THE DEVELOPMENT OF A PROTOTYPE COMPUTER-BASED MODELING SYSTEM FOR ANALYSIS OF THE SENSITIVITY OF SELECTED COSTING ASSUMPTIONS IN AN ACADEMIC DEPARTMENT

DISSERTATION

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The subject of this study was the development of a computer-based system for the modeling of costing assumptions in an academic department. Initially, costing assumptions were defined as those assumptions made in the selection of costing sources and apportioning procedures in cost studies. The major theme of this study was that the system should allow for multiple sets of costing assumptions to be modeled, and it should allow for a very low level of cost disaggregation. This modeling system allows costs to be attached to individual course enrollments, and it also allows multiple departmental cost studies to be performed simultaneously so that any two may be compared for sensitivity analysis.

The modeling system was developed from an environmental analysis. The analysis took the form of a review of literature from which design specifications were formulated. Chapter II contains this review of literature. A second review of literature, contained in Chapter III, was undertaken to establish a background for the selection of costing sources and apportioning procedures.

Chapter IV contains system documentation. In this chapter the six basic computer jobs and programs are described. Also, job control language, system files, and system operation are discussed.

Chapter V contains a demonstration of the prototype computer-based modeling system. Seven costing iterations or cost studies were performed. Costs in each iteration were computed for every student major by level combination and for the whole department. Any two iterations at a time may be selected for sensitivity analysis, and the SENSITIVITY REPORT displays ratios containing the costs of one iteration divided by the respective costs of another iteration.

Data used in Chapter V were selected from various sources. The data base, consisting primarily of department faculty, their courses, and enrollments in those courses, was obtained from existing institutional computer files for the 1973-74 academic year. Actual expenses used in the study were derived from departmental records, the institutional budget, and the RRPM 1.6 study performed on campus for that academic year.

Chapter VI contains implications and recommendations. The following implications were listed. First, there is not necessarily any basis for addressing questions of academic quality through a costing process. Second, "soft" approaches to modeling are appropriate, and third, they contribute to the expansion of existing modeling capability. Fourth, new meaning attaches to the term "costing assumptions". Fifth, department level costs exert the major influence on resultant computed costs, and, sixth, a definite interaction exists between costing sources, apportioning procedures, and the data base. Finally, program costs computed by the system bear no relationship to the apportioning rates in formulas established by The Coordinating Board, Texas College and University System, and used for legislative appropriations requests.

The following recommendations were made. First, additional development in the area of departmental level management information systems should follow. Other recommendations were that the capabilities of the existing prototype system could be expanded to include data pertaining to the demographic properties of students, the expanded simulation properties of the modeling system, and the characteristics of potential student dropouts. Another recommendation was that the existing system could be expanded to include other apportioning alternatives. Finally, departmental administrators could perform their own cost studies and the individual departmental studies could then be combined to form an institutional study.

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CHAPTER I

INTRODUCTION

Higher education faces many crises usually subsumed under the general headings of governance, accountability, role, financing, etc. A generally accepted proposition is that the institution of higher education is unique in society and it follows that crises facing higher education are also unique. In the current era of financial stringency many of these crises are ultimately traceable to monetary considerations. Widespread interest exists in studies of university costs; the numerous efforts aimed at establishing cost values for instruction, research, and public service attest to the lack of agreement on cost objectives, definitions, units, sources, and apportioning procedures. The uniqueness of higher education contributes to the disagreement, since no definite profit motive or productivity functions exist as in business. A lack of precise definition and meaning also exists for measurable sources of costing input and output. In fact, general agreement is usually reached not on measures but only on the three major purposes of the university: instruction, research, and public service.

Interest in higher education costing is not limited to the immediate university community. Robert L. Williams (22, p. 322) listed as interested groups (in addition to university presidents and administrators) legislators, boards of trustees, faculty, and supporting public. He continued: "The competition for financial support for higher education has led us to be more cost conscious than ever before" (22, p. 322).

The literature is replete with cost studies and cost models. The present study is intended to help address some of the aforementioned questions, through the development of a prototype computer-based modeling system.

Cost studies are not a recent development. Witmer (24, p.99) traced the origins of cost studies to the early 1900's and the advent of the scientific management movement. Early efforts were directed toward establishing acceptable accounting systems which emphasized uniformity in record-keeping and reporting. Today, efforts continue at perfecting classification schemes (5, 6, 7). Early cost studies also were concerned with establishing simple measures of costs. Various measures were used: cost per unit, cost per full-time student, cost per credit hour, cost per clock hour, cost per faculty member, etc. Similarly, various measures are used today.

Establishing measures of cost, however, is usually only one step in the process of dealing with questions of quality and economy. Some studies have examined the multiple relationships between educational expenditures and quality of education, state economic development and family income.

Recently, studies have addressed the less tangible issues of cost-benefit, cost-effectiveness and cost-utility (21).

Cost information is recognized to be a useful tool in the management of educational institutions. In periods of growth and unrestricted resources, administrators do not have to deal with questions of efficient or financially justifiable operation. However, in periods of economic retrenchment, administrators must address financial questions on a priority basis, and the continued existence of many programs is primarily determined by financial considerations.

The Carnegie Commission (3) in its report, Institutional Aid: Federal Support to Colleges and Universities, referred to a "new depression" in higher educatuon. This depression, a direct result of the financial crisis facing presidents and boards of trustees, emerged in the early seventies. The report specified that the crisis was not limited to private institutions; several public institutions, public and private research universities, private liberal arts and two-year colleges, and black colleges were suffering financial problems (3, pp. 51-52). However, the Commission presented an apparent paradox in its final report (4) by concluding that increases in expenditures per student must continue to rise. One of the problems they saw, in fact, was that those expenditures had not risen fast enough (4, p. 63).

Historically, costs per student had risen at a rate equal to the cost of living plus 2.5 percent. In the 1960's the rate increased to plus 3.4 percent (4, p. 63). Recently, however, costs per student rose at a rate only slightly higher than the cost of living. The report attempted to justify the need for adequate resources to maintain expenditure levels by comparing higher education to industry. According to the report, increased costs in industry are offset by annual increases in productivity of 2.5 percent. Higher education, however, does not lend itself to increases in productivity as is also the case with some other service sectors in the economy; therefore, to maintain quality and comparable salaries, the report recommended that expenditures per student must rise at a rate equal to the cost of living plus 2.5 percent (4, p. 64).

Framed in the light of demands for increased accountability, the need for a different view of costing becomes apparent. In the introduction to their book on higher education outputs, Lawrence, Weathersby, and Patterson referenced an unidentified quotation:

> "Our mandate is clear . . . We are going to have to prove that we deserve the dollars spent on higher education and justify our asking for each additional dollar . . ." (11, p. 1).

Focusing specifically on the broad issue of accountability, they stated:

> As never before, the university is being asked to justify itself--its purpose, its methods of achieving that purpose; its allocation of precious resources; its priorities; its responsibilities to the individual and to society. Yes, both from within and from without, institutions of higher education are being called to account (11, p. 3).

The costing issue is compounded by problems reflected in statements like one made by June O'Neill in the introduction to her report for the Carnegie Commission in reference to the rapid growth of higher education and public concern about costs in higher education, ". . . there is really very little firm knowledge about the magnitude of the costs of higher education and how they change over time" (15, p. 1). Directing her attention to units of measure, she speculated that changes in credit-hour measures of were dubious measures of real changes in output. She continued, ". . . underlying data are more imperfect than one would wish" (15, p. 1). The conclusion drawn by O'Neill was that measures of productivity are only tentative and should serve as the impetus for further research.

As has been established previously, there is no unanimity of agreement on any particular approach to costing in higher education. The National Association of College and University Business Officers (NACUBO) (12, p. 1) described the determination of cost information as a process of approximation. Individual judgment plays an important role in costing, and it must reflect ". . . circumstances relevant to the purposes for which cost information is collected" (12, p. 1). Consequently, NACUBO recommended different cost methods for different purposes instead of one method for all purposes.

Part of the reason for the process of approximation is the nature of the university. The university environment is basically social and political, and Baughman stated that "University management is fundamentally different from industrial management because its problems must be solved with political rationality as a primary criterion and economic rationality as a secondary criterion" (1, p. 2).

In addition, few, if any, academic positions are simply associated with only one university function. As mentioned earlier, at least three university functions are generally identified: instruction, research and public service. In most cases it is a questionable practice to arbitrarily apportion all of a faculty member's salary to instruction alone. However, such practices are not uncommon. On the other hand, attempting to get a measure of every faculty member's activities for costing purposes is, at best, a process of approximation.

The various approaches to costing contribute to a lack of data compatibility and some confusion. Russell Thackrey concluded, "There is, in fact, no agreement whatever on how certain costs should be allocated among the multiple functions performed by American higher education . . ." (19, p. 415). In addition he noted:

> The assumptions and the nature of the evidence are usually stated in detail in papers describing the research, but what reaches the public, and policy makers, is most often only the summarized findings and conclusions, without any warning that the product may

> be unreliable or have dangerous side effects untested by the producer (19, p. 415).

The problem of getting acceptable data, according to Thackrey, involved agreement on definitions, reporting categories and allocation procedures (19, p. 417). Thackrey recommended that time should be taken to ask basic questions about statistics. Similarly, Logan Wilson summarized succinctly by noting that, ". . . obsession with costs can lead us to know the price of everything and the real value of nothing in higher education" (23, p. 102).

Examples of Cost Studies

Joan Frisbee (8) studied direct and indirect costs of the organized instructional program in a small private liberal arts college. The unit of measure used in her study was the credit hour generated (CHG). Frisbee defined direct costs to include teaching salaries, and payments made by the school for Social Security, insurance and retirement. Indirect costs included departmental expenditures which were not identifiable at the course level and institutional expenditures which were identified at other than the departmental or course levels. Some costs were prorated on a semester-hours-taught basis while others were prorated on either a credit hour generated basis or full-time-equivalent staff basis (8, p. 34).

Scheerer (17) claimed that her efforts were directed toward deriving a realistic measure of instructional costs.

Her study was limited to the courses in the divisions of arts, business administration and the graduate school of a university. Her unit of measure was cost per equivalent student credit hour (ESCH) which provided for the assumption that faculty spend more time and energy on graduate courses than on upper-level courses and likewise on upper-level courses than lower-level courses. Direct costs included departmental costs (salary, non-salary and library book allotment), the departmental share of the costs of the undergraduate dean's office, and the departmental share of the graduate dean's office. Indirect costs included central administration, student services and plant maintenance. Capital expenditures were excluded (17, pp. 25-26).

Raichle's analytical study (16) concerned private and public costs as well as cost-utility aspects of a selected post-secondary vocational-technical educational program. In this study direct per pupil costs included teachers' salaries, depreciation of classroom or laboratory furniture used in each course, and depreciation of the facility space cost of the classroom or laboratory used in each course. Indirect costs allocated to each student included salaries other than instructors', administration expense, general expense, physical plant expense, resources of the library, student personnel services costs, and depreciation costs of equipment, furniture and facility space associated with administration, student personnel services and the library

(16, pp. 33-34). Private costs included foregone earnings, fees paid by the student, book costs and miscellaneous supplies costs (16, p. 58). Public costs were calculated by subtracting internal funds (student fees, vending machine profits, and other miscellaneous sources of non-public income) from the total program cost (16, pp.59-60). Private and public utility costs were also calculated.

The National Center for Higher Education Management Systems (NCHEMS) at the Western Interstate Commission for Higher Education has established a lead in the research and development of higher education planning and management systems. Computer software developed and marketed by NCHEMS includes the Resource Requirements Prediction Model 1.6 (RRPM 1.6), an instructional cost simulation model. Recently, NCHEMS marketed the Costing and Data Management System which interfaces with RRPM 1.6. The entire system allows user institutions substantial flexibility in cost source selection, apportioning procedures and units of measure.

The Study of Assumptions

Some effort has been directed toward the study of costing assumptions, that is, those assumptions made in cost studies which concern costing sources or apportioning procedures.

E. G. Bogue (2) reported on a study conducted at Memphis State University. The study concerned researching the changes in instructional cost patterns which resulted from salary allocation to courses on the basis of faculty effort as opposed to course credit, and course number as opposed to student classification. The unit of measure used in his study was the semester credit hour and the only cost source was faculty salaries. Two primary findings of Bogue's study were:

> 1. There is a definite and pronounced stair-step increase in unit costs when allocation to instructional level follows course number rather than student classification.
> 2. There is a tendency toward higher unit costs at the doctoral level when allocation follows faculty distribution of effort rather than course credit value (2, p. 91).

Explaining the first finding, Bogue pointed out that there were large numbers of upper division students taking lower division work; therefore, more costs were allocated to lower division courses than were the case when costs were allocated on the basis of course numbers. Regarding the second finding, a dramatic shift in costs from lower division courses to doctoral courses resulted when allocation was based on faculty distribution of effort as opposed to allocation on the basis of course credit value. Such a shift was directly related to the assumption that faculty members devoted more effort to doctoral level courses than to master's level courses, etc.

Sheehan and Michaels (18) reported the results of seven sensitivity tests on an established cost study methodology at the University of Calgary. Sensitivity tests were used to show the dependency of results of modifications to procedures in the methodology. Sensitivity tests involved dividing per-student costs produced by each modification to the methodology by the corresponding costs determined by the methodology. The output was one column of ratios for each sensitivity test that depicted, for each type of student by major and level, the cost computed by the particular modification divided by the corresponding cost computed by the methodology.

The methodology had been used to ". . . assess the validity of the enrollment weighting formula by which the Alberta Universities Commission apportions operating funds among universities in Alberta" (18, p. 186). The research performed by Sheehan and Michaels involved modifying some cost apportioning procedures from those established in the methodology. For example, "Activity costs for Research, Library Services and Department Administration are assigned by the methodology to Instruction and Supervision of Graduate Student Research and Thesis Work" (18, p. 188). The first sensitivity test of their study concerned the effect of allocating all of the aforementioned activity costs exclusively to Instruction. Important cost source omissions in this study were capital expenditures and research fundings. Results of two of the tests indicated that the methodology amplified costs of undergraduate programs relative to graduate programs when compared with the respective modifications to the methodology (18, pp. 189-190).

Other researchers have concluded that additional studies in the area of costing assumptions should be encouraged. In a paper dealing with simulation models and their effectiveness in higher education, Krampf and Heinlein (10, p. 96) listed the study of "What types of relationships exist among variables that are part of the models?" as a recommendation for further research. David Humphrey (9), in a dissertation concerned with the development of a course cost-analysis instrument in higher education, listed the need for assessment of course cost assumptions as one implication. Finally, in regard to the proposed study, Russell Thackrey in personal correspondence concluded with the following statement, "Your dissertation is on a topic of major importance which has, in my opinion, been far too much neglected" (20).

A review of the literature on cost studies in higher education confirms that individual studies vary greatly from one another. Some of the causes for the variation are purposes of the study, definition of terms, units of measure, sources of costs and apportioning procedures. One conclusion drawn by Williams in his cost study was:

> There are so many variations in the factors affecting costs that comparisons of average costs, with implied meanings for efficiency of operation without consideration of quality, become of highly questionable value (22, p. 327).

Subject of the Study

The subject of the study is the development of a prototype computer-based modeling system for analysis of the sensitivity of selected costing assumptions in an academic department. The modeling system was tested in an academic department at North Texas State University (NTSU).

Purposes of the Study

The purposes of this study are to

1. Develop a framework which establishes the role of costing at the Department level in higher education management.

2. Review higher education costing literature to synthesize major costing sources in higher education.

3. Review higher education costing literature to synthesize major apportioning procedures in higher education.

4. Simulate the application of selected costing sources and apportioning procedures to develop sensitivity tests for each.

5. Establish a precedent for higher education costing development to document implications of costing assumptions.

Exploratory Questions

1. What is the role of costing at the departmental level in higher education management?

    1.1 What role does cost analysis, cost-benefit analysis, cost-utility analysis, and cost-effectiveness analysis play in higher education costing?

    1.2 What role does educational output play in the costing process?

    1.3 With regard to purposes, to what extent is the costing process commonly pursued in cost studies?

    1.4 What is the role of costing in an academic Management Information System?

    1.5 What is the use of costing information developed at the macro level and micro level?

2. What costing sources are commonly used in higher education cost studies?

    2.1 What costs are commonly identified as direct costs?

    2.2 What costs are commonly identified as indirect costs?

3. What apportioning procedures are commonly used in higher education cost studies?

3.1 What quantifiable procedures are commonly used to apportion cost sources?

3.2 How do apportioning procedures relate to the costing purposes?

3.3 What is the role of weighting in establishing an equitable distribution of costs?

4. How sensitive are costs to selected costing sources and selected apportioning procedures?

4.1 How sensitive are costs to selected costing sources commonly identified in costing systems?

4.1.1 What effect do costing sources identified at the departmental level have on cost sensitivity?

4.1.2 What effect do costing sources identified at the college level have on cost sensitivity?

4.1.3 What effect do costing sources identified at the institutional level have on cost sensitivity?

4.2 How sensitive are costs to selected apportioning procedures commonly identified in costing systems?

4.2.1 What effect do selected methods of apportioning salaries have on cost sensitivity?

4.2.2 What effect do selected methods of apportioning other expenses have on cost sensitivity?

4.2.3 What effect do selected weighting schemes have on cost sensitivity?

4.2.4 What effect do dropouts have on cost sensitivity?

5. What implications and recommendations may be drawn from the study of costing assumptions?

5.1 What relationship exists between costing and academic quality?

5.2 What are the implications of the study of selected costing assumptions modeled by the prototype system?

5.3 What recommendations may be made from this study of selected costing assumptions?

Definitions

Costing refers to the process of determining the monetary value of a product by measuring and relating prices paid for materials, labor and overhead to some measurable unit of output.

Costing assumptions are those assumptions made in cost studies or cost simulations which concern costing sources or apportioning procedures.

Cost-benefit analysis refers to analysis which yields numerical ratios. In each ratio the numerator and denominator represent the economic benefits of competing objectives.

Cost-effectiveness analysis refers to analysis concerned with assessing the desirability of alternative approaches to a single objective. This type of analysis often yields units of measure which are other than economic units.

Cost-utility analysis refers to analysis concerned with assessing the usefulness or importance of competing objectives. Utility is generally conceded to be a subjective measure used with ordinal scales where statements may be made concerning a "greater than" or "less than" relationship between objectives; however, it is often used with interval scales where statements may be made concerning the equality of intervals separating objectives.

There is no unanimity of agreement concerning the precise meanings of the three preceding forms of analysis. Frequently, differences in meaning exist only in degree and emphasis. In fact, some authors like Raichle (16, p. 9) use the terms cost-benefit, -effectiveness, and -utility synonymously.

Model refers to a representation of a system. For purposes of this study, various costing representations will be developed.

Sensitivity of an application is determined by dividing the costs of each set of simulated assumptions by the costs of an initial set of simulated assumptions.

Simulation means the execution of a model.

Weighting is a process used to relate quantitatively the value or importance of different variables to each other.

Limitations

Data can be gathered only for the Fall 1973 and Spring 1974 semesters at North Texas State University. These are the only two semesters for which the RRPM 1.6 has been run on campus. Both semesters have been combined to yield cost information for the 1973-74 academic year--a commonly accepted practice. This study is not intended to provide comparable cost information to the RRPM 1.6 or to serve as an alternative to RRPM 1.6. RRPM 1.6 and a supporting subsystem, the Induced Course Load Matrix, will simply be referenced in this study. The induced Course Load Matrix is a multidimensional matrix which shows the number of credit hours that students of each major take from each department. Some of the information generated by these systems (such as hours generated by departments and consumed by majors, departmental expenses, and departmental budget as a percent of institutional budget, etc.) is used in the simulation of selected costing assumptions.

Possible Benefits of the Study

This study is intended to shed light on the impact of some assumptions commonly made in cost studies. Little research has been done in this area. By expanding on the work already accomplished, this dissertation will establish a basis for documenting implications of some costing assumptions.

A more subtle benefit may be reflected in the generation of dialogue as a result of the proposed study. No two cost studies are the same, due in part to the fact that no two universities or departments of a university are the same. Consequently, this study should provide the impetus for similar studies elsewhere.

Unique Features of the Study

The uniqueness of this study derives from the expansion on the limited work done in the area of costing assumptions, plus the level of detail to which this study proceeds, the departmental level, and the development of a prototype computer-based modeling system for departmental analysis of the sensitivity of selected costing assumptions. As previously established, typical cost studies are characterized by assumptions made in what may be referred to as two dimensions: costing sources and apportioning procedures. Consequently, costing assumptions may be viewed in matrix form with costing sources and apportioning procedures representing a two-dimensional matrix. A typical cost study, therefore, may be viewed as a matrix of one row and one column--that is, one set of costing sources and one set of apportioning procedures. The results of any cost study are highly dependent upon the assumptions that are made in these two dimensions.

Two studies (2, 18) have been referenced which were more than typical cost studies--they were studies of costing assumptions. Bogue's institutional study (2) included only one costing source, faculty salaries, and four methods of apportioning that source to instructional levels. The assumptions Bogue studied, therefore, may be viewed in matrix form as one column, the single costing source, and four rows, the four methods of apportioning that source.

The institutional study by Sheehan and Michaels (18) concerned seven different ways of apportioning costs to per-student costs of programs. Although their study included more than one source of costs, those sources remained constant in each sensitivity test. Their sensitivity tests, therefore, represented seven different ways of apportioning the same costing sources. Viewed in matrix form their research may be described as one column, the costing sources, and seven rows which represent seven methods of apportioning costs.

Similarly, RRPM 1.6, used at NTSU as well as at many other institutions, provides the flexibility for modeling selected costing sources and apportioning procedures, and for simulating their impact at the institutional level. Each separate model may reflect hypothetical policy decisions and the simulation of those decisions may aid in forecasting resource requirements. RRPM 1.6 does not directly provide the capability of comparing one simulated model with another to produce sensitivity tests as was performed in the Sheehan and Michaels study. However, institutional-level sensitivity tests could be computed by hand.

An important notation is that Bogue's study, the Sheehan and Michaels study, and the RRPM 1.6 system do not actually apportion costs through individual courses. Rather, they group all courses of a level together along with the sum of corresponding costs and the sum of corresponding enrollments and compute an output measure based on both sums.

This study expands on work done in the area of costing assumptions by including more than one set of costing sources and more than one set of apportioning procedures. This study, therefore, may be viewed in matrix form as comprised of more than one column and more than one row.

This study, instead of focusing on an institution, focuses on a single university department where enrollment in courses can be studied in detail. Cost studies typically deal with entire levels of costs apportioned in a uniform way and do not attach specific costs or enrollments to specific courses. The prototype modeling system allows costing sources to be apportioned to courses and enrollments within courses in four different alternative ways.

This study concerns the development of a prototype computer-based modeling system which allows sensitivity tests to be performed on two cost models simultaneously. Sensitivity tests concerning student major costs are reported. No comparable departmental modeling system has been found in the literature.

Finally, departmental administrators will be able to reference this work as a basis for similar departmental studies. This study provides a background for data base development, modeling characteristics, and the implications of both.

Procedures for Collecting Data

The Director of the NTSU Office of Planning and Analysis granted permission for the NTSU RRPM 1.6 cost study of 1973-1974 to be referenced (14). This material served both as a cost study to be cited in the dissertation and as part of the data for simulation purposes.

The NTSU Registrar granted permission for the Student Schedule and Student Master files for Fall 1973 and Spring 1974 to be accessed in this study. These files were accessed to tabulate enrollment by major and level in the courses offered by the department to be studied, and to tabulate dropouts by major and level in the same courses.

The chairperson of the department to be studied in this dissertation granted permission to access departmental budget records for Fall 1973 and Spring 1974. These records were searched primarily for a detailed breakdown of departmental expenditures. The chairperson also agreed to provide a brief activity analysis for the faculty of the department for the period of time to be covered in the study.

Additional cost source data were obtained from the North Texas State University Budget, 1973-1974, located in the NTSU library (13). No budget information is disaggregated below the departmental level except for the department being studied.

In accordance with a reasonable concern for confidentiality, no salary information for any faculty or staff member is specified in the study except for the department studied. In the department studied, no names are specified.

A computer-based system was designed and written to perform the sensitivity tests previously described. The system consists of programs written in COBOL. One program represents an interface with existing institutional administrative files and it produces a departmental roster file suitable for system use. Another program is used to read in different sets of apportioning procedures in the form of weights. The next program converts each set of apportioning procedure weights to percentages which sum to 1.00. Another program computes costs for one set of costing sources and one set of apportioning procedures--both of which represent one iteration. This program reports costs pertaining to the particular iteration and it writes a data file to be subsequently accessed by the final program. The final program computes and displays sensitivity information regarding any two existing iterations or costing models resident on the data file.

Organization of the Study

This study is developmental in nature. Consequently, the purpose of the review of literature is to develop system specifications and identify system input. Rather than approaching a review of literature from the point of view of justifying preconceived notions, direction is provided by Exploratory Questions 1, 2 and 3. These questions were formulated with the goal of establishing a comprehensive basis for inquiry to provide the background for system specifications and system input.

Chapter II, the first literature review, addresses the question of the role of costing in departmental level management as specified by Exploratory Question 1. The purpose of this chapter is to establish the prototype system's specifications. Specifications are presented in the form of premises which define the scope of this particular system in view of the costing process as it exists in higher education at the departmental level.

Chapter III, a second distinct review of literature, identifies costing sources and apportioning procedures commonly found in higher education cost studies. This review, directed by Exploratory Questions 2 and 3, provides a background for the selection of costing sources (system variables) and apportioning procedures (system parameters). A final premise is presented in this chapter.

The purpose of Chapter IV is to document the prototype system's design. Appendix A contains program listings, Appendix B contains file formats, and Appendix C contains system job control language (JCL).

Chapter V is concerned with responding to Exploratory Question 4 which concerns the sensitivity of computed departmental level costs. Exploratory Question 4 provides direction for determining the ability of the system to meet its specifications.

Implications of the study and recommendations are presented in Chapter VI. Direction for the development of this chapter is provided by Exploratory Question 5. This chapter represents an attempt to step away from the preceding work, and to return, in effect, to the starting point for the purpose of assessing meaning and implications of the study. Chapter VI, instead of being conclusive, is a point of departure for further development in the area of departmental costing.

CHAPTER BIBLIOGRAPHY

1. Baughman, George W., "Evaluating the Performance and Effectiveness of the University Management Information Systems," Management Information Systems: Their Development and Use in the Administration of Higher Education, edited by John Minter and Ben Lawrence, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

2. Bogue, E. G., "An Inquiry Into the Relationship Between Instructional Cost Patterns and Assumptions Influencing Analysis of Basic Data in Unit Cost Studies," Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

3. Carnegie Commission on Higher Education, Institutional Aid: Federal Support to Colleges and Universities, A Report and Recommendations by The Carnegie Commission on Higher Education, McGraw-Hill Book Company, 1972.

4. Carnegie Commission on Higher Education, Priorities for Action: Final Report of the Carnegie Commission on Higher Education, A Report and Recommendations by The Carnegie Commission on Higher Education, McGraw-Hill Book Company, 1973.

5. College and University Business Administration, Washington, D. C., American Council on Education, 1968.

6. Collier, Douglas J., Higher Education Finance Manual, Boulder, Colorado, Western Interstate Commission for Higher Education, 1975.

7. Committee on College and University Accounting and Auditing, Audits of Colleges and Universities, New York, American Institute of Certified Public Accountants, 1973.

8. Frisbee, Joan, "Analysis of Instructional Program Costs in a Small Liberal Arts College," unpublished doctoral dissertation, Department of Education, The University of Tennessee, Knoxville, Tennessee, 1970.

9. Humphrey, David Allen, "The Development of an Instrument for Course Cost-Analysis in Higher Education," unpublished doctoral disseratation, Department of Education, State University of New York at Albany, Albany, New York, 1974

10. Krampf, Robert F. and Albert C. Heinlein, "The Effecttiveness of Simulation Models in Academic Administration," Decision Models in Academic Administration, edited by Albert C. Heinlein, Kent, Ohio, Decision Sciences Institute, 1974.

11. Lawrence, Ben, George Weathersby, and Virginia W. Patterson, editors, The Outputs of Higher Education: Their Identification, Measurement and Evaluation, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

12. National Association of College and University Business Officers, "Fundamental Considerations for Determining Cost Information in Higher Education," College and University Business Administration, 4:5, Washington, D. C., NACUBO, 1975.

13. "1973-1974 Budget, North Texas State University," Denton, Texas, 1973.

14. Office of Institutional Analysis and Planning, North Texas State University, "Resource Requirements Prediction Model 1.6 (RRPM 1.6): Reports and Introductory Notes," Denton, Texas, 1974.

15. O'Neill, June, Resource Use in Higher Education: Trends in Output and Inputs, 1930 to 1967, A Report Prepared for The Carnegie Commission on Higher Education, Berkeley, California, The Carnegie Commission on Higher Education, 1971.

16. Raichle, Henry Frederick, "A Cost-Utility Analysis of a Selected Post-Secondary Vocational-Technical Education Program," unpublished doctoral dissertation, The Florida State University, Tallahassee, Florida, 1969.

17. Scheerer, Anne E., "A Formula for Determining Instructional Costs," College Management, VII (November, 1972), 25-29.

18. Sheehan, Bernard S., and Mervin G. Michaels, "Sensitivity Tests on a University Cost Study Methodology," Institutional Research and Institutional Policy Formulation,

edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

19. Thackrey, Russell I., "If You're Confused About Higher Education Statistics, Remember: So Are the People Who Produce Them," Phi Delta Kappan, LVI (February, 1975), 415-419.

20. ____________________, Personal Letter, March 13, 1976.

21. Weiss, Edmond H., "Apples, Oranges and College Administration," College Management, VIII (November/December, 1973), 26-27.

22. Williams, Robert L., "The Cost of Educating One College Student," The Educational Record, XLII (October, 1961), 322-329.

23. Wilson, Logan, "Analyzing and Evaluating Costs in Higher Education," The Educational Record, XLII (April, 1961), 99-105.

24. Witmer, David R., "Cost Studies in Higher Education," Review of Educational Research, XLII (Winter, 1972), 99-127.

CHAPTER II

A REVIEW OF THE ROLE OF COSTING AT THE DEPARTMENTAL LEVEL

Developing prototype system specifications requires an analysis of the environment within which the system is intended to operate. This analysis consists of a thorough review of available literature and other relevant solicitations as necessary. Little work in the area of departmental level costing has been published; therefore, primary analysis is based on those sources defining the environment which can be assessed in the literature.

