.0751	0.8434	0.11(0)
PAGESSOW	0.2935	0.9992	1.79(1)
NODIDS	0.4335	0.9194	4.40(1)
PLWBSDEV	0.2835	0.9653	1.66(1)
PLWBSL3	0.0398	0.9924	0.03(0)
PLDRRFP	-0.2766	0.8421	1.57(1)
TECHDEFN	0.5865	0.9010	9.96(0)
SOWDWBS	0.1958	0.9637	0.76(1)
SOWCSSR	0.3561	0.9378	2.76(1)
SOWSDISP	-0.0052	0.9964	0.00(1)
SOWRCWP	-0.2325	0.9171	1.09(1)
SOWRCBP	-0.0068	0.9719	0.00(1)
SOWFRSI	0.0276	0.9684	0.01(1)
NOPMDIDS	0.4344	0.8225	4.42(1)
NOEVCRIT	0.1627	0.9465	0.52(1)
EVSDISP	0.0612	0.8673	0.07(1)
EVRCWP	0.3816	0.9508	3.24(1)
EVRCBP	0.2349	0.8727	1.11(1)
		F=	0.03
SET SPLSRISK		P=0.96886(1)	
PLSRISK1	-0.0020	0.9254	(1)
PLSRISK2	-0.0527	0.9693	(1)
		F=	0.70
SET SPLTRISK		P=0.50768(1)	
PLTRISK1	-0.2308	0.9257	(1)
PLTRISK2	-0.0559	0.9966	(1)
		F=	0.82
SET SCOMPLEX		P=0.45786(1)	
COMPLEX1	0.2741	0.9362	(1)
COMPLEX2	-0.1039	0.8649	(1)
		F=	6.24
SET STECHDEF		P=0.00472(1)	
TECHDEF1	-0.4224	0.8146	(1)
TECHDEF2	-0.1521	0.9548	(1)
TECHDEF3	0.6961	0.8718	(1)
		F=	0.59
SET SPLWBSL3		P=0.62746(1)	
PLWBSL31	0.0792	0.7321	(1)
PLWBSL32	0.2567	0.8928	(1)
PLWBSL33	-0.1070	0.9938	(1)

STEP NO. 3

VARIABLE ENTERED SET STECHDEF
40 TECHDEF1
41 TECHDEF2
42 TECHDEF3

MULTIPLE R	0.9535
MULTIPLE R-SQUARE	0.9092
ADJUSTED R-SQUARE	0.8825
STD. ERROR OF EST.	15.5654

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	41253.711	5	8250.742	34.05
RESIDUAL	4118.8022	17	242.2825	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	41.6281)			
NOECPS	1.7583	0.1544	0.8234	129.70(1)
PLPRESCH	-59.2192	9.0166	0.9019	43.14(1)
			F=	6.24
SET STECHDEF				P=0.00472(1)
TECHDEF1	-9.2498	9.761	0.5734	(1)
TECHDEF2	2.2527	10.5950	0.6532	(1)
TECHDEF3	28.2415	9.0678	0.5648	(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
UCOSTCD	-0.0839	0.5929	0.11(1)
CTYPE	0.2266	0.6820	0.87(1)
D_DP	0.2454	0.7067	(0.326)(1)
PRODOPT	0.0182	0.8286	0.01(1)
PLAGGR	0.1331	0.8556	0.29(1)
PLCONC	0.4746	0.6407	4.65(1)
PLSRISK	-0.2462	0.8748	1.03(0)
PLTRISK	-0.1859	0.9034	0.57(0)
COMPLEX	0.0087	0.5033	0.00(0)
PAGESSON	0.3031	0.6170	1.62(1)
NODIDS	0.5898	0.7595	8.53(1)
PLWBSDEV	0.1785	0.8390	0.53(1)
PLWBSL3	-0.0269	0.4872	0.01(0)
PLDRRFP	-0.3854	0.6919	2.79(1)
TECHDEFN	0.0000	1.0000	0.00(0)
SOWDWBS	0.1393	0.9357	0.32(1)
SOWCSSR	0.2562	0.8045	1.12(1)
SOWSDISP	0.1045	0.9798	0.18(1)
SOWRCWP	-0.3148	0.8317	1.76(1)
SOWRCBP	-0.1655	0.9409	0.45(1)
SOWFRSI	-0.0127	0.9143	0.00(1)
NOPMDIDS	0.3953	0.7474	2.96(1)
NOEVCRIT	-0.2452	0.7659	1.02(1)
EVSDISP	-0.1172	0.7511	0.22(1)
EVRCWP	0.1322	0.6416	0.28(1)
EVRCBP	0.0194	0.5137	0.01(1)
		F=	0.78
SET SPLSRISK			P=0.47795(1)
PLSRISK1	-0.1179	0.8121	(1)
PLSRISK2	-0.1781	0.9306	(1)
		F=	0.31
SET SPLTRISK			P=0.73726(1)
PLTRISK1	-0.0617	0.8326	(1)
PLTRISK2	-0.1594	0.9039	(1)
		F=	0.34
SET SCOMPLEX			P=0.71934(1)
COMPLEX1	0.2070	0.8806	(1)
COMPLEX2	-0.1361	0.6024	(1)
		F=	0.44
SET SPLWBSL3			P=0.72860(1)
PLWBSL31	0.2356	0.6517	(1)
PLWBSL32	0.0731	0.7322	(1)
PLWBSL33	-0.0798	0.3415	(1)

```
STEP NO.    4
--------------
VARIABLE ENTERED   17 NODIDS

MULTIPLE R              0.9699
MULTIPLE R-SQUARE       0.9408
ADJUSTED R-SQUARE       0.9186

STD. ERROR OF EST.      12.9567

ANALYSIS OF VARIANCE
                      SUM OF SQUARES      DF   MEAN SQUARE      F RATIO
           REGRESSION  42686.492           6   7114.416           42.38
           RESIDUAL    2686.0229          16   167.8764

       VARIABLES IN EQUATION                        VARIABLES NOT IN EQUATION
-------------------------------------------------  -------------------------------
                          STD.ERR          F AND P              PARTIAL        F AND P
VARIABLE    COEFF.     OF COEFF  TOL.  REMOVE(L)  VARIABLE   CORR.    TOL.   ENTER(L)
-------------------------------------------------  -------------------------------
(CONSTANT  16.2540)
NOECPS       1.8609    0.1332 0.7661   195.10(1) UCOSTCD -0.1718 0.5879      0.46(1)
PLPRESCH   -58.1240    7.5148 0.8996    59.82(1) CTYPE    0.1882 0.6707      0.55(1)
NODIDS       0.4419    0.1513 0.7595     8.53(1) D_DP     0.1978 0.6912      0.61(1)
                                       F=    8.62
SET STECHDEF                           P=0.00124(1)
TECHDEF1   -14.2837     8.306 0.5488         (1) PRODOPT -0.0364 0.8232(0.890)(1)
TECHDEF2    -9.3812    9.6767 0.5426         (1)
TECHDEF3    21.6174    7.8813 0.5180         (1)
                                                 PLAGGR  -0.1726 0.6913      0.46(1)
                                                 PLCONC   0.3656 0.5698      2.31(1)
                                                 PLSRISK  0.0122 0.7112      0.00(0)
                                                 PLTRISK -0.1171 0.8811      0.21(0)
                                                 COMPLEX -0.0109 0.5028      0.00(0)
                                                 PAGESSOW 0.3799 0.6170      2.53(1)
                                                 PLWBSDEV 0.2730 0.8349      1.21(1)
                                                 PLWBSL3  0.0011 0.4861      0.00(0)
                                                 PLDRRFP -0.3549 0.6707      2.16(1)
                                                 TECHDEFN 0.0000 1.0000      0.00(0)
                                                 SOWDWBS  0.2813 0.9161      1.29(1)
                                                 SOWCSSR  0.3026 0.8042      1.51(1)
                                                 SOWSDISP 0.0940 0.9775      0.13(1)
                                                 SOWRCWP -0.3272 0.8254      1.80(1)
                                                 SOWRCBP -0.2514 0.9371      1.01(1)
                                                 SOWFRSI  0.0155 0.9126      0.00(1)
                                                 NOPMDIDS 0.2685 0.6698      1.17(1)
                                                 NOEVCRIT-0.1980 0.7492      0.61(1)
                                                 EVSDISP -0.0069 0.7241      0.00(1)
                                                 EVRCWP   0.1660 0.6416      0.43(1)
                                                 EVRCBP   0.0238 0.5137      0.01(1)
                                                                     F=    0.03
                                                 SET SPLSRISK        P=0.97504(1)
                                                 PLSRISK1-0.0596 0.8007          (1)
                                                 PLSRISK2 0.0302 0.8225          (1)
                                                                     F=    0.41
                                                 SET SPLTRISK        P=0.67278(1)
                                                 PLTRISK1-0.1994 0.8101          (1)
                                                 PLTRISK2-0.0574 0.8702          (1)
                                                                     F=    0.61
                                                 SET SCOMPLEX        P=0.55900(1)
                                                 COMPLEX1 0.2822 0.8795          (1)
                                                 COMPLEX2-0.2021 0.6012          (1)
                                                                     F=    0.54
                                                 SET SPLWBSL3        P=0.66165(1)
                                                 PLWBSL31 0.3234 0.6505          (1)
                                                 PLWBSL32-0.0630 0.7005          (1)
                                                 PLWBSL33-0.0525 0.3402          (1)

***** P-VALUES( 0.100, 0.110) OR TOLERANCE INSUFFICIENT FOR FURTHER STEPPING
```

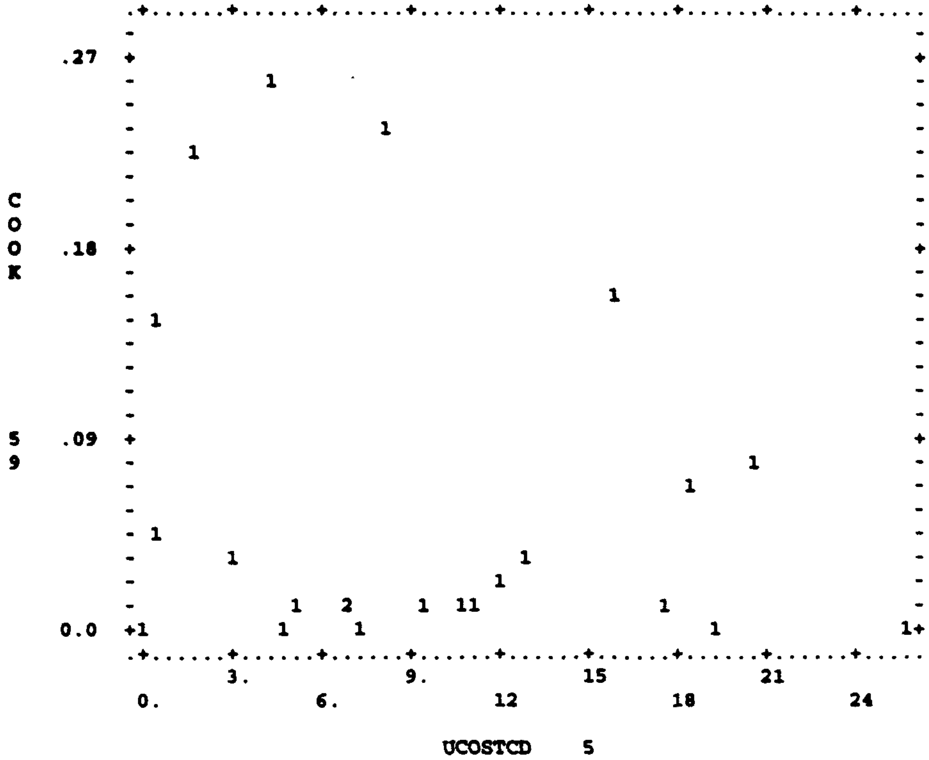
SUMMARY TABLE

STEP NO.	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	RSQ	CHANGE IN RSQ	P-VALUE ENTER	P-VALUE REMOVE	NO.OF VAR. INCLUDED
1	9 NOECPS		0.7793	0.6073	0.6073	0.00		1
2	10 PLPRESCH		0.8996	0.8093	0.2020	0.00		2
3	SET STECHDEF 40 TECHDEF1 41 TECHDEF2 42 TECHDEF3		0.9535	0.9092	0.0999	0.00		5
4	17 NODIDS		0.9699	0.9408	0.0316	0.01		6

SERIAL CORRELATION -0.3805
DURBIN-WATSON STATISTIC 2.7150 BASED ON 23 CASES

```
CASE PLOTS           RESIDUALS              LEVERAGE              INFLUENCE

CASE  LABEL           STRESID              -LOG P(H)               MODCOOK
NO.          -4   -2   0    2    4 0    1    2    3    4 0  1  2  3  4  5  6
             +....+....+....+....+ +....+....+....+....+ +..+..+..+..+..+..+
   1         .         ***       . **                  . ***               .
   2-        .         M         . M                   . M                 .
   3         .     *****         . ****                . *******           .
   4-        .         M         . M                   . M                 .
   5         .         **        . *******             . **                .
   6         .        **         . **                  . **                .
   7         .         **        . ***                 . **                .
   8         .       ***         . *                   . **                .
   9         .         ******    . ****                . *******           .
  10-        .         M         . M                   . M                 .
  11         .        **         . ****                . **                .
  12         .         *****     . ****                . ******            .
  13         .       ***         . *****               . ***               .
  14         .         ***       . **                  . **                .
  15         .         **        . ***                 . **                .
  16         .         **        . *                   . **                .
  17         .        **         . *                   . **                .
  18-        .         M         . M                   . M                 .
  19         .         *         . ******************* . **                .
  20         .      ****         . *                   . ***               .
  21-        .         M         . M                   . M                 .
  22         .        **         . ***                 . **                .
  23         .       ***         . ******              . ****              .
  24-        .         M         . M                   . M                 .
  25         .       ***         . ********            . ****              .
  26         .      ****         . *******             . ******            .
  27         .         *******   . **                  . *********         .
  28         .       ***         . ***                 . ***               .
  29         .        **         . **                  . **                .
             +....+....+....+....+ +....+....+....+....+ +..+..+..+..+..+..+
             -4   -2   0    2    4 0    1    2    3    4 0  1  2  3  4  5  6
```



EXTREME CASES --

CASE NO.	COOK	CASE NO.	UCOSTCD
27	0.2578	17	25.7384
3	0.2326	25	20.7504

EXTREME CASES IN THE PLOTS --

STATISTICS	EXTREME VALUE	NO.	CASE LABEL	WEIGHT	3 SCHEDMOD	9 N[illegible]ECPS
COOK	0.2578	27		1.0000	64.2000	28.0000
COOK	0.2326	3		1.0000	-10.0000	8.0000

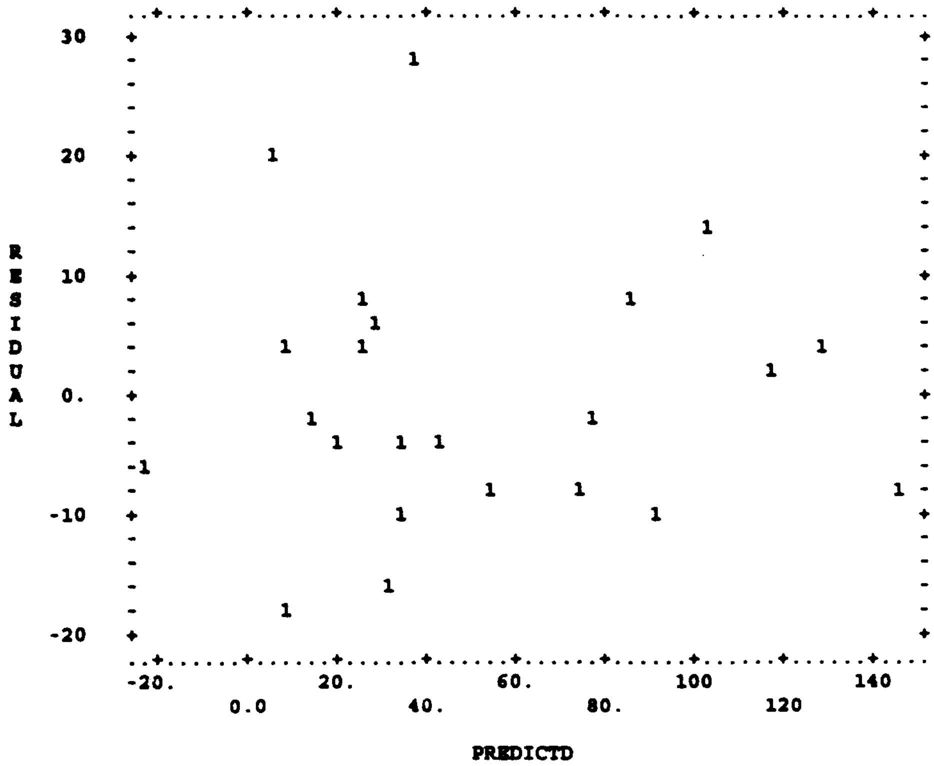
CASE NO.	LABEL	10 PLPRESCH	17 NODIDS	40 TECHDEF1	41 TECHDEF2
27		1.0000	58.0000	0.0000	0.0000
3		1.0000	100.0000	0.0000	1.0000

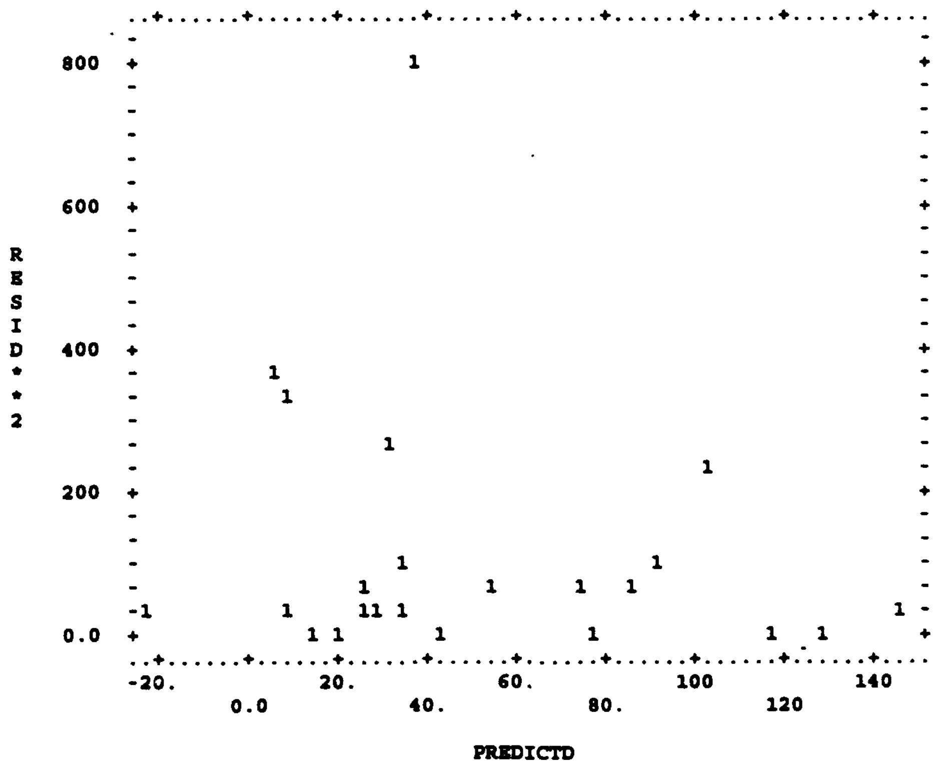
CASE NO.	LABEL	42 TECHDEF3
27		0.0000
3		0.0000

LIST OF PREDICTED VALUES, RESIDUALS, AND VARIABLES
- CASES WITH MISSING VALUES ARE MARKED WITH A MINUS SIGN BETWEEN THE CASE NUMBER AND CASE LABEL.
- ASTERISKS (UP TO 3) TO THE RIGHT OF A RESIDUAL INDICATE THAT THE RESIDUAL DEVIATES FROM THE MEAN BY MORE THAN THAT NUMBER OF STANDARD DEVIATIONS.
- MISSING VALUES AND VALUES OUT OF RANGE ARE DENOTED BY VALUES GREATER THAN OR EQUAL TO 2.12676E+37 IN ABSOLUTE VALUE.

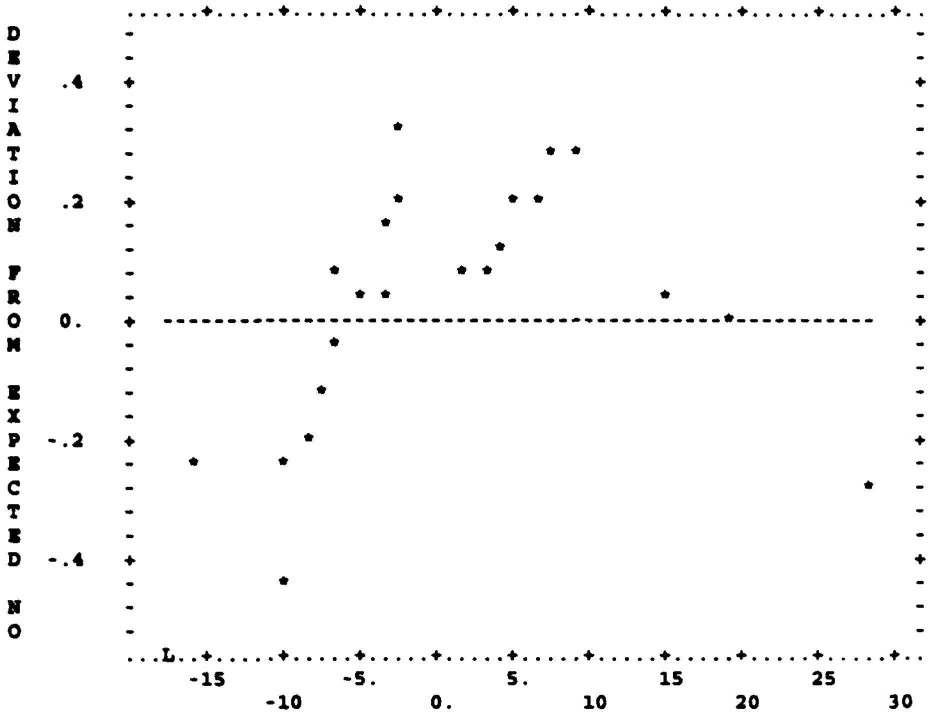
CASE NO.	LABEL	PREDICTED	RESIDUAL	WEIGHT	3 SCHEDMOD	51 DSTRESID	55 HATDIAG
1		85.9048	8.8952	1.000	94.8000	0.7587	0.2029
2-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
3		7.8228	-17.8228*	1.000	-10.0000	-1.8376	0.3564
4-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
5		128.8612	3.0388	1.000	131.9000	0.3126	0.4687
6		15.5555	-2.5555	1.000	13.0000	-0.2197	0.2416
7		8.4603	4.9397	1.000	13.4000	0.4322	0.2613
8		33.9862	-9.7862	1.000	24.2000	-0.8022	0.1333
9		4.2878	19.5122*	1.000	23.8000	1.9880	0.3203
10-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
11		76.7534	-2.3534	1.000	74.4000	-0.2174	0.3434
12		101.9670	14.7330*	1.000	116.7000	1.4717	0.3595
13		-21.5188	-6.3812	1.000	-27.9000	-0.6164	0.3864
14		24.5201	7.8799	1.000	32.4000	0.6502	0.1566
15		25.8710	4.1290	1.000	30.0000	0.3571	0.2472
16		28.6584	6.6416	1.000	35.3000	0.5442	0.1518
17		34.4280	-4.9280	1.000	29.5000	-0.3978	0.1337
18-		2.1268E+37	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
19		117.9730	1.3270	1.000	119.3000	0.1900	0.7268
20		31.8703	-15.8703*	1.000	16.0000	-1.3550	0.1402
21-		0.6167	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
22		21.3164	-3.0164	1.000	18.3000	-0.2630	0.2619
23		54.5605	-7.7605	1.000	46.8000	-0.7910	0.4400
24-		94.5399	2.127E+37***	1.000	2.1268E+37	2.1268E+37	2.1268E+37
25		146.7032	-7.0032	1.000	139.7000	-0.7439	0.4868
26		91.3113	-10.0113	1.000	81.3000	-1.0685	0.4725
27		35.8638	28.3362**	1.000	64.2000	3.0723	0.2260
28		74.4330	-8.7330	1.000	65.7000	-0.7778	0.2675
29		42.6106	-3.2106	1.000	39.4000	-0.2715	0.2152

CASE NO.	LABEL	59 COOK
1		0.0215
2		2.1268E+37
3		0.2326
4		2.1268E+37
5		0.0130
6		0.0023
7		0.0099
8		0.0145
9		0.2246
10		2.1268E+37
11		0.0038
12		0.1619
13		0.0356
14		0.0116
15		0.0063
16		0.0079
17		0.0037
18		2.1268E+37
19		0.0146
20		0.0406
21		2.1268E+37
22		0.0037
23		0.0719
24		2.1268E+37
25		0.0772
26		0.1448
27		0.2578
28		0.0324
29		0.0031


RESIDUAL
30
20
10
0.
-10
-20
-20.
0.0
20.
40.
60.
80.
100
120
140
PREDICTD


RESID**2
800
600
400
200
0.0
-20.
0.0
20.
40.
60.
80.
100
120
140
PREDICTD

DETRENDED NORMAL PROBABILITY PLOT OF UNWEIGHTED RESIDUALS



VALUES FROM NORMAL DISTRIBUTION WOULD LIE
ON THE LINE INDICATED BY THE SYMBOL - .

END OF INSTRUCTIONS

PROGRAM TERMINATED

Appendix J: BMDP 2R Stepwise Regression on SCHEDPER, Full Variable Set, Interaction Terms Included (Edited Data Output)