Since the subject of this study is the development of a prototype computer-based modeling system for analysis of the sensitivity of selected departmental level costing assumptions, the research of the environment was directed by Exploratory Question 1, which concerned the role of costing at the departmental level. If this role can be established through premises advanced from an environmental analysis, then system specifications may be developed and translated into computer software. Chapter II represents a written narrative of this process.

Cost and Costing

The terms "cost" and "costing" are in constant use in higher education and frequently serve as a basis for decision making. Their use is often unaccompanied by definition, the assumption is that such common-knowledge terms to not warrant definition. However, the numerous approaches to costing cast doubt on the legitimacy of this assumption. Therefore, an examination of these terms serves to establish an initial environmental background. Since the terms originate from accounting and economics, discussion will begin in these two areas.

Crowningshield (16, p. 8) asserted that cost is a term which is loosely used and cannot be simply defined. As an authority in accounting, he stated that definitions in accounting often differ from those in economics. Within the academic field of accounting, he defined cost as representing ". . . an expenditure . . . to secure resources for the purpose of producing revenue" (16, p. 8). Expenditures represent transactions which transfer actual resources, usually money.

Costs may be distinguished on the basis of cost systems. Describing two basic types of cost systems, the author defined a job-order cost system as existing where ". . . costs are accumulated for specific jobs or production orders . . ." and a process cost system as existing where " . . . costs are accumulated by processes, or departments, for a selected period of time" (16, p. 48).

In the field of economics, costs are viewed from a perspective where definitions and usage differ from those in accounting. The study of costs resulting from opportunities foregone (16, p. 8) is characteristic of an economic approach. Briefly, opportunity costs may be defined as those costs which ". . . consist in foregoing the opportunity of deriving an income from employing factors in alternative uses" (54, p. 256). Rather than being necessarily shown explicitly as in a profit or loss statement, these costs are often implicit.

The economic orientation stresses the study of optimization in policymaking. Typically, optimization takes the form of profit maximization or cost minimization for a firm. Numerous cost concepts are involved in the procedures necessary to optimize the profit position of a firm, for example, fixed costs, variable costs, total costs, marginal costs, average fixed costs, average variable costs, and average total costs (54, p. 141). Optimization methodologies often reduce the study of a firm to that of a black box where primary interest is with inputs to and outputs from the box, both usually defined in pecuniary terms.

Being input-output oriented, a definition of cost in terms of input and output is consistent with an economic point of view. Murad defined average physical cost as

". . . the number of units of input required on the average to produce one unit of output" (54, p. 19). Other costs referenced above are also defined in terms of input-output, rather than as entries on a balance sheet as is characteristic of an accounting orientation.

Having briefly touched on approaches to cost definition from accounting and economics, the precedents for similar efforts in higher education may be clearly established. Two highly regarded national organizations that have done much work in this area are the National Association of College and University Business Officers (NACUBO) and the National Center for Higher Education Management Systems (NCHEMS) at the Western Interstate Commission for Higher Education (WICHE). NACUBO's historical precedents, established by the American Council of Education, are well documented (77, 58), and Humphrey (33, pp. 44-45) documented the development of NACUBO itself. Two recent NACUBO publications are *College and University Business Administration*, 1968, and the Administrative Service that was published subsequently under the same title, *College and University Business Administration*. The latter publication is loose-leaf in design with individual section copyright dates. These two publications are commonly regarded as authoritative sources on budgetry structure and definitions in college and university business administration.

NACUBO regarded the determination of cost information as an inexact process requiring the exercise of judgment on the part of individuals performing cost determinations (56, p. 1). NACUBO also distinguished different definitions for cost depending upon whether background derivation was from the field of financial accounting, cost accounting or economics (56, p. 3). In financial accounting, cost was defined as " . . . the amount or equivalent paid or charged for something of value . . ." and it was viewed as primarily an organizational unit or function measure. In cost accounting a similar definition resulted, but it was a unit cost measure (56, pp. 3-4). In economics the view would be of society as a whole, "macro", or of an organization, "micro" (56, p. 4).

NCHEMS' growing impact on higher education (33, p. 23; 78, p. 23) is a result of its research and development of resource allocation and information system tools. Its efforts encompass a wide range of products and applications. NCHEMS has led the way in product development for application at the institutional level. Recently its work has expanded in diverging directions: in the area of state and national level applications and in the area of intrainstitutional applications.

Of immediate interest to this study are definitions found in the Cost Analysis Manual (69), one of the publications of the NCHEMS Cost Finding Principles project.

Although a disclaimer noted that the manual was not intended to suggest one set of procedures to cover all situations, the final outcome of the recommended procedures was a term referred to as "full costs". NCHEMS defined full costs as "The sum of direct costs, capital costs, and allocated support costs for an activity center or group of activity centers" (69, p. 22). Activity centers take on meaning in light of a standard structure advanced by NCHEMS, the Program Classification Structure. An activity center represents a level of aggregation within this structure to which costs are attached (69, p. 10).

The brief preceding review is intended to establish a frame of reference for understanding limitations in the terminology of cost concepts. No single commonly-accepted approach to cost determination exists. The process of costing serves many distinct purposes. The problem is not limited to higher education; its origins, as aforementioned, may be traced to accounting and economics. For example, Meigs claimed the distinguishing feature of cost accounting is the resolution of problems in accurately measuring costs; however, he warned that "If cost information is to be used intelligently, the user must understand that any cost figure has inherent limitations and that no single method of arriving at cost will serve equally well all the varied purposes for which such information is needed" (46, p. 746). With regard to higher education, Topping concurred by alerting users of his manual that he ". . . has not identified one particular set of procedures to cover all situations . . ." since different cost studies are conducted for different purposes (69, p. v). About the only consensus to be found in the literature regarding the use of the terms cost and costing concerns the latter, and that consensus may be reflected by the nebulous definition of costing as ". . . the cost determination process" (56, p. 1).

Cost Analysis, Cost-Benefit Analysis, Cost-Effectiveness Analysis and Cost-Utility Analysis

Numerous cost concepts are referenced in higher education costing literature. The most frequently applied concepts are cost analysis, cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis. The selection of one concept as the most appropriate one for general use at the departmental level is not readily apparent. The following review of literature is intented to clarify this matter and to guide system specification development.

Limitations concerning consistent definition of cost have been reviewed. Since some kind of costing process is fundamental to cost analysis, cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis, the stage is set for an approach to individual definition.

Cost Analysis

Cost analysis terminology ranges from the general to the specific. For example, Rourke claimed that ". . . cost analysis measures the unit cost of past and present operations" (62, p. 74). Humphrey, in a dissertation concerned with course cost analysis, referred to cost analysis as ". . . the basic element in the conduct of fiscal analysis and constitutes an essential ingredient therein" (33, p. 4). The specific cost analysis definition listed by Humphrey for his purposes cited the utilization of objective data and procedures so that relationships between costs and programs might be established (33, p. 12).

The National Association of College and University Business Officers devoted an entire section of *College and University Business Administration* to the subject of fundamental cost considerations in higher education (56). Their definition, which was the most detailed and specific of those reviewed, is considered to be the accepted standard for higher education business administration. NACUBO defined cost analysis as ". . . the process of examining cost and statistical information and deriving meaning to satisfy the needs of users. The three basic cost analysis categories are full cost analysis, cost-volume-revenue analysis, and controllable cost analysis" (56, p. 2).

An interesting paradox was presented by Topping in his work sponsored by NCHEMS entitled Cost Analysis Manual because the manual contained no specific definition of cost analysis (69). The closest Topping come to defining cost analysis was to refer to costing procedures that are included in the manual to give users a way to determine full cost (69, p. v). As previously discussed, this approach identified with a program budgeting orientation based on the NCHEMS PCS structure.

Although the recommendations of NACUBO and NCHEMS are highly regarded in higher education, other potentially useful definitions of cost analysis are in the literature. One notable characteristic of the definition of concepts reviewed in this chapter is the frequent use of one or more concepts in the definition of other concepts. For example, in Witmer's article concerning higher education cost studies, cost accounting was used to define cost analysis as follows:

> Cost accounting is that method of accounting that provides for the assembling and recording of all the elements of cost incurred to accomplish a particular purpose. Cost accounting facilitates cost analysis, which is useful in relating costs to benefits and in reducing costs relative to benefits (77, p. 107).

Sheehan and Gulko (66) compared the uses of cost analysis to cost accounting when defining the former. In their view, cost analysis was the more useful procedure:

> Cost analysis attributes cost to selected cost objectives by means of various analytic formulations; usually it relates to specific management problems and purposes and often to specific institutions. Therefore,

> cost analysis normally is more useful than cost accounting for institutional management decisions (66, p. 57).
>
> Cost accounting is a procedure that permits financial transactions to be recorded by cost center so that each expenditure is attributable to the ultimate cost objective (66, p. 56).

In some studies, cost analysis was viewed as a component of one of the other costing concepts. For example, Lovell, in his cost-effectiveness study of instructional programs, made this distinction: "Program cost-analysis is an essential aspect of cost-effectiveness analysis" (42, p. 112). He subsequently listed the main features of cost analysis as " . . . direct costs are emphasized; (2) short-cut formulae are used in allocating indirect costs; (3) appropriation account records may be used (ex-ante evaluation); (4) it is periodic operation; (5) it may be done in a sampling rather than on a complete basis" (42, p. 113).

Some studies view cost analysis as being a comprehensive term encompassing one or more of the other costing concepts. As an example, Meeth defined cost analysis as " . . . a general term used to describe a three-part concept composed of cost accounting, cost-effectiveness analysis, and cost benefit" (45, p. 123). He then stated ". . . cost accounting is essentially the act of determining the cost of a single program or educational unit, taking all the costs related to a particular objective or program and grouping them together" (45, p. 123). Far more detailed was his definition of cost-effectiveness analysis, an unusually comprehensive concept:

> Cost-effectiveness is a much more complex concept [than cost accounting] and is the heart of the cost analysis idea. It is the act of comparing the relationship between input and output, between the resources and their related dollar costs and the achievement of desired goals, competencies, or other outcomes. As a technique for comparison, cost-effectiveness analysis can (1) help assess the relative worth of several programs with the same educational outcome . . . ; (2) determine whether a single program is becoming more or less effective as time passes; (3) help assess the relative worth of the same program for different groups of people . . . ; and (4) act as a useful device for comparing programs among institutions of similar purpose and types of programs (45, p. 124).

Cost-benefit analysis concluded Meeth's definition of cost analysis and it built upon the preceeding concept. Being the final step, Meeth stated:

> The result of ranking alternative analyses of costs in relationship to effective program results is cost-benefit determination. That is, cost benefit is the accrued value of the least expensive, most effective program outcome in terms of all resource allocations, looking both at accomplishing objectives and assessing consequences (45, p. 124).

Cost-Benefit Analysis

Paralleling cost analysis, definitions of cost-benefit analysis may be exclusive of other cost concepts as well as inclusive of them.

Warren Gulko, who was done extensive work in the area of program classification in higher education, portrayed costing concepts in terms of a program budgeting perspective. He stated that " . . . cost/benefit analysis in higher education attempts to assist admistrators in evaluating the cost of an individual program relative to the expected benefits of that program and other alternative programs" (23, p. 6). Gulko's view of cost-benefit analysis allows incommensurables to be compared, that is, not only can various approaches to the same program be compared, but also different programs as well. Another definition from the program perspective was offered by Harris (28) in his dissertation concerning program benefit-cost analysis. His definition also allowed for the comparison of various programs although his main interest was with economic returns. He stated that ". . . an analytical, economic approach for evaluating and projecting the economic returns of students who attended vocational education programs is a benefit-cost analysis" (28, p. 8).

The economic frame of reference pervades cost-benefit analysis definitions. Rather than simply containing a passing reference to the economic approach or to economic returns, some definitions are rooted firmly in the terminology of economics. For example, the concepts of value added and input-output are derived from economic theory and both surface in a definition by Iyell: "Cost benefit studies compare the costs of resource use relative to the value added to the product--the difference between input quality and output quality" (35, p. 76).

Some authors view cost-benefit analysis as being applicable only in macro-level studies. Their studies assume a high level of aggregation. In a paper on the topic of higher-education outputs, the economist John Vaizey found cost-benefit analysis applicable at a high level of aggregation: "Benefit-cost analysis provides but small opportunity for contrasting different sectors of the economy; it is only applicable within sectors, and is there to compare and contrast activities which closely resemble each other" (72, p. 20). Note that this definition appears to exclude the comparison of incommensurables in contrast to the definition of cost-benefit analysis by Gulko.

Marshall Harris offered a definition of benefits which included high and low levels of aggregation. Although his definition of cost-benefit analysis has been previously referenced, his view of benefits further clarified the scope of his study. He defined the economic benefits of vocational education as ". . . the change in economic welfare of society (public benefits) and the individual student (private benefits) caused by vocational education" (28, p. 8).

Many researchers advocate the measurement of benefits in dollars while others allow for nonpecuniary benefits. Following are examples of both points of view. Lelong and Mann advocated the former: "Ideally, all benefits should be measured in terms of dollars as a common denominator" (41, pp. 190-192). One of the most specific examples of this orientation may be found in a definition by the economist, E. H. Weiss:

> A cost-benefit analysis may be thought of as a fraction, with dollars in both the numerator and the donominator. Thus, it is possible to perform a cost-benefit comparison of programs with very different objectives (76, p. 26).

Weiss' definition appears to allow for the comparison of incommensurables also. As an example of both points of view, a definition of benefits advanced by F. G. Cary is the view of benefits as

> . . . being related to the fulfillment of intermediate range goals and objectives. Benefits might be used to describe the performance of high school students in colleges, employment incomes five years after graduation, the number of different jobs held five-six years after graduation (12, p. 42).

A significantly different twist to cost-benefit analysis definition surfaced in a dissertation by Lovell. Here the main criterion remained monetary and was based on the distinction that if alternative outputs were quantifiable in terms of dollars, cost-benefit analysis should be used; if outputs were not quantifiable in terms of dollars, cost-effectiveness analysis should be used (42, p. 10). Lovell viewed value judgments as being an integral part of cost-benefit analysis where ". . . value judgments are given dollar values and thus the result is a single answer--the cost-benefit ratio" (42, p. 10).

Some references blur the distinction between cost-benefit analysis and other cost concepts. Thus, even though the purpose of his article was to distinguish major cost concepts, Weiss readily conceded that benefit is frequently used synonymously for utility (76, p. 26). NACUBO, on the other hand, established a relationship between benefits, utility and effectiveness. For example, benefits ". . . may be considered as the utility to be derived from a given program. This is the cost-benefit/cost effectiveness as employed in program budgeting" (55, p. 3).

Other references view these cost concepts with little or no distinction. Cost-benefit analysis in the view of AASA was

> . . . the process of examining and comparing alternative courses of action with respect to two main considerations: the cost in terms of needed resources, and the benefits (in general, the gains, utility, value or effectiveness) in terms of the objectives to be attained (1, p. 162).

Raichle (61) was more specific with regard to lack of distinction between cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis. He stated in his dissertation:

> For the purposes of this study, these terms are used synonymously and are assumed to be common in principle. Whatever differences are found in the literature are considered as simply matters of degree, emphasis, and context (61, p. 9).

Cost-Effectiveness Analysis

A progression through the literature of cost-effectiveness analysis is similar to that of cost analysis and cost-benefit analysis. Definitions of this cost concept abound; some are definitions exclusive of other cost concepts and some are not.

As is the case with other cost concepts, some references define cost-effectiveness analysis in terms of outputs or outcomes. The question of what constitutes outcomes remains to be discussed, but reference to outcomes and their qualitative nature is common. L. R. Meeth noted that cost-effectiveness analysis was one part of a three-part concept which described cost analysis. Concerning cost-effectiveness analysis in particular, however, he referred to it as a ". . . qualitative judgment made about the relationship of cost to outcomes" (45, p. 124). As previously discussed, it concerned the comparison of input (resources and their costs) and output (outcomes of which goals and competencies were two types) (45, p. 124).

Other writers refer to evaluating alternative approaches to objective achievement. No specific mention of output is found in some of these definitions. In a study concerned with the development of a cost-effectiveness model, F. G. Cary presented a cost-effectiveness analysis definition of this type:

> The process of solving problems of choice which requires the definition of measurable objectives, identification of alternative ways of achieving the objectives, identification of the anticipated cost and effectiveness of each alternative, and identification of the optimum alternative which potentially achieves the desired objectives (12, p. 6).

For Cary, the cost-effectiveness analysis process was concluded by selecting an optimum strategy to accomplish a mission (12, p. 2).

Weiss concurred with Cary on the view that cost-effectiveness analysis pertained only to the evaluation of commensurables. In this regard he stated that ". . . cost-effectiveness comparisons are concerned with the evaluation of alternative means to the same objective" (76, p. 26).

Although Cary presented an explicit definition of cost-effectiveness analysis exclusive of other cost concepts, his definition of cost-effectiveness included a reference to benefits. Specifically, cost-effectiveness was ". . . the relationship of anticipated resource requirements to anticipated results or benefits" (12, p. 6). Both definitions were found on the same page; while one was defined as a process and the other as a relationship, the two did little to complement each other in terms of specificity.

John Vaizey, an economist, in a paper concerned with outputs in higher education, saw little distinction between the concepts of cost-benefit analysis and cost-effectiveness analysis. His was an input-output orientation and the following passage succinctly established his view:

> . . . the technique which has become prominent for calculating the relationships of output to input in the public sector goes under the name of 'benefit-cost analysis' or--something similar, 'cost effective techniques.' These techniques date, in essence, from Pigou's work on the Economics of Welfare . . ." (72, p. 20).

While Vaizey established the fact that these cost concepts were rooted in economic theory, he also limited the use of cost-benefit analysis to ". . . compare and contrast activities which closely resenble each other" (72, p. 20). This restriction typifies the problem of dealing with cost definitions since it contradicts definitions from other sources.

About the only consistent theme in cost definitions is the lack of consistency. This point is easily documented by referring to the various writers, some of whom distinguish cost-effectiveness analysis from cost-benefit analysis primarily on the basis of the issue of commensurables, while others do not. Lovell adopted the former view by concurring with those authorities who consider the cost-effectiveness concept as appropriate for comparison of different approaches to one goal, that is, the comparison of commensurables. Cost benefit, on the other hand, was viewed as appropriate for comparing incommensurables--the comparison of different goals (42, p. 11).

A diametrically opposed position was asserted by Sanford Temkin (68) in an article written specifically to attempt to clarify meanings and implications of these terms. In effect Tempkin agreed with Vaizey regarding the relationship of cost-benefit analysis to commensurables, and he took exactly the opposite view from Lovell with regard to both cost concepts. Although he added that time was a distinguishing characteristic, the main basis upon which he distinguished the two was the issue of commensurables:

> Methodologically Cost-Effectiveness Analysis aims at the selection of one or more alternatives from a pool of alternatives, each of which has been designed to meet one or more objectives. Where the time dimension is a near dominant consideration in the benefit-cost approach, time as a structural component is ignored in the cost-effectiveness approach. Cost-Effectiveness Analysis is, moreover, a natural substitute for Benefit-Cost Analysis for those situations in which benefits are incommensurable and inappropriate for dollar valuation (68, p. 43).

Temkin viewed both concepts as being of limited value. Briefly, he contended that the main limitation of cost-benefit analysis was its limited applicability where results need to be acceptable to various audiences. In addition, since cost-effectiveness analysis deals with even less tangible issues, Tempkin asserted that there was no accepted model for the cost-effectiveness analysis concept (68, pp. 42-43).

Cost-Utility Analysis

Cost-utility analysis is the most abstract of the concepts reviewed in this study. As with the other concepts, its origins are found in general economic theory (61, p. 10).

The application of cost-utility analysis is most frequent in those cases where incommensurable quantities must be related on a common basis, that is, where the attempt is to make incommensurables commensurable. The common unit of measure in such cases is the utile, hence the concept, cost-utility analysis.

The main assumption in any cost-utility analysis study concerns the need to establish at least an ordinal numerical relationship, and often an interval numerical relationship, between variables. The ordinal relationship requires a ranking scheme to rate alternatives. Often an additional assumption is made that money values are an adequate measure of utility. Weiss was an exponent of this view: "Cost-utility comparisons are performed by having policy makers and managers assign false money values (units of utility, or 'utiles') to a wide range of program results" (76, p. 26).

More advanced work in the area of cost-utility analysis has been done by Tuscher in a dissertation concerned with the development of a cost-utility analysis model for educational programs. His requirements were such that an interval numerical relationship had to be assumed. For his purpose he referred to the utility of a program as ". . . a function of some set of criteria or objectives" (71, p.50). He continued by stating,

> Most allocation decisions will be based on such multi-criteria situations. The problem is one of evaluation.

> That is, how to obtain single valued comparisons of the utilities of program alternatives when each utility must take into account the contributions of several criteria or objectives. Additive utility theories offer one possible approach to this problem (71, pp. 50-51).

In order for utilities to be additive, however, an interval numerical relationship must be established and Tuscher asserted this point with the following statement: "The resource allocation problem requires at least an interval scaling of program utilities with respect to the given set of criteria or objectives (Cardinal Utility)" (71, p. 53).

Other references view cost-utility analysis in more classic economic terms. Raichle, for example, while holding to a monetary unit, viewed utility as measured in marginal returns. He stated,

> The term utility refers to the usefulness or marginal return that is produced by the program under study. Relationships between utility and costs are sometimes expressed in numerical ratios similar to investment-return ratios. These ratios are computed simply by dividing the marginal utility (return), which is either quantifiable in monetary terms or assigned a utility rank number, by the total costs of the program (61, pp. 8-9).

Finally, the concept of utility is often found to be relegated to those areas of analysis where constraints yield a problem beyond the scope of other cost concepts--generally the more abstract or intangible areas. For example, Lovell defined cost-utility as ". . . a decision-making value based on the relationship between the cost of a process and its utility value" (42, p. 194). On a much larger scale, Cary wrote of a relationship between long range goals and utility: "Long range goals and objectives are fulfilled by 'utility' criteria involving the returns to society" (12, pp. 42-43).

Cost Concepts Summary

The cost concepts reviewed in this study suffer from a number of limitations. One is the lack of concise, consistent definition and application. Authors attempting cost-benefit analysis, cost-effectiveness analysis or cost-utility analysis studies usually acknowledge that the concept chosen will have its own reticular definition and application. Many concede no substantive difference between cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis. Cary was of this disposition as verified by his claim that differences in terminology ". . . usually reflect the degree, emphasis, and context used by the author" (12, p. 42). He established his particular definitions.

Lovell, in a cost-effectiveness analysis study, concurred almost verbatim with Cary's assessment, but went one step further. While acknowledging that much effort has been applied to seeking precise, accepted definitions, he conceded that such efforts have not been successful, and the destruction of precise meaning has resulted from popular usage of the terms (42, p. 9).

A second limitation pertains to cost-benefit analysis and concerns the problem of defining benefits. Many authors are highly critical of studies which define benefits solely in monetary terms. Harris, in his benefit-cost analysis study, considered an analysis limited to monetary benefits to be a partial analysis only (28, p. 7). Keniston and Gerzon pursued this theme by declaring,

> . . . acceptance of the pecuniary concept of 'benefit' neatly sidesteps and avoids all of the issues that are most controversial about higher education today. Public anxieties about higher education have very little to do with its influence on lifetime earnings or gross national product, but very much to do with its effects on the outlook, consciousness, and behavior of those who attend colleges and universities (36, p. 55).

Some writers see many types of benefits. In a chapter on the economic benefits of higher education, Hansen and Witmer developed the notion of benefits by defining those which are monetary and nonmonetary as well as those which are individual and social. They distinguished these definitions as follows:

> Monetary benefits--higher earnings--are economic benefits; moreover, they can be measured, though not always easily, in dollars. Nonmonetary benefits--including the joys and pleasures derived from one's education--might or might not be classified as economic; some nonmonetary benefits can be expressed in monetary equivalents but others are difficult or impossible to quantify. Further, there are individual benefits and social benefits, that is, the benefits which are captured by individuals as contrasted to the total benefits, including individual benefits, which accrue to society (27, p. 24).

Some authors have addressed this issue by dealing with the question of who benefits from higher education. In response, Louis Hausman listed employers, the individual and society as benefitting (29, pp. 7-11). He noted that industry and government would rather hire college graduates, and many economic benefits to the nation flow from the greater earnings of college-educated persons. Hausman primarily viewed benefits in an economic light.

The well known author and authority in the area of institutional analysis, Paul Dressel, also discussed benefits by responding to the question of who benefits. His was a much more broadly based response:

> To whom do the benefits of higher education accrue? Statements of educational objectives usually emphasize individual benefits, but benefits are multifold. Some are highly personal or consumer oriented and accrue primarily to the individual and his immediate associates; others accrue to the geographical or political region, the immediate community, state, and nation. Society benefits; donors and supporters of higher education benefit; and to a much greater extent than is commonly realized, the institution itself benefits (19, pp. 7-8).

Instead of expanding on the question of who benefits, some sources see the need to decide how the question of benefits can be limited. One well-known authority, F. E. Balderston, on the topic of higher education outputs, considered the problem of distinguishing between ". . . the social benefits of higher education and the private benefits accruing to business firms and to the individual student and his immediate family" (3, p. 12) as one of the broadest issues to be resolved. He also wondered whether benefits should be limited to a consideration of money income or utility for a student or whether the various implications for society should be considered.

Even when narrow and restricted views of benefits are adopted, as with institutional level benefit studies, problems still remain. Donald Lelong (40) succinctly pointed out that there was no way to establish a cost-benefit relationship for various instructional modes as far as a student was concerned since a student cannot allocate his fees to maximize his benefit. In other words, although the fulltime student could usually take between twelve and twenty hours a semester, his impact on faculty time inside and outside the classroom varied with the student, and his fees remained unchanged irrespective of class size (40, p. 212).

The reason for the inability to measure benefits satisfactorily, even on the limited institutional level, results in part from the inadequacy of existing measures. In a discussion of their institution's attempt to deal with the questions of benefits, Lelong and Mann listed this perplexing problem:

> After reviewing the most commonly used measures of output from the instructional process, they were discarded as grossly inadequate for any really meaningful analysis. The credit hour, for example, is neither a measure of input nor of output. It is only tenuously related to the effort expended by the student or the teacher, much less to what the student achieves toward his own education. Number of degrees granted represents another straw which is probably grasped by most, at one time or another, in a desperate attempt to show concrete evidence of the institution's productivity. However, no one would suggest that those students who do not receive a degree do not receive some worthwhile instruction, nor that degrees in various fields and at various levels, awarded to persons of differing intellectual capacity, represent equivalent units of output (41, p. 192).

The reluctance of many authorities to be involved with cost-benefit analysis in higher education is typified by the current policy of NCHENS which holds strictly to the position of developing cost analysis tools independent of other costing concepts. The products developed by NCHEMS allow users tremendous flexibility in local application and definition, but no encouragement is given for the use of cost-benefit, cost-effectiveness or cost-utility concepts. This philosophy was enunciated by Warren Gulko in documentation for the project he worked on at NCHEMS, the Program Classification Structure:

> Although many studies have been undertaken, some of which have exhibited a careful and thoughtful approach to the problems, the general application of cost/benefit analysis will remain a theoretical exercise until more is known about measuring and evaluating the outputs or benefits of institutions of higher learning (23, p. 6).

Limitations similar to those found in applications of cost-benefit analysis are found in applications of cost-effectiveness analysis. As alluded to previously, most studies which concern cost-effectiveness are usually prefaced by a concession that procedures will be subject to question from many quarters, and that other titles or descriptions could be appropriate. Ned Lovell made such a statement in his dissertation on cost-effectiveness. He said, "The type of study proposed in this chapter might very well be called a systematic study of generated alternatives rather than cost-effectiveness" (42, p. 57). Lovell concurred with other authors who saw the main problem of higher education cost-effectiveness analysis studies as being the inability to determine the final product of the teacher (42, p. 56). He conceded that ". . . there are no universally useful ways to assess effectiveness" (42, p. 12).

Most studies which concern the issues of benefit, effectiveness or utility, usually present both sides of the argument. These studies point to limitations previously discussed, then counter with arguments that such limitations are acceptable. The economist, Alain Enthoven, on the issue of higher education outputs stated that experience had taught him that ". . . one should not expect to find an all-embracing criterion of value added or effectiveness, and such criteria really aren't necessary for improved allocation decisions. Simple, crude indices can be very useful" (21, pp. 52-53). This, then, is the main issue regarding the use of these cost concepts in higher education. Lack of information, said Harris, is ". . . an important imperfection in estimating the returns to education" (28, p. 1). This imperfection pertains particularly to benefit, effectiveness and utility relationships; they are frequently considered synonymous or as differing only slightly. Lovell acknowledged that ". . . there has been little research on the actual effectiveness of the educational system" (42, p. 27).

The reluctance of many authorities to be involved with cost-benefit analysis pertains also to cost-effectiveness analysis. The same kind of statement made by Gulko with reference to cost-benefit analysis studies is frequently made with reference to cost-effectiveness analysis studies. Cary, in his own cost-effectiveness analysis study, conceded that the potential for analysis of that type was restricted since measures of effectiveness are approximate and the future cannot be adequately predicted (12, p. 50).

Cost-utility analysis suffers even more dramatically from the same limitations and criticisms. Even those references which recommend the use of cost-utility analysis in the business environment, where a measure may be established by observable market phenomena, concede that there is no way to measure the utility of an intangible (47, p. 26). The main theme of arguments against the use of benefit, effectiveness and utility concepts in higher education costing has been the lack of tangible measures which enjoy common acceptance. Thus it is consistent with those arguments that few attempts have been made in the area of cost-utility analysis in higher education.

A final limitation of the concepts of cost-benefit analysis, cost-effectiveness analysis, and cost-utility analysis (alluded to previously) concerns their inherent high levels of aggregation. These studies, without exception, require aggregation of data, and studies of interinstitutional measures require high levels of aggregation.

Summary: Departmental Costing

Limitations of the cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis concepts directly impact the design of a modeling system intended for use at the departmental level. Although occasionally applied at a low level of aggregation, these concepts are founded on tenuous assumptions, and individual applications usually address broad areas of analysis. Newman and others, for example, contended that "So far, most of the thinking about cost effectiveness has concerned itself with problems once or twice removed from the goals of courses or curriculum" (59, p. 31). General agreement with regard to the societal costs of education and the benefits of education to individuals and society was offered by Russell Hankins in a paper on the literature of college and university cost analysis applications (25). In his study ". . . societal costs of education, out of pocket and opportunity costs to students and their families, capital costs, and the valuation of the outputs of higher education as benefits to individuals and society . . ." were not included since they were deemed ". . . not related directly to institutional decisions or current operations" (25, p. 2).

The origins of these cost concepts have been traced to economic theory. They are all tied to the fundamental input-output underpinning; they are frequently used interchangably, and they suffer from common limitations. The consequent impact of these concepts on higher education, voiced by a substantial segment of the higher education community, was summarized by Trotter and Creet: "A growing body of literature in diverse fields provides testimony that cost/benefit or input-output approaches have not worked for universities" (70, p. 52).

Cost analysis also enjoys no consistent definition. The lack of consistency in definition, however, allows this concept to be widely applied in higher education cost studies. Many studies are simply referred to as cost analysis studies. In addition, however, analysis of costs is basic to the study of benefits, effectiveness or utility. The costing process (determination of costs) is fundamental to any cost study. Humphrey succinctly affirmed this point: "Cost-analysis is the basic element in the conduct of fiscal analysis and constitutes an essential ingredient therein" (33, p. 4).

Cost analysis applications are found at high levels of aggregation as are applications of the other cost concepts, but they are also found at low levels of aggregation. In fact, as the level of aggregation decreases, applications of the other cost concepts decrease since their required assumptions become increasingly tenuous. Consequently, intrainstitutional cost studies are generally some kind of cost analysis.

Tremendous variation in the types of intrainstitutional cost analyses remain. To accommodate this variation, tools developed by NCHEMS have been designed so that users are provided with substantial latitude in definition and procedures (69, 51). For example, the following admonition is highlighted in the Academic Unit Planning and Management manual: "It is most important to note that this planning manual does not prescribe standards for academic unit planning, nor does use of the manual imply the exchange of information about academic units" (51, p. vi).

Intrainstitutional costing is the environment of the present study. To focus on costing assumptions in this environment, the thesis is advanced that a highly disaggregated level of costing is appropriate. Support for this thesis is found in two recent cost analysis studies (78, 33). One premise advanced by Ziegler to justify his focus at the course level in an institutional cost study was that "there could be cost characteristics of academic programs that would appear only if the costing was carried out at the course section level" (78, p. 7). Ziegler supported this premise with logic based on a low level of aggregation and lent credence to his study by pointing to its uniqueness:

> The point advanced here is that if variances in scheduling due to the needs of the students have any effect on program costs this is an ideal environment in which

> to explore and the use of the class as the final cost center should be the most sensitive vehicle to use.
>
> Other studies in the field have either not used the matrix approach to costing which loses the interaction effects or, when employing the matrix system, utilized higher levels of aggregated activity as cost centers such as courses, disciplines or departments (78, p. 8).

The matrix approach to which Ziegler referred is basically the induced course load matrix concept pioneered by Suslow and NCHEMS (67, 31).

Humphrey was of a similar disposition when he set out to develop a course cost analysis instrument for use with specific traditional and nontraditional courses (33). He also opted for the same disaggregated level of study. In reference to current approaches to costing, he offered this criticism:

> Current techniques for analyzing instructional costs focus primarily on departmental or program calculations, although some adaptations in the existing systems have been made to allow for cost determination by course. Such techniques heavily rely on averaging and are inherently based on traditional instructional patterms. Contemporary approaches to the cost-effectiveness of education are thwarted by an inability to subject teaching-learning situations to detailed cost-analysis for purposes of determining their financial implications (33, p. 7).

Humphrey added additional weight to his argument and highlighted the dearth of similar studies:

> Furthermore, previous instructional cost-analysis efforts have generally culminated at the departmental level. Course costing which has occurred results from a variety of averages and percentages within the department allocation. A cost-analysis instrument specifically designed to measure the financial implications of a single course in higher education, has not previously been designed (33, pp. 10-11).

Finally, Humphrey bolstered the argument that cost analysis is the appropriate costing concept at this level by noting that his effort was not aimed at the budgeting level nor the interinstitutional comparison level. Also, he rejected the notion of using the concepts of cost-benefit analysis, cost-effectiveness analysis or cost-efficiency analysis (33, pp. 3-4).

In light of the preceding review, initial design premises may now be advanced. A modeling system designed for use as a tool to examine costing assumptions must focus on a disaggregated level. Although the level of disaggregation in any study is subject to debate, for intrainstitutional studies the course level is a common point of interface for costing and the measures to which they are attached. Also, the individual course has now been adequately established as a justifiable, appropriately disaggregated level. The study of costing assumptions at this level would relate to subsequent studies at the same or higher levels of aggregation, including studies based on the other cost concepts.

Premise 1. The prototype modeling system should be based on the cost analysis concept.

Premise 2. The individual course represents an acceptable level of disaggregation for the costing point of interface.

Premise 3. Subject to conceptual cost analysis limitations, and limitations imposed by a low level of disaggregation, the prototype model will concern only commensurables.

Micro and Macro Costing

The terms "macro" and "micro" surface frequently in the costing vernacular. As with costing terminology previously discussed, a thorough understanding of these terms should help define the costing environment of this study and contribute to the development of system specifications. Consequently, in light of Premise 2, which proposes the individual course as the costing point of interface, a context for use of cost information at this level remains to be developed. The purpose of this section of Chapter II is to develop that context.

A previous reference to College and University Business Administration highlighted the basic economic definition of macro and micro. To elaborate, NACUBO specified,

> In economics, cost can be viewed from the 'macro' or 'micro' point of view. The macro definition of cost typically considers society as a whole rather than focusing attention on a particular institution. . . . On the other hand, the micro definition of cost used in economics focuses on the activities of an organization (56, p. 4).

In an article concerning state and national level higher education models, Iyell (35) distinguished between the two on the basis of detail. He characterized each as follows:

> An overview or macro model would take some broad parameters and variables and simulate the effect of changes in the environment on broadly based categories. . . . At the same time, it may be appropriate to develop very detailed models for specific applications (35, p. 84).

A slight variation on this theme, yet consistent with the view that detail is the distinguishing characteristic, was offered by Corcoran and Anderson:

> The differences in macro- and micro- level conceptions of enrollment study are epitomized by the contrast between the term student flow, which is frequently used in conjunction with macro-level studies, and the terms student movement or student enrollment behavior, which seem more appropriate to micro-level studies. The term student flow suggests a conception of enrollments as analogous to a liquid mass, flowing through a course, regulated by gates of various heights. The student population under investigation is assumed to be homogeneous in character and consistent in enrollment decision processes. The terms student movement or enrollment behavior, on the other hand, suggest a more dynamic conception of enrollment choices, involving many different forms of decisions, including changes in course and interruptions of enrollment. The focus of attention for the macro approach is on the prediction of general trends in college enrollment patterns without attention to the underlying considerations that are the prime concern of the micro approach.
>
> Another way of expressing this difference in perspective of the two approaches is that the macro-level view looks at the educational system from the outside while the micro-level view gets inside the system (14, p. 54).

Another source also distinguished on the basis of detail, but claimed that both macro and micro models could be used within the same area of application. Webster Cash (13) used both terms to define cost simulation models designed for institutional use. In a paper presented at the Thirteenth Annual Forum of The Association for Institutional Research, he described the development and use of a locally designed do-it-yourself model implemented at approximately the same time as the NCHEMS RRPM 1.6 and Cost Finding Principles models. In a comparison of the separate models, Cash referred to the locally designed model as involving only macroanalysis--". . . a broad-brush treatment of budget projections" (13, p. 100). Basically, this model was intended to make future projections of the institution's operating budget. With regard to the Cost Finding Principles and RRPM 1.6 models from NCHEMS, Cash referred to them as microanalysis models due to their considerable detail (13, p. 100).

A distinguishing characteristic between the terms macro and micro appears to be the level of detail. Consensus on the relative amount of detail required to distinguish, however, is lacking. Assuming that micro means disaggregative, advantages and limitations of both remain to be distinguished.

In a dissertation on efficient resource allocation in a university, David concurred with the view of macro models as aggregative and micro models as disaggregative (17, p. 7). She cited the following advantages of disaggregative models: (1) the smaller size of decision units which reduces aggregation problems, and (2) more meaningful evaluation of effects of various policies (17, p. 19).

Robert Wallhaus (74) described very real constraints for potential users which pertain to the question of aggregation.

He stated that "aggregation, of course, tends to cloud details, whereas disaggregation may render the model virtually useless, due to infeasibilities in obtaining data or performing experiments" (74, p. 130). He elaborated on the question of disaggregation:

> The question of the degree of disaggregation depends on many factors--the availability of data, the economics of data collection, the purposes of the model, the constraints on the computational requirements of the model, and the structure of the system being modeled, including the amount of stratification which is possible (74, p. 130).

Wallhaus concluded by emphasizing the basic strength of disaggregation resulting from attention to detail. "Micro modeling minimizes the probability of 'teetering on the brink of witchcraft' and, indeed, often allows one to solve the model, in the sense of selecting the best alternative directly" (74, p. 138).

A counter argument to the contention that detail is necessary derives from the situation where funds are limited. An aggregative approach may be viewed as being the less expensive alternative. In a technical report sponsored by the Carnegie Commission on Higher Education, Mood and others set out to determine the extent to which three preconditions for effective management (defined by the authors) had been adopted by institutions of higher education (52, p. 12). As the approach selected, the authors tried to ". . . limit the amount of detail and simply deal with fairly large aggregations of students, staff and faculties" (52, p. 44) since it was a less expensive task than creating a large detailed model.

Criticisms of aggregative models, however, persist. Two recent articles (35, 18) claimed that these models were severely lacking. Iyell contended that ". . . few of the hoped for results of implementing large-scale models have been achieved, but there is reason to expect some improvement in the future" (35, p. 75). He also noted that few of the goals of large-scale models have been achieved (35, p. 85).

In an article which evaluated planning models in higher education, Dresch advocated studies of narrow focus:

> The important question, of course, is whether research of this type directly focused on the postsecondary education sector can be most effectively pursued in the context of broader, comprehensive models or in the form of individual, more narrowly focused studies. My own guess is that at this stage more restricted studies of individual facets of the system will make a greater contribution to our long-term understanding of the postsecondary education system. The fact that such studies are partial need not imply that they ignore significant interactions in the system. Rather, by breaking the required research into more limited modules, they offer at least the hope that as the understanding of these modules is improved, it will become possible to integrate the components into a more comprehensive view of the complex of interactions which characterize the system (18, p. 271).

Dresch noted that "while the more aggregative analyses have attempted to capture important environmental effects ignored in the micro studies . . . effects are of limited value because the analysis is at such a high level of aggregation" (18, p. 259). As a counter argument, he noted that:

". . . micro studies have captured fewer of the important elements of the environment which impinge upon educational decisions" (18, p. 259). Although pointing out limitations of both, in regard to policy making, he viewed macro models as being of limited use:

> Finally, research directed at the development of comprehensive models should be clearly recognized as of limited and qualified relevance for current policy decisions. Preliminary prototype models may be useful in suggesting unanticipated potential implications of particular policies in a closed context, incorporating indirect, feedback effects. However, those involved in the policy process should not delude themselves (or others) into believing that such models at the current stage are capable of providing a firm basis for policy decisions. Less inclusive, more restricted, and perhaps more informal policy analyses should also be employed to inform decisions and to evaluate the apparent implications of formative models (18, p. 250).

Some references view both types of models as unique where each has a separate and distinct role to play. In this view both types of models should complement and support each other. Corcoran and Anderson, for example, have written:

> Macro-level models can provide a valuable base for enrollment prediction, particularly under stable circumstances, but they need to be supplemented by experimental investigations in which the interaction of individual and situational variables in enrollment decisions can be explored (14, p. 58).

Thomas Mason argued the place for both macro and micro modeling:

> A debate has developed during the years of experimental modeling between advocates of large-scale, comprehensive systems and more limited, problem-solving approaches. . . . One argues that large masses of data structured in the vast conceptual scheme that is out of date before the data can be integrated cannot help with real-world decisions. But the advocates of larger scale modeling contend that the critical problems are at least

> institutional and often statewide, provincewide, or nationwide in scope; therefore, small-scale problem solving generally should contribute to the larger framework.
>
> An apparent systhesis is that large, even cosmological, conceptual frameworks are needed if small-scale problem solving work is to advance a growing, comprehensive understanding of the complex processes of policy making. Using the larger scale modeling experience to identify and define issues of immediate concern should help to establish the goals that small-scale problem solving seeks to achieve (44, p. 107).

Summary: Micro and Macro

The advantages of micro costing have been documented: problem solving support for larger models, and the capability to investigate variable interaction by focusing on a level of detail otherwise clouded by aggregation. These advantages are in consonance with the proposed study and lend credence to it.

Premise 4. A prototype modeling system, as proposed in this study, should support more highly aggregated models like RRPM 1.6. Consequently, costs will be computed for students by major subject of study, and for the department.

Educational Outputs

Preceding sections of this chapter have documented the lack of consensus that exists with regard to definition and application of the cost concepts previously reviewed. Costing is assumed to be the process of determining costs, and the process itself is subject to criticisms and limitations documented earlier. Paralleling those limitations and contributing to them are the varied views of educational outputs.

The topic of educational outputs has been discussed previously, and it will surface again in other parts of Chapter II since Exploratory Questions 1.1 through 1.5 are interrelated. Dealing with one question is impossible without concurrently dealing with the others. Thus it is that the cost concepts are in fact tied directly or indirectly to various views of educational outputs. Some studies make definite references to output and output measures; others simply discuss what measures are used. Both, however, deal with some form of output. Output, after all, is the subject of measurement.

The concept of output is rooted in economic theory. References to output are generally based upon the black box or input-output theory (30, p. 93; 12, p. 19). This theory advances the notion that input is related to output by relationships, known or unknown, which transpire within the black box or firm. Thus, any firm takes input, subjects it to some kind of processing, and produces output which is then subject to environmental market mechanisms: supply and demand. The input-output theory holds to the notion that actual costing of output does not require detailed knowledge of a firm's operations as long as costs can be attached to input and to output--hence, the term "black box" in reference to an operation which converts input to output.

Whether the input-output theory is appropriate for higher education is subject to debate. There is no doubt, however, that tremendous interest exists in higher education resources, the processes of higher education, whatever they may be, and the results of those processes. In the introductory remarks of published proceedings of a seminar held to address the issue of higher education outputs, Lawrence, Weathersby and Patterson identified three broad issued which have forced this interest--demands for accountability, dwindling financial support, and overreaction to matters which were short-term, for example, Sputnik (38, pp. 2-3). The proposition that higher education is being subjected to increasing scrutiny from many segments of society is commonly acknowledged. In a paper written to develop a perspective on higher education outputs, Balderston described the problem at hand: ". . . we have bumped hard into the question of output and its measurement because, among other things, we are seeking now to link the resources used to the results achieved--in other words, to link inputs with outputs" (3, p. 11).

With critical attention being drawn to higher education, and much of it concerning that which is called output, the application of an input-output approach to higher education costing has received extensive attention and application.

This portion of Chapter II addresses higher education outputs or output proxies.

Some authors attempt to define output in rather general terms so as to be consistent with a local design. For example, Lovell defined output as "the result(s) or end product(s) that should occur when resources or inputs are used through a strategy (usually a program) to achieve a specified objective" (42, p. 196).

Other writers highlight the difficulty in deriving acceptable measures of output. Balderston, for example, suggested three measures of output: the earned degree or certificate, class standing, and students' relationship at program completion relative to their standing at the beginning of a program--the value-added concept. Conceding that these three measures of output are often referenced, Balderston acknowledged that they do not address matters of student attrition or educational quality (3, p. 14).

David G. Brown, an economist, administrator and an exponent of the input-output concept, claimed that output measures must have the following characteristics: quantifiability, additivity, divisibility, transferability, consensus acceptability, and flexibility (10, pp. 28-29). He depicted the university as a growth environment which produces multiple products. For Brown, growth in the university was of five types: whole man growth, specialized man growth, pool of knowledge growth, growth of society, and the joy of growing and being in an educational environment (10, pp. 27-28). Since Brown's major thrust was with the idea of growth, he claimed the most meaningful proxy measure was value-added. Thus, he defined gross educational outputs as the sum of the five types of university growth. Net educational output was gross output minus gross input (10, p. 38).

A different view was expressed by Alexander W. Astin. Although not from an economic background, he basically adhered to the input-output concept. He viewed the higher education process as being comprised of three distinct components: student outputs, student inputs, and the college environment. Student outputs included ". . . measures of the student's achievements, knowledge, skills, values, attitudes, aspirations, interests, daily activities, and contributions to society (2, p. 75).

Astin proposed a three dimensional taxonomy model for output measures. One dimension would consist of cognitive and noncognitive measures. The second dimension would consist of psychological and behavioral measures. The third dimension would portray the temporal aspect of output measurement (2, pp. 77-78). To yield these measures, Astin suggested the use of achievement tests. A high level of aggregation was assumed.

An example of one of the most rigid applications of the input-output model to higher education was presented by

Robbin R. Hough (30). Hough did not view outputs specifically in terms of the value added; rather, he viewed outputs simply as a marketable product, the degree. An economist, Hough saw institutions of higher learning, referred to as IHLs, as being directly comparable to firms in microeconomic theory. As such, IHLs were decision-making institutions in possession of ". . . clearly specifiable goals and instruments for attaining those goals" (30, p. 93). Hough defined outputs as degrees and inputs as students and faculty. Within the black box, the IHL production function related student and faculty input to degree-holder output (30, p. 98).

The notion of production function was clearly derived from the input-output model where the firm and its production function(s) tie input to output. For Hough, then, production functions in higher education were ". . . commonly used to relate characteristics of incoming students to the characteristics of outgoing students" (30, p. 98).

This application to higher education of the input-output model was concluded by locating IHLs in the environment of the market place. Hough viewed IHLs as operating in a market place characterized by the supply and demand for degrees. The role of IHLs was that of certifying and legitimizing. "The 'firm', then, might be said to produce in a market in which degrees are supplied and demanded" (30, p. 97).

Hough's quantitative view of this subject was typified by his references to baccalaureats who pursued doctorates. He referred to them as "apples" (30, p. 93).

Although the preceding discussion of outputs is far from exhaustive, it documents the general tenor of debate regarding higher education outputs. Review of the literature on cost studies quickly establishes the understanding that a direct or indirect foundation based on some input-output concept undergirds most studies. Equally easy to establish are acknowledgements of production functions in higher education and the value-added concept of output. However, beyond acknowledging these two, little agreement exists on consistent definition or application. For example, Lelong and Mann (41) described a struggle for an acceptable output measure. After rejecting conventional measures, they turned to the value-added approach, but conceded that it was not adequately developed.

> What must be found are usefully sophisticated, and, at the same time, usefully simple measures of the value added by the education process. Only by measuring before-and-after differences in students can the institution's productivity with respect to the students be determined. For that matter, the same holds for all output effects and side effects of institutional operations. For this reason, the basic concept of value-added, as employed by economists, seems to be fundamental to valid techniques for measuring institutional output (41, p. 192).

Other sources acknowledged the potential of the value-added concept and its limitations. In a thoughtful and comprehensive paper on the subject of graduate outputs in higher education, John Perry Miller stated,

> The first instinct of an economist is to explore the concept of 'value-added' by graduate education. This is, of course, a useful measure for judging the overall effectiveness of the total system of graduate education and of many subdivisions. It has the advantage of being expressed in the common denominator of money and, therefore, can be readily balanced against costs, which are to a large extent expressed in such terms (48, p. 107).

However, he continued by pointing to its limitations. One was the lack of ". . . appropriate predictive scores" (48, p. 107). A related matter concerned the fact that value-added as measured by income ". . . may not be all value-added" (48, p. 108). In other words, that which contributes to a person's value-added may be the result of more than the formal academic experience.

Miller concluded his paper by suggesting that the value-added approach may be appropriate on a large scale or aggregated basis--that is, at a nationwide, regional or institutional level. In addition, he saw the need for other measures of output, some of which are not monetarily oriented. For example, he cited as other output measures: man-years of study, number of degrees, opportunity equality, and measures of those completing degrees as opposed to those who do not (48, p. 108).

The difficulty in reaching consensus on the concept of value-added may be traced directly to what transpires within the black box: the concept of production functions or productivity. Resolution of this debate is far from complete.

Describing the plight of an analyst in higher education, Robert Wallhaus, deputy director of NCHEMS and an acknowledged authority in the field, warned,

> In assessing the productivity of higher education, the first and most obvious difficulty is measurement--determination of the value of inputs and the virtually insurmountable problem of quantifying the value of outputs. But measuring productivity is only a point of departure. The relationships between inputs and outputs must also be determined. At the same time analysts must recognize that not only are outputs related to inputs, they are a function of the educational process and a host of other factors, such as the environment in which higher education is carried out and the attributes of those who participate (75, p. 6).

The close relationship of value-added to productivity was apparent in a definition of the latter by Wallhaus: ". . . productivity is defined as the value of outputs relative to the value of inputs" (75, p. 1). Further, he contended that this definition might be interpreted in many ways based on different decisions, policy issues or persons in higher education: "in summary, the technical definition of productivity--the value of outputs relative to the value of inputs--when viewed in the context of policy issues, the products, and the missions and goals of higher education has many complex meanings" (75, p. 6). This view is currently maintained by NCHEMS and is reflected in documents like the Cost Analysis Manual by Topping: "A good understanding of the production functions in the higher education process still does not exist" (69, p. 2).

The literature is replete with arguments advancing the shortcomings of output measures in higher education. Most arguments tend to tie directly or indirectly to the matter of productivity. Rourke, for example, said "the belief that educational outputs cannot be measured is a highly cherished one in higher education and it is, in some respects at least, unassailable" (62, pp. 8-9). He contended that judgments about the many aspects of institutional productivity were ultimately based on qualitative rather than quantitative standards of achievement, and were, therefore, highly subjective. Plourde maintained this theme by stating: "The production functions of higher education are not concisely defined, and there is no accepted formula for determining the resources required to produce a unit of output" (60, p. 18).

Criticisms of the economic basis of costing approaches in higher education usually are heard from academicians with backgrounds in fields other than economics. However, a notable exception is John E. Brandl (9), whose academic background includes economics. His position left little room for doubt: ". . . it is claimed that the analytical techniques for estimating production functions of firms are inapplicable to universities" (9, p. 85). Brandl also pointed out that ". . . economic theory has to do with maximization (consciously or unconsciously) of known objectives" (9, p. 86). However, higher education, unlike the firm, is fraught with competing viewpoints and objectives: "Academic organization is, then, the institutionalized antithesis of the firm . . ." (9, p. 87).

Other criticisms of attempts to view institutions in higher education as synonymous with the firm in economics can be found. John Vaizey, also an economist, made the following point:

> . . . evaluation of the outputs is not independent of the evaluation of the inputs or of the procedures by which you reach the outputs and that, therefore, many of the techniques which are used for measuring the results or industrial or economic activity are not necessarily applicable to education (72, p. 21).

Vaizey indirectly referenced the incommensurable or multi-dimensional nature of educational outputs when he highlighted the critical assumption of the economic approach to output measurement: ". . . there is a constant marginal utility of money so that scarcities in one area can be compared with scarcities in every other area" (72, p. 19). Critics point out that this assumption in higher education is tenuous.

Still another criticism of the comparison of the firm to an institution in higher education concerns the profit motive or lack of one in education (26, p. 152). Economic theory apparently assumes agreement on the pursuit of profit within the firm; such is not the case in education.

Due to the aforementioned reasons, many authorities view the definition of higher education outputs and their measurement with open skepticism. Lelong stated: "Definition of the outputs of higher education is largely impossible in any final social or philosophical sense" (40, p. 238). Brandl struck an equally disconsonate note with the statement "There are irreconcilable differences in this society as to what the outputs of higher education are [italics omitted]" (9, p. 86).

Other references are more conciliatory. Astin (2, p. 82) declared the largest problem with student output measures to be the existence of multiple measures; he viewed the use of a single measure as unrealistic. However, Bowen and Douglass (8, p. 80) simply stated that outputs are subjective. Others contended that outputs simply vary with constituencies (41, p. 189; 51, pp. 69-70).

Summary: Outputs

Productivity and output measures are directly related. Criticisms of various output measures or proxies are in fact criticisms of the weak underpinnings of such measures--the ill-defined production function. The desire to skirt these criticisms culminates in an abundance of unit cost measures of output in institutional and intrainstitutional cost studies. A unit cost measure enjoys the general agreement that institutions do produce credit hours; hence, an output measure based on the credit hour is defensible. Credit hour measures may be poor proxies for output, but their current wide acceptance bespeaks the shortcomings of other measures. A comment by Robert Wallhaus reflecting his position summed up current sentiment:

> Perhaps the state of the art of measuring productivity in post-secondary education is best reflected in the use of unit costs (such as dollars per student credit hour--$/SCH) as a basis for allocating resources. Many states (and institutions) utilize some variation of unit costs (student/faculty ratios or degree/cost ratios, for example) as a basis for 'formula budgeting' (75, pp. 11-12).

In his paper Wallhaus listed a number of assumptions which underlie the state of the art with regard to productivity. One of the assumptions listed concerned credit hour measures: "The student credit hour, a unidimensional measure, is assumed to be a proxy for the multiple outcomes of post-secondary education" (75, p. 13). He continued by noting that, as such, this unidimensional measure was not capable of reflecting joint products or production functions. He concluded, however, by advocating the use of unit costs as a proxy for a production function which relates costs as the measure of input and semester credit hours as the measure of output (75, p. 12).

In an article entitled "The Fundamental Cost Model", Sheehan and Gulko (66) listed the elementary ideas necessary for understanding cost analysis. Their theme was consistent with that expressed by Wallhaus (75) when they defined the fundamental cost model to be based on the unit cost, dollar per semester credit hour ($/SCH) (66, p. 65). The focus of both articles was on institutional level cost analysis studies, the most common type of study found in the literature.

Ample support has now been accumulated to advance an additional premise. Two justifications, authored by acknowledged authorities of national prominence, have been cited for the use of unit cost measures (66, 75). In addition, two variations on the cost analysis theme have been cited which contended that the disaggregated level of the individual course is a justifiable focal point for the study of heretofore unreachable nuances of cost studies (33, 78). Consequently, the following design premise is advanced:

Premise 5. The unit cost measure of this study will be cost per semester credit hour ($/SCH).

This premise is based on the following cumulative conclusions: that a general input-output approach to cost analysis is fundamental; that the concepts of value-added and joint production functions are beyond the scope of a study intended to focus on departmental level costing assumptions; and that cost per semester credit hour is the most widely accepted unit cost measure in cost analysis studies.

Costing and Purposes

The preceding discussion of output measures has highlighted the lack of general agreement on the nature of higher education's black box in the general economic input-output model. Since the relationship of higher education's purposes to higher education's production functions is generally unquestioned, could the ill-defined nature of one account for the same in the other? In light of the preceding review of output measures, therefore, a related question is whether a lack of well established foundations in purposes contributes to the wide variation in costing methodologies.

Most recent cost studies begin with a background developed from references to accountability or financial stringency in higher education. For example, Harris made the following reference in his dissertation:

> Increasing public demand for educational accountability and a persistent scarcity of resources have encouraged administrators-economists to research and develop new evaluation and planning methods in order to allocate scarce resources to those programs which are most efficient (28, p. 1).

He cited the need to assess the costs and benefits of vocational programs since they were more expensive than conventional programs, and he added,

> Another dimension of educational accountability pertains to the need to provide advance information about the costs and benefits of vocational education programs to prospective students in order for them to make informed decisions relative to their vocational training choices, and thus their future occupations and primary source of income (28, p, 1).

The purposes which are referenced in cost studies usually pertain to the purposes of the study, not educational purposes. In the Harris dissertation, for example, purposes of the study were listed as follows:

> . . . first, it developed a methodology for conducting a statewide benefit-cost study of vocational education programs in Florida; second, it examined, compared, and analyzed the public and private benefit and cost aspects of four vocational education programs in Florida; third, it compared the public and private benefit and cost aspects of students who attended vocational education

> programs while enrolled in day high school and students not enrolled in day high school; fourth, it yielded formulae which resulted in the development of a model for predicting public and private economic returns of vocational education programs (26, pp. 2-3).

In developing background for his study, Cary contended "The need for an explicit instructional cost-effectiveness analysis model for use in school district decision making is becoming more apparent. Administrators need a systematic tool for more rational allocation of scarce resources" (12, p. 2). Correspondingly, he cited as the purpose of his study the need ". . . to invent an operational cost-effectiveness analysis tool that has the potential to assist school personnel to rationally and systematically analyze and plan instructional activities" (12, p. 3). In seven research questions formulated as germain to his study, none addressed the relationship of methodology to the purposes of higher education (12, pp. 5-6).

Typical of the pattern, Raichle, when discussing purposes, wrote in terms of those pertaining to his study. Three were listed:

> . . . first, it examined the public and private costs and utility aspects of a representative technical education program related to the field of electronics technology; second, it yielded formulae which resulted in the development of a simulation model which can be used by educational administrators for planning optimum allocation of staff, facilities, finances, and other resources; and third, although the analysis in and of itself was not equivalent to a planning, programming, budgeting system (PPBS), it provided the basic conceptual tools for future implementation of a PPBS (61, p. 3).

In tying study purposes to cost measures, Raichle acknowledged "there are numerous methods and procedures for educational program cost accounting" (61, p. 29). Following procedures detailed in a statewide public junior college accounting manual, he established per pupil costs as the cost unit in his study by contending that multiples of this unit allow for the calculation of larger units like courses or programs.

Joan Frisbee (22), in a study concerned with analyzing instructional program costs in a small private college, cited as background to her study the problem of accelerating costs out-distancing accelerating income. She noted that private colleges have not realized the increased governmental support or increased private sector support as have public institutions (22, pp. 1-2). Consequently, she stated,

> . . . many of the private and church-related institutions of higher learning have been engaging in information gathering processes to secure base data about the detailed characteristics of their institutions so that some long-range planning might be initiated to save their schools from possible disaster (22, p. 5).

In this regard, her study concerned the analysis of classroom instructional and supply costs at the course level. These costs would reveal ". . . some important bases for more effective long-range staffing and curriculum planning and scheduling" (22, p. 7).

Frisbee's mention of purposes concerned the purposes of her study, not educational purposes. Her purposes had to do with identifying, allocating, and analyzing direct and indirect instructional costs of the organized instructional program at a college (22, p. 8). She referred to her study as quantitative rather than qualitative; it did not consider ". . . the value or success of the instructional function" (22, p. 17).

Frisbee used a common cost analysis unit of measure in her study, the credit hour generated (CHG). She assumed it to be ". . . a reliable method for placing a value on instructional output" (22, p. 19). She conceded the results of her study were not comparable to similar forms of analysis and placed the blame on variances in institutional accounting systems (22, p. 17).