PROGRAM INSTRUCTIONS

```
/INPUT      FILE='THESIS.ASC'.
            VARIABLES=33.
            FORMAT=FREE.

/VARIABLE   NAMES=CHO, SCHEDPER, SCHEDMOD, SCHEDPLR, UCOSTCD, CTYPE,
            D_DP, PRODOPT, NOECPS, PLPRESCH, PLAGGR, PLCONC, PLSRISK,
            PLTRISK, COMPLEX, PAGESSOW, NODIDS, PLWBSDEV, PLWBSL3, PLWBSLL,
            PLDRRFP, TECHDEFN, SOWDWBS, SOWCSSR, SOWSDISP, SOWRCWP,
            SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVSDISP, EVRCWP, EVRCBP.

            USE=SCHEDPER, CTYPE, PLAGGR, PLCONC, PAGESSOW, NODIDS, PLDRRFP,
            SOWCSSR, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVRCWP, EVRCBP,
            UCOSTCD, D_DP, PRODOPT, NOECPS, PLPRESCH, PLWBSDEV, SOWDWBS,
            SOWSDISP, SOWRCWP, EVSDISP, PLSRISK, PLSRISK1, PLSRISK2, PLTRISK,
            PLTRISK1, PLTRISK2, COMPLEX, COMPLEX1, COMPLEX2, TECHDEFN, TECHDEF1,
            TECHDEF2, TECHDEF3, PLWBSL3, PLWBSL31, PLWBSL32, PLWBSL33, DUMMY1,
            DUMMY2, DUMMY3, DUMMY4, DUMMY5, DUMMY6, DUMMY7, DUMMY8, DUMMY9,
            DUMMY10, DUMMY11, DUMMY12, DUMMY22, DUMMY23, DUMMY24, DUMMY25,
            DUMMY26, DUMMY27, DUMMY28, DUMMY29, DUMMY30, DUMMY31, MPTRISK1,
            MPTRISK2, MPTRISK3, MPTRISK4, MNOECPS1, MNOECPS2, MNOECPS3,
            MNOECPS4, MNOECPS5, MNOECPS6, MPSRISK1, MPSRISK3, MPRESCH1,
            MPRESCH2, MPRESCH3, MPRESCH4, MPRESCH6, MPLAGGR, MSOWRC, MPLCONC3,
            MSOWSINT, MEVSINT.

/TRANSFORM  IF(PLSRISK EQ 1) THEN(PLSRISK1=0. PLSRISK2=0.).
            IF(PLSRISK EQ 2) THEN(PLSRISK1=1. PLSRISK2=0.).
            IF(PLSRISK EQ 3) THEN(PLSRISK1=0. PLSRISK2=1.).

            IF(PLTRISK EQ 1) THEN(PLTRISK1=0. PLTRISK2=0.).
            IF(PLTRISK EQ 2) THEN(PLTRISK1=1. PLTRISK2=0.).
            IF(PLTRISK EQ 3) THEN(PLTRISK1=0. PLTRISK2=1.).

            IF(COMPLEX EQ 1) THEN(COMPLEX1=0. COMPLEX2=0.).
            IF(COMPLEX EQ 2) THEN(COMPLEX1=1. COMPLEX2=0.).
            IF(COMPLEX EQ 3) THEN(COMPLEX1=0. COMPLEX2=1.).

            IF(TECHDEFN EQ 1) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=0.).
            IF(TECHDEFN EQ 2) THEN(TECHDEF1=1. TECHDEF2=0. TECHDEF3=0.).
            IF(TECHDEFN EQ 3) THEN(TECHDEF1=0. TECHDEF2=1. TECHDEF3=0.).
            IF(TECHDEFN EQ 4) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=1.).

            IF(PLWBSL3 EQ 0) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=0.).
            IF(PLWBSL3 GT 0 AND PLWBSL3 LE 10) THEN(PLWBSL31=1. PLWBSL32=0. PLWBSL33=0.).
            IF(PLWBSL3 GT 10 AND PLWBSL3 LE 16) THEN(PLWBSL31=0. PLWBSL32=1. PLWBSL33=0.).
            IF(PLWBSL3 GT 16) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=1.).

            MPTRISK1=PLTRISK*NOECPS.
            MPTRISK2=PLTRISK*PLWBSDEV.
            MPTRISK3=PLTRISK*SOWDWBS.
            MPTRISK4=PLTRISK*PLSRISK.
            MNOECPS1=NOECPS*PLCONC.
            MNOECPS2=NOECPS*PLDRRFP.
            MNOECPS3=NOECPS*EVSDISP.
            MNOECPS4=NOECPS*TECHDEFN.
            MNOECPS5=NOECPS*UCOSTCD.
            MNOECPS6=NOECPS*COMPLEX.
            MPSRISK1=PLSRISK*PLPRESCH.
            MPSRISK3=PLSRISK*COMPLEX.
            MPRESCH1=PLPRESCH*PLCONC.
            MPRESCH2=PLPRESCH*PLDRRFP.
            MPRESCH3=PLPRESCH*SOWRCWP.
            MPRESCH4=PLPRESCH*EVRCWP.
            MPLAGGR=PLAGGR*SOWSDISP.
            MSOWRC=SOWRCBP*SOWRCWP.
            MPLCONC3=PLCONC*PLSRISK.
```

```
         MPRESCH6=PLPRESCH*PLAGGR*PLCONC.
         MSOWSINT=SOWSDISP*SOWRCWP*SOWRCBP.
         MEVSINT=EVSDISP*EVRCWP*EVRCBP.

         IF(MPTRISK2 EQ 0) THEN(DUMMY1=0. DUMMY2=0. DUMMY3=0.).
         IF(MPTRISK2 EQ 1) THEN(DUMMY1=1. DUMMY2=0. DUMMY3=0.).
         IF(MPTRISK2 EQ 2) THEN(DUMMY1=0. DUMMY2=1. DUMMY3=0.).
         IF(MPTRISK2 EQ 3) THEN(DUMMY1=0. DUMMY2=0. DUMMY3=1.).

         IF(MPTRISK3 EQ 0) THEN(DUMMY4=0. DUMMY5=0. DUMMY6=0.).
         IF(MPTRISK3 EQ 1) THEN(DUMMY4=1. DUMMY5=0. DUMMY6=0.).
         IF(MPTRISK3 EQ 2) THEN(DUMMY4=0. DUMMY5=1. DUMMY6=0.).
         IF(MPTRISK3 EQ 3) THEN(DUMMY4=0. DUMMY5=0. DUMMY6=1.).

         IF(MPLCONC3 EQ 0) THEN(DUMMY7=0. DUMMY8=0. DUMMY9=0.).
         IF(MPLCONC3 EQ 1) THEN(DUMMY7=1. DUMMY8=0. DUMMY9=0.).
         IF(MPLCONC3 EQ 2) THEN(DUMMY7=0. DUMMY8=1. DUMMY9=0.).
         IF(MPLCONC3 EQ 3) THEN(DUMMY7=0. DUMMY8=0. DUMMY9=1.).

         IF(MPSRISK1 EQ 0) THEN(DUMMY10=0. DUMMY11=0. DUMMY12=0.).
         IF(MPSRISK1 EQ 1) THEN(DUMMY10=1. DUMMY11=0. DUMMY12=0.).
         IF(MPSRISK1 EQ 2) THEN(DUMMY10=0. DUMMY11=1. DUMMY12=0.).
         IF(MPSRISK1 EQ 3) THEN(DUMMY10=0. DUMMY11=0. DUMMY12=1.).

         IF(MPTRISK4 EQ 1) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=0. DUMMY25=0. DUMMY26=0.).
         IF(MPTRISK4 EQ 2) THEN(DUMMY22=1. DUMMY23=0. DUMMY24=0. DUMMY25=0. DUMMY26=0.).
         IF(MPTRISK4 EQ 3) THEN(DUMMY22=0. DUMMY23=1. DUMMY24=0. DUMMY25=0. DUMMY26=0.).
         IF(MPTRISK4 EQ 4) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=1. DUMMY25=0. DUMMY26=0.).
         IF(MPTRISK4 EQ 6) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=0. DUMMY25=1. DUMMY26=0.).
         IF(MPTRISK4 EQ 9) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=0. DUMMY25=0. DUMMY26=1.).

         IF(MPSRISK3 EQ 1) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=0. DUMMY30=0. DUMMY31=0.).
         IF(MPSRISK3 EQ 2) THEN(DUMMY27=1. DUMMY28=0. DUMMY29=0. DUMMY30=0. DUMMY31=0.).
         IF(MPSRISK3 EQ 3) THEN(DUMMY27=0. DUMMY28=1. DUMMY29=0. DUMMY30=0. DUMMY31=0.).
         IF(MPSRISK3 EQ 4) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=1. DUMMY30=0. DUMMY31=0.).
         IF(MPSRISK3 EQ 6) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=0. DUMMY30=1. DUMMY31=0.).
         IF(MPSRISK3 EQ 9) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=0. DUMMY30=0. DUMMY31=1.).

/GROUP   CODES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
         SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
         SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
         PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
         PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3, MPRESCH1, MPRESCH2,
         MPRESCH3, MPRESCH4, MPLAGGR, MSOWRC, MSOWSINT, MEVSINT,
         MPRESCH6, DUMMY1, DUMMY2, DUMMY3, DUMMY4, DUMMY5, DUMMY6,
         DUMMY7, DUMMY8, DUMMY9, DUMMY10, DUMMY11, DUMMY12, DUMMY22,
         DUMMY23, DUMMY24, DUMMY25, DUMMY26, DUMMY27, DUMMY28, DUMMY29,
         DUMMY30, DUMMY31)=1, 0.

         NAMES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
         SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
         SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
         PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
         PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3, MPRESCH1, MPRESCH2,
         MPRESCH3, MPRESCH4, MPLAGGR, MSOWRC, MSOWSINT, MEVSINT,
         MPRESCH6, DUMMY1, DUMMY2, DUMMY3, DUMMY4, DUMMY5, DUMMY6,
         DUMMY7, DUMMY8, DUMMY9, DUMMY10, DUMMY11, DUMMY12, DUMMY22,
         DUMMY23, DUMMY24, DUMMY25, DUMMY26, DUMMY27, DUMMY28, DUMMY29,
         DUMMY30, DUMMY31)=YES, NO.

         CODES(PLSRISK, PLTRISK, COMPLEX)=1, 2, 3.
         NAMES(PLSRISK, PLTRISK)=LOW, LOW_MED, OTHER.
         NAMES(COMPLEX)=LOW, MED, HI.

         CODES(TECHDEFN)=1, 2, 3, 4.
         NAMES(TECHDEFN)=DRAFT_A, FULL_A, DRAFT_B, FULL_B.

         CODES(PLWBSL3)=1, 2, 3, 4.
         NAMES(PLWBSL3)='UNDER_2', '2_11', '11_17', 'OVER_17'.
```

```
/REGRESS    DEPEND=SCHEDPER.
            SETNAMES=SPLSRISK, SPLTRISK, SCOMPLEX, STECHDEF, SPLWBSL3,
            SPTRISK2, SPTRISK3, SPLCONC3, SPSRISK1, SPTRISK4, SPSRISK3.
            SPLSRISK=PLSRISK1, PLSRISK2.
            SPLTRISK=PLTRISK1, PLTRISK2.
            SCOMPLEX=COMPLEX1, COMPLEX2.
            STECHDEF=TECHDEF1, TECHDEF2, TECHDEF3.
            SPLWBSL3=PLWBSL31, PLWBSL32, PLWBSL33.
            SPTRISK2=DUMMY1, DUMMY2, DUMMY3.
            SPTRISK3=DUMMY4, DUMMY5, DUMMY6.
            SPLCONC3=DUMMY7, DUMMY8, DUMMY9.
            SPSRISK1=DUMMY10, DUMMY11, DUMMY12.
            SPTRISK4=DUMMY22, DUMMY23, DUMMY24, DUMMY25, DUMMY26.
            SPSRISK3=DUMMY27, DUMMY28, DUMMY29, DUMMY30, DUMMY31.
            INPVAL=0.1, 0.1.
            OUTPVAL=0.11, 0.11.
            INDEPEND=CTYPE, PLAGGR, PLCONC, PAGESSOW, NODIDS, PLDRRFP,
            SOWCSSR, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVRCWP,
            EVRCBP, UCOSTCD, D_DP, PRODOPT, NOECPS, PLPRESCH, PLWBSDEV,
            SOWDWBS, SOWSDISP, SOWRCWP, EVSDISP, SPLSRISK, SPLTRISK,
            SCOMPLEX, STECHDEF, SPLWBSL3, SPTRISK2, SPTRISK3, SPLCONC3,
            SPSRISK1, SPTRISK4, SPSRISK3, MPTRISK1, MNOECPS1, MNOECPS2,
            MNOECPS3, MNOECPS4, MNOECPS5, MNOECPS6, MPRESCH1, MPRESCH2,
            MPRESCH3, MPRESCH4, MPLAGGR, MSOWRC, MPRESCH6, MSOWSINT, MEVSINT.
            TOL=0.1.

/PRINT      LEVEL=MINIMAL.
            NO DATA.
            NO CORR.
            STEP.
            ANOVA.
            NO COVA.
            NO PART.
            NO COEF.
            NO FRAT.
            NO RREG.
            CASE=0.
            LINESIZE=80.

/PLOT       RESIDUALS.
            DNORMAL.
            SIZE=60, 25.
            CASEPLOTS.
            XVAR=UCOSTCD.
            YVAR=COOK.
            STEP=ALL.
            NO DATA.

/END

NUMBER OF CASES READ. . . . . . . . . . . . . . .        29
   CASES WITH DATA MISSING OR BEYOND LIMITS . .           4
      REMAINING NUMBER OF CASES . . . . . . . .          25
```

DESCRIPTIVE STATISTICS OF DATA

VARIABLE NO.	NAME	TOTAL FREQ.	MEAN	STANDARD DEV.	SKEW-NESS	KURTOSIS	SMALLEST VALUE	SMALLEST Z-SCR	LARGEST VALUE	LARGEST Z-SCR
2	SCHEDPER	25	70.768	81.812	1.714	2.723	-27.900	-1.21	334.00	3.22
6	CTYPE	25	.36000	.48990	0.549	-1.765	0.0000	-0.73	1.0000	1.31
11	PLAGGR	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
12	PLCONC	25	.44000	.50662	0.227	-2.025	0.0000	-0.87	1.0000	1.11
16	PAGESSOW	25	38.920	18.216	0.885	0.027	16.000	-1.26	87.000	2.64
17	NODIDS	25	60.600	20.294	0.064	-0.930	25.000	-1.75	100.00	1.94
21	PLDRRFP	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
24	SOWCSSR	25	.40000	.50000	0.384	-1.925	0.0000	-0.80	1.0000	1.20
27	SOWRCBP	25	.64000	.48990	-0.549	-1.765	0.0000	-1.31	1.0000	0.73
28	SOWFRSI	25	.88000	.33166	-2.200	2.962	0.0000	-2.65	1.0000	0.36
29	NOPMDIDS	25	7.3600	2.3072	0.123	-0.763	3.0000	-1.89	12.000	2.01
30	NOEVCRIT	25	3.9600	2.4576	1.418	1.473	1.0000	-1.20	11.000	2.86
32	EVRCWP	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
33	EVRCBP	25	.64000	.48990	-0.549	-1.765	0.0000	-1.31	1.0000	0.73
5	UCOSTCD	25	9.0161	7.3135	0.548	-0.825	.10166	-1.22	25.738	2.29
7	D_DP	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
8	PRODOPT	25	.60000	.50000	-0.384	-1.925	0.0000	-1.20	1.0000	0.80
9	NOECPS	25	28.440	22.862	1.497	1.641	5.0000	-1.03	95.000	2.91
10	PLPRESCH	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
18	PLWBSDEV	25	.76000	.43589	-1.145	-0.712	0.0000	-1.74	1.0000	0.55
23	SOWDWBS	25	.80000	.40825	-1.411	-0.005	0.0000	-1.96	1.0000	0.49
25	SOWSDISP	25	.72000	.45826	-0.922	-1.193	0.0000	-1.57	1.0000	0.61
26	SOWRCWP	25	.76000	.43589	-1.145	-0.712	0.0000	-1.74	1.0000	0.55
31	EVSDISP	25	.56000	.50662	-0.227	-2.025	0.0000	-1.11	1.0000	0.87
13	PLSRISK	25	2.2400	.92556	-0.462	-1.714	1.0000	-1.34	3.0000	0.82
34	PLSRISK1	25	.12000	.33166	2.200	2.962	0.0000	-0.36	1.0000	2.65
35	PLSRISK2	25	.56000	.50662	-0.227	-2.025	0.0000	-1.11	1.0000	0.87
14	PLTRISK	25	2.1200	.92736	-0.224	-1.845	1.0000	-1.21	3.0000	0.95
36	PLTRISK1	25	.16000	.37417	1.745	1.092	0.0000	-0.43	1.0000	2.24
37	PLTRISK2	25	.48000	.50990	0.075	-2.072	0.0000	-0.94	1.0000	1.02
15	COMPLEX	25	1.9600	.73485	0.056	-1.222	1.0000	-1.31	3.0000	1.42
38	COMPLEX1	25	.48000	.50990	0.075	-2.072	0.0000	-0.94	1.0000	1.02
39	COMPLEX2	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
22	TECHDEFN	25	2.6800	1.1446	-0.187	-1.474	1.0000	-1.47	4.0000	1.15
40	TECHDEF1	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
41	TECHDEF2	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
42	TECHDEF3	25	.32000	.47610	0.726	-1.530	0.0000	-0.67	1.0000	1.43
19	PLWBSL3	25	12.840	16.069	2.057	4.263	0.0000	-0.80	70.000	3.56
43	PLWBSL31	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
44	PLWBSL32	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
45	PLWBSL33	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
68	DUMMY1	25	.28000	.45826	0.922	-1.193	0.0000	-0.61	1.0000	1.57
69	DUMMY2	25	0.0000	0.0000			0.0000		0.0000	
70	DUMMY3	25	.48000	.50990	0.075	-2.072	0.0000	-0.94	1.0000	1.02
71	DUMMY4	25	.32000	.47610	0.726	-1.530	0.0000	-0.67	1.0000	1.43
72	DUMMY5	25	.04000	.20000	4.416	18.235	0.0000	-0.20	1.0000	4.80
73	DUMMY6	25	.44000	.50662	0.227	-2.025	0.0000	-0.87	1.0000	1.11
74	DUMMY7	25	.08000	.27689	2.912	6.757	0.0000	-0.29	1.0000	3.32
75	DUMMY8	25	.08000	.27689	2.912	6.757	0.0000	-0.29	1.0000	3.32
76	DUMMY9	25	.28000	.45826	0.922	-1.193	0.0000	-0.61	1.0000	1.57
77	DUMMY10	25	.24000	.43589	1.145	-0.712	0.0000	-0.55	1.0000	1.74
78	DUMMY11	25	.12000	.33166	2.200	2.962	0.0000	-0.36	1.0000	2.65
79	DUMMY12	25	.44000	.50662	0.227	-2.025	0.0000	-0.87	1.0000	1.11
80	DUMMY22	25	.16000	.37417	1.745	1.092	0.0000	-0.43	1.0000	2.24
81	DUMMY23	25	.20000	.40825	1.411	-0.005	0.0000	-0.49	1.0000	1.96
82	DUMMY24	25	.04000	.20000	4.416	18.235	0.0000	-0.20	1.0000	4.80
83	DUMMY25	25	.04000	.20000	4.416	18.235	0.0000	-0.20	1.0000	4.80
84	DUMMY26	25	.40000	.50000	0.384	-1.925	0.0000	-0.80	1.0000	1.20
85	DUMMY27	25	.12000	.33166	2.200	2.962	0.0000	-0.36	1.0000	2.65
86	DUMMY28	25	.16000	.37417	1.745	1.092	0.0000	-0.43	1.0000	2.24
87	DUMMY29	25	.08000	.27689	2.912	6.757	0.0000	-0.29	1.0000	3.32
88	DUMMY30	25	.32000	.47610	0.726	-1.530	0.0000	-0.67	1.0000	1.43
89	DUMMY31	25	.16000	.37417	1.745	1.092	0.0000	-0.43	1.0000	2.24
46	MPTRISK1	25	61.120	67.633	2.299	4.581	8.0000	-0.79	285.00	3.31
47	MPTRISK2	25	1.7200	1.3077	-0.143	-1.815	0.0000	-1.32	3.0000	0.98

48	MPTRISK3	25	1.7200	1.2423	-0.111	-1.733	0.0000	-1.38	3.0000	1.03
49	MPTRISK4	25	5.0800	3.4269	0.167	-1.861	1.0000	-1.19	9.0000	1.14
50	MNOECPS1	25	7.6400	10.988	1.323	0.792	0.0000	-0.70	39.000	2.85
51	MNOECPS2	25	19.720	20.824	1.930	4.359	0.0000	-0.95	95.000	3.62
52	MNOECPS3	25	19.360	27.004	1.466	1.180	0.0000	-0.72	95.000	2.80
53	MNOECPS4	25	69.400	57.833	1.681	2.364	5.0000	-1.11	255.00	3.21
54	MNOECPS5	25	318.36	449.12	2.143	4.769	1.6266	-0.71	1971.3	3.68
55	MNOECPS6	25	61.440	64.520	1.888	3.421	5.0000	-0.87	285.00	3.46
56	MPSRISK1	25	1.8000	1.2247	-0.287	-1.618	0.0000	-1.47	3.0000	0.98
57	MPSRISK3	25	4.5600	2.7092	0.257	-1.230	1.0000	-1.31	9.0000	1.64
58	MPRESCH1	25	.36000	.48990	0.549	-1.765	0.0000	-0.73	1.0000	1.31
59	MPRESCH2	25	.64000	.48990	-0.549	-1.765	0.0000	-1.31	1.0000	0.73
60	MPRESCH3	25	.56000	.50662	-0.227	-2.025	0.0000	-1.11	1.0000	0.87
61	MPRESCH4	25	.64000	.48990	-0.549	-1.765	0.0000	-1.31	1.0000	0.73
65	MPRESCH6	25	.12000	.33166	2.200	2.962	0.0000	-0.36	1.0000	2.65
62	MPLAGGR	25	.20000	.40825	1.411	-0.005	0.0000	-0.49	1.0000	1.96
63	MSOWRC	25	.64000	.48990	-0.549	-1.765	0.0000	-1.31	1.0000	0.73
64	MPLCONC3	25	1.0800	1.3515	0.542	-1.614	0.0000	-0.80	3.0000	1.42
66	MSOWSINT	25	.44000	.50662	0.227	-2.025	0.0000	-0.87	1.0000	1.11
67	MEVSINT	25	.44000	.50662	0.227	-2.025	0.0000	-0.87	1.0000	1.11

*** N O T E *** KURTOSIS VALUES GREATER THAN ZERO INDICATE A DISTRIBUTION WITH HEAVIER TAILS THAN NORMAL DISTRIBUTION.

STEP NO. 0

STD. ERROR OF EST. 81.8118

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE
RESIDUAL	160636.20	24	6693.175

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	70.7680)			

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	-0.2596	1.0000	1.66(1)
PLAGGR	0.1434	1.0000	0.48(1)
PLCONC	-0.0428	1.0000	0.04(1)
PAGESSOW	-0.2173	1.0000	1.14(1)
NODIDS	-0.1517	1.0000	0.54(1)
PLDRRFP	-0.3649	1.0000	3.53(1)
SOWCSSR	-0.2076	1.0000	1.04(1)
SOWRCBP	-0.1018	1.0000	0.24(1)
SOWFRSI	0.1376	1.0000	0.44(1)
NOPMDIDS	-0.0194	1.0000	0.01(1)
NOEVCRIT	-0.0979	1.0000	0.22(1)
EVRCWP	-0.1319	1.0000	0.41(1)
EVRCBP	-0.0333	1.0000	0.03(1)
UCOSTCD	-0.0836	1.0000	0.16(1)
D_DP	-0.1893	1.0000	0.85(1)
PRODOPT	0.2608	1.0000	1.68(1)
NOECPS	0.3935	1.0000	4.21(1)
PLPRESCH	-0.4452	1.0000	5.69(1)
PLWBSDEV	-0.3460	1.0000	3.13(1)
SOWDWBS	-0.1459	1.0000	0.50(1)
SOWSDISP	-0.4224	1.0000	4.99(1)
SOWRCWP	-0.1637	1.0000	0.63(1)
EVSDISP	0.0762	1.0000	0.13(1)
PLSRISK	-0.1037	1.0000	0.25(0)
		F=	0.75
SET SPLSRISK			P=0.48413(1)
PLSRISK1	-0.2191	1.0000	(1)
PLSRISK2	-0.0230	1.0000	(1)
PLTRISK	-0.0314	1.0000	0.02(0)
		F=	4.91
SET SPLTRISK			P=0.01721(1)
PLTRISK1	0.5557	1.0000	(1)
PLTRISK2	-0.2324	1.0000	(1)
COMPLEX	-0.1431	1.0000	0.48(0)
		F=	0.77
SET SCOMPLEX			P=0.47461(1)
COMPLEX1	-0.2196	1.0000	(1)
COMPLEX2	0.0078	1.0000	(1)
TECHDEFN	0.0493	1.0000	0.06(0)
		F=	1.27
SET STECHDEF			P=0.31000(1)
TECHDEF1	-0.0241	1.0000	(1)
TECHDEF2	0.3783	1.0000	(1)
TECHDEF3	-0.1840	1.0000	(1)
PLWBSL3	-0.1657	1.0000	0.65(0)
		F=	1.10
SET SPLWBSL3			P=0.37055(1)
PLWBSL31	0.1207	1.0000	(1)
PLWBSL32	-0.2213	1.0000	(1)
PLWBSL33	-0.1977	1.0000	(1)
		F=	1.54
SET SPTRISK2			P=0.23715(1)
DUMMY1	-0.0704	1.0000	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.2324	1.0000	(1)

			F= 2.70
SET SPTRISK3			P=0.07166(1)
DUMMY4	-0.1379	1.0000	(1)
DUMMY5	0.4895	1.0000	(1)
DUMMY6	-0.1812	1.0000	(1)
			F= 0.21
SET SPLCONC3			P=0.89055(1)
DUMMY7	-0.0422	1.0000	(1)
DUMMY8	-0.1562	1.0000	(1)
DUMMY9	0.0726	1.0000	(1)
			F= 1.97
SET SPSRISK1			P=0.14993(1)
DUMMY10	-0.1264	1.0000	(1)
DUMMY11	-0.2191	1.0000	(1)
DUMMY12	-0.1065	1.0000	(1)
			F= 2.04
SET SPTRISK4			P=0.11902(1)
DUMMY22	0.2570	1.0000	(1)
DUMMY23	-0.1872	1.0000	(1)
DUMMY24	-0.1471	1.0000	(1)
DUMMY25	0.4895	1.0000	(1)
DUMMY26	-0.1516	1.0000	(1)
			F= 0.43
SET SPSRISK3			P=0.81958(1)
DUMMY27	-0.0190	1.0000	(1)
DUMMY28	0.0578	1.0000	(1)
DUMMY29	-0.1768	1.0000	(1)
DUMMY30	-0.1689	1.0000	(1)
DUMMY31	0.0676	1.0000	(1)
MPTRISK1	0.3222	1.0000	2.66(1)
MPTRISK2	-0.2966	1.0000	2.22(0)
MPTRISK3	-0.1169	1.0000	0.32(0)
MPTRISK4	-0.0765	1.0000	0.14(0)
MNOECPS1	0.1027	1.0000	0.25(1)
MNOECPS2	0.0875	1.0000	0.18(1)
MNOECPS3	0.2144	1.0000	1.11(1)
MNOECPS4	0.4421	1.0000	5.59(1)
MNOECPS5	0.2054	1.0000	1.01(1)
MNOECPS6	0.2576	1.0000	1.64(1)
MPSRISK1	-0.2959	1.0000	2.21(0)
MPSRISK3	-0.1143	1.0000	0.30(0)
MPRESCH1	-0.0829	1.0000	0.16(1)
MPRESCH2	-0.4014	1.0000	4.42(1)
MPRESCH3	-0.4996	1.0000	7.65(1)
MPRESCH4	-0.2073	1.0000	1.03(1)
MPRESCH6	0.1611	1.0000	0.61(1)
MPLAGGR	-0.0868	1.0000	0.17(1)
MSOWRC	-0.1018	1.0000	0.24(1)
MPLCONC3	0.0012	1.0000	0.00(0)
MSOWSINT	-0.2766	1.0000	1.91(1)
MEVSINT	0.0289	1.0000	0.02(1)

STEP NO. 1

VARIABLE ENTERED 60 MPRESCH3

MULTIPLE R 0.4996
MULTIPLE R-SQUARE 0.2496
ADJUSTED R-SQUARE 0.2169

STD. ERROR OF EST. 72.3954

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	40091.109	1	40091.11	7.65
RESIDUAL	120545.10	23	5241.091	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT 115.9455)				
MPRESCH3	-80.6740	29.1689	1.0000	7.65(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	-0.2095	0.9740	1.01(1)
PLAGGR	0.2369	0.9854	1.31(1)
PLCONC	-0.0644	0.9993	0.09(1)
PAGESSOW	-0.2273	0.9983	1.20(1)
NODIDS	-0.1784	1.0000	0.72(1)
PLDRRFP	-0.3326	0.9740	2.74(1)
SOWCSSR	-0.2021	0.9957	0.94(1)
SOWRCBP	0.3724	0.5400	3.54(1)
SOWFRSI	0.1134	0.9937	0.29(1)
NOPMDIDS	0.0596	0.9801	0.08(1)
NOEVCRIT	-0.0830	0.9973	0.15(1)
EVRCWP	-0.1757	0.9984	0.70(1)
EVRCBP	-0.0345	1.0000	0.03(1)
UCOSTCD	-0.0571	0.9953	0.07(1)
D_DP	-0.2583	0.9954	1.57(1)
PRODOPT	0.2637	0.9957	1.64(1)
NOECPS	0.3940	0.9882	4.04(1)
PLPRESCH	-0.2284	0.6818	1.21(1)
PLWBSDEV	-0.2601	0.9342	1.60(1)
SOWDWBS	-0.1918	0.9984	0.84(1)
SOWSDISP	-0.4959	0.9998	7.17(1)
SOWRCWP	0.2284	0.5981	1.21(1)
EVSDISP	0.3099	0.8770	2.34(1)
PLSRISK	-0.1382	0.9990	0.43(0)
		F=	0.28
SET SPLSRISK			P=0.76107(1)
PLSRISK1	-0.0679	0.8929	(1)
PLSRISK2	-0.1062	0.9814	(1)
PLTRISK	0.0315	0.9863	0.02(0)
		F=	3.60
SET SPLTRISK			P=0.04524(1)
PLTRISK1	0.5033	0.9257	(1)
PLTRISK2	-0.1525	0.9574	(1)
COMPLEX	-0.1293	0.9961	0.37(0)
		F=	0.37
SET SCOMPLEX			P=0.69422(1)
COMPLEX1	-0.1373	0.9574	(1)
COMPLEX2	-0.0302	0.9954	(1)
TECHDEFN	0.0354	0.9986	0.03(0)
		F=	1.30
SET STECHDEF			P=0.30208(1)
TECHDEF1	-0.1819	0.9342	(1)
TECHDEF2	0.3985	0.9954	(1)
TECHDEF3	-0.1613	0.9919	(1)
PLWBSL3	-0.0110	0.9018	0.00(0)
		F=	0.23
SET SPLWBSL3			P=0.87360(1)
PLWBSL31	-0.0090	0.9342	(1)
PLWBSL32	0.0367	0.7519	(1)
PLWBSL33	-0.1598	0.9854	(1)

		F=	0.77
SET SPTRISK2			P=0.47675(1)
DUMMY1	-0.0730	0.9998	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.1525	0.9574	(1)
		F=	2.29
SET SPTRISK3			P=0.10931(1)
DUMMY4	-0.2078	0.9931	(1)
DUMMY5	0.4442	0.9470	(1)
DUMMY6	-0.1318	0.9814	(1)
		F=	0.48
SET SPLCONC3			P=0.69790(1)
DUMMY7	-0.2551	0.8893	(1)
DUMMY8	-0.0307	0.9317	(1)
DUMMY9	0.0921	0.9998	(1)
		F=	0.41
SET SPSRISK1			P=0.74593(1)
DUMMY10	-0.0769	0.9854	(1)
DUMMY11	-0.0679	0.8929	(1)
DUMMY12	-0.0447	0.9814	(1)
		F=	1.59
SET SPTRISK4			P=0.21424(1)
DUMMY22	0.2667	0.9972	(1)
DUMMY23	-0.1930	0.9984	(1)
DUMMY24	-0.0666	0.9673	(1)
DUMMY25	0.4442	0.9470	(1)
DUMMY26	-0.1374	0.9957	(1)
		F=	0.21
SET SPSRISK3			P=0.95202(1)
DUMMY27	0.0238	0.9937	(1)
DUMMY28	0.1653	0.9721	(1)
DUMMY29	-0.0553	0.9317	(1)
DUMMY30	-0.1437	0.9919	(1)
DUMMY31	-0.0823	0.9257	(1)
MPTRISK1	0.3303	0.9946	2.69(1)
MPTRISK2	-0.2066	0.9392	0.98(0)
MPTRISK3	-0.1000	0.9963	0.22(0)
MPTRISK4	-0.0623	0.9980	0.09(0)
MNOECPS1	0.0066	0.9622	0.00(1)
MNOECPS2	0.0006	0.9697	0.00(1)
MNOECPS3	0.3181	0.9859	2.48(1)
MNOECPS4	0.4147	0.9686	4.57(1)
MNOECPS5	0.1783	0.9893	0.72(1)
MNOECPS6	0.2355	0.9879	1.29(1)
MPSRISK1	-0.1269	0.8483	0.36(0)
MPSRISK3	-0.1824	0.9926	0.76(0)
MPRESCH1	-0.0028	0.9740	0.00(1)
MPRESCH2	-0.1965	0.7395	0.88(1)
MPRESCH4	-0.0445	0.8827	0.04(1)
MPRESCH6	0.2324	0.9937	1.26(1)
MPLAGGR	0.0405	0.9416	0.04(1)
MSOWRC	0.3724	0.5400	3.54(1)
MPLCONC3	0.0323	0.9971	0.02(0)
MSOWSINT	-0.0602	0.7874	0.08(1)
MEVSINT	0.1131	0.9814	0.28(1)