Ziegler conformed to the examples previously cited by initially establishing a background based on a call to accountability (78, pp. 1-4). His main purpose was to implement a cost model (78, p. 16). However, he went one step further by noting that while research and public service are two outputs of higher education ". . . the major portion of resources input and resultant outputs is gauged by the ability to meet the educational needs of post secondary students" (78, p. 2). He saw this need as being met primarily by the offering of academic programs: his output.

Humphrey (33) also referred to the call to accountability as he developed a background for his study. He noted that as one response to this call, non-traditional instructional programs have been developed in higher education. He then proposed, as the purpose of his study, the development of an instrument for cost analysis at the course level ". . . through provision of a new perspective towards analyzing the cost implications of both traditional and non-traditional instructional programs" (33, p. 2).

Humphrey, like other sources cited, made no attempt to tie his unit of measure and methodology directly to a purpose of higher education. Purposes referenced in his study referred to purposes of the study. Humphrey's assumption was that instruction itself was a purpose within the focus of the study, and the credit hour was an acceptable unit of measure.

Other studies exhibit even less specificity toward educational purposes as well as study purposes (32, 64, 63, 65, 6). Often, no purposes are mentioned at all, just a brief explanation of what the study has attempted to do (64, 6). The tacit assumption in many cost analysis studies seems to be that the instructional program is the primary educational purpose and related units of measure, for example, credit hour costs, costs per FTE student, program costs, department costs, etc., need no justification.

One notable exception to the trend was a book titled _University Costs and Outputs_ By Verry and Davies (73). While accepting the general economic input-output model, the authors went to great length to discuss strengths and weaknesses of various input and output measures as well as the concept of production functions in higher education. Through this process they adequately justified their selection of variables and procedures. In fact they went a step further by elaborating on the limitations of selected variables, procedures and model design, and they specified reasonable alternative approaches where feasible. As an example, they noted their ". . . analysis has been conducted within the paradigm of orthodox economic theory" (73, p. 242), and they admitted to taking certain liberties with the theory as required by the context of the study.

As an alternative to the economic approach, Verry and Davies suggested the study of costs and outputs deriving from political and social science. They said,

> For example, it can be argued that the decision-making process and resource flows within universities would be better understood by a thorough examination of the location and exercise of power, i.e., by using the paradigms of the political scientist and the sociologist (73, pp. 242-243).

The concern shown by Verry and Davies to explain their approach was exemplified by their frequent assumption of the devil's advocate role. As an example, in the following quote, they acknowledged that the economic model used in their study might be inappropriate at times.

> Some readers may be especially unconfortable at our somewhat bland use, in the model of Chapter 3, of the concept of a 'university utility function', in which the welfare or utility of the university depends on the teaching and research output of its departments. We

> would emphasize therefore that this idea is simply a conceptual device . . . specified at the level of abstraction and simplification appropriate to the model of which it is a part. In no sense is this utility function intended to reflect the actual conplexities of university behaviour and organization, or to imply the existence of a concensus as to the relative weights to be attached to the different arguments in the university objective function. The direct and indirect participants in the university production process have diverse, and often conflicting, interests and we freely admit that a socio-political approach may sometimes be more relevant to the study of these conflicts and their resolution than the more strictly economic approach followed in this study (73, p. 243).

Consistent with the theme running throughout this chapter, there are numerous reasons for the many approaches to conducting cost studies. Differences in cost studies have been related to differences in measures of output. Measures of output are directly related to purposes: both identification of one or more purposes of higher education which account for initial interest in some attempt at proxy measurement, and study purposes. References to the former are typically lacking in cost studies; references to the latter are more common but usually lack substance since clearly defined educational purposes are rarely cited.

Some sources speak to the need for developing clearly defined purposes. For example, NACUBO stated,

> There are many purposes for determining cost information to satisfy both internal and external requirements. It is essential that the purpose of obtaining cost information be identified at the outset in order that appropriate definitions and methods of costing can be selected (56, p. 2).

NACUBO contended,

> The definition of cost depends on the purposes for which cost information is to be used. There is no single definition of cost that will satisfy the variety of needs for cost information. Accordingly, significant differences in cost information will be derived, depending on the selection of cost definitions used for different purposes (56, p. 4).

In the context of a discussion on decision-making in higher education, Lawrence, Weathersby and Patterson (38) concurred with NACUBO. In introductory remarks to their volume they stated,

> The major point of this discussion is that different roles have very different perspectives of the institution and a different set of descriptive attributes is appropriate for each decision-making role. Therefore, in our analysis of the major challenges our institutions face, it is critically important that we identify all of the relevant decision-making roles and then choose the attributes appropriate to each role (38, p. 4).

Continued emphasis is placed on the need for a well developed theoretical background before initiating a study. This process is assumed to be a prerequisite to the selection of measures:

> The basic assistance to decision-making that the use of activity or output measures offers is one in which a person, faced with a difficult resource allocation decision, seeks to think through his problem very carefully. He first identifies the characteristics of higher education that are important to him and then selects an appropriate measurement technique (38, p. 5).

In the same volume and speaking specifically to the topic of purposes, Enthoven declared,

> Output and cost information does not exist in a vacuum. To be meaningful, each bit must be an answer

> to a precisely formulated question. In searching for output measures, it is important to keep the purpose of each measure clearly in mind (21, p. 51).

He continued: "Measures for different purposes are answers to different questions. They do not have to be the same. In fact, they probably will not be the same. Moreover, we may have no explicit way of relating one to another" (21, p. 51).

The inability to relate one to another was described in a paper which documented an attempt to compare the results of three different cost models at one institution. Donald C. Bruegman (11) claimed that different methodologies accounted for the inability to compare model results. Differences in output format, program classification structure, financial data used, faculty effort allocation, indirect cost allocation procedures, and joint cost inclusions attested to differences in methodologies (11, p. 5). Bruegman concluded,

> As long as there are so many different cost models, there is little chance anyone will understand the costs of higher education. There needs to be much more cooperation than there is now among the national associations, state agencies and institutions when undertaking cost studies and developing standardized cost methodologies. Somehow, too, the leaders in higher education must come together and champion a united course of action. (11, p. 10).

Tying in with the discussion of purposes and adding to what has been established, Russell L. Hankins (25), in a paper concerned with a review of literature on cost analysis, noted an interesting absence of written material regarding specific uses of cost analysis. In describing how his analysis was structured from the standpoint of four potential uses of cost analysis, resource acquisition, resource allocation, managerial control, and accountability, he acknowledged that ". . . it was recognized that few authors have addressed the uses of cost analysis in specific terms. Most have concerned themselves with methodology, but frequently out of context" (25, p. i).

Hankins offered four observations resulting from his review:

> . . . 1) inadequate attention has been given in the literature to applications of cost analysis to administrative processes; 2) there has been a general lack of awareness of the historical development of cost analysis; 3) communication of current developments is inadequate; and 4) few writers seem willing to discuss successes and failures of specific cost analysis applications (25, p. i).

Consistent with the theme developed in this chapter, it appears reasonable that such shortcomings are inextricably related to ill-defined purposes as precedent underpinnings in cost studies. With indefinite ties to purposes in higher education and consequent purposes of cost studies, results of cost studies are often dubious and their impact on consequent decision making is frequently inconsequential.

Hankins summed up his study of cost analysis literature by describing the lack of clear relationships of cost analysis to decision making:

> Most discussions of decision making that we found were general in their approach and did not consider

> information system theory. It is relatively easy to develop from this literature a picture painted with a wide brush of how colleges were managed ten or twenty years ago. It is difficult to come away knowledgable about the sociological, political or educational ramifications of specific decision processes and the implications of these for cost analysis. To describe this in simplistic terms, the cart has preceded the horse. Contributors to this literature have considered primarily the technical feasibility of cost analysis rather than where, when and how cost analysis can become a useful input to decision making (25, p. 11).

Summary: Costing and Purposes

The relationship of purposes to measures and to methodologies has been established. As cited in Chapter I, general agreement is usually only reached on three purposes of the university: instruction, research and public service. More concise definition and consensus is lacking. In light of this background, the following premise is now advanced.

Premise 6. A prototype modeling system, as proposed in this study, assumes a basic educational purpose to be the instructional program: the generation of credit hours.

Consistent with Premise 3, which stipulated the constraint to deal with commensurables, only one educational purpose should be assumed. Study purposes are listed in Chapter I.

Role of Costing in a Management Information System

Premises advanced to this point have restricted and clarified the characteristics of a modeling system intended for the study of costing assumptions. Questions pertaining to various forms of cost analysis, purposes, output measures, and levels of costing, have been pursued to establish system specifications. Although prototype system specifications are essentially defined, the system's relationship to departmental level information generation mechanisms remains to be established. Along with other notable limitations observed in cost studies, one is the often overlooked place of definitions of objectives and of cost studies in day-to-day management. Final system specifications, therefore, should establish the relationship of any costing effort to existing information generation mechanisms. Consequently, attention is now directed toward the role of costing in a management information system.

In the classic work, Institutional Research in the University: A Handbook, Thomas Mason documented the need for management information systems in higher education:

> As political awareness of higher education has become more acute, a national movement to establish systems of control and accountability over the pluralistic, diverse, and previously self-regulating (or unregulated) higher education complex has taken shape. The development of systematic management information systems designed to support massive reorganization of the governance of higher education has become an imperative in the eyes of institutional, state, and federal administrators concerned with justification and rationalization of resource allocation in higher education (43, p. 194).

Mason's reference to resource allocation justification established the pecuniary role as an important aspect of a management information system in his view. He also viewed management information as deriving from a broader contextual concept, the information system.

> An information system functions at three levels: (1) Data collection, storage, and maintenance. . . . (2) Data retrieval and reporting. Operating reports are generated at various levels of summarization and at specified time intervals. . . . These reports tend to be highly detailed and are used primarily in the control and management of a particular operation or activity. (3) Analysis and evaluation. Management information is created when the detailed operational data are interrelated, analyzed, interpreted, and evaluated in reference to the policy issues and decision problems facing the institutional administration (43, p. 174).

A similar view of information system levels was expressed by Dusseldorp:

> Information needed for a college to function can be divided into three levels--(1) information for management decisions and planning, (2) information for control, and (3) information for operations.
>
> The lowest level, information for operations, consists of the information needed for clerical functions--payroll, student records, financial transactions, and the like.
>
> The middle level, information for control, involves information needed to implement administrative decisions and policies.
>
> The highest level, management decisions and planning, involves the use of information in formulating management decisions as well as developing policies and plans (20, pp. 30-31).

Dusseldorp stated that most attention has been directed toward the lowest level of information system: "To date, most of the effort to improve information systems with the aid of the computer has been directed toward applications at the operations level" (20, p. 31). However, he offered a broad comprehensive definition of management information system as

". . . an organized method of providing management with information needed for decisions, when it is needed and in a form which aids understanding and stimulates action" (20, p. 32). In order to provide this kind of management information, a definite supportive relationship must exist between information system levels:

> Thus the systems for the three levels--operation, control, and management--should be developed together with the operations systems feeding information into the control and management systems and the control system feeding information into the management system. The operations and control systems then form a data base from which some information for management may be drawn (20, p. 36).

Another view of the relationship of management information systems to information systems was presented by Robert Huff who contended that "Educational information systems can be thought of in three hierarcial levels" (31, p. 3). Every institution has the lowest level of information system for daily operation.

> First-level information systems provide the control and operating reports that are necessary for the daily execution of institutional business. Such reports include budget and accounting information, student registration records, payroll and personnel information, grade reports, etc. (31, p. 3).

Huff claimed that the second level of information system is the management information system (MIS). This level of information system yields analytic reports by linking data elements from level one. "These analytic reports can display a great deal of historical information about utilization of resources, interrelationships among organizational units, and a variety of measures related to the current operation of the institution" (31, p. 3).

Huff referred to the third level of information systems as planning and management systems (PMS).

> The major difference between the second-level of management information systems and the third-level of planning and management systems is that the second-level systems are driven by historical data and display reports related to the status quo, while third-level systems offer the user an opportunity to alter the historical inputs on the basis of policy decisions and thus forecast the resource requirements that will be a consequence of those decisions (31, p. 3).

A different slant on information systems and management information systems was proposed by Khateeb Hussain (34). He adhered to the basic input-output approach by noting that an information system has the following components: input, processing, control and feedback, and output (34, pp. 83-85). Specifically, he defined an information system as ". . . an assemblage or combination of things or parts forming a complex or unitary whole to produce information according to a plan (34, p. 85).

Hussain (34) questioned the existence of management information systems, and focused instead on information types and hierarchy. He defined five administrative activities as planning, organization, direction, operation and control (34, p. 103). These activities were viewed as a pyramid with planning and organizing at the apex, direction and control in the middle and operations at the base. These activities corresponded to top administrators, middle-level administrators and operations personnel (34, p. 107). An information system must produce relevant information for the three defined administrative levels according to Hussain.

NACUBO defined a management information system as ". . . an organized method of providing past, present, and projection information related to internal operations and external intelligence" (57, p. 1). Further, NACUBO contended that it must have ". . . the understanding, involvement, and support of the chief administrative officers to be successful" (57, p. 2) and ". . . the capability of transcend organizational boundaries" (57, p. 4).

NACUBO specified that a management information system could be tied to three major systems and related subsystems. Major systems were resource management information, student-sponsor-patron information, and program management information. Examples of subsystems within the resource management information system were personnel, facilities, equipment-supplies-materials, and finance (57, p. 5).

Another approach to MIS definition is related to the data base concept. John Gwynn offered the following definitions and relationships:

> A data management system (DMS) may be defined as a set of procedures to facilitate the construction and maintenance of a data base.

> A management information system (MIS) is a set of processes (mechanical or otherwise) which, when properly executed, obtain data or produce information from data in the data base in a manner which is responsive to the needs of institutional management and in direct response to a request.
>
> Often an MIS will be coupled with a DMS, and the combined package is referred to an an MIS (24, p. 12).

The wide range of variation in management information system development was documented by Minter and Lawrence (50). They stated: "Management information systems range from very simple to complex. They may be operated by hand or may employ third generation computers and sophisticated analytical models" (50, p. viii). Baughman added to this theme by noting,

> . . . most university management information systems range in goals from 'collect a data base and then model' to 'build a model and then collect the data' and are, in general, too far from full implementation to permit evaluation as to performance or effectiveness (5, p. 1).

He continued,

> . . . the performance of the university management information system will be evaluated on the basis of how well it serves in making university management viable. Its effectiveness will be evaluated on the basis of how well it supports the planning, organizing, and controlling processes of this management (5, p. 7).

Baughman touched on the underlying issue which plagues efforts to produce consistency in MIS definition as well as related costing definitions. He defined management functions as planning, organizing and controlling. However, he contended that agreement is lacking as to what constitutes management in the university (4, p. 4). Such an assertion is bolstered by the lack of agreement on what constitutes management functions. NACUBO, for example, defined management functions as planning, control, and operation (57, p. 2). Miller, however, defined four: planning, programming, personneling, and financing and budgeting (49, p. 4). Finally, as previously referenced, Hussain discussed five administrative activities. His activities substantially overlap what are referred to by others as management functions. In fact, the literature yields no consistency in definition concerning either term: management or administration (53, 50, 7, 4, 49).

Summary: MIS

Consistent with the theme running throughout this chapter, limitations pertaining to other cost related concepts pertain to MIS development. This theme was best summarized by the following statement:

> The problem lies in our inability to specify the goals and objectives of the systems, to identify decisions that must be made, and to specify the information needed for these decisions. The major need for research and development in college information systems today is not in hardware, software, or systems development. It is in the decision process at the college level, identification of decisions and decision situations, and specifications of the information needed for decision making (20, p. 40).

Eugene Craven (15) concurred. In an article on information decision systems in higher education, he contended that "In the fields of higher education administration and management information science, there does not seem to be a universally accepted definition of information systems, generally, or management information systems, in particular" (15, p. 127).

From the preceding review, it is not unreasonable to argue that the costing process is a fundamental aspect in most management information system definitions. Many definitions like those offered by NACUBO (57, p. 5), Huff (31, p. 3) and Mason (43, p. 194) directly referenced the use of a MIS in justification of resource allocation or budgeting. Other definitions contained references to management or administrative functions (34, p. 103; 49, p. 4). Further study of these references showed ultimately that costs in some form surfaced within one of the defined functions. And, in an article concerned with three MIS case studies by Leo Kornfeld (37), the study of costs surfaced as the major focal point of each.

Costing also is the main point of interest in two recent preeminent model development efforts: CAMPUS by Systems Research Group and RRPM 1.6 by NCHEMS. RRPM 1.6, for example, is an ". . . instructional cost simulation model" (31, p. 1). Ben Lawrence (39) director of NCHEMS, considered cost information to be essential to the management information systems (MIS) program developed by NCHEMS. Discussing the MIS program, he said,

> In justifying rising budgets and deciding where to allocate scarce resources, the administrator should be able to calculate the costs of various alternative courses of action and relate them to some measure of achievement of institutional objectives (39, p. 109).

Although the costing process is generally assumed to be fundamental to management information system development, both enjoy such varied definition and application that acceptance of specific definitions requires some rejection of other definitions. Therefore the following premise is now advanced:

Premise 7. A prototype model, as proposed in this study, should yield cost information consistent with that found in the literature. In this case consistency with NCHEMS' approach is assumed.

CHAPTER BIBLIOGRAPHY

1. AASA Commission on Administrative Technology, Administrative Techology and the School Executive, edited for the American Association of School Administrators by Stephen J. Knezevich, Washington, D.C., American Association of School Administrators, 1969.

2. Astin, Alexander W., "Measuring Student Outputs in Higher Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

3. Balderston, F. E., "Thinking About the Outputs of Higher Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

4. Baughman, George W. and Ronald Brady, "Towards a Theory of University Management," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke Univerisity Press, 1969.

5. Baughman, George W., "Evaluating the Performance and Effectiveness of University Management Information Systems," Management Information Systems: Their Development and Use in the Administration of Higher Education, edited by John Minter and Ben Lawrence, Boulder, Colorado, Western Interstste Commission for Higher Education, 1969.

6. Bogue, E. G., "An Inquiry Into the Relationship Between Instructional Cost Patterns and Assumptions Influencing Analysis of Basic Data in Unit Cost Studies," Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

7. __________, "Method and Meaning in Faculty Activity Analysis," Reformation and Reallocation in Higher Education, edited by Clifford T. Stewart, Miami Beach, Florida, The Association for Institutional Research, 1972.

8. Bowen, Howard R. and Gordon K. Douglass, "Cutting Instructional Costs, "Efficient College Management, edited by William W. Jellema, San Francisco, California, Jossey-Bass, Inc., 1972.

9. Brandl. John E., "Public Service Outputs of Higher Education: An Exploratory Essay," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

10. Brown, David G., "A Scheme for Measuring the Output of Higher Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

11. Bruegman, Donald C., "Conflict in Cost Analysis Experiences with Three Different Cost Models," unpublished paper presented at the Association for Institutional Research, Los Angeles, California, May 2-6, 1976.

12. Cary, Francis, G., "Development of an Instructional Cost-Effectiveness Analysis Model for Use in School Districts," unpublished doctoral dissertation, Department of Educational Studies, State University of New York at Buffalo, Buffalo, New York, 1972.

13. Cash, Webster C., "Resource Prediction Models: A Do-It-Yourself Approach for Institutional Researchers," Tomorrow's Imperatives Today, edited by Robert G. Cope, Vancouver, British Columbia, The Association for Institutional Research, 1973.

14. Corcoran, Mary and Douglas H. Anderson, "Rationale for Using Micro-Analytic Approaches in Predicting the Character and Size of College Student Enrollments," Institutional Research and Academic Outcomes, edited by Cameron Fincher, San Francisco, California, The Association for Institutional Research, 1968.

15. Craven, Eugene C., "Information Decision Systems in Higher Education: A Conceptual Framework," Journal of Higher Education, XLVI (March/April, 1975), 125-139.

16. Crowningshield, Gerald R., Cost Accounting: Principles and Managerial Applications, Boston, Houghton Mifflin Company, 1969.

17. David, Jean Margaret, "A Model for the Efficient Allocation of Resources in a State University," unpublished dissertation, Department of Economics, The Florida State University, Tallahassee, Florida, 1972.

18. Dresch, Stephen P., "A Critique of Planning Models for Postsecondary Education: Current Feasibility, Potential Relevance, and a Prospectus for Further Research," Journal of Higher Education, XLVI (May/ June, 1975), 245-286.

19. Dressel, Paul L., "Relating Benefits and Costs in Higher Education," Institutional Research and Academic Outcomes, edited by Cameron Fincher, San Francisco, California, The Association for Institutional Research, 1968.

20. Dusseldorp, Ralph Van, "Some Principles for the Development of Management Information Systems," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke University Press, 1969.

21. Enthoven, Alain C., "Measures of the Outputs of Higher Education: Some Practical Suggestions for Their Development and Use," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

22. Frisbee, Joan, "Analysis of Instructional Program Costs in a Small Liberal Arts College," unpublished doctoral dissertation, Department of Education, The University of Tennessee, Knoxville, Tennessee, 1970.

23. Gulko, Warren W., Program Classification Structure, Technical Report No. 27, Boulder, Colorado, Western Interstate Commission for Higher Education, 1972.

24. Gwynn, John, "The Data Base Approach to a Management Information System," Management Information Systems: Their Development and Use in the Administration of Higher Education, edited by John Minter and Ben

Lawrence, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

25. Hankins, Russell L., "Disconcerting Conclusions Drawn from the Literature of Cost Analysis, unpublished paper presented at the Association for Institutional Research, Los Angeles, California, May 2-6, 1976.

26. Hansen, Bertrand L., "University Costing--The Ontario Experience," Reformation and Reallocation in Higher Education, edited by Clifford T. Stewart, Miami Beach, Florida, The Association for Institutional Research, 1972.

27. Hansen, W. Lee and David R. Witmer, "Economic Benefits of Universal Higher Education," Universal Higher Education, edited by Logan Wilson and Olive Mills, Washington, D. C., American Council on Education, 1972.

28. Harris, Marshall A., "A Benefit-Cost Analysis of Selected Vocational Education Programs in Florida," unpublished doctoral dissertation, Department of Educational Administration, The Florida State University, Tallahassee, Florida, 1972.

29. Hausman, Louis, "Pressures, Benefits, and Options," Universal Higher Education, edited by Logan Wilson and Olive Mills, Washington, D. C., American Council on Education, 1972.

30. Hough, Robbin R., "The Outputs of Undergraduate Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

31. Huff, Robert A. and Michael E. Young, A Blueprint for RRPM 1.6 Application, Boulder, Colorado, Western Interstate Commission for Higher Education, 1973.

32. Hume, Harold A. and Joe L. Saupe, "The Allocation of Publically Controlled Resources in Missouri," Public Policy: Issues and Analyses, edited by Robert G. Cope, Washington, D. C., The Association for Institutional Research, 1974.

33. Humphrey, David Allen, "The Development of an Instrument for Course Cost-Analysis in Higher Education," unpublished doctoral dissertation, Department of Education, State University of New York at Albany, Albany, New York, 1974.

34. Hussain, Khateeb M., Development of Information Systems for Education, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1973.

35. Iyell, Edward H., "Higher Education Modeling at the State and National Levels," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

36. Keniston, Kenneth and Mark Gerzon, "Human and Social Benefits," Universal Higher Education, edited by Logan Wilson and Olive Mills, Washington, D. C., American Council on Education, 1972.

37. Kornfeld, Leo L., "Advanced Applied Management Information Systems in Higher Education," Management Information Systems: Their Development and Use in the Administration of Higher Education, edited by John Minter and Ben Lawrence, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

38. Lawrence, Ben, George Weathersby, and Virginia W. Patterson, editors, The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

39. Lawrence, Ben, "The Western Interstate Commission for Higher Education Management Information Systems Program," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke University Press, 1969.

40. LeLong, Donald C., "Allocating and Utilizing Resources," Institutional Research in the University: A Handbook, edited by Paul Dressel and Associates, San Francisco, California, Jossey-Bass, Inc., 1971.

41. LeLong, Donald C. and William R. Mann, "Systems Analysis for Institutional Output Decisions," Institutional Research and Academic Outcomes, edited by Cameron Fincher, San Francisco, California, The Association for Institutional Research, 1968.

42. Lovell, Ned Broward, "Cost-Effectiveness Evaluation of Instructional Programs: A Developmental Design (K-12)," unpublished doctoral dissertation, The Florida State University, Tallahassee, Florida, 1971.

43. Mason, Thomas, "Developing and Using Information Systems," Institutional Research in the University: A Handbook, edited by Paul Dressel and Associates, San Francisco, California, Jossey-Bass, Inc., 1971.

44. Mason, Thomas R., "New Directions for Modeling?," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

45. Meeth, L. Richard, Quality Education for Less Money, San Francisco, California, Jossey-Bass, Inc., 1974.

46. Meigs, Walter B., A. N. Mosich, and Charles E. Johnson, Accounting: The Basis for Business Decisions, New York, NcGraw-Hill Book Company, 1972.

47. Miller, David W. and Martin K. Starr, Executive Decisions and Operations Research, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1969.

48. Miller, John Perry, "Outputs of Higher Education: Graduate Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

49. Miller, William A., Jr., Planning and Program Management, Denton, Texas, North Texas State Press, 1975.

50. Minter, John and Ben Lawrence, editors, Management Information Systems: Their Development and Use in the Administration of Higher Education, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

51. Miyataki, Glen K. and Maureen L. Byers, Academic Unit Planning and Management, Technical Report 75, Boulder, Colorado, Western Interstate Commission for Higher Education, 1976.

52. Mood, Alexander M., Colin Bill, Helen Brownlee, Lawrence Bogard, and Joseph McCloskey, Papers on Efficiency in the Management of Higher Education, A Technical Report Sponsored by the Carnegie Commission on Higher Education, Berkeley, California, The Carnegie Commission on Higher Education, 1972.

53. Moore, William, Jr., Blind Man on a Freeway, San Francisco, Jossey-Bass, Inc., 1971.

54. Murad, Anatol, Economics: Principles and Problems, Totowa, New Jersey, Littlefield, Adams and Co., 1963.

55. National Association of College and University Business Officers, "Budgets and Budgetary Accounting," College and University Business Administration, 4:3, Washington, D. C., NACUBO, 1974.

56. National Association of College and University Business Officers, "Fundamental Considerations for Determining Cost Information in Higher Education," College and University Business Administration, 4:5, Washington, D. C., NACUBO, 1975.

57. National Association of College and University Business Officers, "Management Information Systems and Data Processing," College and University Business Administration, 2:2, Washington, D. C., NACUBO, 1974.

58. National Committee to Revise Volumes I and II, College and University Business Administration, College and University Business Administration, Washington, D. C., American Council on Education, 1968.

59. Newman, Frank and others, Report on Higher Education, Washington, Government Printing Office, 1971.

60. Plourde, Paul J., "Institutional Use of Models: Hope or Continued Frustration?," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

61. Raichle, Henry Frederick, "A Cost-Utility Analysis of a Selected Post-Secondary Vocational-Technical Education Program," unpublished doctoral dissertation, The Florida State University, Tallahassee, Florida, 1969.

62. Rourke, Francis E. and Glenn E. Brooks, The Managerial Revolution in Higher Education, Baltimore, Maryland, The Johns Hopkins Press, 1966.

63. Scheerer, Anne E., "A Formula for Determining Instructional Costs," College Management, VII (November, 1972), 25-29.

64. Sheehan, Bernard S. and Marvin G. Michaels, "Academic Program Analysis for Budgeting," Public Policy: Issues and Analyses, edited by Robert G. Cope, Washington, D. C., The Association for Institutional Research, 1974.

65. Sheehan, Bernard S. and Mervin G. Michaels, "Sensitivity Tests on a University Cost Study Methodology," Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

66. Sheehan, Bernard S. and Warren W. Gulko, "The Fundamental Cost Model," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

67. Suslow, Sidney, "Induced Course Load Matrix: Conception and Use," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

68. Temkin, Sanford, "Making Sense of Benefit-Cost Analysis and Cost-Effectiveness Analysis," Improving Human Performance, III (Summer, 1974), 39-48.

69. Topping, James R., Cost Analysis Manual, Technical Report 45, Boulder Colorado, Western Interstate Commission for Higher Education, 1974.

70. Trotter, Bernard and Mario Creet, "Accountability: Subjective Imperative," Tomorrow's Imperatives Today, edited by Robert G. Cope, Vancouver, British Columbia, The Association for Institutional Research, 1973.

71. Tuscher, LeRoy Joseph, "Cost-Utility Analysis: An Evaluation and Resource Allocation Model for Educational Programs," unpublished doctoral dissertation, Department of Educational Administration, The Florida State University, Tallahassee, Florida, 1971.

72. Vaizey, John, "The Outputs of Higher Education: Their Proxies, Measurement and Evaluation," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

73. Verry, Donald and Bleddyn Davies, University Costs and Outputs, Amsterdam, Elsevier Scientific Publishing Company, 1976.

74. Wallhaus, Robert A., "Modeling for Higher Education Administration and Management," Management Information Systems in Higher Education: The State of the Art, edited by Charles B. Johnson and William G. Katzanmeyer, Durham, North Carolina, Duke University Press, 1969.

75. ________________, "The Many Dimensions of Productivity," Measuring and Increasing Academic Productivity, Vol. II of New Directions for Institutional Research, (Winter, 1975), Jossey-Bass, Inc.

76. Weiss, Edmond H., "Apples, Oranges and College Administration," College Management, VIII (November/December, 1973), 26-27.

77. Witmer, David R., "Cost Studies in Higher Education," Review of Educational Research, XLII (Winter, 1972), 99-127.

78. Ziegler, Clayton L., "An Implementation of a Matrix Cost Model at the Course Section Level to Determine Academic Program Costs in a Community and Technical College," unpublished doctoral dissertation, Department of Educational Administration and Supervision, Bowling Green State University, Bowling Green, Ohio, 1975.

CHAPTER III

A REVIEW OF COSTING SOURCES AND APPORTIONING PROCEDURES

This chapter represents a separate review of literature concerned with identifying costing sources and apportioning procedures commonly used in higher education cost studies. Seven prototype system specifications were established in Chapter II. Costing sources and apportioning procedures respectively constitute system input variables and system parameters. While the basic system design, once established, remains unchanged, each iteration of the system is unique since different variables or parameters or both are modeled. Each iteration of the system constitutes, in effect, a cost study--selected costing sources and apportioning procedures. Thus, the purpose of Chapter III is to identify some costing sources and apportioning procedures found in the literature.

Frisbee pointed out that most intrainstitutional unit cost studies undertaken in this country are usually confidential and confined for distribution purposes within an institution. Her literature review was correspondingly limited to representative studies by funded groups, state higher edication officers, and individual university researchers (4, p. 46). Frisbee studied the institution and her literature review extended to inter-institutional studies.

The study at hand is a departmental level study, not an institutional level study. Literature reviewed in this chapter, therefore, will be restricted to representative institutional and intrainstitutional cost analysis studies.

Available representative literature may be divided into three groups for review purposes: dissertations, other institutional studies, and NCHEMS' projects. These three divisions developed naturally once the review of literature was underway. Dissertations, while not always readily available, can be accessed. Other institutional studies, typically initiated by faculty of staff members, are available through journals and copies of proceedings. NCHEMS' materials are available locally.

Dissertations

The David Allen Humphrey Study

David Allen Humphrey (7) undertook the development of a cost analysis instrument for his dissertation. Instead of being a typical institutional level cost study, however, Humphrey's study focused at a disaggregated level on three traditional and non-traditional college courses. Initially, he performed a cost analysis on both types of courses using "contemporary instructional costing procedures" (7, p. 149). Next, he identified problems resulting from the application of these contemporary techniques. The problems Humphrey identified then served as the basis for a new cost analysis instrument entitled the Course Cost-Analysis Instrument (CCAI) (7, p. 175).

Humphrey limited his study to instructional costs in individual courses. He noted that "Previous efforts had not specifically pursued cost factors to this operational level" (7, p. 14). He contended that current costing techniques ". . . focus primarily on departmental or program calculations . . ." and they ". . . heavily rely on averaging and are inherently based on traditional instructional patterns" (7, p. 7). The instrument he developed was intended to combat these limitations.

Consistent with other cost studies, the focal point for Humphrey's dissertation was the instructional process. Cost sources were generally limited to operational expenditures, not capital and other expenditures (7, p. 14). Also, Humphrey concurred with general findings in the literature that the semester credit hour was ". . . the most reliable numerical measurement for course output calculations" (7, p. 182).

Humphrey defined two cost sources: direct and indirect costs (7, p. 56). Direct costs consisted of salaries of faculty members who taught the selected courses. Indirect costs were defined as a proportional amount of support costs for the department. Both costs, direct and indirect, were combined to produce a measure called the direct cost of instruction for each course (7, p. 149). Computation procedures were described in Chapter V of his dissertation:

> . . . a proportionate share of each instructor's salary was calculated, according to Weekly Faculty Contact Hours (WFCOH) and assigned the section(s) of the course for which he had instructional responsibilities. Total course salary costs for each course were determined through addition of all appropriate instructional faculty costs.
>
> The second step, calculation of the direct course costs, was accomplished in this chapter. This procedure involved the application of a proportionate share of departmental support budgets to each course. The costs were apportioned according to three contemporary techniques which required the determination of total departmental instructional activities in three areas: Weekly Faculty Contact Hours (WFCOH), a measure of faculty classroom hours; Weekly Student Contact Hours (WSCOH), a measure of student-faculty interaction; and Student Credit Hours (SCRH), the number of academic (term) credits generated by all students. The support costs, once apportioned, were added to the instructional salary costs to achieve the direct course costs. Cost-analysis of each course was then conducted to establish unit costs per WFCOH, WSCOH, and SCRH. The cost per FTE student was also computed for each instructional activity indicator using this information (7, pp. 149-150).

The relationship of apportioning procedures utilized by Humphrey and the purposes of his study warrents discussion. As previously noted, Humphrey costed six courses using what he called contemporary costing procedures. Then he sought to detect ". . . analytical failures to provide cost data representative of the instructional techniques employed" (7, p. 56). He noted two basic failures and proceeded to develop his CCAI.

Humphrey's contemporary costing procedures were distilled from his review of literature (7, p. 56). However, although he cited a couple of references which approximated what he referred to as contemporary costing procedures (7, pp. 33, 42, 46), he also cited a number of references which adhered to entirely different approaches (7, pp. 44, 34-38, 23-26). One point to note is that those references upon which he based his selection of contemporary costing procedures reflect an approach to costing which is dated and not consistent with the current, contemporary efforts of NCHEMS, for example. In addition, it appears that Humphrey did not distinguish the basic difference between budgeting and costing. The two are not the same. The work of NACUBO which he traces to the efforts in 1935 of the National Committee on Standard Reports for Institutions of Higher Education (NCSRIHE) is basically associated with attempts to standardize budgeting and reporting procedures in higher education. On the other hand, although tools developed by NCHEMS which Humphrey referenced are intended to supplement and impact the budgeting process, they are primarily intended for use as cost simulation tools based on the PCS structure.

The point of the preceding digression concerns the relationship of apportioning procedures to study purposes. The use of dated costing procedures serves as a distinct contrast to his proposed CCAI. Although, it has been established in Chapter II that no two cost studies are the same, many contemporary costing approaches do not share the limitations Humphrey attributed to them in his version of contemporary costing procedures.

Two of the three contemporary costing procedures utilized by Humphrey also involved differing units of measure in each computation. All three ultimately produced SCRH costs. However, the first procedure apportioned support costs on the basis of WFCOH and then divided the resulting cost by semester credit hours. The second procedure apportioned support costs on the basis of WSCOH and likewise divided the resulting cost by semester credit hours. The third procedure apportioned support costs on the basis of semester credit hours and divided the resulting cost by semester credit hours. Consequently, what Humphrey cited as one of the major problem areas is, in fact, to be expected when different apportioning procedures are used. Whether different apportioning approaches should be viewed as problems is beyond the scope of the present study. Suffice it to say that there exists no unanimity of agreement on any particular approach, and the lack of such agreement no doubt pertains to the approach ultimately recommended by Humphrey: apportioning on the basis of instructional FTE (7, p. 184).

Humphrey did not utilize a formal weighting scheme. Costs, however, were indirectly weighted when WFCOH, WSCOH or SCRH were used.

The Joan Frisbee Study

This study concerned an analysis of instructional program costs in a small Baptist College over a three-year period (4). Citing the problems of relatively less givernment support than public institutions receive, declining private contributions and existing high tuition rates (4, p. 2), Frisbee stated that many ". . . private and church-related institutions of higher learning have been engaging in information gathering processes to secure base data about the detailed characteristics of their institutions so that some long-range planning might be initiated to save their schools from possible disaster" (4, p. 5). Specifically, she stated,

> Since a large percentage of the school's operating budget goes for classroom instructional and supply costs, it was felt a detailed analysis of these costs at the individual course level would reveal some important bases for more effective long-range staffing and curriculum planning and scheduling (4, p. 7).

Thus, Frisbee defined three purposes of her study: to identify direct and indirect costs of the instructional program for a three-year period, to allocate those costs to the instructional program on a departmental basis using appropriate apportioning procedures, and to analyze resultant costs expressed as costs per credit hour generated (4, p. 8). Formal analysis and presentation of costs was at the aggregated levels of ". . . semester, department, course level, laboratory/nonlaboratory, subject and enrollment classifications" (4, p. 9).

Some cost sources were initially excluded from her study as not being directly related to the instructional program. Basically, ". . . current operating expenditures for general support, research, services to the public, and services to the academic community were not allocated to instructional costs" (4, p. 12). Two particular expenditure exclusions were Office of the Dean of Students and operation and maintenance of the plant.

An exclusion of a different type concerned enrollment. Frisbee costed each semester with no provision to account for withdrawals or audits. She considered the number of withdrawals to be insignificant to the extent that costing results would not be affected (4, p. 17).

Noting that ". . . there is little uniformity in the nethods for aggregating instructional costs among the colleges" (4, pp. 17-18), Frisbee defined three instructional cost source levels: course, departmental, and institutional. Costs identified directly with courses were charged to courses. Costs identified at the departmental level were charged to that level and were then prorated to courses. Costs identified at the institutional level were handled in like manner (4, p. 29).

Direct costs in Frisbee's study were divided into two major categories: faculty salaries and fringe benefits. A faculty member's salary was ". . . prorated over the teaching load of that instructor, on the basis of credit hours taught" (4, p. 31). Therefore, if five three-hour courses were taught by an instructor, each course would receive one-fifth of the salary. Fringe benefits consisted of faculty Social Security, retirement and insurance payments made by the school. As with faculty salaries, fringe benefits were prorated to courses on the basis of credit hours taught.

Indirect costs were also divided into two major categories: department costs and institution-wide costs. Department costs included ". . . department administration, faculty development, professional training facilities, the department expense account, department secretarial help, and department book purchases" (4, p. 32) and any fringe benefits. The first three cost sources were prorated on a semester-hours-offered basis. The last three, expense account, secretarial help and book purchases, were prorated to all courses on a credit hour generated basis (4, pp. 32-33).

Institution-wide costs included ". . . catalog publications, mimeograph services, geneneral supplies and services, registrar's office, guidance and placement office, library (including operation and general book purchases), audio-visual equipment, and the expenses attached to the academic dean's office" (4, p. 33). Again, any applicable fringe benefits were included. Costs associated with the academic dean's office were prorated on the basis of FTE staff; all others were prorated on the basis of credit hours generated (4, p. 139).

In order to establish the relationship between selected apportioning procedures and purposes of her study, a review of Frisbee's explanation of each was necessary. As noted previously, one of her purposes was to allocate instructional program costs using appropriate apportioning procedures (4, p. 8). To select appropriate apportioning procedures, Frisbee presented a review of related literature on the major cost categories. She then selected a procedure on the basis of that review. In the case of faculty salaries and fringe benefits, Frisbee's review of literature established numerous approaches: teacher contact hours; the product of faculty hourly rate, course credit hour value, and the number of weeks in the semester; semester hours taught; and others (4, pp. 106-109). She concluded that local definitions of faculty workload would determine which procedures to use. Correspondingly, the number of semester hours taught served to define workload at the institution of her study and it, therefore, was selected as her basis for allocation.

When she surveyed indirect instructional costs, Frisbee found that ". . . no uniform definition [of indirect costs] could be derived from the related studies that were reviewed" (4, pp. 111-112). Consequently, she stated that the final choice of which indirect costs to include in the study was hers. Her choice was made based on consensus in the literature and objectives of the institution where the study was done (4, p. 118). Similarly, concerning indirect cost allocation, she concluded that ". . . no prevailing rules were evident from the studies reviewed" (4, p. 126). She continued: "It is difficult, if not impossible, to find a method of allocating indirect expenses that is free from theoretical objections" (4, p. 129). In the end, she selected two apportioning procedures for indirect costs at the departmental level. One procedure was based on personnel involved; the other was based on time (4, p. 130). At the departmental level, costs for department administration, faculty development and professional training were apportioned on the basis of semester hours offered (time). Costs for department expense account, secretarial help and department library books were apportioned on the basis of credit hours generated (personnel) (4, p. 131). The rationale for apportioning some costs on the basis of time was that they were basically fixed over time and did not fluctuate relative to enrollment. The opposite was true for costs apportioned on the basis of personnel or enrollment. Here, costs were assumed to fluctuate in relation to enrollment; hence, credit hours generated was used as the apportioning basis.

In the case of department chairpersons, Frisbee noted that it was administrative policy to consider one-fifth of these salaries to be apportioned to administration with the remainder being apportioned to their respective instructional responsibilities (4, p. 132).

At the institutional level, Frisbee chose two apportioning procedures based on credit hours generated and FTE staff. These two procedures

> . . . were derived from a consensus in the related research, from logical reasoning of what seemed appropriate under the budgeting and accounting procedures of the institution, and from necessity where the manner of record keeping limited prorating choices (4, p. 140).

Institutional level costs for the academic dean's office were apportioned on the basis of FTE staff; all other institutional costs were apportioned on the basis of credit hours generated. Consistent with the rationale used to apportion departmental level costs, institutional level costs apportioned on the basis of credit hours generated were assumed to vary in relation to enrollment or the generation of credit hours. Costs associated with the academic dean's office, on the other hand, were assumed to vary on the basis of FTE staff rather than enrollment.

Of the cost studies reviewed, Frisbee's presented the most thorough explanation of apportioning procedures ultimately utilized. All of her apportioning procedures were founded on previous research. With regard to one purpose of her study, the use of appropriate apportioning procedures, she satisfied that purpose.

Frisbee did not implement a formal weighting scheme. Indirectly, however, the apportioning procedures utilized in her study constituted a weighting scheme.

The Clayton Lawrence Ziegler Study

The study by Clayton Ziegler differed from other studies reviewed in this chapter in a number of ways. First, his approach to cost source identification was unique in that he did not distinguish between direct and indirect costs. Instead, he identified what were called elements necessary for college operation, and assigned costs to them. Second, the object of his dissertation was the development and implementation of a disaggregated cost model, not of the pursuit of a specific cost study (12, p. 15). Finally, Ziegler utilized a matrix approach similar in concept to the ICLM from NCHEMS for the purpose of deriving academic program costs.

Ziegler's approach to cost source identification consisted of defining an expenditure sector for his model which fed to individual course sections. The expenditure sector consisted of ten elements primarily identified by the line item budget which were ". . . Plant Operations, Faculty, Departmental Costs, Administration, Instructional Resource Center, Faculty Service Center, Student Services, Library, Classrooms, and Laboratories" (12, p. ii). Interrelationships between these elements were established for cost transferral purposes on the basis of services rendered. First, each element was assigned a prime cost. Next, since some of the elements fed entirely or fractionally into other elements for costing purposes, Ziegler described a cascade process which accounted for the flow and accumulation of costs through the expenditure sector. Correspondingly, costs of the Plant Operation element fed only to other elements, not directly to the final cost center defined by Ziegler as the course section. Plant Operations costs were cascaded into each of the other expenditure segment elements except the Department element. The basis for this apportioning was total campus building area (12, p. 70).

Instructional Resource Center (IRC) costs consisted of prime costs plus those cascaded in from Plant Operations. IRC total costs were then cascaded into individual departments in the Department element on the basis of the proportion of supplies consumed by each. The head of the IRC directed that this method be used since he viewed it as being the most accurate (12, p. 83).

Faculty Service Center (FSC) costs were cascaded into two other elements: Administration and Department. Total FSC costs consisted of prime costs plus those cascaded in from Plant Operations. FSC proration ". . . was based solely on the proportion of total jobs processed for each department or the administration as identified on each work order" (12, pp. 85-86).

Administration costs fed into the Department and Faculty elements as well as directly into the final cost center, the course section. The reason for this apportioning approach was that efforts of the five central administrators who constituted this element were viewed as being divided into three activities: college, faculty, and student (12, p. 87). These administrators responded via surveys designed to elicit from them what portion of their own costs should be assigned to each of the three activities. Total Administration costs consisted of prime costs resulting from the five administrators as well as cascaded costs from FSC and Plant Operations. The costs which flowed directly from this element into the final cost center were ". . . directly related to the number of students enrolled in the various classes offered by the college" (12, p. 92). That is, the sum of all class enrollments became the denominator of a fraction whose numerator was the total cost cascaded directly from the Administration element to the course section. The resulting quotient, cost per student in a class, was multiplied by the number of students in each class to compute the cost apportioned to each class. This quotient was called a cost transfer constant.

Department element costs flowed directly into the final cost center, the course section. These costs consisted of prime costs plus those cascaded in from the IRC, FSC and

Administration. Actual apportioning of costs to individual course sections was on the basis of the number of classes offered rather than student enrollment or credit hours. Ziegler made this decision on the basis of discussions with department chairpersons (12, p. 96). Therefore, a cost transfer constant was computed for each department based on the costs for an individual department divided by the number of classes that department offered. The resulting quotient was expressed as a cost per class section.

Costs from the Faculty element of Ziegler's expenditure sector were apportioned to the final cost center in two ways. First, costs cascaded into this element from Administration were distributed on the basis of the total sections: the cost transfer constant derived was in terms of cost per section (12, p. 97). Other costs cascaded into this element from Plant Operations were distributed on the basis of total full-time faculty. In other words, a cost figure was computed for each full-time faculty member, and it was added to each member's contract salary. These costs were then distributed over classes taught on the basis of credit hours (12, pp. 98-99). Cost transfer constants were computed for each faculty member since they would vary depending on salary and credit hour load (12, p. 109).

Classroom element costs flowed directly into course sections. Total Classroom costs consisted of prime costs plus those cascaded in from Plant Operation. Again, cost transfer constants were computed and they varied with the type of room. The formula was room area for each room type multiplied by the number of rooms of each type multiplied in turn by building costs per square foot. Once costs for each room type were computed, they were divided by the respective number of scheduled hours to yield cost transfer constants in the form of cost per hour (12, pp. 103-106).

Library costs also flowed directly into course sections. Total library costs consisted of prime costs plus those cascaded in from Plant Operations. Apportioning of costs was on the basis of student enrollment in all classes (12, p. 100). Thus, total element costs were divided by total class enrollment. The resulting quotient, cost transfer constant, was expressed as cost per student in a class.

Laboratory costs, likewise, fed directly into course sections. Total laboratory costs consisted of prime costs plus those cascaded in from Plant Operations. Costs of this element were apportioned on the basis of actual usage hours for each department. A cost transfer constant was computed for each laboratory, and it was expressed as cost per laboratory hour (12, p. 105).

Finally, Student Services (SS) element costs flowed directly to course sections. Total costs again consisted of prime costs and cascaded Plant Operations costs. As with Library costs, SS costs were apportioned on the basis of student enrollment in all classes. Therefore, total element costs were divided by the total enrollment in all classes (12, p. 100), and the resulting cost transfer constant was expressed as cost per student in a class.

Cost transfer constants, computed for each terminal channel from the expenditure sector of the model to the final cost center ". . . provided the vehicle for making cost assignments to the classes" (12, p. 135). These cost transfer constants along with enrollment data from each class were used to calculate course section costs which were then distributed to academic programs on the basis of section enrollment by major.

As mentioned previously, Ziegler did not define direct or indirect costs. Cost sources input to his model corresponded, instead, to functional institutional elements. These elements constituted his expenditure sector and the pecuniary relationship between them was based on what he defined as services rendered. In fact, most of the costs utilized by Ziegler would have been defined in other studies as indirect costs. Only certain faculty salaries and other benefits closely related to course sections would have been considered direct costs.

Since Ziegler's primary purpose was to implement a model to demonstrate ". . . feasibility of utilization" (12, p. 15), the study time frame and apportioning procedures utilized were of relatively less importance. For example, he used data from one quarter only and he noted that other analysts would no doubt want to look at a year (12, p. 15). In like manner, quantifiable apportioning procedures were well defined, but they were variously derived from faculty or staff members employed in those elements defined in the expenditure sector. The basic cost apportioning guide corresponded to services rendered (12, p. 11); however, as has been well established, consensus in this area on any basis is lacking. The relationship, therefore, in Ziegler's study of apportioning procedures to costing purposes is a tenuous one. Other approaches could have been selected (12, p. 96).

As with the two dissertations discussed previously, no formal weighting scheme was utilized by Ziegler. Each method of apportioning costs in the expenditure sector elements, however, constituted a weighting scheme based on services rendered. Additionally, many of the elements produced cost transfer constants which may also be viewed as weights. As with any study, the apportioning scheme adopted constitutes a weighting scheme which has a definite effect on resultant costs.

Other Institutional Studies

The Sheehan and Michaels Study

The Sheehan and Michaels Study differed from typical cost studies in that it dealt with costing assumptions rather than a single approach to costing. An initial cost study, called the methodology, had been completed at the University of Calgary (10, p. 186). Noting that "many logical alternatives exist for the detailed procedures used in most steps of the methodology," Sheehan and Michaels developed some sensitivity tests ". . . to determine dependency of final results on certain steps in the procedures of the study" (10, p. 188). Consequently, their study consisted of computing a total per-student cost for every academic program using the methodology (10, p. 187). Next, they would modify apportioning procedures in the methodology and recompute per-student costs for every academic program. These costs per program were divided by corresponding costs per program produced by the methodology to yield a sensitivity test for the particular modification. Seven modifications were made and seven sensitivity tests were developed. Thus, each sensitivity test resulted in a set of ratios where each ratio depicted the relationship of modified methodology per-student costs for one program divided by methodology per-student costs for the same program. "These ratios show the relative effect of various changes in the methodology on cost study results" (10, p. 188). The approach to sensitivity testing presented by Sheehan and Michaels has been adopted as the approach for analysis of the sensitivity of selected costing assumptions in the prototype computer based modeling system discussed in Chapter IV.

Sheehan and Michaels did not distinguish between direct and indirect costs; their paper represented only a brief review of the study. However, they did note that net university operating expenditures for the academic year were included in the study and capital expenditures were not (10, p. 188). Aside from brief comments concerning effects to be studied with each modification, Sheehan and Michaels offered no rationale for the selection of modifications to the methodology. They stated however that ". . . there is no absolute standard against which to measure validity of final answers of the cost study [methodology]" (10, p. 188), and that was the basis for developing sensitivity tests. One sensitivity test involved comparing costs apportioned to courses by the methodology on the basis of separate instructional levels to costs apportioned to courses based on no instructional level distinction. Another sensitivity test compared costs apportioned to courses by the methodology on the basis of teaching units to costs apportioned to courses on the basis of the product of course credit value multiplied by the respective number of enrolees in each course.

In regard to the avowed purpose to ". . . present results of several sensitivity tests on a given university cost study methodology" (10, p. 186), their selection of various apportioning procedures for use in sensitivity testing did relate to the study purpose. Ties between each apportioning procedure and a particular costing purpose, however, were not clearly established (10, p. 188).

Sheehan and Michaels did not specifically refer to weights in their apportioning scheme; however, as has been previously established, each apportioning scheme was in effect a weighting scheme.

The E. G. Bogue Study

The study undertaken by E. G. Bogue at Memphis State University was called an instructional unit cost analysis (1, p. 90). However, primary interest was in analyzing the impact of separate costing assumptions on credit hour costs. Instead of being a typical cost study utilizing one costing approach, Bogue's study examined four approaches, two at a time, to apportioning one cost source. As a rationale for his study, Bogue noted that:

> Even though the fundamental objectives for the study of instructional costs are essentially the same, there are interesting differences reflected in procedure manuals used by various states and agencies. These differences are to be found in the assumptions influencing ways in which basic data are analyzed and may be specifically illustrated via the following two questions:
>
> 1. What criterion is used to allocate instructional salary costs to individual courses?
> 2. What criterion is used to allocate instructional salary costs to different instructional levels (i.e., lower, upper, graduate, etc.)? (1, p. 90).

The design of Bogue's study was institution wide and focused specifically on changes in institutional costs per semester credit hour for different apportioning procedures. Disaggregation to the departmental or course level was not attempted.

Bogue considered only one cost source, faculty salaries (1, p. 90). Since no other cost source was involved, indirect costs did not exist.

Basically, Bogue defined a two-step process for apportioning salaries. In each step two separate apportioning methods were used. In the first step salaries were allocated to courses based either on reported faculty effort or course credit value. In other words, salaries were apportioned to courses based either on how individual faculty members viewed their relative effort in each course or simply on the basis of the credit hour value of each course. Next, within each of the two preceding methods, salary allocation to instructional levels was based either on course number or student classification. Thus, salaries were apportioned to courses based on faculty effort, then they were apportioned to instructional levels based on course number then on student classification. The other basic approach started with salaries being apportioned to courses based on course credit value, then they were similarly apportioned to instructional levels based first on course number then on student classification. Bogue offered this example of student classification:

> . . . if you have a second year course in English, say English 210, and there are ten sophomores and five juniors in the course, then two thirds of the cost for that course would be allocated to lower division and one third to upper division costs (2).

Bogue's study of effects on costs resulting from different apportioning procedures may be viewed as relating directly to his study purposes: his objective was to study four costing assumptions. He did not, however, tie any of the four assumptions to a particular study purpose. Unlike the typical costing study, his was actually a comparative analysis of four different costing approaches; that is, it was a study of costing assumptions. As with most cost analysis studies, Bogue assumed that instructional costs were a legitimate focus and credit hour costs was a legitimate cost measure.

Bogue did not deal directly with a formal weighting scheme. An implicit weighting scheme did exist, however, in that salaries were allocated on the basis of course credit value then on the basis of faculty effort. Both approaches to allocation are common.

The Anne Scheerer Study

Anne Scheerer's study attempted to get ". . . realistic measures of instructional costs" (9, p. 25). The costs of interest in her study were costs per student in a discipline or special program. She did not specifically consider educational outputs; her implicit assumption was that costs per student were acceptable proxy measures of output. The sole purpose of her stydy was to develop cost-per-student data that would aid institutional decision makers.

The complete study by Sheerer was the result of a process which included two prior attempts to develop measures of instructional costs, and research into three methods of apportioning costs in the third attempt. In the first attempt faculty salaries represented the single cost source apportioned to each school and college in the institution. The unit of measure was cost-per-student credit hour. This attempt was abandoned because the unit of measure was considered too crude to be meaningful (9, p. 25).

A second attempt restricted the focus to courses in the divisions of arts, business administration and the graduate school. Professional schools were excluded from the study since cost computation was considered ". . . considerably more intricate both because of the larger number of income factors and the differences between clinical and pre-clinical instruction" (9, p. 25). In this attempt course levels were defined as lower-division, upper-division and graduate. The output computed was average cost-per-student credit hour by level.

The third attempt represented an approach which included refinements on the previous attempt. Cost sources were finalized, three methods of apportioning cost sources were examined, and one method was accepted for the final study.

Scheerer defined direct and indirect costs in her study. Direct costs were departmental costs (salary, non-salary, and library book allotment costs), departmental shares of the undergraduate dean's office costs, and departmental shares of the graduate dean's office costs. Indirect costs included costs for central administration, student services and the plant (9, p. 26). Additional specificity regarding particular costs was not given in the article, and capital costs were excluded.

In recognition of the understanding that faculty will spend more time and energy with higher level courses than with lower level courses, Scheerer defined the equivalent student credit hour (ESCH) as her unit of measure. The ESCH represented a simple weighting scheme where a weight of 1 was assigned to lower division credit hours, 2 was assigned to upper division credit hours and 3 was assigned to graduate division credit hours. The number of equivalent student credit hours produced by a department equaled the sum of the lower division student credit hours plus two times the number of upper division student credit hours plus three times the number of graduate division student credit hours. According to Scheerer, this weighting scheme represented the ". . . collective judgment of the deans as to the relative demands on faculty time when teaching lower-division, upper-division and graduate courses" (9, p. 26).

Scheerer's final selection of quantifiable procedures for apportioning costs involved examination of cost sources, and decision making relative to the policy environment of the institution. Direct costs were apportioned as follows: Library book allotment costs, other than those directly costed to departments, were initially apportioned to the three divisions on the basis of the percentage of full-time equivalent students in each division. Graduate school costs including its share of library costs were apportioned to the divisions it served: arts, business administration, dentistry, and medicine. These costs were apportioned on the basis of the number of graduate student credit hours generated in each division (9, p. 26). Although costs were apportioned to the divisions of dentistry and medicine, and they represented demands on the graduate school, they were excluded from the study as previously mentioned.

Three methods of apportioning direct division costs to individual departments were then examined. The first method apportioned dean's costs for arts and business administration to their respective departments on the basis of ". . . each department's percent of the total cost of all departments in the college" (9, p. 27). The second method of apportioning dean's costs to their respective departments was on the basis of ". . . the percent of total full-time faculty in the schools" (9, p. 27). The third method, which was eventually utilized in the study, apportioned dean's costs for arts and business administration to their respective departments ". . . based on the percent of total equivalent student credit hours in the school" (9, p. 27).

Scheerer found, with each of the three methods of apportioning costs, that the lowest, highest, and median cost departments remained the same. There was some change in the order of departmental costs for other departments, but the differences were not considered appreciable (9, p. 27). Methods I and II yielded ranges in costs approximately 20 percent higher than the range produced by Method III. Subsequent computations were limited to the third method since it was felt that demands on dean's offices correlated more closely to semester credit hours than to the procedures of the first two methods (9, p. 27).

Indirect costs (central administration, student services and plant) were apportioned to the three divisions like direct costs. Graduate school costs were apportioned to the divisions of arts and business administration on the basis of ESCH, method three, then to individual departments on the basis of graduate semester credit hours (9, pp. 27-28).

The output unit of measure in Scheerer's study was an average cost referred to as cost per equivalent student credit hour (cost/ESCH). This measure of cost was computed by dividing total direct and indirect costs apportioned to a department by the number of ESCH generated by that department.

Apportioning procedures used by Scheerer were those which seemed most appropriate for the institutional environment as envisioned by the deans. The decision to select Method III for apportioning costs was based on the collective, subjective judgment of the deans (9, p. 27). Two other approaches were considered--both would have produced measures of cost.

The feeling that semester credit hours was the most legitimate bases for apportioning dean's costs was consistent with the view that credit hour generation is a primary purpose of higher education.

Finally, Sheerer's study did not actually examine individual courses or apportion costs through courses. Instead, all courses of a department were grouped together when semester credit hours per department were totaled by level to produce ESCH per department. The point of interface for attaching costs to students was the department.

NCHEMS' Projects

RRPM 1.6

The Resource Requirements Prediction Model 1.6 (RRPM 1.6) is an instructional cost simulation model available to postsecondary institutions from the National Center for Higher Education Management Systems (NCHEMS) at the Western Interstate Commission for Higher Education (WICHE). The system consists of computer software and supporting documentation. Two purposes for RRPM 1.6 are the following. First, emphasis on program budgeting is highlighted by the capability of RRPM 1.6 to produce program budgets. In this system program is synonymous with academic major, and computing costs for various academic majors is a primary purpose of the system. Second, emphasis on simulation is highlighted by the capability of the software to provide the facility to study resource utilization alternatives. Once a historical data base has been developed, selective modification to input, representing various resource policies, may be simulated to show the effect of those policies (3, p. 2).

The heart of RRPM 1.6 is the Induced Course Load Matrix (ICLM), ". . . a multidimensional matrix that displays the number of units (credit hours) that students in various degree or certificate programs take in each of the disciplines or departments of the institution" (6, p. 13). In this matrix rows represent disciplines or departments; columns represent student programs. Another matrix used in the system is the Instructional Work Load Matrix (IWLM). Both matrices directly correspond to each other:

> Whereas the Induced Course Load Matrix displays the number of units taken in each discipline by the average student enrolled in each program, the Instructional Work Load Matrix displays the total number of units each discipline must generate in order to satisfy the demand placed on it by all students enrolled in each program. The number in any given cell of the IWLM is determined by multiplying the same cell of the ICLM by the number of students in that program (6, p. 19).