STEP NO. 2

VARIABLE ENTERED 25 SOWSDISP

MULTIPLE R	0.6589
MULTIPLE R-SQUARE	0.4341
ADJUSTED R-SQUARE	0.3827
STD. ERROR OF EST.	64.2803

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	69733.172	2	34866.59	8.44
RESIDUAL	90903.039	22	4131.957	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT 171.7258)				
SOWSDISP	-76.6979	28.6357	0.9998	7.17(1)
MPRESCH3	-81.6701	25.9019	0.9998	9.94(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	-0.1850	0.9643	0.74(1)
PLAGGR	0.3591	0.9648	3.11(1)
PLCONC	-0.0662	0.9991	0.09(1)
PAGESSOW	-0.3339	0.9834	2.64(1)
NODIDS	-0.1494	0.9901	0.48(1)
PLDRRFP	-0.3072	0.9555	2.19(1)
SOWCSSR	-0.1506	0.9742	0.49(1)
SOWRCBP	0.3640	0.5325	3.21(1)
SOWFRSI	-0.0020	0.9401	0.00(1)
NOPMDIDS	0.1514	0.9603	0.49(1)
NOEVCRIT	-0.0589	0.9931	0.07(1)
EVRCWP	-0.2546	0.9903	1.46(1)
EVRCBP	-0.0953	0.9907	0.19(1)
UCOSTCD	-0.0038	0.9836	0.00(1)
D_DP	-0.1040	0.8732	0.23(1)
PRODOPT	0.1227	0.8879	0.32(1)
NOECPS	0.4394	0.9876	5.02(1)
PLPRESCH	-0.1675	0.6617	0.61(1)
PLWBSDEV	-0.0132	0.6963	0.00(1)
SOWDWBS	-0.0188	0.8718	0.01(1)
SOWRCWP	0.1675	0.5805	0.61(1)
EVSDISP	0.3512	0.8770	2.95(1)
PLSRISK	-0.1775	0.9980	0.68(0)
		F=	0.48
SET SPLSRISK			P=0.62645(1)
PLSRISK1	-0.1020	0.8913	(1)
PLSRISK2	-0.1317	0.9811	(1)
PLTRISK	-0.0865	0.9421	0.16(0)
		F=	0.60
SET SPLTRISK			P=0.55680(1)
PLTRISK1	0.2374	0.4303	(1)
PLTRISK2	-0.1368	0.9529	(1)
COMPLEX	-0.0271	0.9504	0.02(0)
		F=	0.15
SET SCOMPLEX			P=0.86155(1)
COMPLEX1	-0.1192	0.9529	(1)
COMPLEX2	0.0463	0.9755	(1)
TECHDEFN	-0.0159	0.9888	0.01(0)
		F=	0.74
SET STECHDEF			P=0.54301(1)
TECHDEF1	-0.1291	0.9151	(1)
TECHDEF2	0.3129	0.9190	(1)
TECHDEF3	-0.1589	0.9897	(1)
PLWBSL3	0.0477	0.8918	0.05(0)
		F=	0.30
SET SPLWBSL3			P=0.82196(1)
PLWBSL31	0.2084	0.8139	(1)
PLWBSL32	0.0030	0.7483	(1)
PLWBSL33	-0.1024	0.9648	(1)

		F=	0.25
SET SPTRISK2			P=0.78042(1)
DUMMY1	0.1500	0.8484	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.1368	0.9529	(1)
		F=	0.92
SET SPTRISK3			P=0.45114(1)
DUMMY4	0.0058	0.8111	(1)
DUMMY5	0.3376	0.8376	(1)
DUMMY6	-0.1423	0.9811	(1)
		F=	0.27
SET SPLCONC3			P=0.84348(1)
DUMMY7	-0.1887	0.8572	(1)
DUMMY8	0.0772	0.8965	(1)
DUMMY9	-0.0119	0.9573	(1)
		F=	0.39
SET SPSRISK1			P=0.76289(1)
DUMMY10	0.1220	0.8614	(1)
DUMMY11	-0.1020	0.8913	(1)
DUMMY12	-0.1476	0.9548	(1)
		F=	1.04
SET SPTRISK4			P=0.42850(1)
DUMMY22	0.1887	0.9512	(1)
DUMMY23	-0.0460	0.9008	(1)
DUMMY24	-0.2810	0.8618	(1)
DUMMY25	0.3376	0.8376	(1)
DUMMY26	-0.1786	0.9944	(1)
		F=	0.37
SET SPSRISK3			P=0.86437(1)
DUMMY27	0.1645	0.9401	(1)
DUMMY28	0.2088	0.9711	(1)
DUMMY29	-0.1485	0.9119	(1)
DUMMY30	-0.1386	0.9897	(1)
DUMMY31	-0.0798	0.9251	(1)
MPTRISK1	0.3141	0.9803	2.30(1)
MPTRISK2	-0.1141	0.8930	0.28(0)
MPTRISK3	-0.0714	0.9904	0.11(0)
MPTRISK4	-0.1555	0.9773	0.52(0)
MNOECPS1	0.0862	0.9444	0.16(1)
MNOECPS2	0.1373	0.9172	0.40(1)
MNOECPS3	0.3940	0.9837	3.86(1)
MNOECPS4	0.4073	0.9525	4.18(1)
MNOECPS5	0.2896	0.9692	1.92(1)
MNOECPS6	0.3381	0.9752	2.71(1)
MPSRISK1	-0.2083	0.8386	0.95(0)
MPSRISK3	-0.1741	0.9886	0.66(0)
MPRESCH1	-0.0536	0.9665	0.06(1)
MPRESCH2	-0.1633	0.7302	0.58(1)
MPRESCH4	-0.1074	0.8743	0.25(1)
MPRESCH6	0.2434	0.9919	1.32(1)
MPLAGGR	0.2455	0.8421	1.35(1)
MSOWRC	0.3640	0.5325	3.21(1)
MPLCONC3	-0.0178	0.9879	0.01(0)
MSOWSINT	0.3745	0.4745	3.43(1)
MEVSINT	0.1396	0.9811	0.42(1)

STEP NO. 3

VARIABLE ENTERED 9 NOECPS

MULTIPLE R 0.7371
MULTIPLE R-SQUARE 0.5434
ADJUSTED R-SQUARE 0.4781

STD. ERROR OF EST. 59.1013

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	87284.055	3	29094.69	8.33
RESIDUAL	73352.148	21	3492.959	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	133.5273)			
NOECPS	1.1903	0.5310	0.9876	5.02(1)
SONSDISP	-75.2071	26.3369	0.9992	8.15(1)
MPRESCH3	-75.8231	23.9575	0.9879	10.02(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	-0.0753	0.8924	0.11(1)
PLAGGR	0.3107	0.9284	2.14(1)
PLCONC	0.1600	0.8024	0.53(1)
PAGESSOW	-0.3908	0.9820	3.61(1)
NODIDS	-0.0347	0.9170	0.02(1)
PLDRRFP	-0.1928	0.8535	0.77(1)
SOWCSSR	-0.0629	0.9283	0.08(1)
SOWRCBP	0.3826	0.5313	3.43(1)
SOWFRSI	0.0094	0.9396	0.00(1)
NOPMDIDS	0.2226	0.9491	1.04(1)
NOEVCRIT	0.0434	0.9448	0.04(1)
EVRCWP	-0.2333	0.9794	1.15(1)
EVRCBP	-0.0319	0.9677	0.02(1)
UCOSTCD	-0.2192	0.8248	1.01(1)
D_DP	-0.0866	0.8701	0.15(1)
PRODOPT	0.1966	0.8751	0.80(1)
PLPRESCH	-0.2075	0.6605	0.90(1)
PLWBSDEV	-0.1350	0.6568	0.37(1)
SOWDWBS	-0.0857	0.8568	0.15(1)
SOWRCWP	0.2075	0.5794	0.90(1)
EVSDISP	0.2250	0.7553	1.07(1)
PLSRISK	-0.1623	0.9926	0.54(0)
			F= 0.28
SET SPLSRISK			P=0.76032(1)
PLSRISK1	-0.0279	0.8637	(1)
PLSRISK2	-0.1405	0.9810	(1)
PLTRISK	-0.1209	0.9398	0.30(0)
			F= 1.42
SET SPLTRISK			P=0.26621(1)
PLTRISK1	0.3597	0.4159	(1)
PLTRISK2	-0.1972	0.9451	(1)
COMPLEX	-0.2319	0.8152	1.14(0)
			F= 0.86
SET SCOMPLEX			P=0.43992(1)
COMPLEX1	-0.1701	0.9475	(1)
COMPLEX2	-0.0838	0.9043	(1)
TECHDEFN	0.1250	0.9105	0.32(0)
			F= 1.27
SET STECHDEF			P=0.31355(1)
TECHDEF1	-0.3303	0.8087	(1)
TECHDEF2	0.3528	0.9189	(1)
TECHDEF3	-0.0215	0.8883	(1)
PLWBSL3	-0.0123	0.8759	0.00(0)
			F= 0.06
SET SPLWBSL3			P=0.98045(1)
PLWBSL31	-0.0028	0.6269	(1)
PLWBSL32	0.0708	0.7344	(1)
PLWBSL33	-0.0877	0.9620	(1)

		F=	0.39
SET SPTRISK2			P=0.67968(1)
DUMMY1	0.1191	0.8401	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.1972	0.9451	(1)
		F=	2.13
SET SPTRISK3			P=0.13196(1)
DUMMY4	-0.0206	0.8086	(1)
DUMMY5	0.4607	0.8159	(1)
DUMMY6	-0.2141	0.9690	(1)
		F=	0.58
SET SPLCONC3			P=0.63778(1)
DUMMY7	-0.1596	0.8478	(1)
DUMMY8	0.1848	0.8624	(1)
DUMMY9	0.1553	0.8548	(1)
		F=	0.33
SET SPSRISK1			P=0.80410(1)
DUMMY10	0.0488	0.8336	(1)
DUMMY11	-0.0279	0.8637	(1)
DUMMY12	-0.1609	0.9547	(1)
		F=	2.24
SET SPTRISK4			P=0.10021(1)
DUMMY22	0.2982	0.9233	(1)
DUMMY23	-0.0340	0.8996	(1)
DUMMY24	-0.3023	0.8614	(1)
DUMMY25	0.4607	0.8159	(1)
DUMMY26	-0.2398	0.9877	(1)
		F=	0.53
SET SPSRISK3			P=0.75264(1)
DUMMY27	0.0644	0.8828	(1)
DUMMY28	0.2926	0.9574	(1)
DUMMY29	-0.1081	0.8990	(1)
DUMMY30	-0.1193	0.9845	(1)
DUMMY31	-0.2246	0.8619	(1)
MPTRISK1	-0.1714	0.2197	0.61(1)
MPTRISK2	-0.1988	0.8748	0.82(0)
MPTRISK3	-0.1324	0.9791	0.36(0)
MPTRISK4	-0.1844	0.9768	0.70(0)
MNOECPS1	0.1994	0.9055	0.83(1)
MNOECPS2	-0.1376	0.6419	0.39(1)
MNOECPS3	-0.0180	0.1660	0.01(1)
MNOECPS4	0.0758	0.2744	0.12(1)
MNOECPS5	-0.2779	0.1788	1.67(1)
MNOECPS6	-0.2937	0.0906	1.89(1)
MPSRISK1	-0.2113	0.8371	0.93(0)
MPSRISK3	-0.2854	0.9573	1.77(0)
MPRESCH1	0.1549	0.8035	0.49(1)
MPRESCH2	-0.0541	0.6789	0.06(1)
MPRESCH4	-0.0949	0.8721	0.18(1)
MPRESCH6	0.3635	0.9607	3.05(1)
MPLAGGR	0.1323	0.7659	0.36(1)
MSOWRC	0.3826	0.5313	3.43(1)
MPLCONC3	0.2069	0.8105	0.89(0)
MSOWSINT	0.4597	0.4711	5.36(1)
MEVSINT	0.1800	0.9787	0.67(1)

STEP NO. 4

VARIABLE ENTERED 66 MSONSINT

MULTIPLE R 0.7999
MULTIPLE R-SQUARE 0.6399
ADJUSTED R-SQUARE 0.5678

STD. ERROR OF EST. 53.7816

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	102787.08	4	25696.77	8.88
RESIDUAL	57849.129	20	2892.457	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	150.0834)			
NOECPS	1.2848	0.4849	0.9806	7.02(1)
SONSDISP	-120.2996	30.8829	0.6017	15.17(1)
MPRESCH3	-109.6435	26.2429	0.6818	17.46(1)
MSONSINT	73.0910	31.5711	0.4711	5.36(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.0264	0.8517	0.01(1)
PLAGGR	0.2518	0.8916	1.29(1)
PLCONC	0.0414	0.7434	0.03(1)
PAGESSON	-0.3914	0.9726	3.44(1)
NODIDS	-0.1631	0.8681	0.52(1)
PLDRRFP	-0.2784	0.8422	1.60(1)
SONCSSR	0.0818	0.8513	0.13(1)
SONRCBP	0.0239	0.1871	0.01(1)
SONFRSI	0.0141	0.9395	0.00(1)
NOPMDIDS	0.0380	0.7836	0.03(1)
NOEVCRIT	-0.1198	0.8515	0.28(1)
EVRCWP	-0.3452	0.9569	2.57(1)
EVRCBP	-0.0631	0.9650	0.08(1)
UCOSTCD	-0.2455	0.8248	1.22(1)
D_DP	-0.0173	0.8491	0.01(1)
PRODOPT	0.0013	0.7166	0.00(1)
PLPRESCH	0.0497	0.4732	0.05(1)
PLNBSDEV	-0.0875	0.6464	0.15(1)
SONDNBS	0.0122	0.8192	0.00(1)
SONRCWP	-0.0497	0.4151	0.05(1)
EVSDISP	0.1167	0.6993	0.26(1)
PLSRISK	-0.0953	0.9634	0.17(0)
		F=	0.12
SET SPLSRISK		P=0.88545	(1)
PLSRISK1	-0.0558	0.8618	(1)
PLSRISK2	-0.0702	0.9519	(1)
PLTRISK	-0.1659	0.9367	0.54(0)
		F=	0.79
SET SPLTRISK		P=0.46945	(1)
PLTRISK1	0.2692	0.3825	(1)
PLTRISK2	-0.2131	0.9448	(1)
COMPLEX	-0.2900	0.8127	1.74(0)
		F=	1.20
SET SCOMPLEX		P=0.32552	(1)
COMPLEX1	-0.1820	0.9471	(1)
COMPLEX2	-0.1230	0.9016	(1)
TECHDEFN	0.1235	0.9095	0.29(0)
		F=	1.16
SET STECHDEF		P=0.35457	(1)
TECHDEF1	-0.3225	0.8008	(1)
TECHDEF2	0.3481	0.9101	(1)
TECHDEF3	-0.0215	0.8883	(1)
PLNBSL3	-0.0891	0.8578	0.15(0)
		F=	0.02
SET SPLNBSL3		P=0.99582	(1)
PLNBSL31	-0.0196	0.6262	(1)
PLNBSL32	0.0328	0.7283	(1)
PLNBSL33	-0.0442	0.9512	(1)

			F= 0.44
SET SPTRISK2			P=0.64948(1)
DUMMY1	0.1792	0.8339	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.2131	0.9448	(1)
			F= 1.60
SET SPTRISK3			P=0.22559(1)
DUMMY4	0.0742	0.7807	(1)
DUMMY5	0.4399	0.7939	(1)
DUMMY6	-0.2111	0.9657	(1)
			F= 0.10
SET SPLCONC3			P=0.95908(1)
DUMMY7	-0.0048	0.7507	(1)
DUMMY8	0.1312	0.8427	(1)
DUMMY9	-0.0364	0.7165	(1)
			F= 0.04
SET SPSRISK1			P=0.99088(1)
DUMMY10	0.0438	0.8332	(1)
DUMMY11	-0.0558	0.8618	(1)
DUMMY12	0.0303	0.7992	(1)
			F= 1.56
SET SPTRISK4			P=0.23053(1)
DUMMY22	0.1968	0.8487	(1)
DUMMY23	-0.0111	0.8972	(1)
DUMMY24	-0.2747	0.8465	(1)
DUMMY25	0.4399	0.7939	(1)
DUMMY26	-0.2169	0.9768	(1)
			F= 0.66
SET SPSRISK3			P=0.65829(1)
DUMMY27	0.0593	0.8822	(1)
DUMMY28	0.3680	0.9524	(1)
DUMMY29	-0.1116	0.8987	(1)
DUMMY30	-0.1426	0.9843	(1)
DUMMY31	-0.2201	0.8583	(1)
MPTRISK1	-0.2034	0.2196	0.82(1)
MPTRISK2	-0.1980	0.8726	0.78(0)
MPTRISK3	-0.1040	0.9715	0.21(0)
MPTRISK4	-0.1654	0.9701	0.53(0)
MNOECPS1	0.0889	0.8403	0.15(1)
MNOECPS2	-0.1799	0.6404	0.64(1)
MNOECPS3	-0.0238	0.1660	0.01(1)
MNOECPS4	0.1253	0.2728	0.30(1)
MNOECPS5	-0.2033	0.1700	0.82(1)
MNOECPS6	-0.2220	0.0862	0.98(1)
MPSRISK1	0.0250	0.6267	0.01(0)
MPSRISK3	-0.2830	0.9518	1.65(0)
MPRESCH1	0.2106	0.7997	0.88(1)
MPRESCH2	0.0706	0.6366	0.10(1)
MPRESCH4	-0.0133	0.8435	0.00(1)
MPRESCH6	0.3044	0.9156	1.94(1)
MPLAGGR	0.0715	0.7484	0.10(1)
MSONRC	0.0239	0.1871	0.01(1)
MPLCONC3	0.0209	0.6721	0.01(0)
MEVSINT	0.1178	0.9514	0.27(1)

STEP NO. 5

VARIABLE ENTERED 16 PAGESSOW

MULTIPLE R 0.8337
MULTIPLE R-SQUARE 0.6950
ADJUSTED R-SQUARE 0.6148

STD. ERROR OF EST. 50.7763

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	111649.82	5	22329.96	8.66
RESIDUAL	48986.398	19	2578.231	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT 192.3236)				
PAGESSOW	-1.0697	0.5769	0.9726	3.44(1)
NOECPS	1.3105	0.4580	0.9797	8.19(1)
SOWSDISP	-122.1006	29.1733	0.6011	17.52(1)
MPRESCH3	-105.4565	24.8792	0.6762	17.97(1)
MSOWSINT	67.6666	29.9502	0.4666	5.10(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.0241	0.8517	0.01(1)
PLAGGR	0.1648	0.8264	0.50(1)
PLCONC	0.1889	0.6693	0.67(1)
NODIDS	-0.0416	0.7769	0.03(1)
PLDRRFP	-0.3777	0.8193	3.00(1)
SOWCSSR	0.0846	0.8512	0.13(1)
SOWRCBP	0.1423	0.1743	0.37(1)
SOWFRSI	0.1040	0.9007	0.20(1)
NOPMDIDS	0.1160	0.7605	0.25(1)
NOEVCRIT	-0.0761	0.8374	0.10(1)
EVRCWP	-0.2729	0.8908	1.45(1)
EVRCBP	-0.1763	0.9090	0.58(1)
UCOSTCD	-0.2391	0.8212	1.09(1)
D_DP	0.0920	0.7946	0.15(1)
PRODOPT	0.1424	0.6457	0.37(1)
PLPRESCH	0.0569	0.4732	0.0[illegible](1)
PLWBSDEV	-0.0036	0.6165	0.00(1)
SOWDWBS	0.0907	0.7931	0.15(1)
SOWRCWP	-0.0569	0.4151	0.06(1)
EVSDISP	0.0849	0.6923	0.13(1)
PLSRISK	-0.0194	0.9253	0.01(0)
		F=	0.05
SET SPLSRISK		P=0.95347(1)	
PLSRISK1	-0.0699	0.8614	(1)
PLSRISK2	0.0044	0.9178	(1)
PLTRISK	-0.1866	0.9365	0.65(0)
		F=	0.31
SET SPLTRISK		P=0.73646(1)	
PLTRISK1	0.0497	0.2476	(1)
PLTRISK2	-0.1797	0.9300	(1)
COMPLEX	-0.2911	0.8100	1.67(0)
		F=	0.86
SET SCOMPLEX		P=0.44173(1)	
COMPLEX1	-0.0781	0.8679	(1)
COMPLEX2	-0.1893	0.8870	(1)
TECHDEFN	0.2845	0.8172	1.59(0)
		F=	2.80
SET STECHDEF		P=0.07342(1)	
TECHDEF1	-0.4163	0.7841	(1)
TECHDEF2	0.4805	0.8683	(1)
TECHDEF3	0.0488	0.8632	(1)
PLWBSL3	0.1145	0.6716	0.24(0)
		F=	0.29
SET SPLWBSL3		P=0.82956(1)	
PLWBSL31	-0.1446	0.5784	(1)
PLWBSL32	0.0342	0.7283	(1)
PLWBSL33	0.1759	0.7352	(1)

			F= 0.40	
SET SPTRISK2			P=0.67574	(1)
DUMMY1	0.2083	0.8331		(1)
DUMMY2	0.0000	1.0000		(1)
DUMMY3	-0.1797	0.9300		(1)
			F= 0.97	
SET SPTRISK3			P=0.43248	(1)
DUMMY4	0.1466	0.7629		(1)
DUMMY5	0.3638	0.7173		(1)
DUMMY6	-0.1813	0.9527		(1)
			F= 0.32	
SET SPLCONC3			P=0.80807	(1)
DUMMY7	0.0928	0.7127		(1)
DUMMY8	0.1868	0.8340		(1)
DUMMY9	0.0244	0.7004		(1)
			F= 0.05	
SET SPSRISK1			P=0.98457	(1)
DUMMY10	0.0076	0.8258		(1)
DUMMY11	-0.0699	0.8614		(1)
DUMMY12	0.0765	0.7910		(1)
			F= 1.24	
SET SPTRISK4			P=0.34052	(1)
DUMMY22	0.1849	0.8447		(1)
DUMMY23	0.0296	0.8886		(1)
DUMMY24	-0.3796	0.8201		(1)
DUMMY25	0.3638	0.7173		(1)
DUMMY26	-0.1637	0.9468		(1)
			F= 0.42	
SET SPSRISK3			P=0.82737	(1)
DUMMY27	-0.0418	0.8286		(1)
DUMMY28	0.2384	0.7717		(1)
DUMMY29	-0.1514	0.8943		(1)
DUMMY30	0.0831	0.7077		(1)
DUMMY31	-0.2708	0.8538		(1)
MPTRISK1	-0.1234	0.2072	0.28	(1)
MPTRISK2	-0.1477	0.8493	0.40	(0)
MPTRISK3	-0.0695	0.9612	0.09	(0)
MPTRISK4	-0.1338	0.9584	0.33	(0)
MNOECPS1	0.1625	0.8212	0.49	(1)
MNOECPS2	-0.3150	0.5984	1.98	(1)
MNOECPS3	-0.0241	0.1660	0.01	(1)
MNOECPS4	0.3222	0.2334	2.08	(1)
MNOECPS5	-0.2849	0.1665	1.59	(1)
MNOECPS6	-0.3080	0.0842	1.89	(1)
MPSRISK1	0.0657	0.6216	0.08	(0)
MPSRISK3	-0.2165	0.9026	0.89	(0)
MPRESCH1	0.3238	0.7655	2.11	(1)
MPRESCH2	-0.0440	0.5868	0.03	(1)
MPRESCH4	0.0402	0.8297	0.03	(1)
MPRESCH6	0.2916	0.9073	1.67	(1)
MPLAGGR	0.0105	0.7297	0.00	(1)
MSOWRC	0.1423	0.1743	0.37	(1)
MPLCONC3	0.1345	0.6292	0.33	(0)
MEVSINT	0.0670	0.9313	0.08	(1)

STEP NO. 6

VARIABLE ENTERED SET STECHDEF
40 TECHDEF1
41 TECHDEF2
42 TECHDEF3

MULTIPLE R	0.8945
MULTIPLE R-SQUARE	0.8001
ADJUSTED R-SQUARE	0.7001
STD. ERROR OF EST.	44.8034

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	128518.75	8	16064.84	8.00
RESIDUAL	32117.459	16	2007.341	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT 170.4494)				
PAGESSOW	-1.5378	0.5461	0.8451	7.93(1)
NOECPS	1.6159	0.4422	0.8184	13.35(1)
SOWSDISP	-99.5787	26.9474	0.5485	13.66(1)
			F=	2.80
SET STECHDEF				P=0.07342(1)
TECHDEF1	-20.3465	29.310	0.5124	(1)
TECHDEF2	60.1653	29.9998	0.4891	(1)
TECHDEF3	25.2843	27.4169	0.4909	(1)
MPRESCH3	-100.7516	22.7969	0.6270	19.53(1)
MSOWSINT	56.0962	26.7282	0.4561	4.40(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	-0.0261	0.6191	0.01(1)
PLAGGR	0.0963	0.7518	0.14(1)
PLCONC	0.1180	0.5831	0.21(1)
NODIDS	-0.1512	0.7187	(0.563)(1)
PLDRRFP	-0.1718	0.6478	0.46(1)
SOWCSSR	0.1266	0.6918	0.24(1)
SOWRCBP	0.2116	0.1369	0.70(1)
SOWFRSI	0.2920	0.7904	1.40(1)
NOPMDIDS	0.1857	0.7387	0.54(1)
NOEVCRIT	-0.1262	0.6935	0.24(1)
EVRCWP	-0.4499	0.7914	3.81(1)
EVRCBP	0.1158	0.5616	0.20(1)
UCOSTCD	-0.0273	0.5013	0.01(1)
D_DP	0.1727	0.5676	0.46(1)
PRODOPT	0.1702	0.5726	0.45(1)
PLPRESCH	-0.1926	0.4056	0.58(1)
PLWBSDEV	-0.1436	0.5581	0.32(1)
SOWDWBS	0.1385	0.7683	0.29(1)
SOWRCWP	0.1926	0.3558	0.58(1)
EVSDISP	0.2865	0.6073	1.34(1)
PLSRISK	0.1181	0.8248	0.21(0)
		F=	0.17
SET SPLSRISK			P=0.84586(1)
PLSRISK1	0.0611	0.7020	(1)
PLSRISK2	0.0860	0.8918	(1)
PLTRISK	-0.3042	0.8959	1.53(0)
		F=	0.77
SET SPLTRISK			P=0.48214(1)
PLTRISK1	0.0820	0.1906	(1)
PLTRISK2	-0.2893	0.9038	(1)
COMPLEX	0.0195	0.3791	0.01(0)
		F=	0.01
SET SCOMPLEX			P=0.98794(1)
COMPLEX1	-0.0378	0.7879	(1)
COMPLEX2	0.0394	0.5710	(1)
TECHDEFN	0.0000	1.0000	0.00(0)
PLWBSL3	-0.2239	0.5043	0.79(0)
		F=	0.39
SET SPLWBSL3			P=0.76161(1)
PLWBSL31	0.0251	0.5191	(1)
PLWBSL32	0.2233	0.5433	(1)
PLWBSL33	-0.2394	0.3924	(1)

			F= 0.64
SET SPTRISK2			P=0.54117(1)
DUMMY1	0.2279	0.8007	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.2893	0.9038	(1)
			F= 0.53
SET SPTRISK3			P=0.66773(1)
DUMMY4	0.2662	0.7301	(1)
DUMMY5	0.2263	0.6139	(1)
DUMMY6	-0.1961	0.8981	(1)
			F= 0.47
SET SPLCONC3			P=0.70686(1)
DUMMY7	-0.1620	0.6100	(1)
DUMMY8	0.2233	0.7033	(1)
DUMMY9	0.0755	0.6949	(1)
			F= 0.29
SET SPSRISK1			P=0.83495(1)
DUMMY10	-0.1910	0.7258	(1)
DUMMY11	0.0611	0.7020	(1)
DUMMY12	0.0087	0.7766	(1)
			F= 0.47
SET SPTRISK4			P=0.78891(1)
DUMMY22	0.1940	0.7938	(1)
DUMMY23	0.1242	0.8323	(1)
DUMMY24	-0.2280	0.5849	(1)
DUMMY25	0.2263	0.6139	(1)
DUMMY26	-0.1888	0.9173	(1)
			F= 0.19
SET SPSRISK3			P=0.96048(1)
DUMMY27	-0.1214	0.6158	(1)
DUMMY28	0.2247	0.7462	(1)
DUMMY29	-0.0065	0.7502	(1)
DUMMY30	0.0881	0.6796	(1)
DUMMY31	-0.0871	0.6631	(1)
MPTRISK1	-0.2895	0.1984	1.37(1)
MPTRISK2	-0.2773	0.8139	1.25(0)
MPTRISK3	-0.0868	0.9187	0.11(0)
MPTRISK4	-0.1477	0.9501	0.33(0)
MNOECPS1	0.1615	0.6732	0.40(1)
MNOECPS2	-0.1231	0.4977	0.23(1)
MNOECPS3	0.0796	0.1607	0.10(1)
MNOECPS4	0.0375	0.0708	0.02(1)
MNOECPS5	-0.1647	0.1100	0.42(1)
MNOECPS6	-0.0563	0.0429	0.05(1)
MPSRISK1	-0.0271	0.5822	0.01(0)
MPSRISK3	0.0336	0.5844	0.02(0)
MPRESCH1	0.1808	0.6442	0.51(1)
MPRESCH2	-0.0533	0.5812	0.04(1)
MPRESCH4	-0.3435	0.5681	2.01(1)
MPRESCH6	0.1833	0.7193	0.52(1)
MPLAGGR	0.0028	0.6941	0.00(1)
MSOWRC	0.2116	0.1369	0.70(1)
MPLCONC3	0.1498	0.5876	0.34(0)
MEVSINT	0.2542	0.8011	1.04(1)