Huff and Young described ICLM operation within RRPM 1.6 as follows:

> Each row of the ICLM represents a specific instructional discipline or department and defines the number of credit hours that the discipline must generate in order to satisfy the demands of student majors in each of the programs of the institution. Operating parameters, such as faculty workloads, salary schedules, and expenses, are input to the model for each of the discipline rows of the IWLM. With this description of

> how each discipline will be operated and the number of students in each program, the model proceeds to calculate the dollars and faculty that each discipline will require. The cost of operating each discipline is distributed to each of the programs in proportion to the number of credit hours each program will draw from the discipline. Thus, the total cost of each discipline is distributed across the cells of its IWLM row. By dividing the total cost of each discipline by the total number of credit hours it produces, a unit cost (cost per credit hour) is calculated.
>
> After all of the individual discipline costs have been calculated and distributed to the various programs in proportion to credit hours consumed, the total cost of each program is calculated by summing down the various columns of the matrix. The total cost of the program is then divided by the number of majors to provide a unit cost (cost per major) (6, p. 23).

RRPM 1.6 requires six types of historical input data. First, the ICLM consists of student enrollments which may be either FTE or headcount for each program. Next are faculty productivity ratios. These data are the number of credit hours produced by an average FTE faculty member at each course level within each discipline. Third are discipline level faculty salary data. Fourth are discipline data relating to nonteaching staff: ratios of staff to faculty and wage schedules for staff. Data for additional discipline or department budget line items may be input through linear estimating equations or simply as constants, and they represent the fifth category. Finally, noninstructional expense data, such as library, research, public service, etc., may also be input either through linear estimating equations or as constants (6, pp. 27-29).

RRPM 1.6 documentation does not clearly distinguish between direct and indirect costs. For example, RRPM 1.6 may be used only with direct costs or it may be used with both direct and indirect costs. When both are input to RRPM 1.6, full unit costs are computed. Huff and Young stipulated,

> After having accomplished implementation of RRPM as a direct cost model, the institution may wish to develop a full unit costing capability. This can be achieved by feeding the results of Cost Finding Principles indirect cost analysis into RRPM, which will then calculate full unit costs (6, p. v).

Three basic cost sources are described in RRPM 1.6 documentation (3, p. 3). First are instructional faculty salaries. These salaries are associated on the basis of rank with the number of FTE faculty in a discipline or department at each course level (3, pp. 10-12). Next are direct discipline nonfaculty instructional costs. Examples of these costs are chairman's salary, supplies, travel, etc. These costs may be apportioned to course levels on the basis of FTE faculty, student credit hours, faculty salaries, or course level designation (3, p, 19). Third, costs other than general academic instruction may be computed. These costs may correspond to research or public service, etc. Such costs ". . . may be input as a constant and/or as a function of enrollment, and/or student credit hours, and/or FTE faculty,, and/or FTE staff, and/or total faculty salaries, and/or total staff salaries, and/or total instructional budget" (3, p. 24).

In a section concerned with interinstitutional data compatibility, Huff and Young suggested four considerations for administrators:

> . . . (1) definition of primary and support cost centers, so that expenditures may be sorted and aggregated on the basis of a standard structure; (2) definition of what specific expenditures comprise direct costs; (3) definition of an FTE student, so that enrollments may be compared and such unit measures as annual cost per major may be developed on a standard basis; and (4) definition of methods for allocating various types of expenses across various cost centers (6, p. 33).

The discussion of direct and indirect cost definition by NCHEMS is addressed in Cost Finding Principles literature and will be reviewed in the next section of the chapter on the Cost Analysis Manual (11). Suffice it to say that RRPM 1.6 does not directly address indirect costs.

As previously noted, RRPM 1.6 allows the flexibility to apportion direct instructional costs other than faculty salaries to discriptive course levels on four bases (3, p. 19). No rationale for the selection of these four approaches is given. The assumption is that they provide flexibility for users and support the general purposes of RRPM 1.6: the generation of information required to prepare instructional program budgets and the use of a tool for analysis of alternatives to resource utilization (3, p. 2).

RRPM 1.6 documentation does not address the question of weighting. The argument may be advanced that the alternative approaches to apportioning some costs constitute different weighting schemes. Notwithstanding such an argument, weighting is left to the user.

The Cost Analysis Manual

The Cost Analysis Manual, one of the publications of NCHEMS' Cost Finding Principles project, is concerned with determining ". . . the full cost of resources used in achieving institutional objectives" (11, p. v). Rather than specifying one set of procedures, however, the manual is intended to provide the flexibility needed to conduct different kinds of cost studies for different purposes:

Topping pointed out,

> The Cost Finding Principles (CFP) project was designed originally to develop a uniform set of standards, definitions, and alternative procedures that would use accounting and statistical data to find the full cost of resources used in the process of achieving institutional objectives (11, p. 1).

This set of standards, definitions and procedures is intended to serve three purposes: improve internal institutional management capabilities, facilitate data exchange between institutions, and improve reporting capabilities to state and federal agencies (11, pp. 1-5).

In order to understand project costing terminology, an understanding of the classification structure must be established. Unlike a budgeting or costing approach closely approximating a typical institutional chart of accounts, the CFP project utilizes the Program Classification Structure (PCS) (11, p. 10). PCS categorizes costs according to institutional programs which in turn are intended to correspond to institutional objectives (5, pp. 4-5). Institutional programs defined in PCS are the following: instruction, organized research, public service, academic support, student service, institutional support, and independent operations (11, p. 11). These seven programs are further distinguished as being either primary programs (the first three) or support programs (the last four).

Within the structure provided by PCS programs, the term activity center defines specific entities of various levels of aggregation for costing purposes. For example, within the program of instruction, the program itself could be defined as an activity center, or it could be subdivided into general academic instruction, occupational and vocational instruction, special session instruction, and extension instruction (11, p. 12). The program of instruction could be further subdivided to the discipline or course level.

As was the case with programs, activity centers are distinguished on the basis of whether they are support activity centers or primary activity centers. Support activity centers are defined as "Those activity centers whose outcomes are necessary or vital for the successful operation of other programs within the institution but do not contribute directly to the accomplishment of the primary missions of the institution" (11, p. 142). Other activity centers are referred to as the final cost objectives and are defined as follows:

> . . . those activity centers whose outcomes are related directly to the accomplishment of the primary missions of the institution or do not demonstrate a vital support function for other programs within the institution. Final cost objectives may or may not be eligible to receive costs from support activity centers (11, p. 142).

For costing purposes, full costs represent "The sum of direct costs, capital costs, and allocated support costs for an activity center or group of activity centers" (11, p. 22). Each defining term has a unique definition in this scheme. Direct costs, for example, are subdivided into four categories. First, direct costs include expenditures assigned for gross salaries and fringe benefits paid to personnel exempt under the Fair Labor Standards Act who have over fifty percent of their activities in the primary programs: instruction, organized research, and public service. Direct costs also include expenditures assigned for gross salaries and fringe benefits paid to exempt personnel who have over fifty percent of their activities in the support programs. The same is true for nonexempt (staff) personnel. Finally, direct costs include expenditures for supplies, communications, travel, other contractual services, and noncapital equipment (11, pp. 19-21).

Topping specified the following as his definition of capital costs:

> . . . the valuation placed upon the services provided by buildings and equipment owned (or leased) and used

> by an institution during any time period. The capital cost of an asset is measured by computing its annual depreciation plus a charge for the annual interest foregone on the investment in that asset (11, p. 21).

Topping distinguished capital from noncapital equipment on the basis of purchase value or service. Capital equipment has an acquisition cost of $500 or more or an expected service life of greater than two years. Noncapital equipment has an acquisition cost of less than $500 or a service life expectancy of less than two years (11, p. 21).

Support costs comprise a large category of other costs. The specific definition presented by Topping emphasized the relationship of support costs to the final cost objective: ". . . those costs not assigned directly to a final cost objective. Support costs are assigned first to support activity centers and subsequently are allocated to final cost objectives via an allocation parameter" (11, p. 22).

In regard to Exploratory Question 2, Topping specifically identified direct costs as discussed above. However, at least conceptually, direct costs could be considered to be support costs when they are assigned to activity centers not chosen as final cost objectives (11, pp. 114-116). The same is true for capital costs (11, pp. 127-128; pp. 140-141; pp. 180-182).

Topping did not identify indirect costs; however, those identified as support costs parallel some of what other authors categorize as indirect costs, except for the specific identification with support programs (11, p. 142). In this sense, therefore, costs defined in the CFP project cannot be compared directly to costs of any other study reviewed in this dissertation.

Apportioning procedures discussed by Topping do lend themselves to comparison with those of other cost studies reviewed, since the definition of programs does not change the requirement for some costs to flow from higher to lower levels of aggregation based on apportioning methods. Direct costs, for example, may be apportioned in basically one of three ways in each of the direct cost categories. First, separate analyses may be conducted to produce greater accuracy in cost assignment to activity centers and to facilitate more detailed costing. These analyses are themselves referred to as direct cost studies. Second, costs within a particular cost category may be redistributed on the basis of a parameter derived elsewhere, for example, on the basis of another cost category. Third, a simple cross over from existing accounting records may be used for apportioning direct costs (11, p. 70).

When considering capital cost apportioning procedures, Topping recommended that two categories of capital costs be defined: buildings and land improvements, and equipment (11, p. 123). The sum of all buildings and land improvements costs should be grouped in a specially defined activity center and then distributed through programs and disciplines to course levels on the basis of assignable square feet. If allocation based on square feet cannot be accomplished, then allocation based on total direct costs is permissible (11, p. 125). Capital costs for equipment should be allocated on the basis of total direct costs (11, p. 138).

Recommended apportioning procedures for support costs are more varied than for either direct or capital costs. Initially two allocation methods are described: direct and recursive (11, pp. 149-151). The recursive method of allocating support costs involves a step-down procedure where higher levels of aggregated support costs flow into lower levels of aggregation and eventually to the final cost objective (11, p. 151). On the other hand, the direct method simply requires that support costs flow directly to appropriate final cost objectives with no intermediate apportioning (11, p. 149). The direct method is recommended (11, p. 152).

Topping viewed allocation parameters as different from allocation methods. Within either method, a number of apportioning parameters may be used. The following are allocation parameters listed: total direct costs, faculty compensation, staff compensation, supplies and services expenditures, full-time equivalent faculty, full-time equivalent staff, headcount faculty, headcount staff, assignable square feet, student credits, student contact hours, course enrollments and faculty contact hours (11, p. 154). The four parameters recommended for use are total direct costs, faculty compensation, semester credits and assignable square feet (11, pp. 155-156).

The numerous apportioning procedures listed and discussed by Topping attest to the many apportioning approaches found in costing literature. As previously described, the Cost Analysis Manual is not a cost study in itself; rather, it is intended to set forth flexible procedures for use by postsecondary institutions in deriving full costs of resources in relationship to institutional objectives (11, p. v). The manual does not advocate a particular procedure although it advances a program costing orientation and the computation of what are referred to as full costs. Users, however, are obligated to adhere to neither of these.

Regarding the relationship of apportioning procedures to costing purposes, the recommended basis in most cases upon which to select an apportioning parameter is level of service. In the introduction to his section on allocation methods, Topping stated,

> The objective of the allocation process is to accomplish this transfer of costs so as to reflect most accurately the actual use of resources by activity centers that receive services from other activity centers. Therefore, in most cases, the methods to be used in the allocation process rely on parameter data that have a high correlation with the level of services provided to the activity centers using those services (11, p. 148).

In those cases where support costs can be allocated on an actual usage basis, Topping recommended apportioning on that basis. However, in the other cases where actual usage data are not available, a wide range of apportioning procedures exist to approximate level of service and the manual provides a listing of many as well as a discussion of four in particular (11, pp. 154-156). In this light the conclusion may be drawn that apportioning procedures listed do in fact exhibit a definite relationship to the purpose listed--to set forth flexible procedures.

A formal weighting scheme for support costs was not discussed by Topping. Implicit, however, is the understanding that each apportioning parameter represents its own unique weight by definition. The same is true in any costing study. Weighting by course, student level, faculty rank, etc., is left entirely to user institutions and is not mentioned in the manual.

The Academic Unit Planning and Management Manual

The Academic Unit Planning and Management Manual (8), written by Miyataki and Byers, is another of the postsecondary education products developed at NCHEMS. Discussing the intent of the manual, the authors stated,

> This document presents a systematic, multi-faceted approach for assisting administrators to plan and manage the scope and direction of academic units. It is intended to help in the identification and organization of data about academic unit functions, the availability and allocation of human and physical resources, the sources and uses of funds, and the planning and assessment of outcomes (8, p. v).

Typical of the approach to product development at NCHEMS, many terms in this document are generic in nature; they provide for flexible application consistent with local definitions rather than require specific definitions or uses. For example, the manual focuses on academic units which are defined as basic organizational units for activities like instruction, research, public service or student counseling. The authors noted, however, that an academic unit may be variously defined as a discipline program, department, division, school or college, although the academic department is considered the basic unit of application (8, pp. v-vi). The typical NCHEMS disclaimer is present: "It is most important to note that this planning manual does not prescribe standards for academic unit planning, nor does use of the manual imply the exchange of information about academic units [italics omitted]" (8, p. vi).

The manual advances a pencil and paper, modularized approach to unit planning and analysis which is not computer based. Six modules are defined and described in six separate chapters. Each chapter contains worksheets depicting an example application and each worksheet is included in an appendix for easy reproduction. The modules are considered to be interrelated and it is suggested that the recommended sequence be followed; however, subsets of procedures may be used depending on specific local concerns (8, pp. 6-7).

The six modules are titled: Identifying and Organizing Academic Unit Functions (Structures Module), Examining Academic Demand (Academic Demand Module), Planning Faculty Resources (Faculty Resource Module), Planning Physical Resources (Physical Resource Module), Planning Financial Resources (Finance Module), and Identifying and Assessing Outcomes (Outcomes Module) (8, p. xiii).

The purpose of the Structures Module is to ". . . help ensure that the functions to be carried out by the unit are as complete as possible, keeping in mind the guidelines, constraints, demands, and expectations of the unit's participants and constituents" (8, p. 13). On worksheets provided, a unit's functions are related to its programs and then to institutional programs. For example, within the institutional program of instruction, the unit's program is undergraduate instruction and specific functions are individual courses (8, p. 15). Within the institutional program of public service, the unit's program is community programs and specific functions are listed as American Heritage Seminars and Community Awareness of History (8, p. 15). Other examples are listed.

The Academic Demand Module is intended to ". . . assist the administrator to understand and examine academic demand and therefore to have a better view of the relationship between the functions to be carried out and those they will serve" (8, p. 22). This module is basically a recapitulation of the ICLM concept common to other NCHEMS products. The major thrust of this module is in response to the instruction program and specific course functions although other academic demand can be recorded on separate worksheets (8, pp. 33-34).

The purpose of the Faculty Resource Module is to ". . . help the administrator to investigate alternative faculty staffing patterns based on the assumption that the tentative inventory of functions . . . will be carried out in the specified time period" (8, p. 39). Again, the major program described in this module is instruction which reduces to individual courses at the function level. Other functions, Impact of Bicentennial and American Heritage Lectures, are included in the example (8, p. 43). The worksheets associated with this module provide an analyst with the capability to tie faculty members to specific unit functions.

The Physical Resource Module is intended to clarify ". . . the impact of physical resources and their relationship to the unit's operation" (8, p. 50). Basically, worksheets provided with this module depict the relationship of resources: classrooms, supplies, equipment, travel, etc., to unit functions. This is the first module in which costs are allocated. For example, various communications costs are allocated to unit functions on the basis of FTE faculty for courses or expected usage (8, p. 56). The same is true for printing and reproduction costs. Travel costs are allocated to unit functions on the basis of expected trips and equipment rental costs are allocated on the basis of proportional usage (8, p. 56).

The purpose of the Financial Module is to ". . . assist the administrator to identify the relationship between the unit's expected operations and the type and level of funds needed to execute them" (8, p. 60). Fund sources depicted in this module are those budgeted which are identifiable at the department level. In the example provided, three major accounts are cited: restricted, unrestricted, and designated (8, p. 63). Restricted accounts are subdivided into various funds pertaining to the unit, and in this case they apply to the unit programs of individual research and community service. One unrestricted account pertained to the unit program, tutorials. The majority of funds flowing into the unit come from the designated accounts of salaries, travel, and support and they pertain primarily to the instruction program (8, p. 63).

In this module no bases for allocation of the various funds is provided. The authors leave this matter for users of the manual to determine. The following statement represents the extent of their involvement.

> . . . since the funds for a function are dependent upon a distribution of the total in each line item (for example, salaries), it is necessary to identify the parameters upon which the distribution is to be made. Since the identification of a specific set of distribution parameters is a difficult and complex task, we suggest that the administrator choose the desirable parameters upon which to base the estimates or query the institutional research or budget office to find out if the parameters are specified by the institution. Because you have some idea of the faculty resources required for each function (from Module 3) and the supporting physical resources (from Module 4), you can use this information to help estimate the funds (8, p. 64).

The Outcomes Module ". . . is intended to help administrators describe what the unit intends to accomplish for the specified time period" (8, p. 70). In this regard, however, the authors stated,

> The identification of outcomes is a very sensitive and complex task because of the differing philosophies with which indivuduals approach the issue. The intent of this module is not to settle any of these philosophical differences--it is to provide a vehicle for arriving at some degree of agreement within an academic unit regarding what the unit members believe to be a reasonable approximation of their accomplishments. It is crucial that in coming to any agreement, the perspectives of each side's arguments be clearly known. For example, it is difficult to argue that student credit hour production is not an outcome if, in fact, the issue is one of resource allocation costs and student credit hour production is a widely used proxy by funders (8, pp. 76-78).

This module, then, does not address costs; it focuses entirely on the nonpecuniary accomplishment of outcomes.

The AUPM manual does not address direct and indirect costs. What costs are identified in Modules 4 and 5 are variously identified as direct and indirect by other authors.

Cost sources identified in these modules also only pertain to the unit--no costs flow into or out of this unit from or to other units.

Cost apportioning procedures are only incidentally depicted in Module 4, and they pertain only to supplies and services as discussed previously. The larger cost sources, like faculty salaries dealt with in Module 5, are not specifically apportioned to unit functions on any identifiable basis.

In this manual the only apparent relationship between apportioning procedures and costing purposes is the absence of a relationship. There are no ties to individual module purposes. The lack of any prescribed apportioning procedures is consistent with the main thrust of the manual: that it ". . . not prescribe standards for academic unit planning" (8, p. vi). Thus, as specific terminology in the manual is generic, so also is the manual itself.

Finally, no specific weighting scheme is discussed in the manual. An implicit weighting scheme does exist in the very limited discussion of apportioning procedures in Module 4.

Summary

This chapter was concerned with the review of representative cost studies for the purpose of identifying costing sources and apportioning procedures commonly used in higher education. The acceptance of various costing sources and apportioning procedures has been established. The prototype modeling system proposed in this study should be flexible enough to model representative selections of each to produce, in effect, simulated cost studies. The comparison of two cost studies will serve as the basis for sensitivity analysis.

In order to model apportioning procedures, the prototype modeling system must accommodate weighting schemes similar to those explicitly found in the literature. In addition to weighting schemes, the modeling system must allow for alternative apportioning hierarchies within the department. For example, some costs might pertain to the whole department,others might pertain only to certain courses, and others might pertain to only one course. Since the logic of the system and its file structures must provide the flexibility to model these alternatives, a final premise is advanced:

Premise 8. The prototype modeling system should accommodate alternative apportioning hierarchies within the department.

CHAPTER BIBLIOGRAPHY

1. Bogue, E. G., "An Inquiry Into the Relationship Between Instructional Cost Patterns and Assumptions Influencing Analysis of Basic Data in Unit Cost Studies", Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

2. Bogue, E. Grady, Personal Letter, April 15, 1976.

3. Clark, David G., Robert A. Huff, Michael J. Haight, and William J. Collard, Introduction to the Resource Requirements Prediction Model 1.6, Technical Report 34A, Boulder, Colorado, Western Interstate Commission for Higher Education, 1973.

4. Frisbee, Joan, "Analysis of Instructional Program Costs in a Small Liberal Arts College", unpublished doctoral dissertation, Department of Education, The University of Tennessee, Knoxville, Tennessee, 1970.

5. Gulko, Warren W., Program Classification Structure, Technical Report No. 27, Boulder, Colorado, Western Interstate Commission for Higher Education, 1972.

6. Huff, Robert A. and Michael E. Young, A Blueprint for RRPM 1.6 Application, Boulder, Colorado, Western Interstate Commission for Higher Education, 1973.

7. Humphrey, David Allen, "The Development of an Instrument for Course Cost-Analysis in Higher Education", unpublished doctoral dissertation, Department of Education, State University of New York at Albany, New York, 1974.

8. Miyataki, Glen K. and Maureen L. Byers, Academic Unit Planning and Management, Technical Report 75, Boulder, Colorado, Western Interstate Commission for Higher Education, 1976.

9. Scheerer, Anne E., "A Formula for Determining Instructional Costs", College Management, VII (November, 1972), 25-29.

10. Sheehan, Bernard S. and Mervin G. Michaels, "Sensitivity Tests on a University Cost Study Methodology", Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

11. Topping, James R., Cost Analysis Manual, Technical Report 45, Boulder, Colorado, Western Interstate Commission for Higher Education, 1974.

12. Ziegler, Clayton L., "An Implementation of a Matrix Cost Model at the Course Section Level to Determine Academic Program Costs in a Community and Technical College," unpublished doctoral dissertation, Department of Educational Administration and Supervision, Bowling Green State University, Bowling Green, Ohio, 1975.

CHAPTER IV

SYSTEM DOCUMENTATION

System Overview

This chapter presents an explanation of the prototype modeling system, and it is directed toward both potential users and computing center staff members who may be interested in implementing similar systems. The approach chosen in this chapter is to document each computer job in sequence so that the general flow aids comprehension of the system. Associated with the documentation of each job is a job flowchart. Actual file formats and program listings are located in the appendices.

Throughout this study attention has been called to the fact that a prototype modeling system was to be developed. No attempt will be made to market this prototype--it is a developmental effort from which subsequent efforts may be patterned, and it serves as a learning experience itself. Typical of the life cycle of many products in the market place, subsequent departmental level costing systems may build upon and, consequently, differ from this prototype.

Consistent with the understanding that a prototype system was being developed, liberal use was made of IBM COBOL extensions. The system is designed for use on an IBM

360/50. Any attempted use of the programs, as written, on other hardware, would probably require the recoding of some statements. In addition, Job Control Language (JCL) is even more dependent on local hardware considerations. A knowledgable computer programmer, however, should be able to write JCL for the system based upon the flowcharts included in this chapter and the program listings located in Appendix A. Local JCL for the prototype system is located in Appendix C.

Specifications used in the design of the prototype system were in accordance with the eight premises developed in Chapter II and Chapter III. These premises established the following general system design constraints: adherence to the basic cost analysis concept, disaggregation to the individual course, focus on commensurables, support of more highly aggregated models like RRPM 1.6, utilization of the cost per semester credit hour unit cost measure, the assumption for costing purposes that the basic educational purpose is credit hour generation, the production of cost information consistent with the management information system approach espoused by NCHEMS, and the accommodation of alternative apportioning hierarchies. Within these general system constraints, the prototype modeling system provides the flexibility to model most of costing sources (input variables) and apportioning procedures (input parameters) reviewed in Chapter III.

The review of cost studies in Chapter III established the need for alternative hierarchies for apportioning costs. Four alternatives are available: first, to all courses of an individual faculty member based on a relationship established for each faculty member; second, to all enrollments in a given course based on a relationship established for the enrollments in the course; third, to all courses within a department based on a departmental level relationship; and fourth, to all enrollments in a department based on a relationship established for the enrollments in the department.

In order for all costs to flow to individual course enrollments, two of the alternatives must be used in conjunction with another alternative. Also, with each of the four alternatives, the established relationship is defined by a weighting scheme. For example, an institutional level indirect cost may pertain to all courses of the department and, therefore, to all enrollments of the department. In this case, the third alternative would be selected in conjunction with the second alternative. The particular relationship chosen in each alternative would be translated into a particular weighting scheme.

As another example, a faculty member's salary may pertain only to his or her courses. Here the first alternative would be selected in conjunction with the second alternative. Again, relationships within each alternative would be established by the use of weights. For the first alternative, all courses may share equally in the costs apportioned to them or they may be weighted on the basis of course credit value, or possibly faculty effort. Similarly, for the second alternative, in each course all students may share equally or they may be weighted on the basis of class rank.

Another costing source, possibly a particular piece of capital equipment, might pertain only to one course. In this case the second alternative would be selected. As previously discussed, a particular relationship would establish the flow of costs to each enrollment within the course.

Finally, a particular costing source may pertain to all department enrollments. However, unlike the first example cited which utilized the third alternative in conjunction with the second alternative, a relationship based only on enrollments may be desired. That is, instead of a preceding departmental relationship impacting the cost flow prior to an enrollment relationship, the cost source would be apportioned to all department enrollments based solely on that relationship. In this case the fourth alternative would be used.

To facilitate the flow of costing sources as described above, a computer file structure is required which describes a given department. The approach taken in this study is to create two basic files, the FACULTY-FILE and the STUDENT-FILE.

One unique feature of this prototype system is that both files share the same format; therefore, both files may be processed by the same computer programs. The files are distinguished by their keys and, therefore, by the sequence in which they are sorted. File formats are located in Appendix B. The FACULTY-FILE is associated with JCL DD names T13621 and D13621 in various computer programs depending upon whether it is on tape or disk. Similarly, the STUDENT-FILE is associated with JCL DD names T13623 and D13623. These two files constitute the heart of the prototype modeling system. They are created in the initial system job and proceed through various stages of updating to the fourth system job where enrollment costs are reformatted into another file for the purpose of aggregation by student major and student level. The final two jobs of the system create, update, and access the SENSITIVITY-DATA-FILE. This file contains the data for sensitivity analysis.

Essentially, the prototype modeling system consists of six computer jobs which include computer programs and sort steps for various files. Job JP1 includes programs P1 and P1A as well as some sort steps. Other jobs include only one program and each program bears the same number as its job. The only anomaly in this scheme concerns jobs JP5A and JP5B which include programs P5A and P5B. P5A and P5B are virtually identical--P5B is simply a duplicate of P5A with a few modifications. In terms of the six basic computer jobs, JP5A and JP5B are considered the fifth job. A more thorough explanation follows in the documentation of JP5A and JP5B.

In each program a consistent effort is made to edit thoroughly all data. Procedures to either avoid invalid data or to terminate a particular run along with an explanatory message are common. In many cases, however, if data simply do not fit anticipated formats, the approach taken is to force the program to ABEND--to cease processing at that particular point and to generate a core dump for detailed investigation of the data. The data item ABND-ITR serves this purpose, and the execution of a statement containing ABND-ITR will terminate program execution at that point and produce a core dump.

JP1

The purpose of JP1 is to create the two major files of the system, the FACULTY-FILE and the STUDENT-FILE. The formats for these files are located in Appendix B. The distinguishing characteristic of these two files is that they share the same format, which contributes to the minimization of redundant computer coding. One description of both files is often used in this system rather than separate descriptions.

Program P1 accesses three existing institutional files in order to create the FACULTY-FILE and the STUDENT-FILE. (See Figure 1, page 168.) One institutional file must contain information tying faculty members to the courses they teach, and it is used in the creation of the FACULTY-FILE. In P1 this file is named COURSE-FILE and it contains all the qualifying information about course titles (department, course, section, and hours) as well as the semester-year code, and faculty identifier. P1 accesses a separate input file, the RANK-FTE-FILE, to add faculty rank and FTE. Input through the RANK-FTE-FILE is matched with input through the COURSE-FILE on the basis of faculty identifier. Once the matching is complete and data from both input files have been copied to a storage area in core, other fields in the storage area are zeroed or spaced out and the storage area is later written to disk as FACULTY-FILE records.

Program P1 also accesses an institutional file which contains information on each student enrollment in each course. The name assigned to this file is NRLMNT-FILE, and it contains all the qualifying information about course titles (department, course, section, and hours) as well as the semester-year code, student identifier, class level, and major field of study.

In order to output an accurate FACULTY-FILE and STUDENT-FILE, P1 matches input from the COURSE-FILE and the NRLMNT-FILE on the basis of course title and semester-year code. That is, every FACULTY-FILE record written must be associated with at least one STUDENT-FILE record, and every STUDENT-FILE record must be associated with only one FACULTY-FILE record.