STEP NO. 7

VARIABLE ENTERED 32 EVRCWP

MULTIPLE R 0.9168
MULTIPLE R-SQUARE 0.8405
ADJUSTED R-SQUARE 0.7448

STD. ERROR OF EST. 41.3252

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	135019.59	9	15002.18	8.78
RESIDUAL	25616.611	15	1707.774	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT 197.8800)				
PAGESSOW	-1.3618	0.5118	0.8188	7.08(1)
EVRCWP	-45.3175	23.2272	0.7914	3.81(1)
NOECPS	1.6305	0.4079	0.8181	15.97(1)
SOWSDISP	-106.9714	25.1426	0.5360	18.10(1)
			F=	3.85
SET STECHDEF				P=0.03167(1)
TECHDEF1	-18.8461	27.046	0.5120	(1)
TECHDEF2	66.0045	27.8322	0.4835	(1)
TECHDEF3	40.6531	26.4869	0.4475	(1)
MPRESCH3	-107.0308	21.2720	0.6127	25.32(1)
MSOWSINT	64.5499	25.0311	0.4425	6.65(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.0528	0.6030	0.04(1)
PLAGGR	0.1960	0.7303	0.56(1)
PLCONC	0.2923	0.5332	1.31(1)
NODIDS	-0.1501	0.7177	0.32(1)
PLDRRFP	0.0121	0.5421	(0.964)(1)
SOWCSSR	0.2757	0.6490	1.15(1)
SOWRCBP	0.1035	0.1267	0.15(1)
SOWFRSI	0.3844	0.7809	2.43(1)
NOPMDIDS	0.4083	0.6496	2.80(1)
NOEVCRIT	-0.0278	0.6579	0.01(1)
EVRCBP	0.5921	0.3295	7.56(1)
UCOSTCD	-0.0455	0.5008	0.03(1)
D_DP	0.0905	0.5430	0.12(1)
PRODOPT	0.0336	0.5158	0.02(1)
PLPRESCH	-0.1695	0.4021	0.41(1)
PLWBSDEV	-0.0333	0.5218	0.02(1)
SOWDWBS	0.1527	0.7683	0.33(1)
SOWRCWP	0.1695	0.3527	0.41(1)
EVSDISP	0.4428	0.5777	3.41(1)
PLSRISK	0.2416	0.7895	0.87(0)
		F=	0.86
SET SPLSRISK			P=0.44728(1)
PLSRISK1	0.1492	0.6848	(1)
PLSRISK2	0.1664	0.8753	(1)
PLTRISK	-0.1752	0.7859	0.44(0)
		F=	0.21
SET SPLTRISK			P=0.81629(1)
PLTRISK1	0.0872	0.1906	(1)
PLTRISK2	-0.1723	0.8119	(1)
COMPLEX	0.1123	0.3673	0.18(0)
		F=	0.09
SET SCOMPLEX			P=0.91328(1)
COMPLEX1	-0.0421	0.7879	(1)
COMPLEX2	0.1056	0.5627	(1)
TECHDEFN	0.0000	1.0000	0.00(0)
PLWBSL3	-0.1994	0.4989	0.58(0)
		F=	0.55
SET SPLWBSL3			P=0.65524(1)
PLWBSL31	0.1872	0.4727	(1)
PLWBSL32	0.2073	0.5393	(1)
PLWBSL33	-0.2614	0.3923	(1)
		F=	0.23
SET SPTRISK2			P=0.80042(1)
DUMMY1	0.1701	0.7764	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.1723	0.8119	(1)

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                                F=     0.51
SET [illegible]RISK3            P=0.68503(1)
DUMMY4    0.1166 0.6262             (1)
DUMMY5    0.3302 0.6009             (1)
DUMMY6   -0.0876 0.8333             (1)
                                F=     0.87
SET SPLCONC3                    P=0.48148(1)
DUMMY7   -0.1171 0.5997             (1)
DUMMY8    0.2510 0.7033             (1)
DUMMY9    0.2013 0.6607             (1)
                                F=     0.45
SET SPSRISK1                    P=0.72335(1)
DUMMY10 -0.2716 0.7168              (1)
DUMMY11  0.1492 0.6848              (1)
DUMMY12  0.0345 0.7747              (1)
                                F=     0.58
SET SPTRISK4                    P=0.71366(1)
DUMMY22  0.1184 0.7618              (1)
DUMMY23  0.1820 0.8265              (1)
DUMMY24 -0.1181 0.5385              (1)
DUMMY25  0.3302 0.6009              (1)
DUMMY26 -0.1261 0.8899              (1)
                                F=     0.29
SET SPSRISK3                    P=0.90742(1)
DUMMY27 -0.1620 0.6141              (1)
DUMMY28  0.1202 0.6920              (1)
DUMMY29  0.0847 0.7259              (1)
DUMMY30  0.0614 0.6758              (1)
DUMMY31  0.0916 0.5758              (1)
MPTRISK1-0.0934 0.1525          0.12(1)
MPTRISK2-0.1517 0.7239          0.33(0)
MPTRISK3 0.0215 0.8683          0.01(0)
MPTRISK4-0.0306 0.8809          0.01(0)
MNOECPS1 0.2990 0.6406          1.37(1)
MNOECPS2 0.0743 0.4148          0.08(1)
MNOECPS3 0.2254 0.1502          0.75(1)
MNOECPS4 0.0025 0.0704          0.00(1)
MNOECPS5-0.1225 0.1082          0.21(1)
MNOECPS6 0.1264 0.0373          0.23(1)
MPSRISK1 0.0300 0.5739          0.01(0)
MPSRISK3 0.2151 0.5213          0.68(0)
MPRESCH1 0.3596 0.5927          2.08(1)
MPRESCH2 0.0255 0.5647          0.01(1)
MPRESCH4 0.0257 0.2095          0.01(1)
MPRESCH6 0.3769 0.6524          2.32(1)
MPLAGGR  0.0646 0.6839          0.06(1)
MSOWRC   0.1035 0.1267          0.15(1)
MPLCONC3 0.3175 0.5437          1.57(0)
MEVSINT  0.6127 0.6063          8.42(1)
```

STEP NO. 8

VARIABLE ENTERED 67 MEVSINT

MULTIPLE R	0.9489
MULTIPLE R-SQUARE	0.9004
ADJUSTED R-SQUARE	0.8293
STD. ERROR OF EST.	33.8057

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	144636.63	10	14463.66	12.66
RESIDUAL	15999.589	14	1142.828	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT 189.8637)				
PAGESSOW	-1.0515	0.4321	0.7686	5.92(1)
EVRCWP	-76.5564	21.8402	0.5990	12.29(1)
NOECPS	1.6428	0.3337	0.8180	24.23(1)
SOWSDISP	-99.2888	20.7375	0.5273	22.92(1)
			F=	7.76
SET STECHDEF				P=0.00270(1)
TECHDEF1	-28.5685	22.377	0.5005	(1)
TECHDEF2	78.5696	23.1763	0.4666	(1)
TECHDEF3	36.4333	21.7162	0.4455	(1)
MPRESCH3	-112.7526	17.5128	0.6049	41.45(1)
MSOWSINT	56.8129	20.6495	0.4351	7.57(1)
MEVSINT	50.7427	17.4922	0.6063	8.42(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.1906	0.5882	0.49(1)
PLAGGR	0.0614	0.6871	0.05(1)
PLCONC	0.1262	0.4776	0.21(1)
NODIDS	0.0545	0.6479	0.04(1)
PLDRRFP	-0.1666	0.5137	(0.553)(1)
SOWCSSR	0.3753	0.6483	2.13(1)
SOWRCBP	0.1556	0.1266	0.32(1)
SOWFRSI	0.1486	0.6179	0.29(1)
NOPMDIDS	0.3065	0.5959	1.35(1)
NOEVCRIT	-0.0586	0.6573	0.04(1)
EVRCBP	0.4191	0.2480	2.77(1)
UCOSTCD	-0.3063	0.4551	1.35(1)
D_DP	0.0549	0.5398	0.04(1)
PRODOPT	-0.1329	0.4904	0.23(1)
PLPRESCH	-0.2639	0.4005	0.97(1)
PLWBSDEV	-0.0835	0.5203	0.09(1)
SOWDWBS	-0.1142	0.6543	0.17(1)
SOWRCWP	0.2639	0.3513	0.97(1)
EVSDISP	-0.2700	0.1253	1.02(1)
PLSRISK	0.0154	0.6779	0.00(0)
		F=	0.60
SET SPLSRISK			P=0.56580(1)
PLSRISK1	0.2814	0.6754	(1)
PLSRISK2	-0.0735	0.7618	(1)
PLTRISK	-0.1640	0.7814	0.36(0)
		F=	1.84
SET SPLTRISK			P=0.20084(1)
PLTRISK1	0.4610	0.1598	(1)
PLTRISK2	-0.2213	0.8119	(1)
COMPLEX	-0.0779	0.3386	0.08(0)
		F=	0.38
SET SCOMPLEX			P=0.68918(1)
COMPLEX1	0.2292	0.6935	(1)
COMPLEX2	-0.2213	0.4586	(1)
TECHDEFN	0.0000	1.0000	0.00(0)
PLWBSL3	-0.0132	0.4511	0.00(0)
		F=	0.03
SET SPLWBSL3			P=0.99405(1)
PLWBSL31	0.0359	0.4405	(1)
PLWBSL32	-0.0611	0.4485	(1)
PLWBSL33	0.0598	0.2967	(1)
		F=	0.32
SET SPTRISK2			P=0.73443(1)
DUMMY1	0.1870	0.7753	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.2213	0.8119	(1)

			F= 0.21
SET SPTRISK3			P=0.88956(1)
DUMMY4	0.0797	0.6214	(1)
DUMMY5	0.1236	0.5085	(1)
DUMMY6	-0.1852	0.8258	(1)
			F= 0.11
SET SPLCONC3			P=0.95398(1)
DUMMY7	0.0270	0.5693	(1)
DUMMY8	0.1157	0.6536	(1)
DUMMY9	0.0354	0.6071	(1)
			F= 0.69
SET SPSRISK1			P=0.57777(1)
DUMMY10	-0.1265	0.6578	(1)
DUMMY11	0.2814	0.6754	(1)
DUMMY12	-0.2394	0.6819	(1)
			F= 0.55
SET SPTRISK4			P=0.73824(1)
DUMMY22	0.0812	0.7557	(1)
DUMMY23	0.0606	0.7862	(1)
DUMMY24	0.4503	0.3183	(1)
DUMMY25	0.1236	0.5085	(1)
DUMMY26	-0.1843	0.8890	(1)
			F= 0.43
SET SPSRISK3			P=0.81554(1)
DUMMY27	-0.0992	0.6025	(1)
DUMMY28	0.0262	0.6736	(1)
DUMMY29	0.3248	0.6747	(1)
DUMMY30	0.1328	0.6725	(1)
DUMMY31	-0.3224	0.4274	(1)
MPTRISK1	-0.2197	0.1500	0.66(1)
MPTRISK2	-0.2064	0.7237	0.58(0)
MPTRISK3	-0.1699	0.8152	0.39(0)
MPTRISK4	-0.1201	0.8714	0.19(0)
MNOECPS1	0.3605	0.6402	1.94(1)
MNOECPS2	-0.1300	0.3817	0.22(1)
MNOECPS3	-0.4564	0.0647	3.42(1)
MNOECPS4	0.2954	0.0616	1.24(1)
MNOECPS5	-0.4451	0.0957	3.21(1)
MNOECPS6	-0.1772	0.0309	0.42(1)
MPSRISK1	-0.2179	0.5167	0.65(0)
MPSRISK3	-0.0916	0.4128	0.11(0)
MPRESCH1	0.1616	0.5000	0.35(1)
MPRESCH2	-0.2036	0.5163	0.56(1)
MPRESCH4	-0.1038	0.2032	0.14(1)
MPRESCH6	0.3086	0.6186	1.37(1)
MPLAGGR	0.0136	0.6786	0.00(1)
MSOWRC	0.1556	0.1266	0.32(1)
MPLCONC3	0.1042	0.4590	0.14(0)

NOTE THAT VARIABLE 37 PLTRISK2 CANNOT BE ENTERED
BECAUSE IT DID NOT PASS THE TOLERANCE TEST.

NOTE THAT SET MNOECPS3 WHICH HAS THE SMALLEST P-VALUE
IN THE PREVIOUS STEP, CANNOT BE ENTERED.

NOTE THAT VARIABLE 52 MNOECPS3 CANNOT BE ENTERED BECAUSE ITS ENTRY
WOULD LOWER THE TOLERANCE OF VARIABLE 9 NOECPS BELOW THE TOLERANCE LIMIT.

STEP NO. 9

VARIABLE ENTERED SET SPLTRISK
36 PLTRISK1

MULTIPLE R	0.9600
MULTIPLE R-SQUARE	0.9216
ADJUSTED R-SQUARE	0.8552
STD. ERROR OF EST.	31.1318

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	148036.77	11	13457.89	13.89
RESIDUAL	12599.434	13	969.1872	

Note: Due to the correlation problems identified at Step No. 8, the remaining steps were removed from the output report.

SUMMARY TABLE

STEP	VARIABLE		MULTIPLE		CHANGE	P-VALUE	P-VALUE	NO.OF VAR.
NO.	ENTERED	REMOVED	R	RSQ	IN RSQ	ENTER	REMOVE	INCLUDED
1	60 MPRESCH3		0.4996	0.2496	0.2496	0.01		1
2	25 SOWSDISP		0.6589	0.4341	0.1845	0.01		2
3	9 NOECPS		0.7371	0.5434	0.1093	0.04		3
4	66 MSOWSINT		0.7999	0.6399	0.0965	0.03		4
5	16 PAGESSOW		0.8337	0.6950	0.0552	0.08		5
6	SET STECHDEF 40 TECHDEF1 41 TECHDEF2 42 TECHDEF3		0.8945	0.8001	0.1050	0.07		8
7	32 EVRCWP		0.9168	0.8405	0.0405	0.07		9
8	67 MEVSINT		0.9489	0.9004	0.0599	0.01		10
9	SET SPLTRISK 36 PLTRISK1		0.9600	0.9216	0.0212	0.08		11
10		16 PAGESSOW	0.9606	0.9228	0.0012		0.68	10
11		25 SOWSDISP	0.9601	0.9218	-0.0009		0.70	9
12	24 SOWCSSR		0.9840	0.9683	0.0465	0.00		10
13	59 MPRESCH2		0.9890	0.9781	0.0098	0.04		11

SERIAL CORRELATION -0.1802
DURBIN-WATSON STATISTIC 2.3121 BASED ON 25 CASES

```
CASE PLOTS                RESIDUALS              LEVERAGE                 INFLUENCE

CASE  LABEL                STRESID               -LOG P(H)                  MODCOOK
NO.               -4    -2    0    2    4  0    1    2    3    4  0  1  2  3  4  5  6
                   +....+....+....+....+  +....+....+....+....+  +..+..+..+..+..+..+
    1              .         *          .  **                  .  *                 .
    2-             .         M          .  M                   .  M                 .
    3              .  ********          .  ****                .  ***************   .
    4-             .         M          .  M                   .  M                 .
    5              .         ****       .  ****                .  *****             .
    6              .         ****       .  **************      .  ********          .
    7              .         *          .  ****                .  *                 .
    8              .       **           .  *                   .  **                .
    9              .         **         .  *****               .  **                .
   10-             .         M          .  M                   .  M                 .
   11              .         *          .  ****                .  *                 .
   12              .         ***        .  ******              .  ***               .
   13              .         *          .  ****                .  *                 .
   14              .         **         .  *                   .  **                .
   15              .         *          .  **                  .  *                 .
   16              .         **         .  *                   .  **                .
   17              .       ***          .  *                   .  **                .
   18-             .         M          .  M                   .  M                 .
   19              .         **         .  ********            .  **                .
   20              .      ****          .  *                   .  ***               .
   21              .         ***        .  ****                .  ****              .
   22              .         *****      .  **                  .  ****              .
   23              .       ***          .  ********            .  ****              .
   24              .        **          .  ********            .  ***               .
   25              .      ****          .  *********           .  ******            .
   26              .     *****          .  *******             .  *********         .
   27              .         ******     .  *                   .  *****             .
   28              .         *          .  ***                 .  **                .
   29              .       ***          .  *                   .  ***               .
                   +....+....+....+....+  +....+....+....+....+  +..+..+..+..+..+..+
                  -4    -2    0    2    4  0    1    2    3    4  0  1  2  3  4  5  6
```

```
         .+......+......+......+......+......+......+......+......+.....
         -                                                             -
     .8  +                                                             +
         -                                                             -
         -                   1                                         -
         -                                                             -
         -                                                             -
         -                                                             -
C    .6  +                                                             +
O        -                                                             -
O        -                                                             -
K        -           1                                                 -
         - 1                                                           -
         -                                                             -
     .4  +                                                             +
         -                                                             -
         -                                                             -
1        -                                                             -
0        -                                                 1           -
3        -                                                             -
     .2  +                                                             +
         -                      1                                      -
         -          1                                                  -
         -2                                            1               -
         -                                       1                     -
         - 1  2             1                                         1-
     0.  +       1    1   2          11 1 1           1   1            +
         .+......+......+......+......+......+......+......+......+.....
                3.            9.           15           21
          0.            6.           12           18           24

                                 UCOSTCD    5
```

EXTREME CASES --

CASE NO.	COOK	CASE NO.	UCOSTCD
3	0.7321	17	25.7384
6	0.4973	25	20.7504

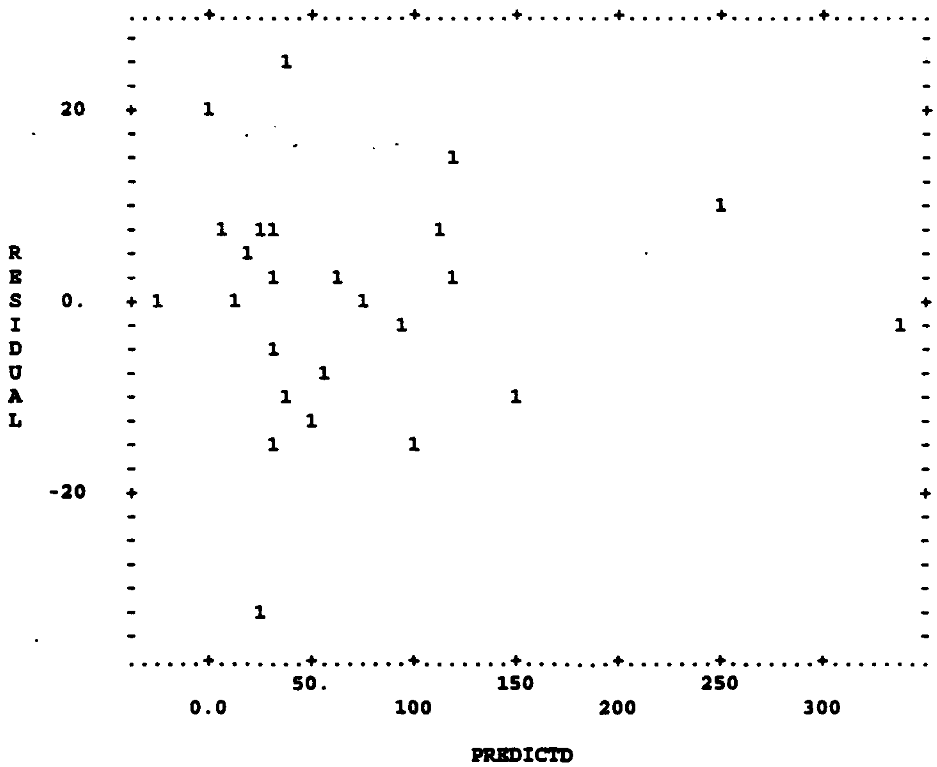
EXTREME CASES IN THE PLOTS --

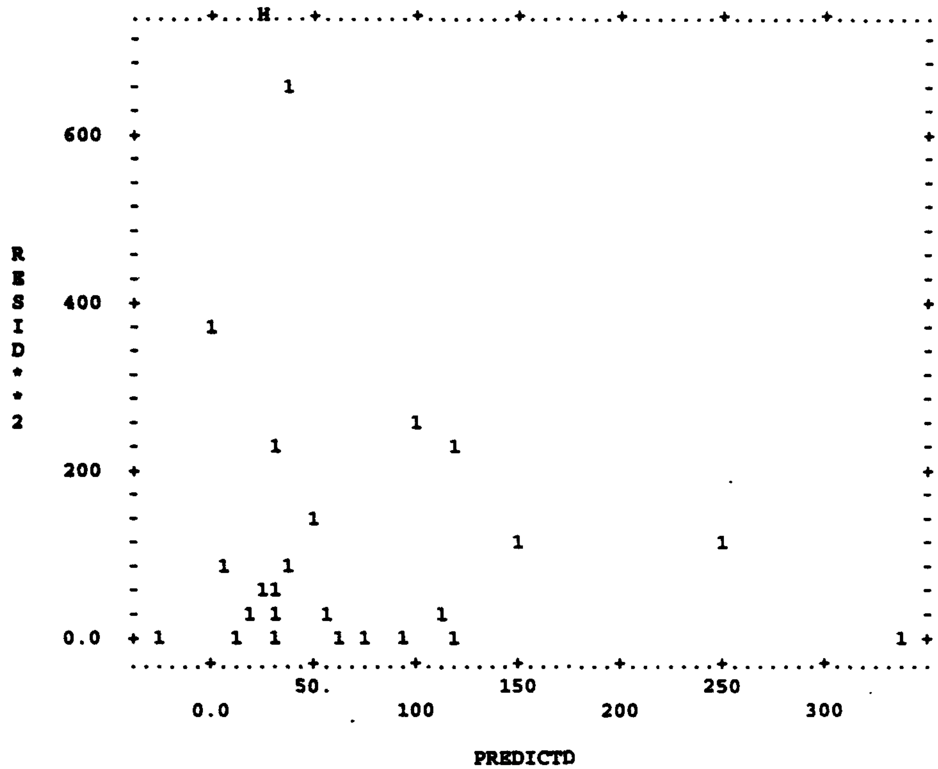
STATISTICS	EXTREME VALUE	NO.	CASE LABEL	WEIGHT	2 SCHEDPER	24 SOWCSSR
COOK	0.7321	3		1.0000	-10.0000	1.0000
COOK	0.4973	6		1.0000	13.0000	0.0000

CASE NO.	LABEL	32 EVRCWP	9 NOBCPS	36 PLTRISK1	37 PLTRISK2
3		1.0000	8.0000	0.0000	1.0000
6		1.0000	25.0000	1.0000	0.0000

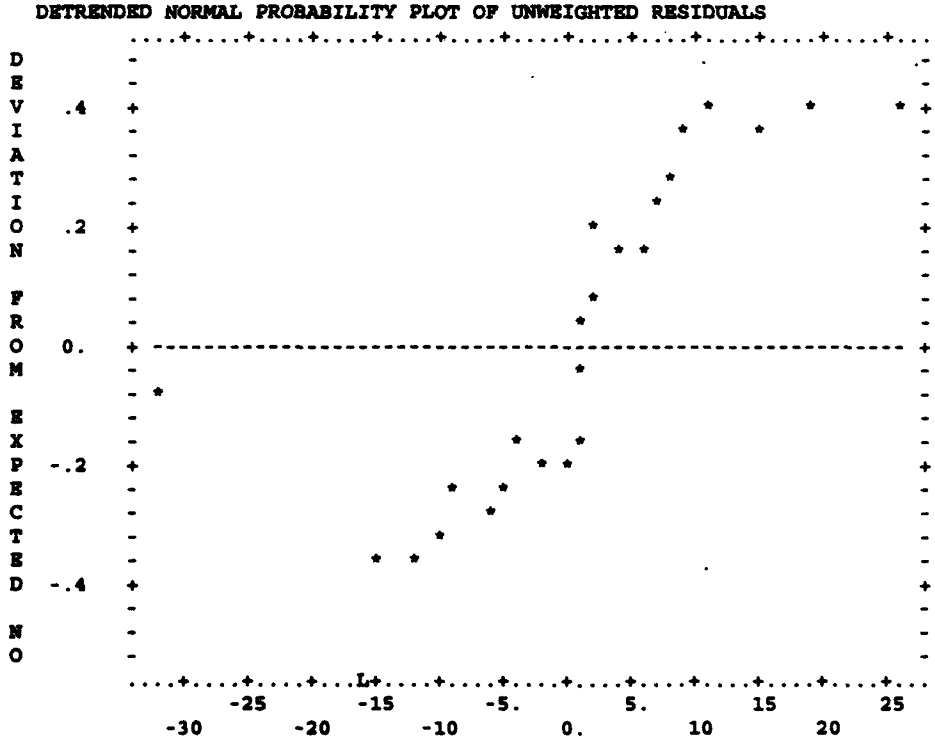
CASE NO.	LABEL	40 TECHDEF1	41 TECHDEF2	42 TECHDEF3	59 MPRESCH2
3		0.0000	1.0000	0.0000	1.0000
6		1.0000	0.0000	0.0000	1.0000

CASE NO.	LABEL	60 MPRESCH3	66 MSOWSINT	67 MEVSINT
3		1.0000	1.0000	0.0000
6		1.0000	0.0000	0.0000
17		1.0000	0.0000	1.0000
25		0.0000	0.0000	1.0000





DETRENDED NORMAL PROBABILITY PLOT OF UNWEIGHTED RESIDUALS



VALUES FROM NORMAL DISTRIBUTION WOULD LIE
ON THE LINE INDICATED BY THE SYMBOL - .

Appendix K: BMDP 2R Stepwise Regression on SCHEDMOD, Full Variable Set, Interaction Terms Included (Edited Data Output)

PROGRAM INSTRUCTIONS

```
/INPUT     FILE='THESIS.ASC'.
           VARIABLES=33.
           FORMAT=FREE.

/VARIABLE  NAMES=CNO, SCHEDPER, SCHEDMOD, SCHEDPLR, UCOSTCD, CTYPE,
           D_DP, PRODOPT, NOECPS, PLPRESCH, PLAGGR, PLCONC, PLSRISK,
           PLTRISK, COMPLEX, PAGESSOW, NODIDS, PLWBSDEV, PLWBSL3, PLWBSLL,
           PLDRRFP, TECHDEFN, SOWDWBS, SOWCSSR, SOWSDISP, SOWRCWP,
           SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVSDISP, EVRCWP, EVRCBP.

           USE=SCHEDMOD, CTYPE, PLAGGR, PLCONC, PAGESSOW, NODIDS, PLDRRFP,
           SOWCSSR, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVRCWP, EVRCBP,
           UCOSTCD, D_DP, PRODOPT, NOECPS, PLPRESCH, PLWBSDEV, SOWDWBS,
           SOWSDISP, SOWRCWP, EVSDISP, PLSRISK, PLSRISK1, PLSRISK2, PLTRISK,
           PLTRISK1, PLTRISK2, COMPLEX, COMPLEX1, COMPLEX2, TECHDEFN, TECHDEF1,
           TECHDEF2, TECHDEF3, PLWBSL3, PLWBSL31, PLWBSL32, PLWBSL33, DUMMY1,
           DUMMY2, DUMMY3, DUMMY4, DUMMY5, DUMMY6, DUMMY7, DUMMY8, DUMMY9,
           DUMMY10, DUMMY11, DUMMY12, DUMMY22, DUMMY23, DUMMY24, DUMMY25,
           DUMMY26, DUMMY27, DUMMY28, DUMMY29, DUMMY30, DUMMY31, MPTRISK1,
           MPTRISK2, MPTRISK3, MPTRISK4, MNOECPS1, MNOECPS2, MNOECPS3,
           MNOECPS4, MNOECPS5, MNOECPS6, MPSRISK1, MPSRISK3, MPRESCH1,
           MPRESCH2, MPRESCH3, MPRESCH4, MPRESCH6, MPLAGGR, MSOWRC, MPLCONC3,
           MSOWSINT, MEVSINT.

/TRANSFORM IF(PLSRISK EQ 1) THEN(PLSRISK1=0. PLSRISK2=0.).
           IF(PLSRISK EQ 2) THEN(PLSRISK1=1. PLSRISK2=0.).
           IF(PLSRISK EQ 3) THEN(PLSRISK1=0. PLSRISK2=1.).

           IF(PLTRISK EQ 1) THEN(PLTRISK1=0. PLTRISK2=0.).
           IF(PLTRISK EQ 2) THEN(PLTRISK1=1. PLTRISK2=0.).
           IF(PLTRISK EQ 3) THEN(PLTRISK1=0. PLTRISK2=1.).

           IF(COMPLEX EQ 1) THEN(COMPLEX1=0. COMPLEX2=0.).
           IF(COMPLEX EQ 2) THEN(COMPLEX1=1. COMPLEX2=0.).
           IF(COMPLEX EQ 3) THEN(COMPLEX1=0. COMPLEX2=1.).

           IF(TECHDEFN EQ 1) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=0.).
           IF(TECHDEFN EQ 2) THEN(TECHDEF1=1. TECHDEF2=0. TECHDEF3=0.).
           IF(TECHDEFN EQ 3) THEN(TECHDEF1=0. TECHDEF2=1. TECHDEF3=0.).
           IF(TECHDEFN EQ 4) THEN(TECHDEF1=0. TECHDEF2=0. TECHDEF3=1.).

           IF(PLWBSL3 EQ 0) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=0.).
           IF(PLWBSL3 GT 0 AND PLWBSL3 LE 10) THEN(PLWBSL31=1. PLWBSL32=0. PLWBSL33=0.).
           IF(PLWBSL3 GT 10 AND PLWBSL3 LE 16) THEN(PLWBSL31=0. PLWBSL32=1. PLWBSL33=0.).
           IF(PLWBSL3 GT 16) THEN(PLWBSL31=0. PLWBSL32=0. PLWBSL33=1.).

           MPTRISK1=PLTRISK*NOECPS.
           MPTRISK2=PLTRISK*PLWBSDEV.
           MPTRISK3=PLTRISK*SOWDWBS.
           MPTRISK4=PLTRISK*PLSRISK.
           MNOECPS1=NOECPS*PLCONC.
           MNOECPS2=NOECPS*PLDRRFP.
           MNOECPS3=NOECPS*EVSDISP.
           MNOECPS4=NOECPS*TECHDEFN.
           MNOECPS5=NOECPS*UCOSTCD.
           MNOECPS6=NOECPS*COMPLEX.
           MPSRISK1=PLSRISK*PLPRESCH.
           MPSRISK3=PLSRISK*COMPLEX.
           MPRESCH1=PLPRESCH*PLCONC.
           MPRESCH2=PLPRESCH*PLDRRFP.
           MPRESCH3=PLPRESCH*SOWRCWP.
           MPRESCH4=PLPRESCH*EVRCWP.
           MPLAGGR=PLAGGR*SOWSDISP.
           MSOWRC=SOWRCBP*SOWRCWP.
           MPLCONC3=PLCONC*PLSRISK.
```

```
MPRESCH6=PLPRESCH*PLAGGR*PLCONC.
MSOWSINT=SOWSDISP*SOWRCWP*SOWRCBP.
MEVSINT=EVSDISP*EVRCWP*EVRCBP.

IF(MPTRISK2 EQ 0) THEN(DUMMY1=0. DUMMY2=0. DUMMY3=0.).
IF(MPTRISK2 EQ 1) THEN(DUMMY1=1. DUMMY2=0. DUMMY3=0.).
IF(MPTRISK2 EQ 2) THEN(DUMMY1=0. DUMMY2=1. DUMMY3=0.).
IF(MPTRISK2 EQ 3) THEN(DUMMY1=0. DUMMY2=0. DUMMY3=1.).

IF(MPTRISK3 EQ 0) THEN(DUMMY4=0. DUMMY5=0. DUMMY6=0.).
IF(MPTRISK3 EQ 1) THEN(DUMMY4=1. DUMMY5=0. DUMMY6=0.).
IF(MPTRISK3 EQ 2) THEN(DUMMY4=0. DUMMY5=1. DUMMY6=0.).
IF(MPTRISK3 EQ 3) THEN(DUMMY4=0. DUMMY5=0. DUMMY6=1.).

IF(MPLCONC3 EQ 0) THEN(DUMMY7=0. DUMMY8=0. DUMMY9=0.).
IF(MPLCONC3 EQ 1) THEN(DUMMY7=1. DUMMY8=0. DUMMY9=0.).
IF(MPLCONC3 EQ 2) THEN(DUMMY7=0. DUMMY8=1. DUMMY9=0.).
IF(MPLCONC3 EQ 3) THEN(DUMMY7=0. DUMMY8=0. DUMMY9=1.).

IF(MPSRISK1 EQ 0) THEN(DUMMY10=0. DUMMY11=0. DUMMY12=0.).
IF(MPSRISK1 EQ 1) THEN(DUMMY10=1. DUMMY11=0. DUMMY12=0.).
IF(MPSRISK1 EQ 2) THEN(DUMMY10=0. DUMMY11=1. DUMMY12=0.).
IF(MPSRISK1 EQ 3) THEN(DUMMY10=0. DUMMY11=0. DUMMY12=1.).

IF(MPTRISK4 EQ 1) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=0. DUMMY25=0. DUMMY26=0.).
IF(MPTRISK4 EQ 2) THEN(DUMMY22=1. DUMMY23=0. DUMMY24=0. DUMMY25=0. DUMMY26=0.).
IF(MPTRISK4 EQ 3) THEN(DUMMY22=0. DUMMY23=1. DUMMY24=0. DUMMY25=0. DUMMY26=0.).
IF(MPTRISK4 EQ 4) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=1. DUMMY25=0. DUMMY26=0.).
IF(MPTRISK4 EQ 6) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=0. DUMMY25=1. DUMMY26=0.).
IF(MPTRISK4 EQ 9) THEN(DUMMY22=0. DUMMY23=0. DUMMY24=0. DUMMY25=0. DUMMY26=1.).

IF(MPSRISK3 EQ 1) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=0. DUMMY30=0. DUMMY31=0.).
IF(MPSRISK3 EQ 2) THEN(DUMMY27=1. DUMMY28=0. DUMMY29=0. DUMMY30=0. DUMMY31=0.).
IF(MPSRISK3 EQ 3) THEN(DUMMY27=0. DUMMY28=1. DUMMY29=0. DUMMY30=0. DUMMY31=0.).
IF(MPSRISK3 EQ 4) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=1. DUMMY30=0. DUMMY31=0.).
IF(MPSRISK3 EQ 6) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=0. DUMMY30=1. DUMMY31=0.).
IF(MPSRISK3 EQ 9) THEN(DUMMY27=0. DUMMY28=0. DUMMY29=0. DUMMY30=0. DUMMY31=1.).

/GROUP    CODES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
          SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
          SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
          PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
          PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3, MPRESCH1, MPRESCH2,
          MPRESCH3, MPRESCH4, MPLAGGR, MSOWRC, MSOWSINT, MEVSINT,
          MPRESCH6, DUMMY1, DUMMY2, DUMMY3, DUMMY4, DUMMY5, DUMMY6,
          DUMMY7, DUMMY8, DUMMY9, DUMMY10, DUMMY11, DUMMY12, DUMMY22,
          DUMMY23, DUMMY24, DUMMY25, DUMMY26, DUMMY27, DUMMY28, DUMMY29,
          DUMMY30, DUMMY31)=1, 0.

          NAMES(D_DP, PRODOPT, PLPRESCH, PLWBSDEV, PLDRRFP, SOWDWBS,
          SOWSDISP, SOWRCWP, EVSDISP, CTYPE, PLAGGR, PLCONC, SOWCSSR,
          SOWRCBP, SOWFRSI, EVRCWP, EVRCBP, PLSRISK1, PLSRISK2,
          PLTRISK1, PLTRISK2, COMPLEX1, COMPLEX2, PLWBSL31, PLWBSL32,
          PLWBSL33, TECHDEF1, TECHDEF2, TECHDEF3, MPRESCH1, MPRESCH2,
          MPRESCH3, MPRESCH4, MPLAGGR, MSOWRC, MSOWSINT, MEVSINT,
          MPRESCH6, DUMMY1, DUMMY2, DUMMY3, DUMMY4, DUMMY5, DUMMY6,
          DUMMY7, DUMMY8, DUMMY9, DUMMY10, DUMMY11, DUMMY12, DUMMY22,
          DUMMY23, DUMMY24, DUMMY25, DUMMY26, DUMMY27, DUMMY28, DUMMY29,
          DUMMY30, DUMMY31)=YES, NO.

          CODES(PLSRISK, PLTRISK, COMPLEX)=1, 2, 3.
          NAMES(PLSRISK, PLTRISK)=LOW, LOW_MED, OTHER.
          NAMES(COMPLEX)=LOW, MED, HI.

          CODES(TECHDEFN)=1, 2, 3, 4.
          NAMES(TECHDEFN)=DRAFT_A, FULL_A, DRAFT_B, FULL_B.

          CODES(PLWBSL3)=1, 2, 3, 4.
          NAMES(PLWBSL3)='UNDER_2', '2_11', '11_17', 'OVER_17'.
```

```
/REGRESS    DEPEND=SCHEDMOD.
            SETNAMES=SPLSRISK, SPLTRISK, SCOMPLEX, STECHDEF, SPLWBSL3,
            SPTRISK2, SPTRISK3, SPLCONC3, SPSRISK1, SPTRISK4, SPSRISK3.
            SPLSRISK=PLSRISK1, PLSRISK2.
            SPLTRISK=PLTRISK1, PLTRISK2.
            SCOMPLEX=COMPLEX1, COMPLEX2.
            STECHDEF=TECHDEF1, TECHDEF2, TECHDEF3.
            SPLWBSL3=PLWBSL31, PLWBSL32, PLWBSL33.
            SPTRISK2=DUMMY1, DUMMY2, DUMMY3.
            SPTRISK3=DUMMY4, DUMMY5, DUMMY6.
            SPLCONC3=DUMMY7, DUMMY8, DUMMY9.
            SPSRISK1=DUMMY10, DUMMY11, DUMMY12.
            SPTRISK4=DUMMY22, DUMMY23, DUMMY24, DUMMY25, DUMMY26.
            SPSRISK3=DUMMY27, DUMMY28, DUMMY29, DUMMY30, DUMMY31.
            INPVAL=0.1, 0.1.
            OUTPVAL=0.11, 0.11.
            INDEPEND=CTYPE, PLAGGR, PLCONC, PAGESSOW, NODIDS, PLDRRFP,
            SOWCSSR, SOWRCBP, SOWFRSI, NOPMDIDS, NOEVCRIT, EVRCWP,
            EVRCBP, UCOSTCD, D_DP, PRODOPT, NOECPS, PLPRESCH, PLWBSDEV,
            SOWDWBS, SOWSDISP, SOWRCWP, EVSDISP, SPLSRISK, SPLTRISK,
            SCOMPLEX, STECHDEF, SPLWBSL3, SPTRISK2, SPTRISK3, SPLCONC3,
            SPSRISK1, SPTRISK4, SPSRISK3, MPTRISK1, MNOECPS1, MNOECPS2,
            MNOECPS3, MNOECPS4, MNOECPS5, MNOECPS6, MPRESCH1, MPRESCH2,
            MPRESCH3, MPRESCH4, MPLAGGR, MSOWRC, MPRESCH6, MSOWSINT, MEVSINT.
            TOL=0.1.

/PRINT      LEVEL=MINIMAL.
            NO DATA.
            NO CORR.
            STEP.
            ANOVA.
            NO COVA.
            NO PART.
            NO COEF.
            NO FRAT.
            NO RREG.
            CASE=0.
            LINESIZE=80.

/PLOT       RESIDUALS.
            DNORMAL.
            SIZE=60, 25.
            CASEPLOTS.
            XVAR=UCOSTCD.
            YVAR=COOK.
            STEP=ALL.
            NO DATA.

/END

NUMBER OF CASES READ. . . . . . . . . . . . . . .       29
   CASES WITH DATA MISSING OR BEYOND LIMITS . .          6
      REMAINING NUMBER OF CASES . . . . . . . .         23
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DESCRIPTIVE STATISTICS OF DATA
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VARIABLE NO.	NAME	TOTAL FREQ.	MEAN	STANDARD DEV.	SKEW-NESS	KURTOSIS	SMALLEST VALUE	SMALLEST Z-SCR	LARGEST VALUE	LARGEST Z-SCR
3	SCHEDMOD	23	50.965	45.414	0.460	-0.842	-27.900	-1.74	139.70	1.95
6	CTYPE	23	.39130	.49901	0.417	-1.904	0.0000	-0.78	1.0000	1.22
11	PLAGGR	23	.21739	.42174	1.282	-0.367	0.0000	-0.52	1.0000	1.86
12	PLCONC	23	.43478	.50687	0.246	-2.022	0.0000	-0.86	1.0000	1.12
16	PAGESSOW	23	40.783	17.789	0.885	-0.004	17.000	-1.34	87.000	2.60
17	NODIDS	23	61.478	20.956	-0.048	-1.028	25.000	-1.74	100.00	1.84
21	PLDRRFP	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
24	SOWCSSR	23	.43478	.50687	0.246	-2.022	0.0000	-0.86	1.0000	1.12
27	SOWRCBP	23	.65217	.48698	-0.598	-1.711	0.0000	-1.34	1.0000	0.71
28	SOWFRSI	23	.86957	.34435	-2.053	2.322	0.0000	-2.53	1.0000	0.38
29	NOPMDIDS	23	7.4783	2.3716	-0.003	-0.845	3.0000	-1.89	12.000	1.91
30	NOEVCRIT	23	4.0000	2.5226	1.398	1.273	1.0000	-1.19	11.000	2.77
32	EVRCWP	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
33	EVRCBP	23	.65217	.48698	-0.598	-1.711	0.0000	-1.34	1.0000	0.71
5	UCOSTCD	23	9.7290	7.1877	0.473	-0.864	.18103	-1.33	25.738	2.23
7	D_DP	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
8	PRODOPT	23	.56522	.50687	-0.246	-2.022	0.0000	-1.12	1.0000	0.86
9	NOECPS	23	28.696	23.688	1.437	1.311	5.0000	-1.00	95.000	2.80
10	PLPRESCH	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
18	PLWBSDEV	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
23	SOWDWBS	23	.82609	.38755	-1.610	0.624	0.0000	-2.13	1.0000	0.45
25	SOWSDISP	23	.78261	.42174	-1.282	-0.367	0.0000	-1.86	1.0000	0.52
26	SOWRCWP	23	.78261	.42174	-1.282	-0.367	0.0000	-1.86	1.0000	0.52
31	EVSDISP	23	.56522	.50687	-0.246	-2.022	0.0000	-1.12	1.0000	0.86
13	PLSRISK	23	2.2609	.91539	-0.501	-1.663	1.0000	-1.38	3.0000	0.81
34	PLSRISK1	23	.13043	.34435	2.053	2.322	0.0000	-0.38	1.0000	2.53
35	PLSRISK2	23	.56522	.50687	-0.246	-2.022	0.0000	-1.12	1.0000	0.86
14	PLTRISK	23	2.1304	.96786	-0.245	-1.932	1.0000	-1.17	3.0000	0.90
36	PLTRISK1	23	.08696	.28810	2.743	5.779	0.0000	-0.30	1.0000	3.17
37	PLTRISK2	23	.52174	.51075	-0.081	-2.078	0.0000	-1.02	1.0000	0.94
15	COMPLEX	23	2.0435	.70571	-0.053	-1.080	1.0000	-1.48	3.0000	1.36
38	COMPLEX1	23	.52174	.51075	-0.081	-2.078	0.0000	-1.02	1.0000	0.94
39	COMPLEX2	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
22	TECHDEFN	23	2.6522	1.1912	-0.115	-1.601	1.0000	-1.39	4.0000	1.13
40	TECHDEF1	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
41	TECHDEF2	23	.17391	.38755	1.610	0.624	0.0000	-0.45	1.0000	2.13
42	TECHDEF3	23	.34783	.48698	0.598	-1.711	0.0000	-0.71	1.0000	1.34
19	PLWBSL3	23	13.957	16.291	1.992	3.866	0.0000	-0.86	70.000	3.44
43	PLWBSL31	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
44	PLWBSL32	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
45	PLWBSL33	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
68	DUMMY1	23	.30435	.47047	0.796	-1.423	0.0000	-0.65	1.0000	1.48
69	DUMMY2	23	0.0000	0.0000			0.0000		0.0000	
70	DUMMY3	23	.52174	.51075	-0.081	-2.078	0.0000	-1.02	1.0000	0.94
71	DUMMY4	23	.34783	.48698	0.598	-1.711	0.0000	-0.71	1.0000	1.34
72	DUMMY5	23	0.0000	0.0000			0.0000		0.0000	
73	DUMMY6	23	.47826	.51075	0.081	-2.078	0.0000	-0.94	1.0000	1.02
74	DUMMY7	23	.08696	.28810	2.743	5.779	0.0000	-0.30	1.0000	3.17
75	DUMMY8	23	.08696	.28810	2.743	5.779	0.0000	-0.30	1.0000	3.17
76	DUMMY9	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
77	DUMMY10	23	.26087	.44898	1.019	-1.000	0.0000	-0.58	1.0000	1.65
78	DUMMY11	23	.13043	.34435	2.053	2.322	0.0000	-0.38	1.0000	2.53
79	DUMMY12	23	.43478	.50687	0.246	-2.022	0.0000	-0.86	1.0000	1.12
80	DUMMY22	23	.13043	.34435	2.053	2.322	0.0000	-0.38	1.0000	2.53
81	DUMMY23	23	.21739	.42174	1.282	-0.367	0.0000	-0.52	1.0000	1.86
82	DUMMY24	23	.04348	.20851	4.188	16.255	0.0000	-0.21	1.0000	4.59
83	DUMMY25	23	0.0000	0.0000			0.0000		0.0000	
84	DUMMY26	23	.43478	.50687	0.246	-2.022	0.0000	-0.86	1.0000	1.12
85	DUMMY27	23	.13043	.34435	2.053	2.322	0.0000	-0.38	1.0000	2.53
86	DUMMY28	23	.13043	.34435	2.053	2.322	0.0000	-0.38	1.0000	2.53
87	DUMMY29	23	.08696	.28810	2.743	5.779	0.0000	-0.30	1.0000	3.17
88	DUMMY30	23	.34783	.48698	0.598	-1.711	0.0000	-0.71	1.0000	1.34
89	DUMMY31	23	.17391	.38755	1.610	0.624	0.0000	-0.45	1.0000	2.13
46	MPTRISK1	23	62.000	70.336	2.189	3.933	8.0000	-0.77	285.00	3.17
47	MPTRISK2	23	1.8696	1.2542	-0.295	-1.727	0.0000	-1.49	3.0000	0.90

48	MPTRISK3	23	1.7826	1.2416	-0.151	-1.764	0.0000	-1.44	3.0000	0.98
49	MPTRISK4	23	5.1739	3.5117	0.121	-1.921	1.0000	-1.19	9.0000	1.09
50	MNOECPS1	23	7.6087	11.220	1.354	0.784	0.0000	-0.68	39.000	2.80
51	MNOECPS2	23	20.739	21.299	1.858	3.908	0.0000	-0.97	95.000	3.49
52	MNOECPS3	23	20.348	27.874	1.361	0.792	0.0000	-0.73	95.000	2.68
53	MNOECPS4	23	68.783	59.749	1.680	2.180	5.0000	-1.07	255.00	3.12
54	MNOECPS5	23	343.63	460.03	2.032	4.193	3.6207	-0.74	1971.3	3.54
55	MNOECPS6	23	64.565	66.373	1.766	2.875	5.0000	-0.90	285.00	3.32
56	MPSRISK1	23	1.8261	1.1929	-0.296	-1.577	0.0000	-1.53	3.0000	0.98
57	MPSRISK3	23	4.7826	2.6961	0.154	-1.265	1.0000	-1.40	9.0000	1.56
58	MPRESCH1	23	.34783	.48698	0.598	-1.711	0.0000	-0.71	1.0000	1.34
59	MPRESCH2	23	.65217	.48698	-0.598	-1.711	0.0000	-1.34	1.0000	0.71
60	MPRESCH3	23	.60870	.49901	-0.417	-1.904	0.0000	-1.22	1.0000	0.78
61	MPRESCH4	23	.65217	.48698	-0.598	-1.711	0.0000	-1.34	1.0000	0.71
65	MPRESCH6	23	.08696	.28810	2.743	5.779	0.0000	-0.30	1.0000	3.17
62	MPLAGGR	23	.21739	.42174	1.282	-0.367	0.0000	-0.52	1.0000	1.86
63	MSOWRC	23	.65217	.48698	-0.598	-1.711	0.0000	-1.34	1.0000	0.71
64	MPLCONC3	23	1.0435	1.3307	0.589	-1.544	0.0000	-0.78	3.0000	1.47
66	MSOWSINT	23	.47826	.51075	0.081	-2.078	0.0000	-0.94	1.0000	1.02
67	MEVSINT	23	.43478	.50687	0.246	-2.022	0.0000	-0.86	1.0000	1.12

*** N O T E *** KURTOSIS VALUES GREATER THAN ZERO INDICATE A DISTRIBUTION WITH HEAVIER TAILS THAN NORMAL DISTRIBUTION.

STEP NO. 0

STD. ERROR OF EST. 45.4135

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE
RESIDUAL	45372.512	22	2062.387

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	50.9652)			

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	-0.1434	1.0000	0.44(1)
PLAGGR	0.0699	1.0000	0.10(1)
PLCONC	-0.0726	1.0000	0.11(1)
PAGESSOW	0.1534	1.0000	0.51(1)
NODIDS	-0.0515	1.0000	0.06(1)
PLDRRFP	-0.2801	1.0000	1.79(1)
SOWCSSR	-0.0114	1.0000	0.00(1)
SOWRCBP	-0.1317	1.0000	0.37(1)
SOWFRSI	0.0878	1.0000	0.16(1)
NOPMDIDS	0.2471	1.0000	1.37(1)
NOEVCRIT	-0.0548	1.0000	0.06(1)
EVRCWP	0.2021	1.0000	0.89(1)
EVRCBP	0.1497	1.0000	0.48(1)
UCOSTCD	0.3910	1.0000	3.79(1)
D_DP	-0.0963	1.0000	0.20(1)
PRODOPT	0.1146	1.0000	0.28(1)
NOECPS	0.7793	1.0000	32.48(1)
PLPRESCH	-0.4464	1.0000	5.23(1)
PLWBSDEV	0.2070	1.0000	0.94(1)
SOWDWBS	0.1732	1.0000	0.65(1)
SOWSDISP	-0.0559	1.0000	0.0[illegible](1)
SOWRCWP	-0.1112	1.0000	0.26(1)
EVSDISP	0.2785	1.0000	1.77(1)
PLSRISK	0.0015	1.0000	0.00(0)
		F=	0.63
SET SPLSRISK			P=0.54269(1)
PLSRISK1	-0.2421	1.0000	(1)
PLSRISK2	0.0836	1.0000	(1)
PLTRISK	0.0023	1.0000	0.00(0)
		F=	0.01
SET SPLTRISK			P=0.99298(1)
PLTRISK1	-0.0265	1.0000	(1)
PLTRISK2	0.0096	1.0000	(1)
COMPLEX	0.3813	1.0000	3.57(0)
		F=	1.75
SET SCOMPLEX			P=0.19921(1)
COMPLEX1	0.0349	1.0000	(1)
COMPLEX2	0.2798	1.0000	(1)
TECHDEFN	-0.0400	1.0000	0.03(0)
		F=	0.37
SET STECHDEF			P=0.77325(1)
TECHDEF1	0.2189	1.0000	(1)
TECHDEF2	-0.1355	1.0000	(1)
TECHDEF3	-0.0280	1.0000	(1)
PLWBSL3	0.0694	1.0000	0.10(0)
		F=	2.16
SET SPLWBSL3			P=0.12686(1)
PLWBSL31	0.4951	1.0000	(1)
PLWBSL32	-0.1574	1.0000	(1)
PLWBSL33	-0.1123	1.0000	(1)
		F=	0.56
SET SPTRISK2			P=0.57841(1)
DUMMY1	0.1601	1.0000	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	0.0096	1.0000	(1)

			F= 0.31
SET SPTRISK3			P=0.73740(1)
DUMMY4	0.0606	1.0000	(1)
DUMMY5	0.0000	1.0000	(1)
DUMMY6	0.0736	1.0000	(1)
			F= 0.18
SET SPLCONC3			P=0.90593(1)
DUMMY7	0.0579	1.0000	(1)
DUMMY8	-0.1575	1.0000	(1)
DUMMY9	-0.0180	1.0000	(1)
			F= 1.98
SET SPSRISK1			P=0.15132(1)
DUMMY10	0.0236	1.0000	(1)
DUMMY11	-0.2421	1.0000	(1)
DUMMY12	-0.1978	1.0000	(1)
			F= 0.32
SET SPTRISK4			P=0.85948(1)
DUMMY22	-0.0436	1.0000	(1)
DUMMY23	-0.1211	1.0000	(1)
DUMMY24	-0.1822	1.0000	(1)
DUMMY25	0.0000	1.0000	(1)
DUMMY26	0.0971	1.0000	(1)
			F= 0.90
SET SPSRISK3			P=0.50332(1)
DUMMY27	0.1366	1.0000	(1)
DUMMY28	-0.2627	1.0000	(1)
DUMMY29	-0.1964	1.0000	(1)
DUMMY30	0.0012	1.0000	(1)
DUMMY31	0.3327	1.0000	(1)
MPTRISK1	0.6610	1.0000	16.29(1)
MPTRISK2	0.0718	1.0000	0.11(0)
MPTRISK3	0.1147	1.0000	0.28(0)
MPTRISK4	0.0462	1.0000	0.04(0)
MNOECPS1	0.2324	1.0000	1.20(1)
MNOECPS2	0.4675	1.0000	5.87(1)
MNOECPS3	0.6305	1.0000	13.86(1)
MNOECPS4	0.7482	1.0000	26.71(1)
MNOECPS5	0.7031	1.0000	20.53(1)
MNOECPS6	0.7503	1.0000	27.05(1)
MPSRISK1	-0.3830	1.0000	3.61(0)
MPSRISK3	0.2711	1.0000	1.67(0)
MPRESCH1	-0.2333	1.0000	1.21(1)
MPRESCH2	-0.5781	1.0000	10.54(1)
MPRESCH3	-0.4407	1.0000	5.06(1)
MPRESCH4	-0.1944	1.0000	0.82(1)
MPRESCH6	-0.1658	1.0000	0.59(1)
MPLAGGR	0.0699	1.0000	0.10(1)
MSOWRC	-0.1317	1.0000	0.37(1)
MPLCONC3	-0.0739	1.0000	0.12(0)
MSOWSINT	-0.1123	1.0000	0.27(1)
MEVSINT	0.0682	1.0000	0.10(1)

STEP NO. 1

VARIABLE ENTERED 9 NOECPS

MULTIPLE R 0.7793
MULTIPLE R-SQUARE 0.6073
ADJUSTED R-SQUARE 0.5886

STD. ERROR OF EST. 29.1276

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	27555.752	1	27555.75	32.48
RESIDUAL	17816.762	21	848.4172	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	8.0927)			
NOECPS	1.4940	0.2622	1.0000	32.48(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.1577	0.9071	0.51(1)
PLAGGR	-0.1911	0.9429	0.76(1)
PLCONC	0.4541	0.8204	5.20(1)
PAGESSOW	0.2181	0.9995	1.00(1)
NODIDS	0.2806	0.9202	1.71(1)
PLDRRFP	-0.0285	0.8859	0.02(1)
SOWCSSR	0.2917	0.9414	1.86(1)
SOWRCBP	-0.1104	0.9935	0.25(1)
SOWFRSI	0.1464	1.0000	0.44(1)
NOPMDIDS	0.5661	0.9820	9.43(1)
NOEVCRIT	0.1805	0.9550	0.67(1)
EVRCWP	0.4111	0.9950	4.07(1)
EVRCBP	0.3959	0.9847	3.72(1)
UCOSTCD	0.1434	0.8434	0.42(1)
D_DP	-0.0732	0.9958	0.11(1)
PRODOPT	0.2974	0.9917	1.94(1)
PLPRESCH	-0.7172	1.0000	21.18(1)
PLWBSDEV	0.1302	0.9737	0.35(1)
SOWDWBS	0.0693	0.9720	0.10(1)
SOWSDISP	-0.0298	0.9977	0.02(1)
SOWRCWP	0.0180	0.9753	0.01(1)
EVSDISP	-0.0028	0.8708	0.00(1)
PLSRISK	0.0473	0.9987	0.04(0)
		F=	0.18
SET SPLSRISK			P=0.83783(1)
PLSRISK1	-0.1322	0.9573	(1)
PLSRISK2	0.0866	0.9986	(1)
PLTRISK	-0.0455	0.9984	0.04(0)
		F=	0.03
SET SPLTRISK			P=0.96992(1)
PLTRISK1	0.0356	0.9961	(1)
PLTRISK2	-0.0532	0.9970	(1)
COMPLEX	0.1589	0.8626	0.52(0)
		F=	0.25
SET SCOMPLEX			P=0.78141(1)
COMPLEX1	0.0060	0.9984	(1)
COMPLEX2	0.1169	0.9279	(1)
TECHDEFN	0.2843	0.9264	1.76(0)
		F=	1.34
SET STECHDEF			P=0.29357(1)
TECHDEF1	-0.0913	0.8777	(1)
TECHDEF2	-0.2546	0.9991	(1)
TECHDEF3	0.4096	0.8810	(1)
PLWBSL3	0.0081	0.9932	0.00(0)
		F=	0.45
SET SPLWBSL3			P=0.71825(1)
PLWBSL31	0.2553	0.7954	(1)
PLWBSL32	-0.0274	0.9675	(1)
PLWBSL33	-0.0829	0.9940	(1)

		F=	0.34	
SET SPTRISK2		P=0.71858		(1)
DUMMY1	0.1639	0.9945		(1)
DUMMY2	0.0000	1.0000		(1)
DUMMY3	-0.0532	0.9970		(1)
		F=	0.05	
SET SPTRISK3		P=0.95007		(1)
DUMMY4	0.0456	0.9983		(1)
DUMMY5	0.0000	1.0000		(1)
DUMMY6	0.0085	0.9923		(1)
		F=	1.68	
SET SPLCONC3		P=0.20698		(1)
DUMMY7	0.1789	0.9952		(1)
DUMMY8	0.0259	0.9505		(1)
DUMMY9	0.3487	0.9151		(1)
		F=	6.46	
SET SPSRISK1		P=0.00370		(1)
DUMMY10	-0.1381	0.9803		(1)
DUMMY11	-0.1322	0.9573		(1)
DUMMY12	-0.3394	0.9996		(1)
		F=	0.53	
SET SPTRISK4		P=0.71683		(1)
DUMMY22	0.2063	0.9526		(1)
DUMMY23	-0.1285	0.9973		(1)
DUMMY24	-0.2487	0.9988		(1)
DUMMY25	0.0000	1.0000		(1)
DUMMY26	0.0701	0.9953		(1)
		F=	0.57	
SET SPSRISK3		P=0.71913		(1)
DUMMY27	-0.0601	0.9505		(1)
DUMMY28	-0.3091	0.9920		(1)
DUMMY29	-0.1376	0.9797		(1)
DUMMY30	0.1179	0.9914		(1)
DUMMY31	0.1924	0.9225		(1)
MPTRISK1	-0.0745	0.2310	0.11	(1)
MPTRISK2	-0.0035	0.9910	0.00	(0)
MPTRISK3	0.0285	0.9845	0.02	(0)
MPTRISK4	0.0254	0.9985	0.01	(0)
MNOECPS1	0.5739	0.9752	9.82	(1)
MNOECPS2	0.0638	0.6895	0.08	(1)
MNOECPS3	-0.2926	0.1760	1.87	(1)
MNOECPS4	0.2740	0.2930	1.62	(1)
MNOECPS5	-0.0119	0.1788	0.00	(1)
MNOECPS6	0.0361	0.0897	0.03	(1)
MPSRISK1	-0.5592	0.9982	9.10	(0)
MPSRISK3	0.1925	0.9616	0.77	(0)
MPRESCH1	0.1368	0.8398	0.38	(1)
MPRESCH2	-0.6142	0.9294	12.11	(1)
MPRESCH3	-0.5465	0.9832	8.52	(1)
MPRESCH4	-0.2447	0.9972	1.27	(1)
MPRESCH6	-0.0883	0.9797	0.16	(1)
MPLAGGR	-0.1911	0.9429	0.76	(1)
MSOWRC	-0.1104	0.9935	0.25	(1)
MPLCONC3	0.4238	0.8350	4.38	(0)
MSOWSINT	-0.0081	0.9810	0.00	(1)
MEVSINT	0.1464	0.9991	0.44	(1)