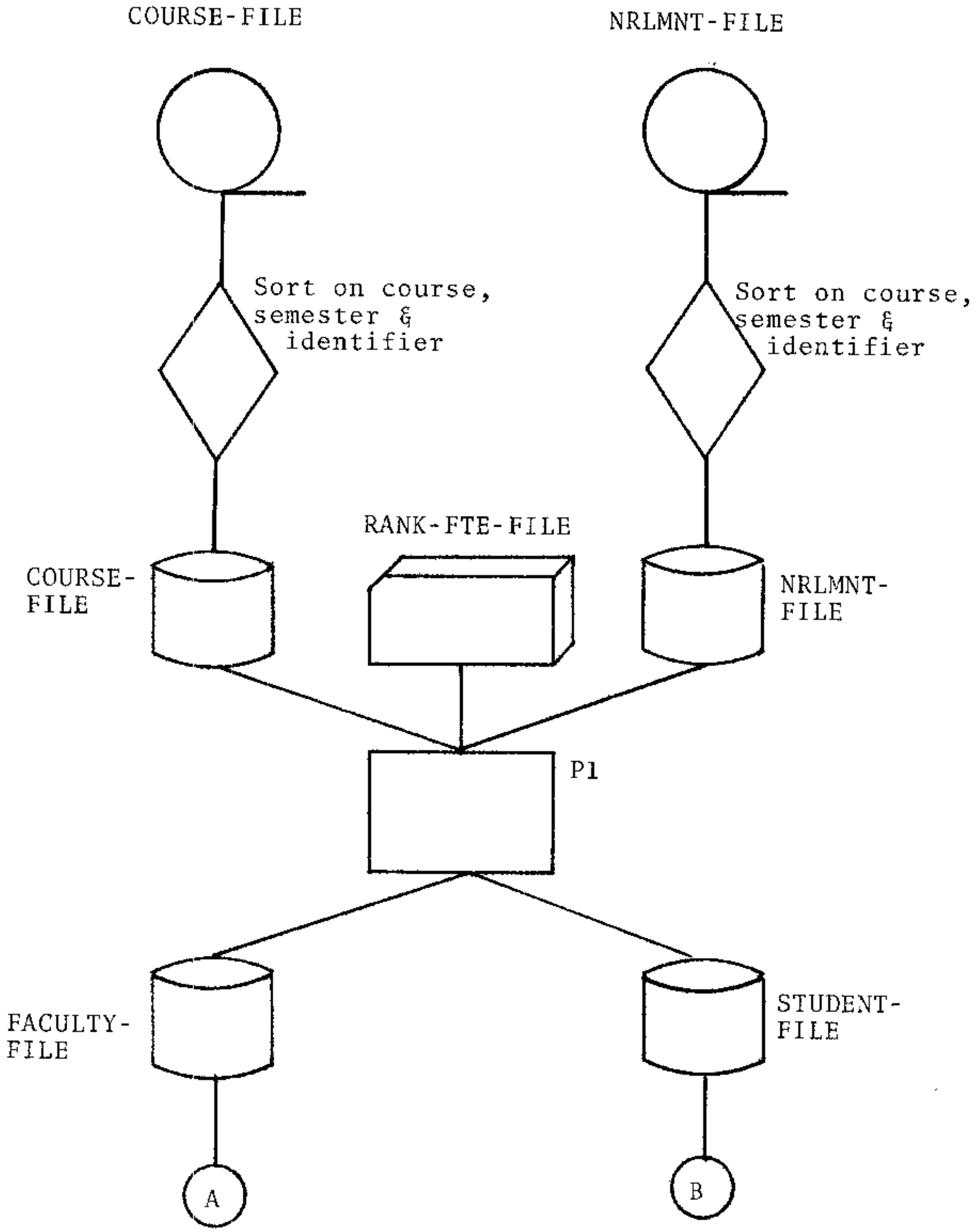

Fig. 1--JP1 Flowchart

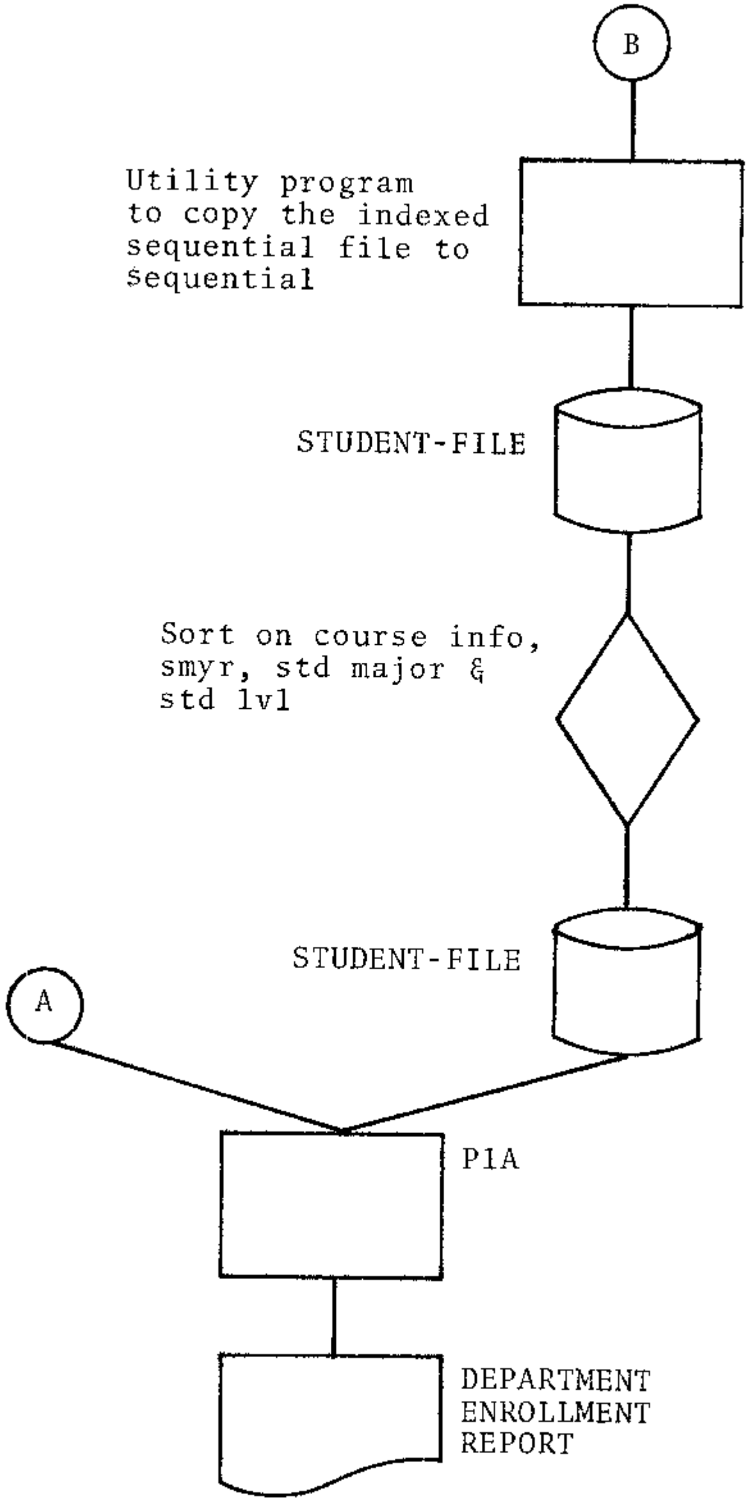

Fig. 1, continued

This procedure assures that all department faculty members and the courses they teach are located on the FACULTY-FILE. Similarly, all student enrollments in each course of the department are located on the STUDENT-FILE.

The FACULTY-FILE and the STUDENT-FILE are created on disk and their file organization is indexed sequential. This type of organization facilitates the subsequent updating in place of both files by P2. This organization also requires defined keys for each file and the respective keys must be in sequence when the files are created. This sequence is assured in JP1 by the two sort steps preceding P1. Both sort steps establish an ascending sequence on course title, semester-year code, and faculty or student identifier as the case may be.

The FACULTY-FILE and the STUDENT-FILE represent two-dimensional matrices. In the FACULTY-FILE each record contains common fields. For example, on each record, one field contains course information, COURSE INFO, and another field identifies the instructor, FAC IDNT. When this file is viewed as an accumulation of records, one following another, then each record represents a matrix row. The corresponding fields in each record represent matrix columns. The combination of rows and columns defines a two-dimensional matrix. The STUDENT-FILE may be similarly viewed as a two-dimensional matrix.

After P1 has created the two files, P1A accesses both to produce the DEPARTMENTAL ENROLLMENT REPORT. This report breaks down enrollment in each course by student major and student level to show enrollment patterns. This report will supplement the SENSITIVITY REPORT produced in JP6.

JP2

The purpose of JP2 is to enter one set of apportioning procedures at a time on the FACULTY-FILE or the STUDENT-FILE. (See Figure 2, page 172 .) Since only one set of apportioning procedures may be entered at a time, it is necessary to execute JP2 a number of times depending upon the number of sets of apportioning procedures selected for study. The iterative nature of JP2, one iteration for each set of apportioning procedures, is enhanced by the indexed sequential organization of both the FACULTY-FILE and the STUDENT-FILE. They may be updated in place and do not require the creation of a new output file with each execution of the job.

Each of the four alternatives for apportioning costs dictates the access of the FACULTY-FILE or the STUDENT-FILE, and the identification of a specific field in each within which the particular set of apportioning procedures is to be entered. At this point, a set of apportioning procedures translates into a set of weights which will actually be entered in a specific field in one of the two files. The weights simply establish the relationship of each record to

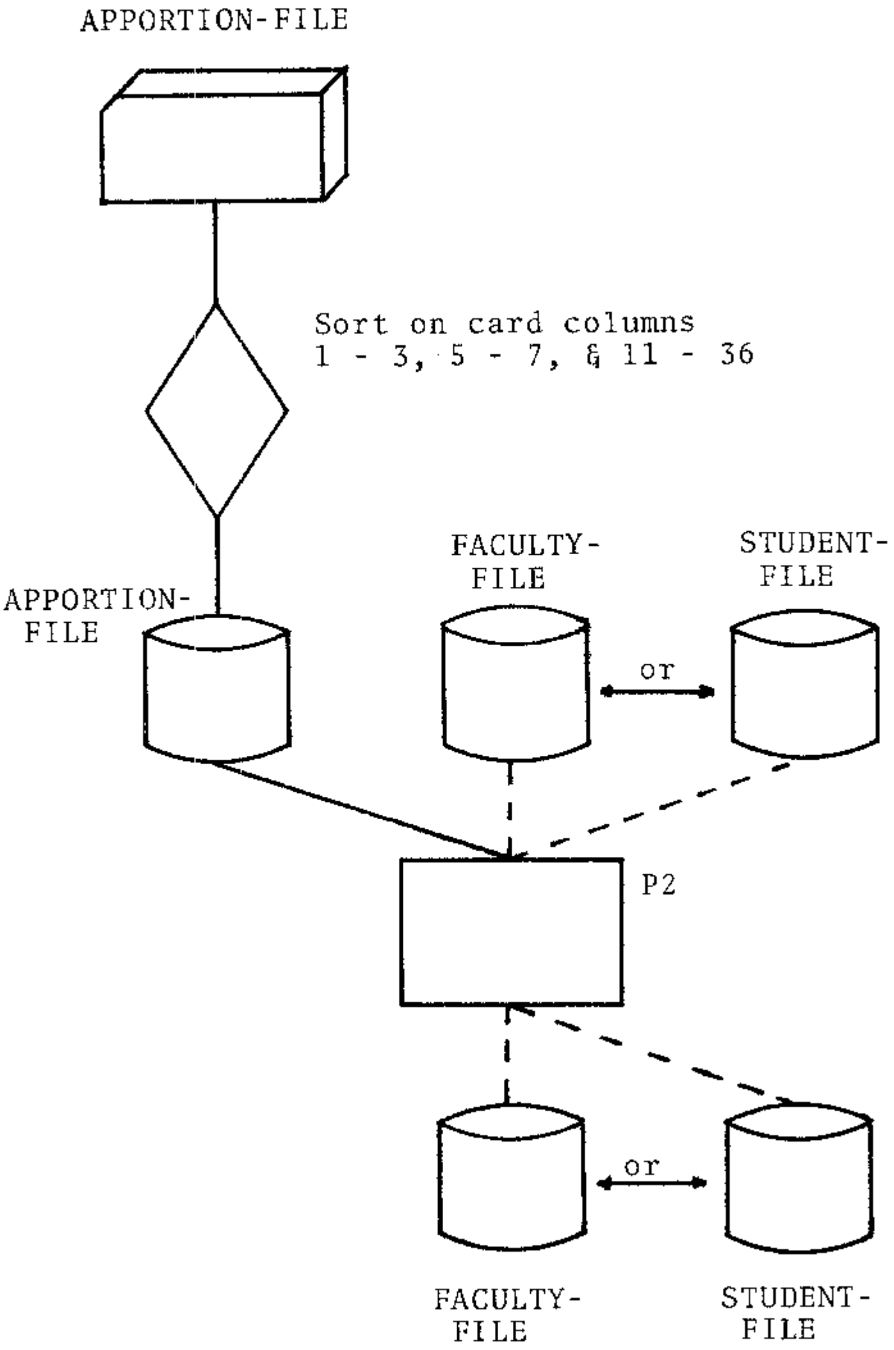

Fig. 2--JP2 Flowchart

all other records in one file for the purpose of apportioning costs. A different set of weights would define a different set of apportioning procedures; they would be entered in another field in each record of one of the two files, and they would establish a different relationship of each record to all others in the particular file.

Program P2 is written to provide a high degree of flexibility in the selection of apportioning procedures. One characteristic of this flexibility is that P2 allows for the selection of apportioning procedures based on any one of the four basic alternatives. The alternative selected defines the file to be accessed and specifies a range of fields in each record in which weights may be entered. The first and third alternatives require access of the FACULTY-FILE, and the second and fourth alternatives require access of the STUDENT-FILE. Four pairs of APPORTION-FILE formats are listed in Appendix B. The four pairs of formats accommodate each of the four alternatives; however, they do not correspond to each alternative. The first record in each pair of formats defines the file to be accessed by the entry in the first three columns: FAC or STD. If a set of apportioning procedures is based on either alternatives one or three, FAC is coded in the first three columns of record type 100. Similarly, STD is coded if a set of apportioning procedures based on alternatives two or four is to be selected.

Apportioning procedures based on the first and third alternatives are distinguished from each other on the FACULTY-FILE by the fields in the file in which they are entered. For example, if each faculty member's salary is to be apportioned specifically to his or her courses, then a weighting scheme based on a relationship between the courses of each faculty member must be established. Five fields, located in columns 32 to 41 of the FACULTY-FILE, are set aside for use with the first alternative. The selection of the particular field, 1 through 5, is designated by the entry in column 9 of record type 100. Column 9 could contain a number in the range of 1 to 5. Similarly, apportioning procedures based on the third alternative would be entered in fields 6 through 10 of the FACULTY-FILE, columns 42 through 51, as designated by an entry of 6, 7, 8, 9, or 0 in column 9 of record type 100 (0 in column 9 designates the tenth field of the FACULTY-FILE).

In like manner apportioning procedures based on the second and fourth alternatives are designated by coding STD in columns 1 through 3 of record type 100. The second alternative is designated by a number from 1 to 5 coded in column 9, the fourth alternative by a number from 6 to 0 coded in column 9.

Weights are actually used to define a set of apportioning procedures, and one weight is entered in one of the ten fields on each record of the FACULTY-FILE or the STUDENT-FILE for each execution or iteration of JP2. Weights for a given iteration establish the desired relationship, but they are not satisfactory for actual use in apportioning costs. They must be converted to percentages and this process takes place in JP3. The conversion of weights to percentages will clarify the meaning which attaches fields 1 through 5, columns 32 through 41, and fields 6 through 10, columns 42 through 51, in both files. This conversion process is described in the documentation which follows for JP3.

A second characteristic of the flexibility of P2 concerns two options available for actually entering apportioning procedure weights. Two options are referred to as the individual option and the blanket option. If the individual option is selected, it is designated by an I coded in column 4 of the type 100 record. This option allows a particular weight to be entered on a particular record of either the FACULTY-FILE or the STUDENT-FILE (previously designated by the entry in columns 1 through 3 of the same record). If this option is chosen, then record type 100 must be followed by one or more records of type 105 formatted with key information in columns 11 through 36 and a corresponding weight in columns 37 through 39. Each record type 105 will reference a particular course taught by a faculty member on the FACULTY-FILE or a particular enrollment in a course on the STUDENT-FILE.

The blanket option is designated by a B coded in column 4 on the type 100 record. This option allows up to six weights entered on record type 105 to be available for use with either the FACULTY-FILE or the STUDENT-FILE based upon predefined selection criteria coded in columns 10 through 13 of record type 100. For the FACULTY-FILE selection criteria are course number (CSE), section number (SCTN), course credit hours (HRS), faculty rank (RANK), or faculty FTE (FTE). For the STUDENT-FILE selection criteria are course number (CSE), section number (SCTN), course credit hours (HRS), or student level (RANK). For each criterion chosen with either file, the data item in each record of either file defined by the criterion is examined and a weight is entered on that record depending on the range within which the data item is located as defined by the ranges on record type 105. Range entries are alphanumeric and should be left-justified. If the blanket option is selected, then only one type 100 and one type 105 record are to be coded.

The blanket option lends itself to ease in coding since only two records are coded for a given set of apportioning procedures. The drawback of the blanket option is that the user is restricted to predefined selection criteria and a maximum of six ranges within which a given weight may be located. Conversely, the individual option allows any weight up to 999 to be entered on any FACULTY-FILE or STUDENT-FILE record. The drawback, of course, is that one type 105 record must be coded for each weight to be entered, and for a sizable department this task requires quite an effort.

One use for the individual option is in conjunction with the blanket option. For example, after a particular set of apportioning procedure weights has been entered on either file, it might be desirous to change a few of the weights. The individual option could then be exercised for the same file and with the same number coded in column 9 of record type 100. Each weight to be changed would be coded on separate 105 record types defined by their respective unique keys.

JP2 is intended to be executed a number of times, one time for each set of apportioning procedure weights to be entered on either file. Five sets of apportioning procedure weights based on the first alternative may be entered in columns 32 through 41 on the FACULTY-FILE. Five sets of apportioning procedure weights based on the third alternative may be entered in columns 42 through 51 of the FACULTY-FILE. Five sets of apportioning procedure weights based on the second alternative may be entered in columns 32 through 41 of the STUDENT-FILE, and, finally, five sets of apportioning procedure weights based on the fourth alternative may be entered in columns 42 through 51 of the STUDENT-FILE. The user is responsible for deciding which alternative will serve as the basis for the selection of apportioning procedure weights, and the particular alternative selected is denoted by the entries in columns 1 through 3 and column 9 of the record type 100. After all of the sets of apportioning procedure weights to be studied have been entered on the two files, they are then accessed by JP3 for further processing.

JP3

The purpose of JP3 is to convert each set of apportioning procedure weights entered on the FACULTY-FILE and the STUDENT-FILE to a respective set of percentages. (See Figure 3, page 179.) This process is necessary since a given set of apportioning procedure weights will not sum to 100 percent; therefore, the conversion process assures a sum of 100 percent or 1.00. The process of converting weights to percentages leaves the relationship between weights intact: the same relationship holds for the percentages. In fact, the percentages are nothing more than corresponding sets of weights which sum to 1.00. In JP4 a cost source will be multiplied by each percentage weight of one set of apportioning procedures in the actual apportioning process. Since all percentage weights in one set of apportioning procedures sum to 1.00, 100 percent of a given costing source will be apportioned.

As mentioned in the discussion of JP1, the FACULTY-FILE and the STUDENT-FILE are in fact two-dimensional matrices. Each record entry of either file may be viewed as a matrix row. A given field in every record, consequently, may be

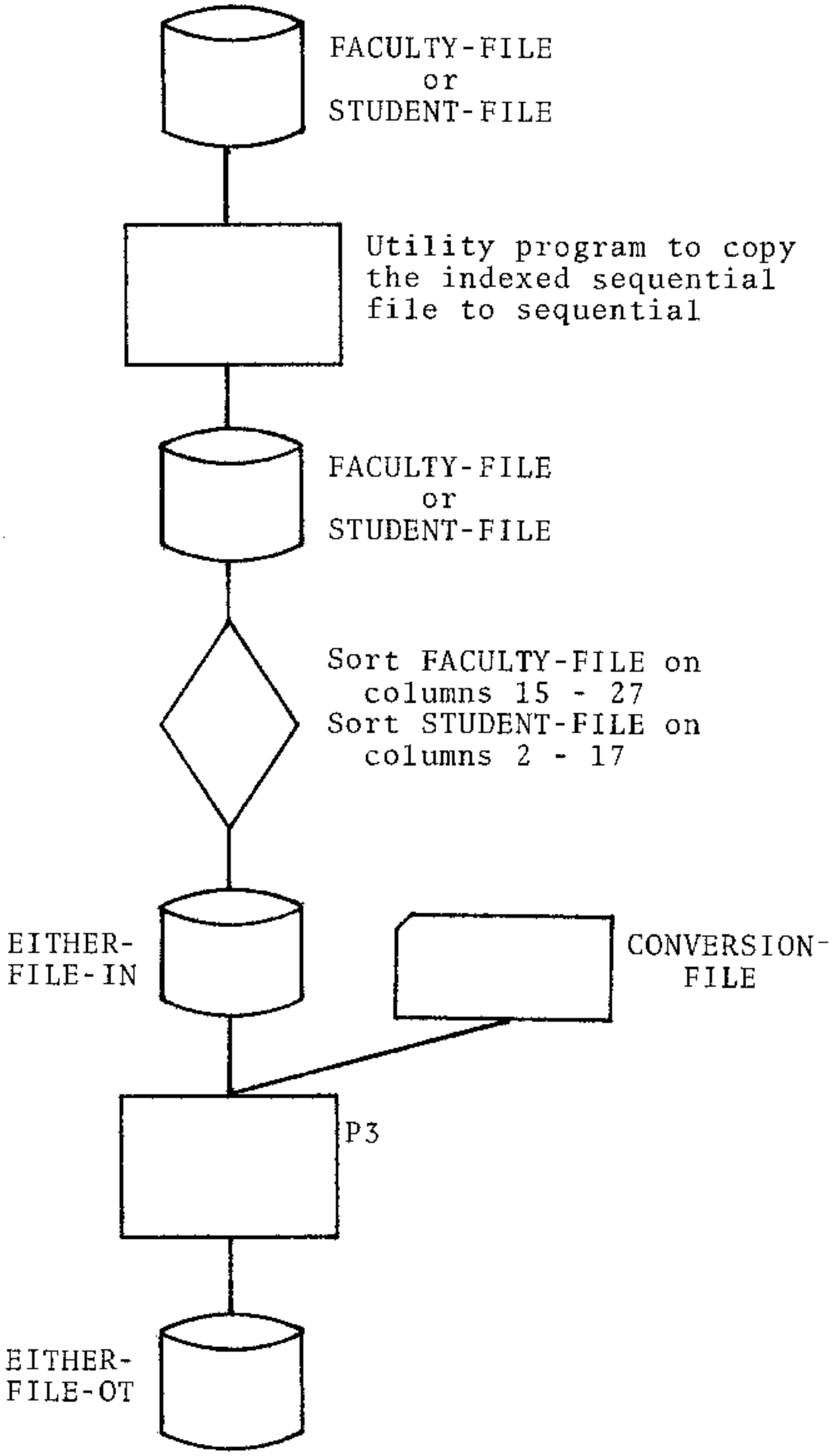

Fig. 3--JP3 Flowchart

viewed as part of a matrix column. Corresponding fields on all records of a file, therefore, constitute a matrix column.

Weights are entered by JP2 on both files in the ten two-column fields located from record columns 32 to 51. Up to ten sets of weights may be entered in these ten fields. (See Appendix B.) JP3 converts the ten sets of weights to ten corresponding sets of percentage weights and enters the latter in corresponding ten three-column fields located from record columns 52 to 81. For example, a weight entered in the field located on record columns 32 to 33 will be converted to a percentage and will be entered in the field located on record columns 52 through 54. Similarly, a weight entered in the field located on record columns 50 and 51 will be converted to a percentage and will be entered in the field located on record columns 79 through 81. The percentage weight fields are three columns (bytes) in length to allow for additional numeric accuracy.

JP3 does not process the FACULTY-FILE and the STUDENT-FIEL concurrently; it processes one at a time. Proper processing is controlled by the JCL, the sort sequence of the input file, and an appropriate entry on the CONVERSION-FILE record. When these three steps have been accomplished, P3 will convert apportioning procedure weights on either file to corresponding percentage weights. Output from P3 is designated as D13621A or D13623A; the suffix A indicates conversion to percentages. D13621A and D13623A are sequential files and should be maintained separately from D13621 and D13623 for the purposes of adequate backup. (See Figure 3, page 179.)

The conversion process for both files is identical within P3. The FACULTY-FILE must be sorted in ascending sequence on record columns 15 through 27 so that the courses of each faculty member per semester are grouped together. The STUDENT-FILE must be sorted on record columns 2 through 17 so that all enrollments for each course are grouped together. Appropriate JCL will assure this requirement. The file name assigned in P3 for use with either file is EITHER-FILE-IN, and to reiterate, it may be either the FACULTY-FILE or the STUDENT-FILE. (See P3, Appendix A.) Similarly, EITHER-FILE-OT pertains to one or the other, depending upon which file has been submitted for conversion. The user is responsible for assigning appropriate data set names in the JCL which correspond to the file being processed.

When the JCL has been written and the correct sort sequence established, all that remains is the proper coding of the CONVERSION-FILE record. This record serves two purposes. First, it is used to designate the columns of apportioning procedure weights which are to undergo conversion to percentages. If all ten sets of apportioning procedure weights are to be converted, then an X should be coded in each of the first 10 columns of the record. If three sets of weights are to be converted, then an X should be coded in the respective columns between 1 and 10 of the record.

The second purpose that the CONVERSION-FILE record serves is to establish the internal logic within P3 to process either file. If the FACULTY-FILE is to be converted, FAC should be coded in columns 16 through 18. If the STUDENT-FILE is to be converted, STD should similarly be coded. This coding establishes an internal key for each file based on its sort sequence. For the FACULTY-FILE records will be grouped by faculty member by semester. Weights entered in record columns 32 through 41, which are weights based on the first alternative, will be converted to percentages for each faculty member. That is, the records for each faculty member will be grouped, they will be converted together, and the converted percentage weights will sum to 1.00 for each member per semester. Similarly, records of the STUDENT-FILE will be grouped on the basis of course per semester. Weights entered in record columns 32 through 41 (weights based on the second alternative) will be converted to percentages for each course. That is, the records of each course which constitute course enrollment will be grouped, they will be converted together, and the converted percentage weights will sum to 1.00 for each course per semester.

Weights entered in one of the five fields from record columns 42 to 51 on either file will be converted to percentages on a departmental basis. That is, for each file all records are grouped, they are converted together, and the converted percentage weights will sum to 1.00 for the department. If the FACULTY-FILE is being processed, these weights correspond to those of the third alternative. If the STUDENT-FILE is being processed, these weights correspond to those of the fourth alternative.

JP4

Actual departmental costing takes place in JP4. (See Figure 4, page 184.) At this point the FACULTY-FILE and the STUDENT-FILE adequately portray the relationship of faculty to courses and courses to enrollments. Also, both files have been updated with apportioning procedure percentage weights. Both files can contain up to ten sets of the weights for the two apportioning alternatives unique to each. In JP4 the user simply defines the costing sources to be applied to the department, and defines a selection of apportioning procedures appropriate for each source. Costing sources and the corresponding codes for their apportioning procedures are input through the COST-SOURCE-FILE. (See Appendix B.)

All costing sources and apportioning procedures codes input at one time through the COST-SOURCE-FILE constitute one costing iteration or one cost study. Each time JP4 is executed, the equivalent of one departmental level cost study is completed since one set of costing sources and one set of apportioning procedures constitute one cost study. Up to ten separate cost studies or iterations may be prepared for subsequent sensitivity analysis in JP6. In other words, JP4 may be executed up to ten times with the COST-SOURCE-FILE containing differing sets of costing sources, apportioning procedure codes, or both.

Each iteration must be assigned an iteration number from one to ten. The iteration number is read in through the SYSIN data set and it must be punched in the first two columns of a standard card. Also, it must be right-justified as is common for numeric data. The iteration number assigned

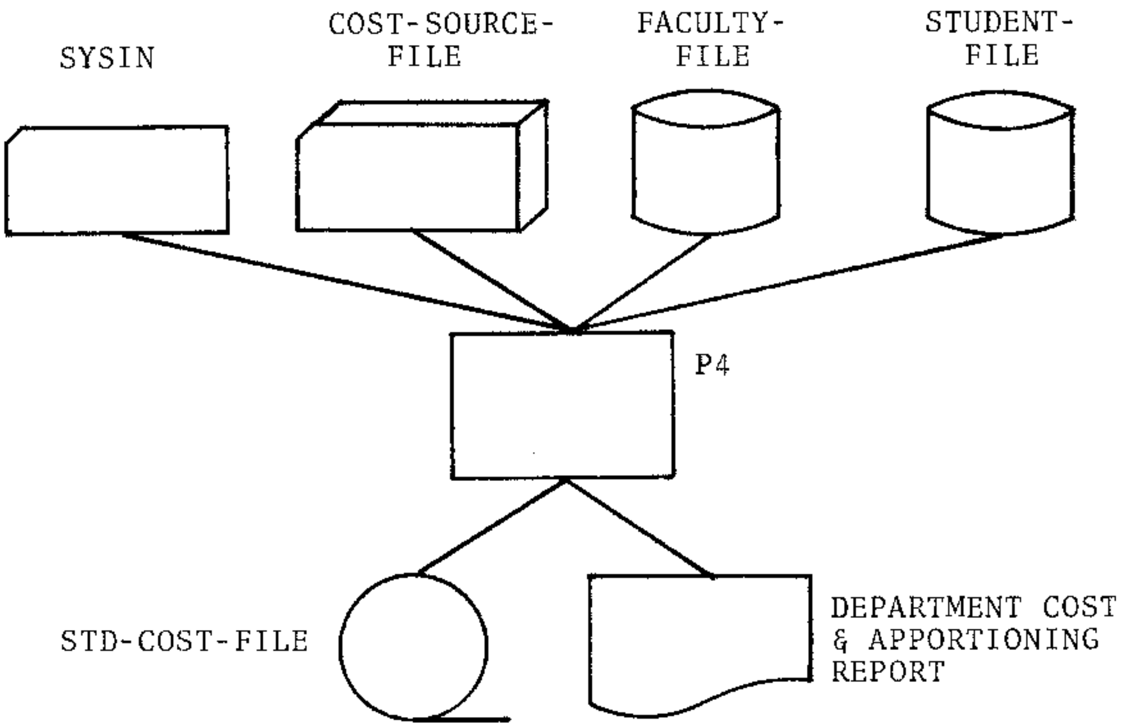

Fig. 4--JP4 Flowchart

at this point becomes the iteration number associated with the costing sources and apportioning procedures concurrently being input through the COST-SOURCE-FILE. Also, the actual date of the run is associated with the iteration number and the costing data so that system audit trails may be established.

In P4 the FACULTY-FILE and the STUDENT-FILE are read separately into core storage areas. The actual costing process takes place sequentially within these storage areas as each costing source and its apportioning procedure codes are read. All costs for an iteration are ultimately lodged in the cost field located in columns 96 to 100 in the STUDENT-FILE records.

Each COST-SOURCE-FILE record contains all the information about one costing source. Actual costing source identification is coded in two fields designated as primary and secondary that are located within record columns 30 to 59. Comments may be coded in the last twenty-one columns of the record. The actual cost amount is coded in the cost field from columns 1 to 9. Finally, apportioning procedures codes and keys are coded in columns 10 through 29. The actual selection of apportioning procedures is designated by entries coded in the four single column fields located on columns 10 through 13 of each COST-SOURCE-FILE record. For example, a faculty member's salary could be apportioned only to his or her courses. Any number from one to five would be coded in column ten. The actual number coded in column ten would define the particular set of apportioning procedure percentages corresponding to the first alternative on the FACULTY-FILE. The semester code and faculty identifier for the particular faculty member would be coded in columns 14 through 26. Once the faculty member's salary is apportioned to his or her courses, the amount for each course must be apportioned further to each enrollment record. Therefore, a number from one to five must be coded in column 12, and this number designates the particular set of apportioning procedure percentages corresponding to the second alternative on the STUDENT-FILE.