STEP NO. 2

VARIABLE ENTERED 10 PLPRESCH

MULTIPLE R	0.8996
MULTIPLE R-SQUARE	0.8093
ADJUSTED R-SQUARE	0.7902

STD. ERROR OF EST. 20.8006

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	36719.246	2	18359.62	42.43
RESIDUAL	8653.2676	20	432.6634	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE (L)
(CONSTANT	51.4996)			
NOECPS	1.4974	0.1872	1.0000	63.97(1)
PLPRESCH	-52.6612	11.4429	1.0000	21.18(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER (L)
CTYPE	0.3749	0.8891	3.11(1)
PLAGGR	-0.0195	0.8849	0.01(1)
PLCONC	0.5861	0.8169	9.94(1)
PAGESSON	0.2935	0.9992	1.79(1)
NODIDS	0.4335	0.9194	4.40(1)
PLDRRFP	-0.2766	0.8421	1.57(1)
SONCSSR	0.3561	0.9378	2.76(1)
SONRCBP	-0.0068	0.9719	0.00(1)
SONFRSI	0.0276	0.9684	0.01(1)
NOPMDIDS	0.4344	0.8225	4.42(1)
NOEVCRIT	0.1627	0.9465	0.52(1)
EVRCWP	0.3816	0.9508	3.24(1)
EVRCBP	0.2349	0.8727	1.11(1)
UCOSTCD	0.1037	0.8350	0.21(1)
D_DP	-0.0930	0.9957	0.17(1)
PRODOPT	0.2541	0.9626	1.31(1)
PLWBSDEV	0.2835	0.9653	1.66(1)
SONDWBS	0.1958	0.9637	0.76(1)
SONSDISP	-0.0052	0.9964	0.00(1)
SONRCWP	-0.2325	0.9171	1.09(1)
EVSDISP	0.0612	0.8673	0.07(1)
PLSRISK	-0.0587	0.9837	0.07(0)
		F=	0.03
SET SPLSRISK			P=0.96886(1)
PLSRISK1	-0.0020	0.9254	(1)
PLSRISK2	-0.0527	0.9693	(1)
PLTRISK	-0.1253	0.9951	0.30(0)
		F=	0.70
SET SPLTRISK			P=0.50768(1)
PLTRISK1	-0.2308	0.9257	(1)
PLTRISK2	-0.0559	0.9966	(1)
COMPLEX	0.0751	0.8434	0.11(0)
		F=	0.82
SET SCOMPLEX			P=0.45786(1)
COMPLEX1	0.2741	0.9362	(1)
COMPLEX2	-0.1039	0.8649	(1)
TECHDEFN	0.5865	0.9010	9.96(0)
		F=	6.24
SET STECHDEF			P=0.00472(1)
TECHDEF1	-0.4224	0.8146	(1)
TECHDEF2	-0.1521	0.9548	(1)
TECHDEF3	0.6961	0.8718	(1)
PLWBSL3	0.0398	0.9924	0.03(0)
		F=	0.59
SET SPLWBSL3			P=0.62746(1)
PLWBSL31	0.0792	0.7321	(1)
PLWBSL32	0.2567	0.8928	(1)
PLWBSL33	-0.1070	0.9938	(1)

		F=	1.32
SET SPTRISK2		P=0.29207(1)	
DUMMY1	0.2913	0.9916	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.0559	0.9966	(1)
		F=	0.47
SET SPTRISK3		P=0.63440(1)	
DUMMY4	0.1630	0.9895	(1)
DUMMY5	0.0000	1.0000	(1)
DUMMY6	-0.0088	0.9919	(1)
		F=	3.63
SET SPLCONC3		P=0.03433(1)	
DUMMY7	0.4072	0.9751	(1)
DUMMY8	0.1896	0.9302	(1)
DUMMY9	0.2411	0.8532	(1)
		F=	0.07
SET SPSRISK1		P=0.92805(1)	
DUMMY10	0.0880	0.9063	(1)
DUMMY11	-0.0020	0.9254	(1)
DUMMY12	-0.0796	0.8377	(1)
		F=	0.74
SET SPTRISK4		P=0.58010(1)	
DUMMY22	0.1269	0.9263	(1)
DUMMY23	-0.2217	0.9960	(1)
DUMMY24	-0.2572	0.9892	(1)
DUMMY25	0.0000	1.0000	(1)
DUMMY26	0.0381	0.9917	(1)
		F=	0.46
SET SPSRISK3		P=0.79957(1)	
DUMMY27	0.1021	0.9193	(1)
DUMMY28	-0.2638	0.9603	(1)
DUMMY29	-0.0502	0.9595	(1)
DUMMY30	0.2681	0.9824	(1)
DUMMY31	-0.1624	0.7659	(1)
MPTRISK1	-0.0536	0.2304	0.05(1)
MPTRISK2	0.0408	0.9890	0.03(0)
MPTRISK3	0.0532	0.9844	0.05(0)
MPTRISK4	-0.0431	0.9925	0.04(0)
MNOECPS1	0.6538	0.9454	14.18(1)
MNOECPS2	-0.1257	0.6595	0.30(1)
MNOECPS3	-0.2425	0.1705	1.19(1)
MNOECPS4	0.4402	0.2924	4.57(1)
MNOECPS5	0.0028	0.1787	0.00(1)
MNOECPS6	-0.0201	0.0893	0.01(1)
MPSRISK1	-0.0900	0.4822	0.16(0)
MPSRISK3	0.0078	0.8960	0.00(0)
MPRESCH1	0.6175	0.7265	11.71(1)
MPRESCH2	-0.2766	0.5334	1.57(1)
MPRESCH3	-0.2325	0.6551	1.09(1)
MPRESCH4	0.3816	0.6022	3.24(1)
MPRESCH6	0.0213	0.9595	0.01(1)
MPLAGGR	-0.0195	0.8849	0.01(1)
MSOWRC	-0.0068	0.9719	0.00(1)
MPLCONC3	0.4352	0.8096	4.44(0)
MSOWSINT	-0.0318	0.9807	0.02(1)
MEVSINT	0.1483	0.9955	0.43(1)

STEP NO. 3

VARIABLE ENTERED 50 MNOECPS1

MULTIPLE R 0.9438
MULTIPLE R-SQUARE 0.8908
ADJUSTED R-SQUARE 0.8736

STD. ERROR OF EST. 16.1485

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	40417.828	3	13472.61	51.66
RESIDUAL	4954.6831	19	260.7728	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	35.0189)			
NOECPS	1.5856	0.1472	0.9746	116.01(1)
PLPRESCH	-46.7239	9.0225	0.9695	26.82(1)
MNOECPS1	1.1885	0.3156	0.9454	14.18(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.1062	0.6973	0.21(1)
PLAGGR	-0.0822	0.8811	0.12(1)
PLCONC	0.1249	0.2781	0.29(1)
PAGESSON	0.3036	0.9893	1.83(1)
NODIDS	0.3418	0.8454	2.38(1)
PLDRRFP	-0.1166	0.7693	0.25(1)
SOWCSSR	0.1751	0.8194	0.57(1)
SOWRCBP	-0.1255	0.9546	0.29(1)
SOWFRSI	-0.1833	0.9089	0.63(1)
NOPMDIDS	0.4368	0.7999	4.25(1)
NOEVCRIT	0.3397	0.9278	2.35(1)
EVRCWP	0.2687	0.8733	1.40(1)
EVRCBP	0.0305	0.7800	0.02(1)
UCOSTCD	-0.0859	0.7808	0.13(1)
D_DP	0.2003	0.8676	0.75(1)
PRODOPT	-0.0256	0.7963	0.01(1)
PLWBSDEV	0.0535	0.8286	0.05(1)
SOWDWBS	0.0573	0.9104	0.06(1)
SOWSDISP	-0.1536	0.9685	0.44(1)
SOWRCWP	-0.1681	0.8926	0.52(1)
EVSDISP	0.0699	0.8672	0.09(1)
PLSRISK	-0.0986	0.9831	0.18(0)
		F=	0.09
SET SPLSRISK		P=0.91577(1)	
PLSRISK1	-0.0138	0.9253	(1)
PLSRISK2	-0.0851	0.9690	(1)
PLTRISK	-0.2003	0.9935	0.75(0)
		F=	0.40
SET SPLTRISK		P=0.67737(1)	
PLTRISK1	-0.0585	0.8488	(1)
PLTRISK2	-0.1755	0.9831	(1)
COMPLEX	-0.1000	0.7997	0.18(0)
		F=	0.15
SET SCOMPLEX		P=0.86182(1)	
COMPLEX1	0.0982	0.8455	(1)
COMPLEX2	-0.1308	0.8649	(1)
TECHDEFN	0.5088	0.7942	6.29(0)
		F=	3.71
SET STECHDEF		P=0.03373(1)	
TECHDEF1	-0.3450	0.7592	(1)
TECHDEF2	-0.1019	0.9420	(1)
TECHDEF3	0.6095	0.7130	(1)
PLWBSL3	0.0138	0.9904	0.00(0)
		F=	1.37
SET SPLWBSL3		P=0.28638(1)	
PLWBSL31	-0.3427	0.5697	(1)
PLWBSL32	0.3271	0.8927	(1)
PLWBSL33	-0.1190	0.9932	(1)

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                          F=     0.49
SET SPTRISK2              P=0.62016(1)
DUMMY1    0.2337 0.9597          (1)
DUMMY2    0.0000 1.0000          (1)
DUMMY3   -0.1755 0.9831          (1)
                          F=     0.42
SET SPTRISK3              P=0.66328(1)
DUMMY4    0.2165 0.9895          (1)
DUMMY5    0.0000 1.0000          (1)
DUMMY6   -0.1672 0.9608          (1)
                          F=     0.33
SET SPLCONC3              P=0.80324(1)
DUMMY7    0.1410 0.7508          (1)
DUMMY8    0.1475 0.9167          (1)
DUMMY9   -0.1174 0.6506          (1)
                          F=     0.01
SET SPSRISK1              P=0.98599(1)
DUMMY10   0.0406 0.8993          (1)
DUMMY11  -0.0138 0.9253          (1)
DUMMY12  -0.0276 0.8310          (1)
                          F=     0.43
SET SPTRISK4              P=0.78541(1)
DUMMY22   0.2127 0.9238          (1)
DUMMY23   0.0492 0.8433          (1)
DUMMY24  -0.2203 0.9696          (1)
DUMMY25   0.0000 1.0000          (1)
DUMMY26  -0.1531 0.9389          (1)
                          F=     0.34
SET SPSRISK3              P=0.87961(1)
DUMMY27  -0.1062 0.8500          (1)
DUMMY28  -0.1245 0.8931          (1)
DUMMY29  -0.0145 0.9560          (1)
DUMMY30   0.1768 0.9391          (1)
DUMMY31  -0.2064 0.7658          (1)
MPTRISK1-0.0895 0.2303       0.15(1)
MPTRISK2-0.1303 0.9455       0.31(0)
MPTRISK3-0.1216 0.9373       0.27(0)
MPTRISK4-0.1816 0.9725       0.61(0)
MNOECPS2 0.0023 0.6345       0.00(1)
MNOECPS3-0.0665 0.1554       0.08(1)
MNOECPS4 0.2493 0.2432       1.19(1)
MNOECPS5-0.0288 0.1784       0.01(1)
MNOECPS6-0.0157 0.0893       0.00(1)
MPSRISK1-0.0364 0.4778       0.02(0)
MPSRISK3-0.1066 0.8798       0.21(0)
MPRESCH1 0.3211 0.4024       2.07(1)
MPRESCH2-0.1166 0.4872       0.25(1)
MPRESCH3-0.1681 0.6376       0.52(1)
MPRESCH4 0.2687 0.5531       1.40(1)
MPRESCH6-0.2512 0.8679       1.21(1)
MPLAGGR -0.0822 0.8811       0.12(1)
MSOWRC  -0.1255 0.9546       0.29(1)
MPLCONC3-0.0124 0.4393       0.00(0)
MSOWSINT-0.1880 0.9536       0.66(1)
MEVSINT  0.0968 0.9822       0.17(1)
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STEP NO. 4

VARIABLE ENTERED SET STECHDEF
40 TECHDEF1
41 TECHDEF2
42 TECHDEF3

MULTIPLE R	0.9673
MULTIPLE R-SQUARE	0.9356
ADJUSTED R-SQUARE	0.9114
STD. ERROR OF EST.	13.5165

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	42449.391	6	7074.898	38.73
RESIDUAL	2923.1252	16	182.6953	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	33.4358)			
NOECPS	1.7477	0.1341	0.8226	169.77(1)
PLPRESCH	-53.8783	8.1033	0.8420	44.21(1)
			F=	3.71
SET STECHDEF				P=0.03373(1)
TECHDEF1	-6.5570	8.541	0.5647	(1)
TECHDEF2	2.4086	9.2006	0.6531	(1)
TECHDEF3	21.3912	8.3170	0.5062	(1)
MNOECPS1	0.7541	0.2948	0.7592	6.54(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.0166	0.5747	0.00(1)
PLAGGR	0.0627	0.8363	0.06(1)
PLCONC	0.0839	0.2279	(0.749)(1)
PAGESSON	0.3281	0.6155	1.81(1)
NODIDS	0.5257	0.6845	5.73(1)
PLDRRFP	-0.2500	0.6076	1.00(1)
SOWCSSR	0.1311	0.7421	0.26(1)
SOWRCBP	-0.2487	0.9348	0.99(1)
SOWFRSI	-0.1824	0.8560	0.52(1)
NOPMDIDS	0.4245	0.7435	3.30(1)
NOEVCRIT	-0.0285	0.6342	0.01(1)
EVRCWP	0.0638	0.6278	0.06(1)
EVRCBP	-0.1439	0.4807	0.32(1)
UCOSTCD	-0.2418	0.5658	0.93(1)
D_DP	0.4820	0.6551	4.54(1)
PRODOPT	-0.1931	0.7438	0.58(1)
PLWBSDEV	-0.0001	0.7469	0.00(1)
SOWDWBS	0.0420	0.9005	0.03(1)
SOWSDISP	-0.0304	0.9234	0.01(1)
SOWRCWP	-0.2637	0.8052	1.12(1)
EVSDISP	-0.0797	0.7445	0.10(1)
PLSRISK	-0.2659	0.8733	1.14(0)
		F=	0.82
SET SPLSRISK			P=0.46114(1)
PLSRISK1	-0.1149	0.8109	(1)
PLSRISK2	-0.1962	0.9301	(1)
PLTRISK	-0.2531	0.9011	1.03(0)
		F=	0.50
SET SPLTRISK			P=0.61804(1)
PLTRISK1	0.0610	0.7967	(1)
PLTRISK2	-0.2569	0.8942	(1)
COMPLEX	-0.1655	0.4677	0.42(0)
		F=	0.23
SET SCOMPLEX			P=0.79556(1)
COMPLEX1	0.0830	0.8216	(1)
COMPLEX2	-0.1697	0.6023	(1)
TECHDEFN	0.0000	1.0000	0.00(0)
PLWBSL3	-0.0598	0.4862	0.05(0)
		F=	0.30
SET SPLWBSL3			P=0.82616(1)
PLWBSL31	-0.1311	0.4161	(1)
PLWBSL32	0.1838	0.7161	(1)
PLWBSL33	-0.1382	0.3400	(1)

			F= 0.61
SET SPTRISK2			P=0.55654(1)
DUMMY1	0.2715	0.9439	(1)
DUMMY2	0.0000	1.0000	(1)
DUMMY3	-0.2569	0.8942	(1)
			F= 0.78
SET SPTRISK3			P=0.47724(1)
DUMMY4	0.3099	0.9227	(1)
DUMMY5	0.0000	1.0000	(1)
DUMMY6	-0.2647	0.9179	(1)
			F= 0.60
SET SPLCONC3			P=0.62489(1)
DUMMY7	0.3063	0.6540	(1)
DUMMY8	-0.0817	0.8000	(1)
DUMMY9	-0.0838	0.6363	(1)
			F= 0.52
SET SPSRISK1			P=0.60348(1)
DUMMY10	0.2544	0.7864	(1)
DUMMY11	-0.1149	0.8109	(1)
DUMMY12	-0.1433	0.8172	(1)
			F= 0.35
SET SPTRISK4			P=0.84236(1)
DUMMY22	0.0297	0.8037	(1)
DUMMY23	0.1102	0.8326	(1)
DUMMY24	-0.0783	0.7945	(1)
DUMMY25	0.0000	1.0000	(1)
DUMMY26	-0.2702	0.9175	(1)
			F= 1.17
SET SPSRISK3			P=0.38169(1)
DUMMY27	-0.1421	0.6217	(1)
DUMMY28	-0.1678	0.8293	(1)
DUMMY29	0.0035	0.8572	(1)
DUMMY30	0.0867	0.8737	(1)
DUMMY31	-0.2340	0.6122	(1)
MPTRISK1	-0.2039	0.2043	0.65(1)
MPTRISK2	-0.2162	0.8380	0.74(0)
MPTRISK3	-0.2056	0.9113	0.66(0)
MPTRISK4	-0.2903	0.9610	1.38(0)
MNOECPS2	0.0766	0.5206	0.09(1)
MNOECPS3	-0.1042	0.1523	0.16(1)
MNOECPS4	-0.2929	0.0702	1.41(1)
MNOECPS5	-0.0575	0.1215	0.05(1)
MNOECPS6	0.1075	0.0477	0.18(1)
MPSRISK1	-0.2086	0.4503	0.68(0)
MPSRISK3	-0.2380	0.6348	0.90(0)
MPRESCH1	0.3434	0.3684	2.00(1)
MPRESCH2	-0.2500	0.3848	1.00(1)
MPRESCH3	-0.2637	0.5752	1.12(1)
MPRESCH4	0.0638	0.3976	0.06(1)
MPRESCH6	0.0460	0.6043	0.03(1)
MPLAGGR	0.0627	0.8363	0.06(1)
MSOWRC	-0.2487	0.9348	0.99(1)
MPLCONC3	-0.0707	0.4182	0.08(0)
MSOWSINT	-0.2020	0.9245	0.64(1)
MEVSINT	-0.0294	0.8086	0.01(1)

STEP NO. 5

VARIABLE ENTERED 17 NODIDS

MULTIPLE R	0.9764
MULTIPLE R-SQUARE	0.9534
ADJUSTED R-SQUARE	0.9316

STD. ERROR OF EST. 11.8749

ANALYSIS OF VARIANCE

	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO
REGRESSION	43257.324	7	6179.618	43.82
RESIDUAL	2115.1907	15	141.0127	

VARIABLES IN EQUATION

VARIABLE	COEFF.	STD.ERR OF COEFF	TOL.	F AND P REMOVE(L)
(CONSTANT	15.5941)			
NODIDS	0.3495	0.1460	0.6845	5.73(1)
NOECPS	1.8317	0.1230	0.7555	221.92(1)
PLPRESCH	-54.4655	7.1234	0.8410	58.46(1)
			F=	5.34
SET STECHDEF				P=0.01052(1)
TECHDEF1	-11.2717	7.758	0.5283	(1)
TECHDEF2	-6.8365	8.9585	0.5317	(1)
TECHDEF3	18.0158	7.4417	0.4880	(1)
MNOECPS1	0.5489	0.2728	0.6842	4.05(1)

VARIABLES NOT IN EQUATION

VARIABLE	PARTIAL CORR.	TOL.	F AND P ENTER(L)
CTYPE	0.0168	0.5747	0.00(1)
PLAGGR	-0.2021	0.6912	0.60(1)
PLCONC	0.0110	0.2233	0.00(1)
PAGESSOW	0.4001	0.6151	(0.125)(1)
PLDRRFP	-0.2491	0.6044	0.93(1)
SOWCSSR	0.2003	0.7380	0.59(1)
SOWRCBP	-0.3173	0.9333	1.57(1)
SOWFRSI	-0.1335	0.8409	0.25(1)
NOPMDIDS	0.3198	0.6690	1.60(1)
NOEVCRIT	-0.0211	0.6340	0.01(1)
EVRCWP	0.1076	0.6260	0.16(1)
EVRCBP	-0.1161	0.4771	0.19(1)
UCOSTCD	-0.3009	0.5654	1.39(1)
D_DP	0.4230	0.6124	3.05(1)
PRODOPT	-0.2133	0.7434	0.67(1)
PLWBSDEV	0.1226	0.7186	0.21(1)
SOWDWBS	0.1908	0.8564	0.53(1)
SOWSDISP	-0.0177	0.9226	0.00(1)
SOWRCWP	-0.2894	0.8043	1.28(1)
EVSDISP	0.0111	0.7232	0.00(1)
PLSRISK	-0.0437	0.7025	0.03(0)
		F=	0.06
SET SPLSRISK			P=0.94213(1)
PLSRISK1	-0.0660	0.8006	(1)
PLSRISK2	-0.0144	0.8153	(1)
PLTRISK	-0.1882	0.8712	0.51(0)
		F=	0.29
SET SPLTRISK			P=0.75374(1)
PLTRISK1	-0.0840	0.7478	(1)
PLTRISK2	-0.1589	0.8431	(1)
COMPLEX	-0.1585	0.4661	0.36(0)
		F=	0.36
SET SCOMPLEX			P=0.70760(1)
COMPLEX1	0.1776	0.8083	(1)
COMPLEX2	-0.2268	0.6012	(1)
TECHDEFN	0.0000	1.0000	0.00(0)
PLWBSL3	-0.0307	0.4842	0.01(0)
		F=	0.05
SET SPLWBSL3			P=0.98429(1)
PLWBSL31	0.0364	0.3773	(1)
PLWBSL32	0.0501	0.6632	(1)
PLWBSL33	-0.1076	0.3373	(1)

```
                              F=     0.46
SET SPTRISK2                  P=0.64219(1)
DUMMY1     0.2527 0.9325           (1)
DUMMY2     0.0000 1.0000           (1)
DUMMY3    -0.1589 0.8431           (1)
                              F=     0.71
SET SPTRISK3                  P=0.51050(1)
DUMMY4     0.3014 0.9126           (1)
DUMMY5     0.0000 1.0000           (1)
DUMMY6    -0.1522 0.8529           (1)
                              F=     0.40
SET SPLCONC3                  P=0.75773(1)
DUMMY7     0.2915 0.6455           (1)
DUMMY8    -0.0328 0.7915           (1)
DUMMY9    -0.1583 0.6305           (1)
                              F=     0.08
SET SPSRISK1                  P=0.92514(1)
DUMMY10    0.0959 0.6966           (1)
DUMMY11   -0.0660 0.8006           (1)
DUMMY12   -0.0349 0.7785           (1)
                              F=     0.12
SET SPTRISK4                  P=0.97040(1)
DUMMY22   -0.0570 0.7862           (1)
DUMMY23    0.1434 0.8322           (1)
DUMMY24   -0.0643 0.7928           (1)
DUMMY25    0.0000 1.0000           (1)
DUMMY26   -0.1466 0.8420           (1)
                              F=     0.60
SET SPSRISK3                  P=0.69917(1)
DUMMY27   -0.1884 0.6209           (1)
DUMMY28   -0.2260 0.8276           (1)
DUMMY29    0.0925 0.8400           (1)
DUMMY30    0.1397 0.8705           (1)
DUMMY31   -0.1328 0.5780           (1)
MPTRISK1-0.1068 0.1944       0.16(1)
MPTRISK2-0.0981 0.7822       0.14(0)
MPTRISK3-0.0662 0.8355       0.06(0)
MPTRISK4-0.1498 0.8609       0.32(0)
MNOECPS2-0.0317 0.5006       0.01(1)
MNOECPS3 0.0151 0.1448       0.00(1)
MNOECPS4-0.0767 0.0562       0.08(1)
MNOECPS5-0.2401 0.1129       0.86(1)
MNOECPS6-0.0181 0.0452       0.00(1)
MPSRISK1-0.0673 0.4118       0.06(0)
MPSRISK3-0.0576 0.5498       0.05(0)
MPRESCH1 0.2601 0.3463       1.02(1)
MPRESCH2-0.2491 0.3828       0.93(1)
MPRESCH3-0.2894 0.5745       1.28(1)
MPRESCH4 0.1076 0.3965       0.16(1)
MPRESCH6-0.0450 0.5890       0.03(1)
MPLAGGR -0.2021 0.6912       0.60(1)
MSOWRC  -0.3173 0.9333       1.57(1)
MPLCONC3-0.1384 0.4149       0.27(0)
MSOWSINT-0.3413 0.9005       1.85(1)
MEVSINT  0.0606 0.7897       0.05(1)

***** P-VALUES( 0.100, 0.110) OR TOLERANCE INSUFFICIENT FOR FURTHER STEPPING
```

SUMMARY TABLE

STEP NO.	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	MULTIPLE RSQ	CHANGE IN RSQ	P-VALUE ENTER	P-VALUE REMOVE	NO.OF VAR. INCLUDED
1	9 NOECPS		0.7793	0.6073	0.6073	0.00		1
2	10 PLPRESCH		0.8996	0.8093	0.2020	0.00		2
3	50 MNOECPS1		0.9438	0.8908	0.0815	0.00		3
4	SET STECHDEF 40 TECHDEF1 41 TECHDEF2 42 TECHDEF3		0.9673	0.9356	0.0448	0.03		6
5	17 NODIDS		0.9764	0.9534	0.0178	0.03		7

SERIAL CORRELATION -0.1216
DURBIN-WATSON STATISTIC 2.2353 BASED ON   23 CASES

```
CASE PLOTS             RESIDUALS             LEVERAGE               INFLUENCE

CASE  LABEL             STRESID              -LOG P(H)               MODCOOK
NO.        -4   -2    0    2    4 0    1    2    3    4 0  1  2  3  4  5  6
            +....+....+....+....+ +....+....+....+....+ +..+..+..+..+..+..+
   1        .        **         . ******              . ***               .
   2-       .         M         . M                   . M                 .
   3        .    ******         . ***                 . ********          .
   4-       .         M         . M                   . M                 .
   5        .         *         . ******              . *                 .
   6        .        **         . **                  . **                .
   7        .         **        . **                  . **                .
   8        .       ***         . *                   . **                .
   9        .         ******    . ***                 . *******           .
  10-       .         M         . M                   . M                 .
  11        .         *         . ****                . *                 .
  12        .         ******    . ****                . *******           .
  13        .       ***         . ****                . ***               .
  14        .         ***       . *                   . **                .
  15        .         ***       . **                  . ***               .
  16        .         ***       . *                   . ***               .
  17        .        **         . *                   . **                .
  18-       .         M         . M                   . M                 .
  19        .         *         . ****************    . **                .
  20        .       ***         . **                  . ***               .
  21-       .         M         . M                   . M                 .
  22        .         *         . **                  . *                 .
  23        .    ******         . *********           . ************      .
  24-       .         M         . M                   . M                 .
  25        .        **         . ******              . ***               .
  26        .        **         . *********           . **                .
  27        .         ******    . ******              . *********         .
  28        .       ***         . **                  . ***               .
  29        .         *         . **                  . *                 .
            +....+....+....+....+ +....+....+....+....+ +..+..+..+..+..+..+
           -4   -2    0    2    4 0    1    2    3    4 0  1  2  3  4  5  6
```

```
         .+......+......+......+......+......+......+......+......+.....
         -                                                             -
    .8   +                                                             +
         -                                                             -
         -                                           1                 -
         -                                                             -
         -                                                             -
         -                                                             -
C   .6   +                                                             +
O        -                                                             -
O        -                                                             -
K        -                                                             -
         -                                                             -
         -          1                                                  -
    .4   +                                                             +
         -                                                             -
         -                                                             -
1        -                                                             -
0        -                   1                 1                       -
3        -                                                             -
    .2   +    1                                                        +
         -                                                             -
         -                                                             -
         -                                                             -
         -                                                             -
         - 1     1    1             1 1 1                 1            -
    0.   +11         1    21    1  1               1   1              1+
         .+......+......+......+......+......+......+......+......+.....
                 3.            9.            15            21
          0.            6.            12            18            24

                                 UCOSTCD     5
```

EXTREME CASES --

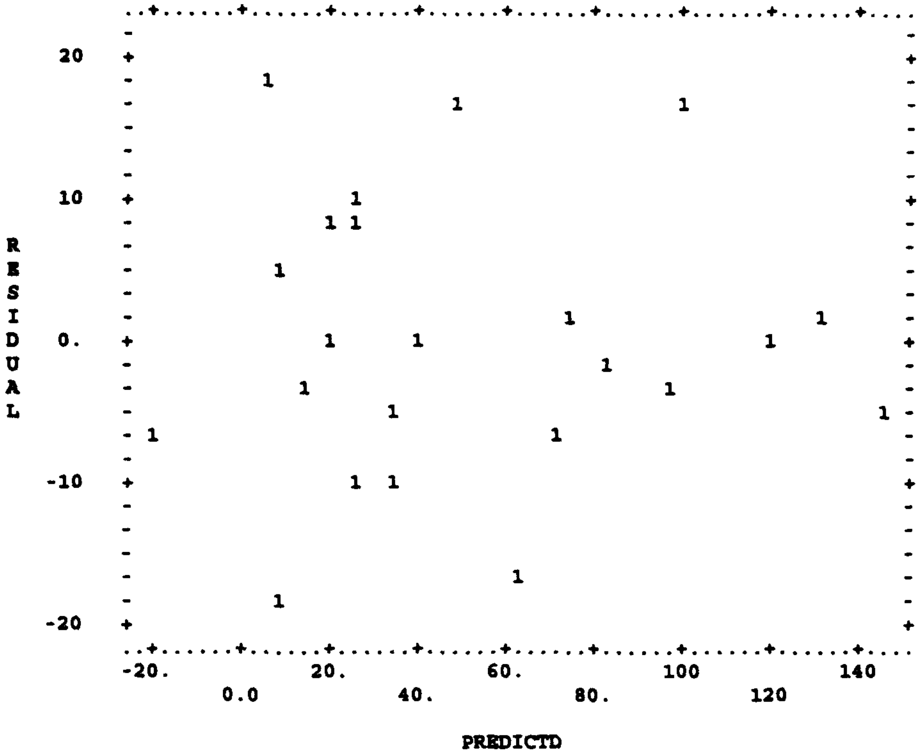
CASE NO.	COOK	CASE NO.	UCOSTCD
23	0.7352	17	25.7384
27	0.4262	25	20.7504

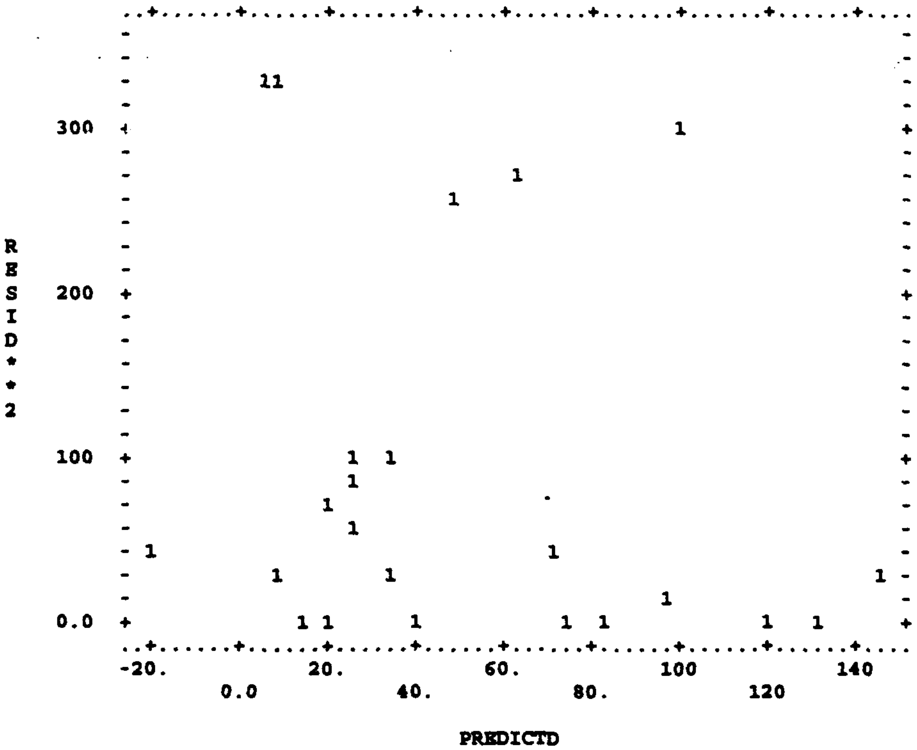
EXTREME CASES IN THE PLOTS --

STATISTICS	EXTREME VALUE	NO.	CASE LABEL	WEIGHT	3 SCHEDMOD	17 NODIDS
COOK	0.7352	23		1.0000	46.8000	39.0000
COOK	0.4262	27		1.0000	64.2000	58.0000

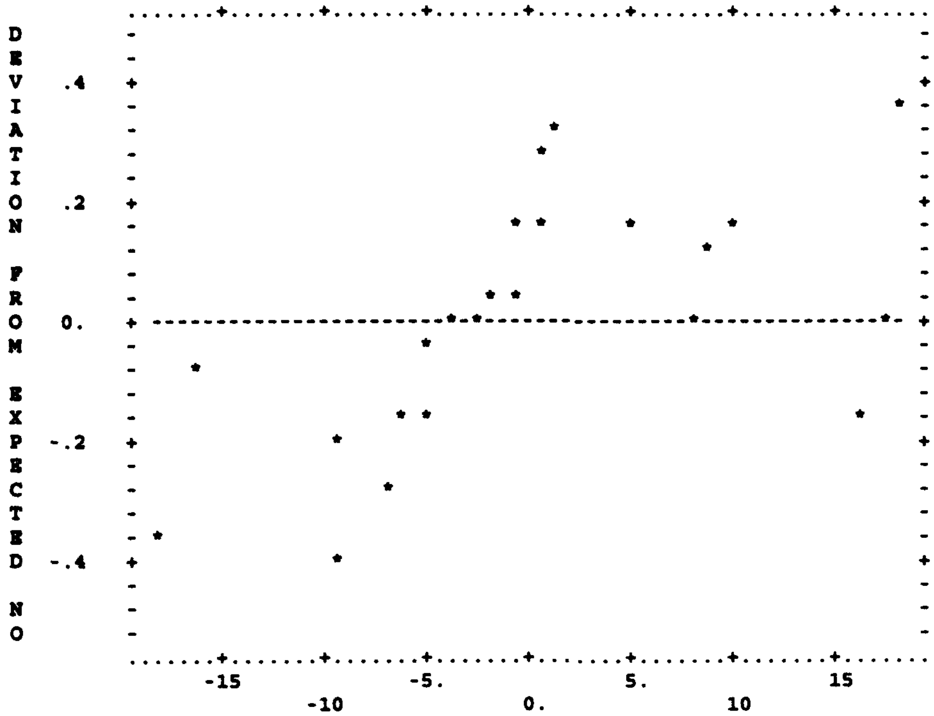
CASE NO.	LABEL	9 NOECPS	10 PLPRESCH	40 TECHDEF1	41 TECHDEF2
23		19.0000	0.0000	1.0000	0.0000
27		28.0000	1.0000	0.0000	0.0000

CASE NO.	LABEL	42 TECHDEF3	50 MNOECPS1
23		0.0000	19.0000
27		0.0000	28.0000


RESIDUAL
20
10
0.
-10
-20
-20.
0.0
20.
40.
60.
80.
100
120
140
PREDICTD


RESID**2
300
200
100
0.0
-20.
0.0
20.
40.
60.
80.
100
120
140
PREDICTD

DETRENDED NORMAL PROBABILITY PLOT OF UNWEIGHTED RESIDUALS



VALUES FROM NORMAL DISTRIBUTION WOULD LIE
ON THE LINE INDICATED BY THE SYMBOL - .

Appendix L: Statistix 4.0 Outputs for the Multiple Regression Models

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (WITHOUT INTERACTION TERMS)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	-16.9593	31.6250	-0.54	0.5983	
PLTRISK1	143.126	32.8045	4.36	0.0004	1.3
PLTRISK2	-29.9876	27.2668	-1.10	0.2859	1.6
NOECPS	1.97563	0.54365	3.63	0.0019	1.3
PLCONC	60.7526	25.2687	2.40	0.0272	1.4
PLSRISK1	-80.3199	38.4366	-2.09	0.0511	1.4
PLSRISK2	10.6096	26.9803	0.39	0.6988	1.6

R-SQUARED	0.6782	RESID. MEAN SQUARE (MSE)	2872.19
ADJUSTED R-SQUARED	0.5709	STANDARD DEVIATION	53.5928

SOURCE	DF	SS	MS	F	P
REGRESSION	6	1.089E+05	18156.1	6.32	0.0010
RESIDUAL	18	51699.4	2872.19		
TOTAL	24	1.606E+05			

CASES INCLUDED 25   MISSING CASES 4

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER (WITHOUT INTERACTION TERMS)

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
PLTRISK1	49598.2	1	49598.2	49598.2	0.2787	17.7	2
PLTRISK2	0.06035	2	49598.3	24799.1	0.2459	19.7	3
NOECPS	30370.8	3	79969.1	26656.3	0.4261	11.1	4
PLCONC	12861.0	4	92830.2	23207.5	0.4935	8.6	5
PLSRISK1	15662.4	5	1.085E+05	21698.5	0.5900	5.2	6
PLSRISK2	444.143	6	1.089E+05	18156.1	0.5709	7.0	7
RESIDUAL	51699.4	24	1.606E+05	6693.17			

R-SQUARED	0.6782	RESID. MEAN SQUARE (MSE)	2872.19
ADJUSTED R-SQUARED	0.5709	STANDARD DEVIATION	53.5928

VARIANCE-COVARIANCE MATRIX FOR COEFFICIENTS

	CONSTANT	PLTRISK1	PLTRISK2	NOECPS	PLCONC	PLSRISK1
CONSTANT	1000.14					
PLTRISK1	-444.135	1076.13				
PLTRISK2	-223.395	279.603	743.479			
NOECPS	-11.5563	2.12058	-0.64370	0.29555		
PLCONC	-377.294	141.943	-44.8518	5.88273	638.507	
PLSRISK1	-411.816	-43.8426	170.609	2.10021	-191.776	1477.37
PLSRISK2	-290.849	36.1431	-286.860	0.49991	-87.7186	329.115

	PLSRISK2
PLSRISK2	727.936

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (WITHOUT INTERACTION TERMS)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	16.2539	12.4217	1.31	0.2092	
NOECPS	1.86091	0.13322	13.97	0.0000	1.3
PLPRESCH	-58.1240	7.51484	-7.73	0.0000	1.1
TECHDEF1	-14.2836	8.30555	-1.72	0.1048	1.8
TECHDEF2	-9.38122	9.67674	-0.97	0.3467	1.8
TECHDEF3	21.6173	7.88126	2.74	0.0144	1.9
NODIDS	0.44186	0.15125	2.92	0.0100	1.3

R-SQUARED	0.9408	RESID. MEAN SQUARE (MSE)	167.876
ADJUSTED R-SQUARED	0.9186	STANDARD DEVIATION	12.9567

SOURCE	DF	SS	MS	F	P
REGRESSION	6	42686.4	7114.41	42.38	0.0000
RESIDUAL	16	2686.02	167.876		
TOTAL	22	45372.5			

CASES INCLUDED 23 MISSING CASES 6

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD (WITHOUT INTERACTION TERMS)

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	87.1	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	34.5	3
TECHDEF1	1544.15	3	38263.3	12754.4	0.8186	27.3	4
TECHDEF2	640.168	4	38903.5	9725.89	0.8257	25.5	5
TECHDEF3	2350.14	5	41253.7	8250.74	0.8825	13.5	6
NODIDS	1432.77	6	42686.4	7114.41	0.9186	7.0	7
RESIDUAL	2686.02	22	45372.5	2062.38			

R-SQUARED	0.9408	RESID. MEAN SQUARE (MSE)	167.876
ADJUSTED R-SQUARED	0.9186	STANDARD DEVIATION	12.9567

VARIANCE-COVARIANCE MATRIX FOR COEFFICIENTS

	CONSTANT	NOECPS	PLPRESCH	TECHDEF1	TECHDEF2	TECHDEF3
CONSTANT	154.300					
NOECPS	-0.70269	0.01775				
PLPRESCH	-45.6500	-0.08025	56.4728			
TECHDEF1	-18.8014	-0.29979	8.14800	68.9822		
TECHDEF2	10.1476	-0.14844	-12.6052	39.0730	93.6394	
TECHDEF3	-15.0161	0.10656	-6.08859	34.2265	43.3452	62.1142
NODIDS	-1.31369	0.00531	0.05670	-0.26061	-0.60232	-0.34294

	NODIDS
NODIDS	0.02287

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (WITH INTERACTION TERMS)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	150.083	29.2945	5.12	0.0001	
MPRESCH3	-109.643	26.2429	-4.18	0.0005	1.5
SOWSDISP	-120.299	30.8828	-3.90	0.0009	1.7
NOECPS	1.28483	0.48491	2.65	0.0154	1.0
MSOWSINT	73.0910	31.5710	2.32	0.0313	2.1

R-SQUARED	0.6399	RESID. MEAN SQUARE (MSE)	2892.45
ADJUSTED R-SQUARED	0.5678	STANDARD DEVIATION	53.7815

SOURCE	DF	SS	MS	F	P
REGRESSION	4	1.028E+05	25696.7	8.88	0.0003
RESIDUAL	20	57849.1	2892.45		
TOTAL	24	1.606E+05			

CASES INCLUDED 25 MISSING CASES 0

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER (WITH INTERACTION TERMS)

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
MPRESCH3	40091.1	1	40091.1	40091.1	0.2170	20.7	2
SOWSDISP	29642.0	2	69733.1	34866.5	0.3827	12.4	3
NOECPS	17550.8	3	87284.0	29094.6	0.4781	8.4	4
MSOWSINT	15503.0	4	1.028E+05	25696.7	0.5678	5.0	5
RESIDUAL	57849.1	24	1.606E+05	6693.17			

R-SQUARED	0.6399	RESID. MEAN SQUARE (MSE)	2892.45
ADJUSTED R-SQUARED	0.5678	STANDARD DEVIATION	53.7815

VARIANCE-COVARIANCE MATRIX FOR COEFFICIENTS

	CONSTANT	MPRESCH3	SOWSDISP	NOECPS	MSOWSINT
CONSTANT	858.173				
MPRESCH3	-409.648	688.691			
SOWSDISP	-566.140	293.424	953.750		
NOECPS	-7.20078	0.55012	-0.50326	0.23514	
MSOWSINT	225.772	-461.203	-614.920	1.28978	996.733

DURBIN-WATSON TEST FOR AUTOCORRELATION

DURBIN-WATSON STATISTIC 2.3027

P-VALUES, USING DURBIN-WATSON'S BETA APPROXIMATION:
P (POSITIVE CORR) = 0.5068, P (NEGATIVE CORR) = 0.4932

EXPECTED VALUE OF DURBIN-WATSON STATISTIC 1.9892
EXACT VARIANCE OF DURBIN-WATSON STATISTIC 3.78953

CASES INCLUDED 25 MISSING CASES 0

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (WITH INTERACTION TERMS, CASE #24 EXCLUDED)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	112.655	24.7783	4.55	0.0002	
MPRESCH3	-85.5379	21.3229	-4.01	0.0007	1.5
SOWSDISP	-84.2546	25.7740	-3.27	0.0040	1.7
NOECPS	1.22127	0.37633	3.25	0.0043	1.0
MSOWSINT	56.3629	24.8740	2.27	0.0353	2.1

R-SQUARED	0.6266	RESID. MEAN SQUARE (MSE)	1738.58
ADJUSTED R-SQUARED	0.5479	STANDARD DEVIATION	41.6963

SOURCE	DF	SS	MS	F	P
REGRESSION	4	55424.8	13856.2	7.97	0.0006
RESIDUAL	19	33033.1	1738.58		
TOTAL	23	88457.9			

CASES INCLUDED 24 MISSING CASES 1

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER (WITH INTERACTION TERMS, CASE #24 EXCLUDED)

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	85824.9						
MPRESCH3	20215.4	1	20215.4	20215.4	0.1935	19.3	2
SOWSDISP	10086.8	2	30302.3	15151.1	0.2799	15.4	3
NOECPS	16195.8	3	46498.1	15499.3	0.4545	8.1	4
MSOWSINT	8926.70	4	55424.8	13856.2	0.5479	5.0	5
RESIDUAL	33033.1	23	88457.9	3845.99			

R-SQUARED	0.6266	RESID. MEAN SQUARE (MSE)	1738.58
ADJUSTED R-SQUARED	0.5479	STANDARD DEVIATION	41.6963

VARIANCE-COVARIANCE MATRIX FOR COEFFICIENTS

	CONSTANT	MPRESCH3	SOWSDISP	NOECPS	MSOWSINT
CONSTANT	613.967				
MPRESCH3	-309.438	454.666			
SOWSDISP	-434.808	237.243	664.300		
NOECPS	-4.16156	0.22333	-0.46300	0.14162	
MSOWSINT	179.570	-305.469	-411.857	0.84974	618.717

PREDICTED/FITTED VALUES OF SCHEDPER (WITH INTERACTION TERMS, CASE #24 EXCLUDED)

LOWER PREDICTED BOUND	20.155	LOWER FITTED BOUND	91.674
PREDICTED VALUE	155.40	FITTED VALUE	155.40
UPPER PREDICTED BOUND	290.64	UPPER FITTED BOUND	219.12
SE (PREDICTED VALUE)	47.272	SE (FITTED VALUE)	22.274

UNUSUALNESS (LEVERAGE)	0.2854
PERCENT COVERAGE	99.0
CORRESPONDING T	2.86

PREDICTOR VALUES: MPRESCH3 = 0.0000, SOWSDISP = 0.0000, NOECPS = 35.000, MSOWSINT = 0.0000

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (WITH INTERACTION TERMS, CASE #24 AND CASE #21 EXCLUDED)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	54.0412	15.4390	3.50	0.0026	
MPRESCH3	-52.7854	12.1397	-4.35	0.0004	1.7
SONSDISP	-36.9013	15.1225	-2.44	0.0253	1.9
NOECPS	1.42425	0.20025	7.11	0.0000	1.0
MSONSINT	35.6783	13.4205	2.66	0.0160	2.1

R-SQUARED	0.8087	RESID. MEAN SQUARE (MSE)	482.296
ADJUSTED R-SQUARED	0.7661	STANDARD DEVIATION	21.9612

SOURCE	DF	SS	MS	F	P
REGRESSION	4	36691.1	9172.79	19.02	0.0000
RESIDUAL	18	8681.33	482.296		
TOTAL	22	45372.5			

CASES INCLUDED 23   MISSING CASES 2

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER (WITH INTERACTION TERMS, CASE #24 AND CASE #21 EXCLUDED)

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
MPRESCH3	8811.88	1	8811.88	8811.88	0.1558	56.8	2
SONSDISP	1024.05	2	9835.93	4917.96	0.1385	56.7	3
NOECPS	23446.5	3	33282.5	11094.1	0.6915	10.1	4
MSONSINT	3408.67	4	36691.1	9172.79	0.7661	5.0	5
RESIDUAL	8681.33	22	45372.5	2062.38			

R-SQUARED	0.8087	RESID. MEAN SQUARE (MSE)	482.296
ADJUSTED R-SQUARED	0.7661	STANDARD DEVIATION	21.9612

VARIANCE-COVARIANCE MATRIX FOR COEFFICIENTS

	CONSTANT	MPRESCH3	SOWSDISP	NOECPS	MSOWSINT
CONSTANT	238.363				
MPRESCH3	-123.862	147.373			
SONSDISP	-175.590	96.5300	228.691		
NOECPS	-1.39008	0.19362	0.06192	0.04010	
MSOWSINT	73.8263	-98.1569	-133.651	0.15257	180.110

PREDICTED/FITTED VALUES OF SCHEDPER (WITH INTERACTION TERMS, CASE #24 AND CASE #21 EXCLUDED)

LOWER PREDICTED BOUND	29.245	LOWER FITTED BOUND	64.194
PREDICTED VALUE	103.89	FITTED VALUE	103.89
UPPER PREDICTED BOUND	178.53	UPPER FITTED BOUND	143.58
SE (PREDICTED VALUE)	25.932	SE (FITTED VALUE)	13.790

UNUSUALNESS (LEVERAGE)	0.3943
PERCENT COVERAGE	99.0
CORRESPONDING T	2.88

PREDICTOR VALUES: MPRESCH3 = 0.0000, SOWSDISP = 0.0000, NOECPS = 35.000, MSOWSINT = 0.0000

PREDICTED/FITTED VALUES OF SCHEDPER (WITH INTERACTION TERMS, CASE #24 AND CASE #21 EXCLUDED)

LOWER PREDICTED BOUND	1.4140	LOWER FITTED BOUND	35.702
PREDICTED VALUE	76.829	FITTED VALUE	76.829
UPPER PREDICTED BOUND	152.24	UPPER FITTED BOUND	117.95
SE (PREDICTED VALUE)	26.200	SE (FITTED VALUE)	14.288

UNUSUALNESS (LEVERAGE)	0.4233
PERCENT COVERAGE	99.0
CORRESPONDING T	2.88

PREDICTOR VALUES: MPRESCH3 = 0.0000, SOWSDISP = 0.0000, NOECPS = 16.000, MSOWSINT = 0.0000

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (WITH INTERACTION TERMS)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	35.0189	10.0748	3.48	0.0025	
NOECPS	1.58564	0.14722	10.77	0.0000	1.0
PLPRESCH	-46.7239	9.02245	-5.18	0.0001	1.0
MNOECPS1	1.18851	0.31558	3.77	0.0013	1.1

R-SQUARED 0.8908 RESID. MEAN SQUARE (MSE) 260.772
ADJUSTED R-SQUARED 0.8736 STANDARD DEVIATION 16.1484

SOURCE	DF	SS	MS	F	P
REGRESSION	3	40417.8	13472.6	51.66	0.0000
RESIDUAL	19	4954.68	260.772		
TOTAL	22	45372.5			

CASES INCLUDED 23 MISSING CASES 0

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD (WITH INTERACTION TERMS)

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	49.3	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	16.2	3
MNOECPS1	3698.58	3	40417.8	13472.6	0.8736	4.0	4
RESIDUAL	4954.68	22	45372.5	2062.38			

R-SQUARED 0.8908 RESID. MEAN SQUARE (MSE) 260.772
ADJUSTED R-SQUARED 0.8736 STANDARD DEVIATION 16.1484

VARIANCE-COVARIANCE MATRIX FOR COEFFICIENTS

	CONSTANT	NOECPS	PLPRESCH	MNOECPS1
CONSTANT	101.501			
NOECPS	-0.70461	0.02167		
PLPRESCH	-71.9496	0.03194	81.4047	
MNOECPS1	-1.38104	0.00739	0.49753	0.09959

DURBIN-WATSON TEST FOR AUTOCORRELATION

DURBIN-WATSON STATISTIC 2.1056

EXPECTED VALUE OF DURBIN-WATSON STATISTIC 1.9769
EXACT VARIANCE OF DURBIN-WATSON STATISTIC 5.17872

CASES INCLUDED 23 MISSING CASES 0

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (WITH INTERACTION TERMS, CASE #23 EXCLUDED)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	48.3890	8.28701	5.84	0.0000	
NOECPS	1.55274	0.11089	14.00	0.0000	1.0
PLPRESCH	-60.0973	7.57237	-7.94	0.0000	1.0
MNOECPS1	1.32935	0.23970	5.55	0.0000	1.0

R-SQUARED	0.9416	RESID. MEAN SQUARE (MSE)	147.134
ADJUSTED R-SQUARED	0.9319	STANDARD DEVIATION	12.1299

SOURCE	DF	SS	MS	F	P
REGRESSION	3	42705.9	14235.3	96.75	0.0000
RESIDUAL	18	2648.42	147.134		
TOTAL	21	45354.3			

CASES INCLUDED 22 MISSING CASES 1

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD (WITH INTERACTION TERMS, CASE #23 EXCLUDED)

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	57569.3						
NOECPS	27649.8	1	27649.8	27649.8	0.5901	102.3	2
PLPRESCH	10530.8	2	38180.7	19090.3	0.8252	32.8	3
MNOECPS1	4525.19	3	42705.9	14235.3	0.9319	4.0	4
RESIDUAL	2648.42	21	45354.3	2159.73			

R-SQUARED	0.9416	RESID. MEAN SQUARE (MSE)	147.134
ADJUSTED R-SQUARED	0.9319	STANDARD DEVIATION	12.1299

VARIANCE-COVARIANCE MATRIX FOR COEFFICIENTS

	CONSTANT	NOECPS	PLPRESCH	MNOECPS1
CONSTANT	68.6745			
NOECPS	-0.42562	0.01229		
PLPRESCH	-52.0032	0.04609	57.3408	
MNOECPS1	-0.65908	0.00387	0.16055	0.05745

PREDICTED/FITTED VALUES OF SCHEDMOD (WITH INTERACTION TERMS, CASE #23 EXCLUDED)

LOWER PREDICTED BOUND	62.180	LOWER FITTED BOUND	81.717
PREDICTED VALUE	103.14	FITTED VALUE	103.14
UPPER PREDICTED BOUND	144.11	UPPER FITTED BOUND	124.58
SE (PREDICTED VALUE)	14.232	SE (FITTED VALUE)	7.4456

UNUSUALNESS (LEVERAGE)	0.3768
PERCENT COVERAGE	99.0
CORRESPONDING T	2.88

PREDICTOR VALUES: NOECPS = 19.000, PLPRESCH = 0.0000, MNOECPS1 = 19.000

Appendix M: Statistix 4.0 Outputs for Best Subsets Regressions

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 1)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	64.8267	36.8685	1.76	0.0933	
NOECPS	1.76779	0.59580	2.97	0.0074	1.1
PLPRESCH	-98.5261	32.2203	-3.06	0.0060	1.0
TDEFM	61.5822	27.2298	2.26	0.0345	1.1

R-SQUARED	0.4714	RESID. MEAN SQUARE (MSE)	4043.18
ADJUSTED R-SQUARED	0.3959	STANDARD DEVIATION	63.5860

SOURCE	DF	SS	MS	F	P
REGRESSION	3	75729.2	25243.0	6.24	0.0034
RESIDUAL	21	84906.9	4043.18		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	12.6	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	7.1	3
TDEFM	20679.6	3	75729.2	25243.0	0.3959	4.0	4
RESIDUAL	84906.9	24	1.606E+05	6693.17			

R-SQUARED	0.4714	RESID. MEAN SQUARE (MSE)	4043.18
ADJUSTED R-SQUARED	0.3959	STANDARD DEVIATION	63.5860

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 2)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	134.519	37.1477	3.62	0.0016	
NOECPS	1.56298	0.58488	2.67	0.0143	1.0
PLPRESCH	-73.5726	32.9285	-2.23	0.0365	1.0
PLWDEV	-64.9264	31.2152	-2.08	0.0500	1.1

R-SQUARED	0.4550	RESID. MEAN SQUARE (MSE)	4169.06
ADJUSTED R-SQUARED	0.3771	STANDARD DEVIATION	64.5682

SOURCE	DF	SS	MS	F	P
REGRESSION	3	73085.8	24361.9	5.84	0.0046
RESIDUAL	21	87550.3	4169.06		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	11.6	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	6.3	3
PLWDEV	18036.3	3	73085.8	24361.9	0.3771	4.0	4
RESIDUAL	87550.3	24	1.606E+05	6693.17			

R-SQUARED	0.4550	RESID. MEAN SQUARE (MSE)	4169.06
ADJUSTED R-SQUARED	0.3771	STANDARD DEVIATION	64.5682

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 3)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	54.7043	32.3093	1.69	0.1052	
NOECPS	2.42202	0.68534	3.53	0.0020	1.4
PLCONC	70.3440	32.1180	2.19	0.0399	1.5
PLWDEV	-110.223	33.9764	-3.24	0.0039	1.3

R-SQUARED	0.4509	RESID. MEAN SQUARE (MSE)	4200.62
ADJUSTED R-SQUARED	0.3724	STANDARD DEVIATION	64.8122

SOURCE	DF	SS	MS	F	P
REGRESSION	3	72423.1	24141.0	5.75	0.0049
RESIDUAL	21	88213.0	4200.62		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	11.3	2
PLCONC	3344.29	2	28214.2	14107.1	0.1007	12.5	3
PLWDEV	44208.8	3	72423.1	24141.0	0.3724	4.0	4
RESIDUAL	88213.0	24	1.606E+05	6693.17			

R-SQUARED	0.4509	RESID. MEAN SQUARE (MSE)	4200.62
ADJUSTED R-SQUARED	0.3724	STANDARD DEVIATION	64.8122

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 4)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	45.6825	34.9665	1.31	0.2055	
NOECPS	2.05500	0.62423	3.29	0.0035	1.1
PLWDEV	-86.4554	31.2762	-2.76	0.0116	1.0
TDEFM	57.7631	27.8827	2.07	0.0508	1.1

R-SQUARED	0.4399	RESID. MEAN SQUARE (MSE)	4284.52
ADJUSTED R-SQUARED	0.3599	STANDARD DEVIATION	65.4562

SOURCE	DF	SS	MS	F	P
REGRESSION	3	70661.2	23553.7	5.50	0.0060
RESIDUAL	21	89974.9	4284.52		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	10.7	2
PLWDEV	27403.3	2	52273.3	26136.6	0.2641	6.3	3
TDEFM	18387.8	3	70661.2	23553.7	0.3599	4.0	4
RESIDUAL	89974.9	24	1.606E+05	6693.17			

R-SQUARED	0.4399	RESID. MEAN SQUARE (MSE)	4284.52
ADJUSTED R-SQUARED	0.3599	STANDARD DEVIATION	65.4562

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 5)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	118.671	36.7795	3.23	0.0040	
NOECPS	1.74331	0.65153	2.68	0.0142	1.2
PLPRESCH	-86.9405	33.6631	-2.58	0.0174	1.0
UCOSTCD	-0.00309	0.00203	-1.52	0.1430	1.2

R-SQUARED	0.4080	RESID. MEAN SQUARE (MSE)	4528.65
ADJUSTED R-SQUARED	0.3234	STANDARD DEVIATION	67.2952

SOURCE	DF	SS	MS	F	P
REGRESSION	3	65534.3	21844.7	4.82	0.0104
RESIDUAL	21	95101.8	4528.65		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	9.0	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	4.3	3
UCOSTCD	10484.8	3	65534.3	21844.7	0.3234	4.0	4
RESIDUAL	95101.8	24	1.606E+05	6693.17			

R-SQUARED	0.4080	RESID. MEAN SQUARE (MSE)	4528.65
ADJUSTED R-SQUARED	0.3234	STANDARD DEVIATION	67.2952

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 6)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	153.979	49.6464	3.10	0.0054	
NOECPS	1.03765	0.64007	1.62	0.1199	1.1
PLPRESCH	-87.4509	33.7299	-2.59	0.0170	1.0
PLDRRFP	-53.4515	35.9280	-1.49	0.1506	1.1

R-SQUARED	0.4057	RESID. MEAN SQUARE (MSE)	4546.10
ADJUSTED R-SQUARED	0.3208	STANDARD DEVIATION	67.4248

SOURCE	DF	SS	MS	F	P
REGRESSION	3	65167.9	21722.6	4.78	0.0108
RESIDUAL	21	95468.2	4546.10		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	8.9	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	4.2	3
PLDRRFP	10118.4	3	65167.9	21722.6	0.3208	4.0	4
RESIDUAL	95468.2	24	1.606E+05	6693.17			

R-SQUARED	0.4057	RESID. MEAN SQUARE (MSE)	4546.10
ADJUSTED R-SQUARED	0.3208	STANDARD DEVIATION	67.4248

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 7)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	18.4012	51.6482	0.36	0.7252	
NOECPS	1.86693	0.63022	2.96	0.0074	1.1
PLNDEV	-107.189	36.9912	-2.90	0.0086	1.4
NOPMDIDS	10.9694	6.95508	1.58	0.1297	1.3

R-SQUARED	0.3969	RESID. MEAN SQUARE (MSE)	4613.64
ADJUSTED R-SQUARED	0.3107	STANDARD DEVIATION	67.9237

SOURCE	DF	SS	MS	F	P
REGRESSION	3	63749.7	21249.9	4.61	0.0125
RESIDUAL	21	96886.4	4613.64		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	8.4	2
PLNDEV	27403.3	2	52273.3	26136.6	0.2641	4.5	3
NOPMDIDS	11476.3	3	63749.7	21249.9	0.3107	4.0	4
RESIDUAL	96886.4	24	1.606E+05	6693.17			

R-SQUARED	0.3969	RESID. MEAN SQUARE (MSE)	4613.64
ADJUSTED R-SQUARED	0.3107	STANDARD DEVIATION	67.9237

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 8)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	114.399	36.8017	3.11	0.0053	
NOECPS	1.41375	0.61029	2.32	0.0307	1.0
PLPRESCH	-83.2141	34.2178	-2.43	0.0241	1.0
PLTRM	-35.9746	27.4386	-1.31	0.2040	1.0

R-SQUARED	0.3924	RESID. MEAN SQUARE (MSE)	4647.50
ADJUSTED R-SQUARED	0.3056	STANDARD DEVIATION	68.1726

SOURCE	DF	SS	MS	F	P
REGRESSION	3	63038.4	21012.8	4.52	0.0135
RESIDUAL	21	97597.7	4647.50		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	8.2	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	3.7	3
PLTRM	7988.94	3	63038.4	21012.8	0.3056	4.0	4
RESIDUAL	97597.7	24	1.606E+05	6693.17			

R-SQUARED	0.3924	RESID. MEAN SQUARE (MSE)	4647.50
ADJUSTED R-SQUARED	0.3056	STANDARD DEVIATION	68.1726

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 9)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	118.340	37.9995	3.11	0.0052	
NOECPS	1.26755	0.61530	2.06	0.0520	1.0
PLPRESCH	-85.3134	34.2287	-2.49	0.0211	1.0
SOWSINT	-34.9336	27.7762	-1.26	0.2223	1.0

R-SQUARED	0.3887	RESID. MEAN SQUARE (MSE)	4675.74
ADJUSTED R-SQUARED	0.3014	STANDARD DEVIATION	68.3794

SOURCE	DF	SS	MS	F	P
REGRESSION	3	62445.4	20815.1	4.45	0.0143
RESIDUAL	21	98190.7	4675.74		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	8.0	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	3.6	3
SOWSINT	7395.92	3	62445.4	20815.1	0.3014	4.0	4
RESIDUAL	98190.7	24	1.606E+05	6693.17			

R-SQUARED	0.3887	RESID. MEAN SQUARE (MSE)	4675.74
ADJUSTED R-SQUARED	0.3014	STANDARD DEVIATION	68.3794

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 10)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	105.933	35.7965	2.96	0.0075	
NOECPS	1.21498	0.62267	1.95	0.0645	1.0
PLPRESCH	-99.7938	35.7865	-2.79	0.0110	1.1
PLAGGR	42.1475	34.0141	1.24	0.2290	1.1

R-SQUARED	0.3875	RESID. MEAN SQUARE (MSE)	4685.36
ADJUSTED R-SQUARED	0.3000	STANDARD DEVIATION	68.4497

SOURCE	DF	SS	MS	F	P
REGRESSION	3	62243.5	20747.8	4.43	0.0146
RESIDUAL	21	98392.6	4685.36		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	8.0	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	3.5	3
PLAGGR	7193.96	3	62243.5	20747.8	0.3000	4.0	4
RESIDUAL	98392.6	24	1.606E+05	6693.17			

R-SQUARED	0.3875	RESID. MEAN SQUARE (MSE)	4685.36
ADJUSTED R-SQUARED	0.3000	STANDARD DEVIATION	68.4497

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 11)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	97.8167	34.7985	2.81	0.0108	
NOECPS	2.03236	0.53456	3.80	0.0011	1.1
PLPRESCH	-84.8554	28.8648	-2.94	0.0081	1.1
PLWDEV	-72.1613	27.2184	-2.65	0.0153	1.1
TDEFM	67.6387	24.1101	2.81	0.0109	1.1

R-SQUARED	0.6089	RESID. MEAN SQUARE (MSE)	3141.34
ADJUSTED R-SQUARED	0.5307	STANDARD DEVIATION	56.0477

SOURCE	DF	SS	MS	F	P
REGRESSION	4	97809.2	24452.3	7.78	0.0006
RESIDUAL	20	62826.9	3141.34		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	22.2	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	14.6	3
PLWDEV	18036.3	3	73085.8	24361.9	0.3771	10.9	4
TDEFM	24723.3	4	97809.2	24452.3	0.5307	5.0	5
RESIDUAL	62826.9	24	1.606E+05	6693.17			

R-SQUARED	0.6089	RESID. MEAN SQUARE (MSE)	3141.34
ADJUSTED R-SQUARED	0.5307	STANDARD DEVIATION	56.0477

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 12)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	104.386	36.4825	2.86	0.0097	
NOECPS	2.30129	0.62646	3.67	0.0015	1.4
PLPRESCH	-69.5015	30.1612	-2.30	0.0321	1.0
PLCONC	66.3152	29.3080	2.26	0.0349	1.5
PLWDEV	-95.5852	31.5939	-3.03	0.0067	1.3

R-SQUARED	0.5661	RESID. MEAN SQUARE (MSE)	3485.31
ADJUSTED R-SQUARED	0.4793	STANDARD DEVIATION	59.0365

SOURCE	DF	SS	MS	F	P
REGRESSION	4	90929.9	22732.4	6.52	0.0016
RESIDUAL	20	69706.2	3485.31		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	18.0	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	11.3	3
PLCONC	3978.63	3	59028.1	19676.0	0.2771	12.2	4
PLWDEV	31901.7	4	90929.9	22732.4	0.4793	5.0	5
RESIDUAL	69706.2	24	1.606E+05	6693.17			

R-SQUARED	0.5661	RESID. MEAN SQUARE (MSE)	3485.31
ADJUSTED R-SQUARED	0.4793	STANDARD DEVIATION	59.0365

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 13)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	71.3285	35.3945	2.02	0.0575	
NOECPS	1.70463	0.56994	2.99	0.0072	1.1
PLPRESCH	-87.1714	31.4416	-2.77	0.0117	1.1
PLWL3M	-45.7614	26.2407	-1.74	0.0965	1.2
TDEFM	72.9137	26.7955	2.72	0.0132	1.2

R-SQUARED	0.5412	RESID. MEAN SQUARE (MSE)	3685.00
ADJUSTED R-SQUARED	0.4494	STANDARD DEVIATION	60.7042

SOURCE	DF	SS	MS	F	P
REGRESSION	4	86936.1	21734.0	5.90	0.0026
RESIDUAL	20	73700.0	3685.00		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	15.8	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	9.7	3
PLWL3M	4601.12	3	59650.6	19883.5	0.2815	10.4	4
TDEFM	27285.4	4	86936.1	21734.0	0.4494	5.0	5
RESIDUAL	73700.0	24	1.606E+05	6693.17			

R-SQUARED	0.5412	RESID. MEAN SQUARE (MSE)	3685.00
ADJUSTED R-SQUARED	0.4494	STANDARD DEVIATION	60.7042

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 14)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	77.4450	36.4773	2.12	0.0464	
NOECPS	1.84081	0.57715	3.19	0.0046	1.1
PLPRESCH	-94.9352	31.1949	-3.04	0.0064	1.0
PLTRM	-39.3033	24.7509	-1.59	0.1280	1.0
TDEFM	63.9000	26.3344	2.43	0.0248	1.1

R-SQUARED	0.5306	RESID. MEAN SQUARE (MSE)	3770.02
ADJUSTED R-SQUARED	0.4367	STANDARD DEVIATION	61.4005

SOURCE	DF	SS	MS	F	P
REGRESSION	4	85235.6	21308.9	5.65	0.0033
RESIDUAL	20	75400.5	3770.02		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	15.0	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	9.0	3
PLTRM	7988.94	3	63038.4	21012.8	0.3056	8.9	4
TDEFM	22197.1	4	85235.6	21308.9	0.4367	5.0	5
RESIDUAL	75400.5	24	1.606E+05	6693.17			

R-SQUARED	0.5306	RESID. MEAN SQUARE (MSE)	3770.02
ADJUSTED R-SQUARED	0.4367	STANDARD DEVIATION	61.4005

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 15)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	68.0736	35.7945	1.90	0.0717	
NOECPS	1.62250	0.58513	2.77	0.0117	1.1
PLPRESCH	-113.450	32.7051	-3.47	0.0024	1.1
PLAGGR	47.1206	30.6915	1.54	0.1404	1.1
TDEFM	64.2893	26.4493	2.43	0.0246	1.1

R-SQUARED	0.5272	RESID. MEAN SQUARE (MSE)	3797.75
ADJUSTED R-SQUARED	0.4326	STANDARD DEVIATION	61.6259

SOURCE	DF	SS	MS	F	P
REGRESSION	4	84681.0	21170.2	5.57	0.0035
RESIDUAL	20	75955.1	3797.75		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	14.7	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	8.8	3
PLAGGR	7193.96	3	62243.5	20747.8	0.3000	8.9	4
TDEFM	22437.5	4	84681.0	21170.2	0.4326	5.0	5
RESIDUAL	75955.1	24	1.606E+05	6693.17			

R-SQUARED	0.5272	RESID. MEAN SQUARE (MSE)	3797.75
ADJUSTED R-SQUARED	0.4326	STANDARD DEVIATION	61.6259

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 16)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	81.9740	37.4602	2.19	0.0407	
NOECPS	2.10534	0.61833	3.40	0.0028	1.3
PLPRESCH	-98.1257	31.2392	-3.14	0.0051	1.0
UCOSTCD	-0.00285	0.00186	-1.53	0.1417	1.2
TDEFM	59.2691	26.4431	2.24	0.0365	1.1

R-SQUARED	0.5268	RESID. MEAN SQUARE (MSE)	3800.45
ADJUSTED R-SQUARED	0.4322	STANDARD DEVIATION	61.6478

SOURCE	DF	SS	MS	F	P
REGRESSION	4	84627.1	21156.7	5.57	0.0035
RESIDUAL	20	76009.0	3800.45		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	14.7	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	8.8	3
UCOSTCD	10484.8	3	65534.3	21844.7	0.3234	8.0	4
TDEFM	19092.7	4	84627.1	21156.7	0.4322	5.0	5
RESIDUAL	76009.0	24	1.606E+05	6693.17			

R-SQUARED	0.5268	RESID. MEAN SQUARE (MSE)	3800.45
ADJUSTED R-SQUARED	0.4322	STANDARD DEVIATION	61.6478

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDPER (MODEL 17)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	186.049	48.2731	3.85	0.0010	
NOECPS	1.24226	0.59930	2.07	0.0513	1.2
PLPRESCH	-74.2064	31.7850	-2.33	0.0301	1.0
PLWDEV	-64.4836	30.1301	-2.14	0.0449	1.1
PLDRRFP	-52.7982	33.1175	-1.59	0.1266	1.1

R-SQUARED	0.5164	RESID. MEAN SQUARE (MSE)	3883.92
ADJUSTED R-SQUARED	0.4197	STANDARD DEVIATION	62.3211

SOURCE	DF	SS	MS	F	P
REGRESSION	4	82957.6	20739.4	5.34	0.0043
RESIDUAL	20	77678.5	3883.92		
TOTAL	24	1.606E+05			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDPER

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	1.252E+05						
NOECPS	24869.9	1	24869.9	24869.9	0.1181	14.0	2
PLPRESCH	30179.5	2	55049.5	27524.7	0.2829	8.2	3
PLWDEV	18036.3	3	73085.8	24361.9	0.3771	5.5	4
PLDRRFP	9871.74	4	82957.6	20739.4	0.4197	5.0	5
RESIDUAL	77678.5	24	1.606E+05	6693.17			

R-SQUARED	0.5164	RESID. MEAN SQUARE (MSE)	3883.92
ADJUSTED R-SQUARED	0.4197	STANDARD DEVIATION	62.3211

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 1)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	32.2592	11.4743	2.81	0.0111	
NOECPS	1.72735	0.17187	10.05	0.0000	1.2
PLPRESCH	-50.7126	9.53248	-5.32	0.0000	1.0
PLCONC	25.3720	8.04702	3.15	0.0052	1.2

R-SQUARED	0.8748	RESID. MEAN SQUARE (MSE)	298.993
ADJUSTED R-SQUARED	0.8550	STANDARD DEVIATION	17.2914

SOURCE	DF	SS	MS	F	P
REGRESSION	3	39691.6	13230.5	44.25	0.0000
RESIDUAL	19	5680.88	298.993		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	40.6	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	11.9	3
PLCONC	2972.38	3	39691.6	13230.5	0.8550	4.0	4
RESIDUAL	5680.88	22	45372.5	2062.38			

R-SQUARED	0.8748	RESID. MEAN SQUARE (MSE)	298.993
ADJUSTED R-SQUARED	0.8550	STANDARD DEVIATION	17.2914

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 2)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	41.2717	10.6109	3.89	0.0010	
NOECPS	1.65160	0.16886	9.78	0.0000	1.1
PLPRESCH	-60.3720	10.1487	-5.95	0.0000	1.1
TDEFM	23.3299	8.08765	2.88	0.0095	1.2

R-SQUARED	0.8674	RESID. MEAN SQUARE (MSE)	316.724
ADJUSTED R-SQUARED	0.8464	STANDARD DEVIATION	17.7967

SOURCE	DF	SS	MS	F	P
REGRESSION	3	39354.7	13118.2	41.42	0.0000
RESIDUAL	19	6017.76	316.724		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	37.3	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	10.3	3
TDEFM	2635.50	3	39354.7	13118.2	0.8464	4.0	4
RESIDUAL	6017.76	22	45372.5	2062.38			

R-SQUARED	0.8674	RESID. MEAN SQUARE (MSE)	316.724
ADJUSTED R-SQUARED	0.8464	STANDARD DEVIATION	17.7967

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 3)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	11.9336	21.7009	0.55	0.5888	
NOECPS	1.55050	0.17484	8.87	0.0000	1.0
PLPRESCH	-42.8709	11.5547	-3.71	0.0015	1.2
NOPMDIDS	4.00545	1.90538	2.10	0.0491	1.2

R-SQUARED	0.8453	RESID. MEAN SQUARE (MSE)	369.495
ADJUSTED R-SQUARED	0.8208	STANDARD DEVIATION	19.2222

SOURCE	DF	SS	MS	F	P
REGRESSION	3	38352.1	12784.0	34.60	0.0000
RESIDUAL	19	7020.40	369.495		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	29.2	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	6.4	3
NOPMDIDS	1632.85	3	38352.1	12784.0	0.8208	4.0	4
RESIDUAL	7020.40	22	45372.5	2062.38			

R-SQUARED	0.8453	RESID. MEAN SQUARE (MSE)	369.495
ADJUSTED R-SQUARED	0.8208	STANDARD DEVIATION	19.2222

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 4)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	22.6741	17.4879	1.30	0.2103	
NOECPS	1.60436	0.18045	8.89	0.0000	1.1
PLPRESCH	-53.3226	10.5846	-5.04	0.0001	1.0
NODIDS	0.42782	0.20405	2.10	0.0496	1.1

R-SQUARED	0.8451	RESID. MEAN SQUARE (MSE)	369.865
ADJUSTED R-SQUARED	0.8207	STANDARD DEVIATION	19.2318

SOURCE	DF	SS	MS	F	P
REGRESSION	3	38345.0	12781.6	34.56	0.0000
RESIDUAL	19	7027.43	369.865		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	29.2	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	6.4	3
NODIDS	1625.83	3	38345.0	12781.6	0.8207	4.0	4
RESIDUAL	7027.43	22	45372.5	2062.38			

R-SQUARED	0.8451	RESID. MEAN SQUARE (MSE)	369.865
ADJUSTED R-SQUARED	0.8207	STANDARD DEVIATION	19.2318

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 5)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	44.6534	11.7771	3.79	0.0012	
NOECPS	1.59899	0.18717	8.54	0.0000	1.1
PLPRESCH	-55.3879	10.9934	-5.04	0.0001	1.0
CTYPE	15.8001	8.96443	1.76	0.0941	1.1

R-SQUARED	0.8361	RESID. MEAN SQUARE (MSE)	391.434
ADJUSTED R-SQUARED	0.8102	STANDARD DEVIATION	19.7847

SOURCE	DF	SS	MS	F	P
REGRESSION	3	37935.2	12645.0	32.30	0.0000
RESIDUAL	19	7437.25	391.434		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	26.5	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	5.1	3
CTYPE	1216.00	3	37935.2	12645.0	0.8102	4.0	4
RESIDUAL	7437.25	22	45372.5	2062.38			

R-SQUARED	0.8361	RESID. MEAN SQUARE (MSE)	391.434
ADJUSTED R-SQUARED	0.8102	STANDARD DEVIATION	19.7847

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 6)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	42.1821	12.5313	3.37	0.0032	
NOECPS	1.57186	0.18499	8.50	0.0000	1.1
PLPRESCH	-51.5428	10.9909	-4.69	0.0002	1.0
SOWCSSR	14.3896	8.66136	1.66	0.1131	1.1

R-SQUARED	0.8335	RESID. MEAN SQUARE (MSE)	397.666
ADJUSTED R-SQUARED	0.8072	STANDARD DEVIATION	19.9415

SOURCE	DF	SS	MS	F	P
REGRESSION	3	37816.8	12605.6	31.70	0.0000
RESIDUAL	19	7555.66	397.666		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	25.8	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	4.8	3
SOWCSSR	1097.60	3	37816.8	12605.6	0.8072	4.0	4
RESIDUAL	7555.66	22	45372.5	2062.38			

R-SQUARED	0.8335	RESID. MEAN SQUARE (MSE)	397.666
ADJUSTED R-SQUARED	0.8072	STANDARD DEVIATION	19.9415

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 7)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	38.0664	15.2381	2.50	0.0218	
NOECPS	1.49207	0.18366	8.12	0.0000	1.0
PLPRESCH	-52.3756	11.2251	-4.67	0.0002	1.0
PPSOW	0.32733	0.24460	1.34	0.1966	1.0

R-SQUARED	0.8257	RESID. MEAN SQUARE (MSE)	416.206
ADJUSTED R-SQUARED	0.7982	STANDARD DEVIATION	20.4011

SOURCE	DF	SS	MS	F	P
REGRESSION	3	37464.5	12488.1	30.00	0.0000
RESIDUAL	19	7907.91	416.206		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	23.8	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	3.8	3
PPSOW	745.352	3	37464.5	12488.1	0.7982	4.0	4
RESIDUAL	7907.91	22	45372.5	2062.38			

R-SQUARED	0.8257	RESID. MEAN SQUARE (MSE)	416.206
ADJUSTED R-SQUARED	0.7982	STANDARD DEVIATION	20.4011

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 8)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	30.9033	10.8393	2.85	0.0106	
NOECPS	1.76449	0.16323	10.81	0.0000	1.2
PLPRESCH	-56.3005	9.48297	-5.94	0.0000	1.1
PLCONC	18.3318	8.49360	2.16	0.0447	1.5
TDEFM	15.2707	8.29412	1.84	0.0821	1.5

R-SQUARED	0.8946	RESID. MEAN SQUARE (MSE)	265.587
ADJUSTED R-SQUARED	0.8712	STANDARD DEVIATION	16.2968

SOURCE	DF	SS	MS	F	P
REGRESSION	4	40591.9	10147.9	38.21	0.0000
RESIDUAL	18	4780.57	265.587		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	48.1	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	15.6	3
PLCONC	2972.38	3	39691.6	13230.5	0.8550	6.4	4
TDEFM	900.304	4	40591.9	10147.9	0.8712	5.0	5
RESIDUAL	4780.57	22	45372.5	2062.38			

R-SQUARED	0.8946	RESID. MEAN SQUARE (MSE)	265.587
ADJUSTED R-SQUARED	0.8712	STANDARD DEVIATION	16.2968

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 9)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	20.3845	14.0742	1.45	0.1647	
NOECPS	1.78890	0.17348	10.31	0.0000	1.3
PLPRESCH	-49.3466	9.35631	-5.27	0.0001	1.0
PLCONC	27.0197	7.94334	3.40	0.0032	1.3
NOEVCRIT	2.06593	1.48280	1.39	0.1805	1.1

R-SQUARED	0.8870	RESID. MEAN SQUARE (MSE)	284.881
ADJUSTED R-SQUARED	0.8619	STANDARD DEVIATION	16.8784

SOURCE	DF	SS	MS	F	P
REGRESSION	4	40244.6	10061.1	35.32	0.0000
RESIDUAL	18	5127.87	284.881		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	43.5	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	13.4	3
PLCONC	2972.38	3	39691.6	13230.5	0.8550	4.9	4
NOEVCRIT	553.009	4	40244.6	10061.1	0.8619	5.0	5
RESIDUAL	5127.87	22	45372.5	2062.38			

R-SQUARED	0.8870	RESID. MEAN SQUARE (MSE)	284.881
ADJUSTED R-SQUARED	0.8619	STANDARD DEVIATION	16.8784

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 10)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	36.2792	10.5406	3.44	0.0029	
NOECPS	1.72554	0.16686	10.34	0.0000	1.2
PLPRESCH	-62.1091	9.73493	-6.38	0.0000	1.1
CTYPE	13.1536	7.75011	1.70	0.1069	1.1
TDEFM	21.7175	7.77314	2.79	0.0120	1.2

R-SQUARED	0.8857	RESID. MEAN SQUARE (MSE)	288.199
ADJUSTED R-SQUARED	0.8603	STANDARD DEVIATION	16.9764

SOURCE	DF	SS	MS	F	P
REGRESSION	4	40184.9	10046.2	34.86	0.0000
RESIDUAL	18	5187.58	288.199		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	42.8	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	13.0	3
CTYPE	1216.00	3	37935.2	12645.0	0.8102	10.8	4
TDEFM	2249.67	4	40184.9	10046.2	0.8603	5.0	5
RESIDUAL	5187.58	22	45372.5	2062.38			

R-SQUARED	0.8857	RESID. MEAN SQUARE (MSE)	288.199
ADJUSTED R-SQUARED	0.8603	STANDARD DEVIATION	16.9764

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 11)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	33.6683	11.0802	3.04	0.0071	
NOECPS	1.70879	0.16467	10.38	0.0000	1.2
PLPRESCH	-59.0174	9.71892	-6.07	0.0000	1.1
TDEFM	22.1763	7.74884	2.86	0.0104	1.2
SOWCSSR	12.5235	7.40596	1.69	0.1081	1.1

R-SQUARED 0.8856 RESID. MEAN SQUARE (MSE) 288.489
ADJUSTED R-SQUARED 0.8601 STANDARD DEVIATION 16.9849

SOURCE	DF	SS	MS	F	P
REGRESSION	4	40179.6	10044.9	34.82	0.0000
RESIDUAL	18	5192.81	288.489		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	42.8	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	13.0	3
TDEFM	2635.50	3	39354.7	13118.2	0.8464	5.9	4
SOWCSSR	824.943	4	40179.6	10044.9	0.8601	5.0	5
RESIDUAL	5192.81	22	45372.5	2062.38			

R-SQUARED 0.8856 RESID. MEAN SQUARE (MSE) 288.489
ADJUSTED R-SQUARED 0.8601 STANDARD DEVIATION 16.9849

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 12)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	27.6095	11.8297	2.33	0.0314	
NOECPS	1.75782	0.17049	10.31	0.0000	1.2
PLPRESCH	-50.1227	9.37678	-5.35	0.0000	1.0
PLCONC	23.1394	8.09147	2.86	0.0104	1.3
SOWCSSR	9.79555	7.55179	1.30	0.2110	1.1

R-SQUARED 0.8855 RESID. MEAN SQUARE (MSE) 288.625
ADJUSTED R-SQUARED 0.8601 STANDARD DEVIATION 16.9889

SOURCE	DF	SS	MS	F	P
REGRESSION	4	40177.2	10044.3	34.80	0.0000
RESIDUAL	18	5195.26	288.625		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	42.7	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	13.0	3
PLCONC	2972.38	3	39691.6	13230.5	0.8550	4.7	4
SOWCSSR	485.616	4	40177.2	10044.3	0.8601	5.0	5
RESIDUAL	5195.26	22	45372.5	2062.38			

R-SQUARED 0.8855 RESID. MEAN SQUARE (MSE) 288.625
ADJUSTED R-SQUARED 0.8601 STANDARD DEVIATION 16.9889

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 13)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	12.5163	19.2151	0.65	0.5230	
NOECPS	1.72129	0.16923	10.17	0.0000	1.2
PLPRESCH	-45.3786	10.2795	-4.41	0.0003	1.2
PLCONC	21.3232	8.53788	2.50	0.0224	1.4
NOPMDIDS	2.30949	1.81854	1.27	0.2203	1.4

R-SQUARED	0.8851	RESID. MEAN SQUARE (MSE)	289.651
ADJUSTED R-SQUARED	0.8596	STANDARD DEVIATION	17.0191

SOURCE	DF	SS	MS	F	P
REGRESSION	4	40158.7	10039.6	34.66	0.0000
RESIDUAL	18	5213.72	289.651		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	42.5	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	12.9	3
PLCONC	2972.38	3	39691.6	13230.5	0.8550	4.6	4
NOPMDIDS	467.155	4	40158.7	10039.6	0.8596	5.0	5
RESIDUAL	5213.72	22	45372.5	2062.38			

R-SQUARED	0.8851	RESID. MEAN SQUARE (MSE)	289.651
ADJUSTED R-SQUARED	0.8596	STANDARD DEVIATION	17.0191

UNWEIGHTED LEAST SQUARES LINEAR REGRESSION OF SCHEDMOD (MODEL 14)

PREDICTOR VARIABLES	COEFFICIENT	STD ERROR	STUDENT'S T	P	VIF
CONSTANT	14.4832	19.2896	0.75	0.4625	
NOECPS	1.66677	0.16215	10.28	0.0000	1.1
PLPRESCH	-52.2267	10.9316	-4.78	0.0002	1.4
TDEFM	19.8749	8.03669	2.47	0.0236	1.3
NOPMDIDS	2.86527	1.75296	1.63	0.1195	1.3

R-SQUARED	0.8845	RESID. MEAN SQUARE (MSE)	291.111
ADJUSTED R-SQUARED	0.8588	STANDARD DEVIATION	17.0619

SOURCE	DF	SS	MS	F	P
REGRESSION	4	40132.5	10033.1	34.46	0.0000
RESIDUAL	18	5240.00	291.111		
TOTAL	22	45372.5			

STEPWISE ANALYSIS OF VARIANCE OF SCHEDMOD

SOURCE	INDIVIDUAL SS	CUM DF	CUMULATIVE SS	CUMULATIVE MS	ADJUSTED R-SQUARED	MALLOWS' CP	P
CONSTANT	59741.4						
NOECPS	27555.7	1	27555.7	27555.7	0.5886	42.2	2
PLPRESCH	9163.49	2	36719.2	18359.6	0.7902	12.7	3
TDEFM	2635.50	3	39354.7	13118.2	0.8464	5.7	4
NOPMDIDS	777.755	4	40132.5	10033.1	0.8588	5.0	5
RESIDUAL	5240.00	22	45372.5	2062.38			

R-SQUARED	0.8845	RESID. MEAN SQUARE (MSE)	291.111
ADJUSTED R-SQUARED	0.8588	STANDARD DEVIATION	17.0619

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Vita

Squadron Leader Richard G. Hazeldean was born on 18 January 1960 in Cheshire, England. He emigrated to Australia with his family in 1967. He graduated from Caboolture High School in Queensland in 1978, and attended the Royal Australian Air Force (RAAF) Engineer Cadet Squadron (ECS), graduating with a Bachelor of Electronic Engineering in December 1981. Upon graduation, he received a permanent commission in the RAAF and served his first tour of duty at RAAF Base Laverton, Victoria. He initially served as an electronics instructor at the RAAF School of Radio. From here, he was posted to Radio Development Flight (RDF) at the Aircraft Research and Development Unit (ARDU), RAAF Base Edinburgh, South Australia. At ARDU, he was responsible for managing modifications to electronic systems on a variety of aircraft. Furthermore, he was responsible for developing, installing, and testing a remote radio receiver site used for aircraft flight-testing. In December 1987, he was posted to the Ground Support Equipment (GSE) cell in Headquarters Logistics Command (HQLC), Victoria, where, initially, he was responsible for the engineering management of, and the acquisition of, all electrical, electronic, and instrument GSE. In January 1990, he was transferred into the Automatic Test Equipment (ATE) and calibration cell, where he was responsible for the engineering management of, and the acquisition of, ATE and associated Test Program Sets (TPSs) and calibration equipment. From here, he was posted to the School of Systems and Logistics, Air Force Institute of Technology, in May 1992.

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Vita

Squadron Leader John R. Topfer was born on 22 November 1961 in Sydney, Australia. He joined the Royal Australian Air Force (RAAF) in January 1979 as an Engineering Cadet, then graduated from the Royal Melbourne Institute of Technology with a Bachelors Degree (with Distinction) in Aeronautical Engineering in December 1982. Upon graduation, he received a Permanent Commission in the RAAF and served his first tour of duty as an engineering officer at No. 34 (VIP) Squadron, RAAF Base Fairbairn, Canberra. In December 1985, he was posted to Headquarters Support Command (HQSC), Melbourne, as the officer in charge of aircraft scheduled maintenance reviews. Squadron Leader Topfer was then posted to a short-term job on the Utility Helicopter Project in December 1986. In October 1987, he was posted within HQSC to be the first Systems Engineer for the RAAF Blackhawk helicopter. In December 1989, he was posted as the Resident Engineer at a contractor's facility in Sydney for RAAF Blackhawk helicopter and Pilatus PC-9 trainer aircraft production. During that posting, he attended an aircraft accident investigation course in the United Kingdom and, as a result, he was posted in December 1990 to the Directorate of Air Force Safety in Canberra as Staff Officer Ground Safety. In that position, he was responsible for RAAF occupational health and safety policy, and was the specialist engineer on several major aircraft accident investigations. Squadron Leader Topfer entered the School of Systems and Logistics, Air Force Institute of Technology, in May 1992.

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This research focused on the pre-contract-award management actions of small-scale, design and development contracts and the relationship of these actions to schedule performance. Three phases of the contractual process were studied: the planning, specifying, and controlling phases. A sample of 25 contracts from SPOs at Wright-Patterson AFB was obtained. Data on the variables were obtained directly from the contract files and from the contract-management database, AMIS. Regression analysis techniques were used to identify the pre-contract-award management actions that were related to schedule performance. The number of contract modifications was found to be the most significant factor related to schedule performance.

Pre-contract-award management actions that showed a significant relationship to schedule performance were whether the contract was pre-scheduled, whether the contract involved concurrency, whether a preliminary WBS had been developed, whether the contract utilized a Type A or Type B specification, whether the contract required the schedule information to be presented in network format, and the number of DIDs specified in the CDRL. In addition to the identification of these actions, the study revealed that the management of schedule was not well understood within the SPOs.

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