As another example, a piece of capital equipment might pertain to only one course. In this case the second alternative would be selected. A number from one to five would be coded in column 12, and the course identifier and semester code would be coded in columns 14 through 29.

If a certain costing source pertained to all courses of the department and the initial relationship was based on courses, then the third and the second alternatives would be used together. No key information would be coded in columns 14 through 29 since the costing source will be apportioned first to all courses on the FACULTY-FILE, not just a subset of courses. The set of apportioning procedure percentage weights selected for use with the FACULTY-FILE would be designated by one of the following numbers coded in column 11: 6, 7, 8, 9, or 0. The number 0 corresponds to the number 10. Once the costing source is apportioned to all courses on the FACULTY-FILE, the amount apportioned to each course is apportioned further to all enrollments in each course as discussed previously for the second alternative.

Finally, a costing source which pertained to all departmental enrollments on the basis of enrollment would be designated by a number from 6 to 0 coded in column 13. Again, no key information would be coded in columns 14 through 29 since the costing source would pertain to all enrollments.

The costs entered on each COST-SOURCE-FILE record are apportioned either to the FACULTY-FILE and then to the STUDENT-FILE, or only to the STUDENT-FILE depending on the apportioning procedure codes selected. Irrespective of the apportioning procedure codes utilized, each costing source ultimately flows to some or all of the enrollment records of the STUDENT-FILE. The apportioned amount of cost which reaches an individual enrollment record is added to any cost which may have been previously apportioned to that record for the particular iteration.

When all of the records of the COST-SOURCE-FILE have been processed, P4 outputs selected data fields from the STUDENT-FILE to the STD-COST-FILE. Initially, P4 outputs a header record which contains the iteration number and date.

Next, P4 outputs the following fields located on each enrollment record: the student major code, the student level code, the credit hours field associated with the enrollment, and the cost data field accumulated for the enrollment. P4 modifies the student level code to each STD-COST-FILE data record. P4 combines freshman and sophomore level codes into one code, 1L. Junior and senior level codes are combined into the code, 2U. Masters and doctoral level codes are output as 3M and 4D respectively. The numeric prefix assures an ascending sequence on student level within student major for subsequent sorting in JP5A and JP5B.

Program P4 outputs and DEPARTMENT COST & APPORTIONING REPORT which documents the costing process for each iteration. This report is used in conjunction with the reports output by P5 and P6 for the purpose of analysis.

JP5A and JP5B

Jobs JP5A and JP5B are essentially identical. (See Figure 5, page 190.) Their purpose is to sort the STD-COST-FILE from JP4, combine and sum subsets of records from the sorted STD-COST-FILE, and output the combined and summed subsets as distinct record entries on the SENSITIVITY-DATA-FILE. (See Appendix B.)

In addition to a header record, the STD-COST-FILE contains a data record for every record on the STUDENT-FILE. All records after the header record correspond to one enrollment in the department by student major and student level. Each contains the credit hours associated with the enrollment. These records also contain the total of all costs apportioned to them. Since students of various majors and levels are enrolled in the department, many of the records on the STD-COST-FILE will have identical entries in the student major and level fields.

Jobs JP5A and JP5B sort the STD-COST-FILE. The header record sorts first followed in ascending sequence by data records grouped on the basis of student major and level. Programs P5A and P5B simply combine all data records of similar student major and level, sum the credit hours and apportioned costs associated with each, and output these data to the SENSITIVITY-DATA-FILE.

The first iteration of the STD-COST-FILE from JP4 must be submitted to JP5A. Job JP5A creates the SENSITIVITY-DATA-FILE. When the header record of the STD-COST-FILE is processed by P5A, a header record for the SENSITIVITY-DATA-FILE is created which contains ten pairs of iteration identification fields. P5A enters the iteration number and date from the STD-COST-FILE header record in the corresponding iteration identification field on the SENSITIVITY-DATA-FILE header record. All subsequent summed credit hours and costs for each distinct student major and level combination are entered in this same field on subsequent SENSITIVITY-DATA-FILE data records. Each distinct student major and level combination is associated with a distinct SENSITIVITY-DATA-FILE data record, and P5A writes the student major and level in columns

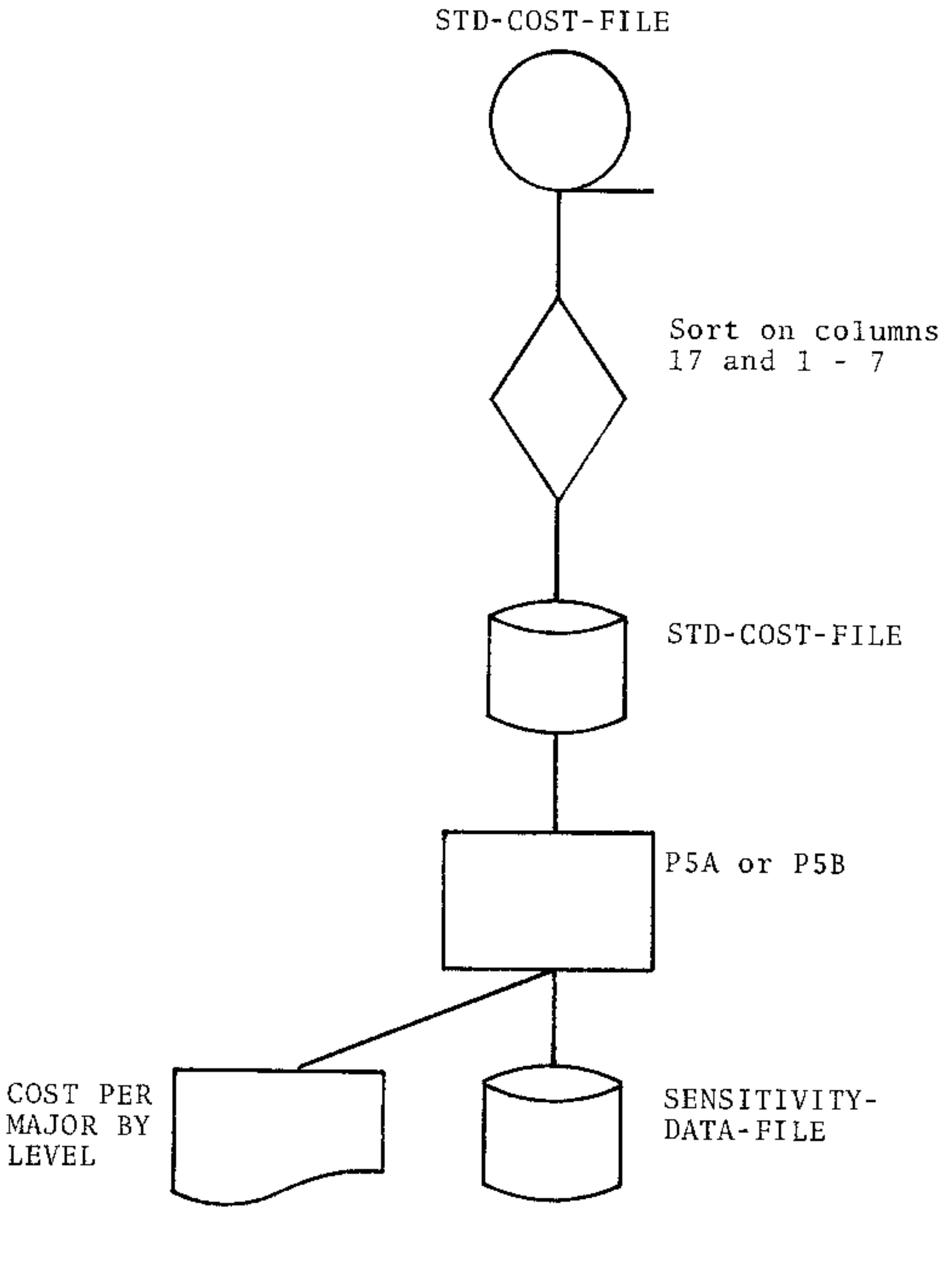

Fig. 5--JP5A and JP5B Flowchart

2 through 8 of each record. All other fields on each record are zeroed out.

When JP5A is successfully run, the SENSITIVITY-DATA-FILE is created. This file contains one header record with all iteration identification fields zeroed out except one which corresponds to the iteration and date input to JP5A. All other data records on this file contain a unique student major and level code plus summed hours and costs for that major and level which are entered in the same fields as are the iteration number and date on the header record. All other cost fields on data records after the header record are zeroed out.

Subsequent STD-COST-FILEs created by JP4, identified by unique iteration numbers and dates, are submitted to JP5B. The same procedure as described for JP5A takes place except that the SENSITIVITY-DATA-FILE already exists and requires updating rather than creation. The iteration number associated with each STD-COST-FILE input to JP5B simply designates one of the remaining iteration identification fields on the SENSITIVITY-DATA-FILE header record. All costs and hours for each student major and level combination for that iteration are entered in the corresponding fields on subsequent data records in the file.

Job JP4 may be executed up to ten times to create as many as ten costing studies. The output from the first execution of JP4 is submitted to JP5A. The remaining executions of JP4 are submitted to JP5B. When this process is complete, the SENSITIVITY-DATA-FILE should contain a minimum of two costing iterations and a maximum of ten. The SENSITIVITY-DATA-FILE is ready to be accessed by the sensitivity analysis job, JP6.

Programs P5A and P5B output the COSTS PER MAJOR BY LEVEL report which documents the particular iteration input to the SENSITIVITY-DATA-FILE. This report serves to verify the accuracy of the SENSITIVITY-REPORT.

JP6

The purpose of job JP6 is to compute and display a sensitivity test for any two costing iterations resident on the SENSITIVITY-DATA-FILE. (See Figure 6, page 193.) For meaningful analysis a minimum of two costing iterations must be on the file because costs associated with each student major and level combination of one iteration are divided by the corresponding costs for each student major and level combination of another iteration. Up to ten iterations may be prepared and entered on the SENSITIVITY-DATA-FILE by jobs JP4, JP5A, and JP5B.

A single SELECTION-FILE record is used for the purpose of selecting any two iterations for sensitivity analysis. (See Appendix B.) The numerator subscript must be a number from one to ten, and it denotes the iteration of costs to be located in the numerator of each ratio of the sensitivity test. Similarly, the denominator subscript must be a number from one to ten, and it denotes the iteration of costs to be located in the denominator of each ratio of the sensitivity test. The program places no restriction on the iterations selected for analysis as long as they are resident on the SENSITIVITY-DATA-FILE. If any student major and level ratio has zero costs in either the numerator or denominator, P6 simply bypasses computation for the ratio and inserts asterisks in place of the quotient.

Initially, the SENSITIVITY-REPORT documents the two iterations selected for analysis by displaying the iteration numbers in ratio form along with the dates they were created. Next, the costs associated with each corresponding student major and level combination from the two iterations are

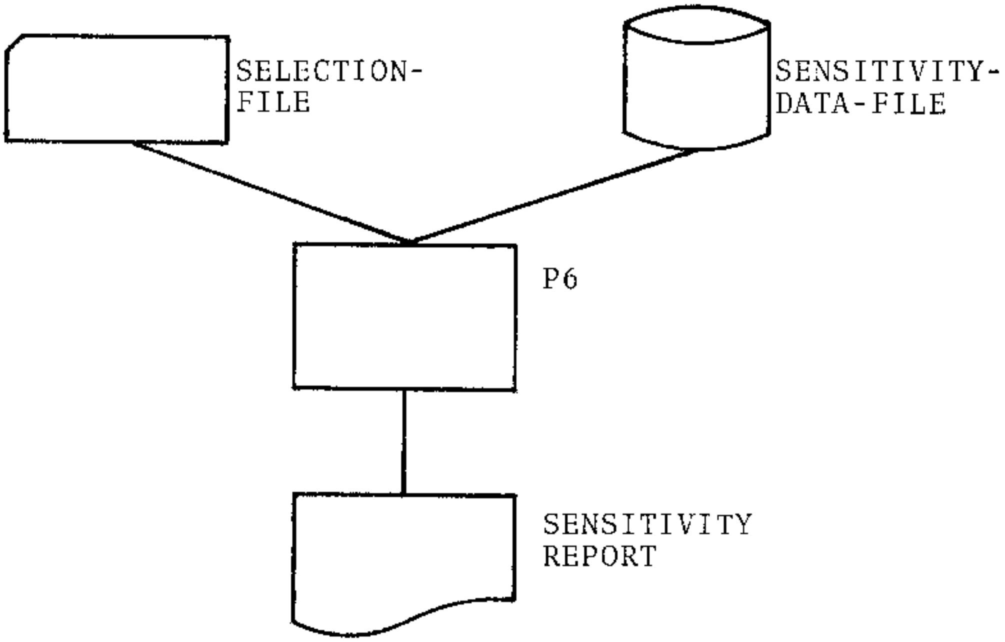

Fig. 6--JP6 Flowchart

displayed as ratios along with the number of credit hours for each and the resulting quotient. Finally, the total costs associated with each iteration along with the total number of hours are displayed and a final quotient is computed. If each iteration has had the same amount of costs apportioned to it, then the resulting quotient should be 1.00000.

System Summary

The prototype modeling system designed in this study meets the system specifications established in Chapter II and Chapter III. The basic costing concept adopted is cost analysis. A highly disaggregated costing level is attained at the course level. The costing process adopted in this system concerns only commensurables; that is, only credit hour costs are computed. The prototype system is based on a highly disaggregated subset of a standard institutional Induced Course Load Matrix which is the heart of RRPM 1.6 as developed by NCHEMS, and is consistent with the management information system approach they espouse. The computation of credit hour costs in this study assumes the generation of credit hours to be the basic educational purpose. Finally, four alternative apportioning hierarchies are provided by the FACULTY-FILE and the STUDENT-FILE.

CHAPTER V

SYSTEM EXECUTION

Introduction

The purpose of this chapter is to respond to Exploratory Question 4, which concerns the sensitivity of costs to selected costing sources and apportioning procedures. The main thrust of this research is the development of a prototype modeling system, and the ability of the system to meet its specifications may be verified by its selective application. No attempt is made to simulate all costing sources or all apportioning procedures because the variations on both are unlimited. In this regard, not all of the system's flexibility is exercised by the applications presented in this chapter.

This chapter is divided into five following sections. The first section contains a brief profile of the department in which the system was tested. The second section contains a discussion of two representations of the department used in this study. One representation reflects departmental enrollment as of the twelfth class day, the State reporting date; the other reflects enrollment as of the end of the semester. Each representation will subsequently be referred to as a data base. The third section contains a discussion of selected sets of apportioning procedures (system parameters). The fourth section contains a discussion of selected costing sources (system variables), the apportioning procedures with which they are combined, and subsequent sensitivity tests. The fifth section concludes this chapter, and contains a summary of the operation of the prototype modeling system.

Department Profile

The department in which the prototype modeling system was tested was one of the smaller Arts and Sciences departments in terms of student enrollment. This department offered undergraduate and graduate courses during the 1973-74 academic year. Undergraduate offerings were intended to provide minors for other degree programs. Graduate offerings were intended to lead to degrees in the department as well as to provide graduate minors for other degrees.

The department's faculty dropped from seven members to five during the academic year. In the fall term, seven faculty members were employed including the department chairman. Five of the seven were employed in the spring term. In the reports located in Appendix D, faculty names have been replaced by alphabetic characters to provide anonymity. The seven names are designated by the letters A through G. Faculty members D and F were not employed in the spring. The letter A denotes the department chairman.

Two Representations of the Department

The representation of departmental enrollment has only received incidental discussion up to this point. As documented in Chapter III, little mention is found in the literature of specific points in time on which cost study enrollments are based. One reference which did discuss enrollment considered the question of dropouts to be of no consequence (1, p. 17).

In order to probe the question of dropouts, the prototype modeling system is designed to accommodate different department enrollment representations or data bases. While the actual computer program coding establishes the structure of this prototype modeling system, the FACULTY-FILE and the STUDENT-FILE constitute the data base upon which costing sources and apportioning procedures can be modeled. The official departmental enrollment at various points during a semester represents different data bases if some students have dropped courses.

Two data bases are used in this study. One data base reflects departmental enrollment as of the twelfth class day of each semester, the date at which official enrollment is reported in Texas. This departmental enrollment is found in the DEPARTMENT ENROLLMENT REPORT, dated 04/18/77, in Appendix D. The second data base reflects departmental enrollment as of the last day of each semester; consequently, those students who dropped out are excluded. The DEPARTMENT ENROLLMENT

REPORT, dated 06/07/77, in Appendix D shows enrollment as of the final day in each semester.

In the DEPARTMENT ENROLLMENT REPORT, each course is listed by its unique identification: department, course, section, and hours. The name of the faculty member and the semester-year code are on the same line as the course identification. Subsequent report lines for each course display unique student major code and level combinations and the number of enrollments in each unique combination. The name ABCD has been assigned to the department listed in the report.

A Discussion of Selected Apportioning Procedures

Six sets of apportioning procedures have been selected to demonstrate the capabilities of the system. Two sets of procedures pertain to the FACULTY-FILE and are based on the first apportioning alternative. Two sets of apportioning procedures pertain to the STUDENT-FILE and are based on the second alternative. The last two sets of procedures also pertain to the STUDENT-FILE and are based on the fourth alternative.

In a meeting with the department chairman concerning departmental costing, two relationships were discussed which could affect a cost study. First, graduate courses with section numbers from 700 to 799 differed from conventionally organized courses in that they represented individual instruction. In terms of faculty load, five individual instruction graduate students equated to one conventional course. Sometimes only one student might be enrolled in an individual instruction section; at other times more than one student might be enrolled. To accommodate this relationship, a set of apportioning procedure weights was developed using the blanket option followed by the individual option in the APPORTION-FILE. Initially in JP2, all FACULTY-FILE records received a common weight of 020. In record type 100, FACB100 was coded in columns 1 through 7 and 1 was coded in column 9 so that weights would be entered in columns 32 and 33 of the FACULTY-FILE. The selection criterion RANK was coded in columns 10 through 13. In record type 105, columns 11 through 14 were left blank. The number 9999 was coded in columns 15 through 18, and 020 was coded in columns 19 through 21. This coding scheme placed 020 in columns 32 and 33 of every FACULTY-FILE record. Next, JP2 was executed again and the individual option was selected by coding FACI100 in columns 1 through 7 and 1 in column 9. Individual type 105 records followed for each section in the 700 to 799 range. Graduate courses received weights based on the relationship of five enrollments equaling one conventional course. Other courses in the 700 to 799 range received weights which equaled the enrollment in each course.

The second set of apportioning procedure weights was entered in columns 34 through 35 of the FACULTY-FILE and was similar to the first set. Again the blanket option was used followed by the individual option. The only difference was that senior level courses received a weight of 040 while all other organized courses received a weight of 020. Using the blanket option, FACB100 was coded in columns 1 through 7 and 2CSE was coded in columns 9 through 12. Since senior level courses are numbered in the 400 range, a single type 105 record was coded such that all courses below 400 and above 499 were weighted with 020 and the rest were weighted with 040. The indivudual option was then selected. The type 100 record was identical to the one used in the first set except that column 9 was changed from 1 to 2 so that the accompanying weights on the type 105 records would be entered in columns 34 and 35 of the FACULTY-FILE. The type 105 records were the same as used in the first set.

The second relationship which could affect a costing study had to do with special requirements affecting some students. Generally, additional attention was given to graduate students enrolled for graduate credit in undergraduate courses. Additional attention could translate into additional costs apportioned to those students if faculty effort was considered as a basis for apportioning costs. In light of this second relationship, two sets of apportioning procedures pertaining to the STUDENT-FILE were developed. Since these procedures concerned enrollments within courses, they were based on the second apportioning alternative.

One set of apportioning procedure weights was coded to weight equally all enrollments in each course. The blanket option was used. A type 100 APPORTION-FILE record was coded with STDB100 in columns 1 through 7 and 1RANK in columns 9 through 13. A single type 105 record followed which was coded with blanks in columns 11 through 14, 9999 in columns 15 through 18, and 020 in columns 19 through 21. This weighting scheme entered a weight of 020 in columns 32 and 33 of every STUDENT-FILE record.

To account for the additional attention often given to graduate students enrolled in undergraduate courses, another set of apportioning procedure weights was developed to weight these enrollments twice as much as all others. The same blanket option was used as in the previous set of procedures which pertained to the STUDENT-FILE except that 2 was coded in column 9 of the type 100 record. This change resulted in the weight of 020 being entered in columns 34 and 35 of every STUDENT-FILE record. The individual option was then chosen to enter the weight 040 in every graduate enrollment record in an undergraduate course. They type 100 record was coded with STDI100 in the first seven columns and a 2 in column 9. Individual type 105 records followed with specific keys to identify enrollments to be weighted with 040.

The fifth and sixth sets of apportioning procedure weights concerned all enrollments in the department and were based on the fourth apportioning alternative. This alternative called for apportioning costs to all enrollments in the department on a departmental basis. The fifth set simply represented a scheme for considering all enrollments on an equal basis, and was similar to the third set except that weights were entered in columns 42 and 43 of every STUDENT-FILE record. Card column 9 of record type 100 was coded with a 6 to accommodate the change.

The sixth set of apportioning procedure weights was intended to implement the assumption often found in cost studies that more costs should be apportioned to higher level students than to lower level students. Consequently, a scheme was devised to weight all enrollments in freshman and sophomore courses with 020. All enrollments in junior and senior courses were weighted with 040, and all enrollments in graduate courses were weighted with 060. The blanket option was used to accommodate this scheme. Again, STDB100 was coded in columns 1 through 7 of the type 100 record. The number 7 was coded in column 9 so that the following weights would be entered in columns 44 and 45 of the STUDENT-FILE. Since weights were to be entered on the basis of course number, CSE was coded in columns 10 through 12 of the type 100 record.

A single type 105 record was then coded. Since freshman and sophomore courses are numbered in the ranges of 100 to 199 and 200 to 299 respectively, columns 11 through 14 on the type 105 record were left blank, 2999 was coded in columns 15 through 18, and 020 was coded in columns 19 through 21. Junior and senior courses are numbered in the ranges of 300 to 399 and 400 to 499 respectively. Corresponding coding, therefore, consisted of 3000 being coded in columns 22 through 25, 4999 being coded in columns 26 through 29, and 040 being coded in columns 30 through 32. Graduate courses are numbered in the 500 and 600 ranges; therefore, 5000 was coded in columns 33 through 36, 9999 was coded in columns 37 through 40, and 060 was coded in columns 41 through 43. As described previously, range entries are considered alpha-numeric and should be left justified. The right-most digit in each range field, therefore, is superfluous when course numbers are three digits in length.

Selected Costing Sources, Apportioning Procedures, and Sensitivity Analysis

ITERATION 1 and ITERATION 2

The first iteration of costing sources and apportioning procedures selected for demonstrating the system is displayed in the DEPARTMENT COST & APPORTIONING REPORT, ITERATION 1, dated 06/06/77, and located in Appendix D. This report documents input to P4 through the COST-SOURCE-FILE. On the DEPARTMENT COST & APPORTIONING REPORT, the locations of the apportioning subscripts verify that procedures based upon the first and second apportioning alternatives have been selected; that is, the four columns located under APPORTIONING SUB-SCRIPTS and denoted by the four printed combinations of dash symbols correspond to the four apportioning alternatives. The left-most column denotes the five fields located on the

FACULTY-FILE which correspond to the first apportioning alternative. The actual subscript denotes which particular field, in this case the first field. Subscripts 1 through 5 are acceptable in this column. The next column to the right under APPORTIONING SUBSCRIPTS denotes the five fields located on the FACULTY-FILE which correspond to the third apportioning alternative. Subscripts 6 through 0 are acceptable in this column. If subscript 0 is used, 10 is actually printed on the report since 0 corresponds to the tenth field on the FACULTY-FILE.

The second column from the right under APPORTIONING SUBSCRIPTS denotes the five fields located on the STUDENT-FILE which correspond to the second apportioning alternative. As with the FACULTY-FILE, subscripts 1 through 5 denote which of the five fields is selected. The right-most column under APPORTIONING SUBSCRIPTS denotes the five fields on the STUDENT-FILE which correspond to the fourth apportioning alternative. Again, subscripts 6 through 0 are acceptable in this column, with 10 being printed if 0 is used.

Only faculty salaries were used as costing sources in ITERATION 1, and they totaled $49,048.00 for the academic year. Of the seven faculty members in the fall, only five returned to teach in the spring. Faculty members A, B, and C were full-time faculty for the academic year and represented three full-time equivalents (FTEs). Faculty member A was a professor, B was an assistant professor, and C was an instructor. Other faculty members were not full-time and were of lesser rank. Taken in sum the other faculty members constituted less than one FTE for the academic year.

The left-most subscript under APPORTIONING SUBSCRIPTS, by its position, denotes the use of the first apportioning alternative. The actual subscript, 1, denotes the set of apportioning procedure weights originally entered in columns 32 and 33 of the FACULTY-FILE, that apportioning procedure which equated five graduate individual instruction enrollments to one organized class. This procedure apportioned the salary of each faculty member directly to his or her courses.

Once the salaries of each faculty member were apportioned to their courses, further apportioning within each course down to individual enrollments took place. Apportioning within each course, based on the second apportioning alternative is denoted by subscripts located in the third column from the left under APPORTIONING SUBSCRIPTS. The actual subscript, 1, denotes the set of apportioning procedure weights originally entered in columns 32 and 33 of the STUDENT-FILE, that apportioning procedure which weighted equally all enrollments in each course.

Input for ITERATION 1, through the COST-SOURCE-FILE, consisted of one record for each faculty member for each semester. The semester salary was coded in columns 1 through 9 of the COST-SOURCE-FILE record. (See Appendix B.) The apportioning subscript 1 was coded in columns 10 and 12 of each record. Since the first apportioning alternative was selected, each record in this file required the coding of a key denoted by the semester-year code in columns 14 through 16 and faculty identifier in columns 17 through 26. As discussed earlier, faculty names were replaced with a single alphabetic character, which was entered in column 17. The key information on each COST-SOURCE-FILE record is listed in the DEPARTMENT COST & APPORTIONING REPORT under the heading APPORTIONING KEYS. The primary and secondary sources of funds listed in the report were taken directly from the fields located from columns 30 through 44 and 45 through 59 respectively on each input record.

The iteration number 1 in this case was coded as 01 on a single record read by P4 through the SYSIN data set. This iteration, the costing sources (system variables) and apportioning procedures (system parameters), was input to the modeling system using the data base which reflected enrollment as of the twelfth class day.

ITERATION 2, dated 06/06/77, was similar to ITERATION 1. (See Appendix D.) The same costing sources were used as in the previous iteration; however, one of the two sets of apportioning procedures was different. Again, procedures based on the first and second apportioning alternatives were used; however, this time salaries were apportioned initially to courses based on weights originally entered in columns 34 and 35 of the FACULTY-FILE. This set of apportioning procedures was similar to the set entered in columns 32 and 33 except that senior level courses received weights of 040, while other organized courses received weights of 020. ITERATION 2 was similar to ITERATION 1 in all other respects.

In addition to the DEPARTMENT COST & APPORTIONING REPORT, JP4 also writes the STD-COST-FILE to tape which is suitable for input to either JP5A or JP5B. The STD-COST-FILE contains a header record in which the iteration number and run date are entered, and a data record for every STUDENT-FILE record. Data records contain student major and level information as well as the sum of all costs eventually apportioned to each STUDENT-FILE record for the iteration.

The STD-COST-FILE containing ITERATION 1 was submitted to JP5A. JP5A sorted the STD-COST-FILE, combined and summed subsets of STD-COST-FILE records for each student major and level combination, and wrote the combined and summed subsets as distinct records on the SENSITIVITY-DATA-FILE. In addition JP5A produced the COSTS PER MAJOR BY LEVEL report, which documented record entries on the SENSITIVITY-DATA-FILE for the iteration. The COSTS PER MAJOR BY LEVEL report for ITERATION 1 is dated 06/06/77. (See Appendix D.) In the report each line corresponds to a record entry on the SENSITIVITY-DATA-FILE, and contains the total number of all hours for, and the sum of all costs apportioned to, all STUDENT-FILE records of each student major and level combination. The final entry in the report contains the total number of hours associated with a particular STUDENT-FILE or data base, and the total of all costs apportioned for the iteration. Of course, the total costs should be identical to those found in the DEPARTMENT COST & APPORTIONING REPORT for each iteration.

The STD-COST-FILE containing ITERATION 2 was submitted to JP5B which performed essentially the same function as JP5A except that it updated the SENSITIVITY-DATA-FILE. JP5B also produced a COSTS PER MAJOR BY LEVEL report for ITERATION 2, dated 06/06/77. This report documents entries on the SENSITIVITY-DATA-FILE made for ITERATION 2.

The SENSITIVITY-DATA-FILE was submitted to JP6 to compute and display a sensitivity test for the first and second iterations. The purpose of this test was to examine the sensitivity of ITERATION 1 to a slight modification in one set of apportioning procedures represented by ITERATION 2. The SENSITIVITY REPORT, dated 06/06/77, and displaying the ratio relationship of ITERATION 1 to ITERATION 2 displays this sensitivity test. (See Appendix D.)

To understand a sensitivity test, the SENSITIVITY REPORT must be studied along with the DEPARTMENT ENROLLMENT REPORT and the DEPARTMENT COST & APPORTIONING REPORT for each iteration. The sensitivity test for ITERATION 1 and ITERATION 2 shows that while costs for some student major and level combinations remain unchanged, others vary by hundreds of dollars.

Some student major and level combinations were completely unaffected by the modification to the second set of apportioning procedures entered on the FACULTY-FILE which doubled the weights for senior level courses. For example, on the DEPARTMENT ENROLLMENT REPORT, dated 04/18/77, in Appendix D, instructor F taught only one course, ABCD 101 001 03. This was a freshman level course and was completely unaffected by the change in the second set of apportioning procedures, since instructor F's salary was entirely apportioned to this course in both iterations. Those student major and level combinations which consisted entirely of enrollments in this course consequently received the same amount of apportioned costs in each iteration. The student major and level combination 10138 1L is an example of this situation. (See Appendix D.) This combination consists entirely of one three hour enrollment in ABCD 101 001 03.

Other student major and level combinations with sensitivity ratios greater than 1.0 indicate a reduction in apportioned costs from ITERATION 1 to ITERATION 2. An example of this situation is the student major and level combination 10103 1L. This single three hour enrollment was in a lower level course taught by instructor B. Instructor B, however, taught some 400 level courses that same semester, and in ITERATION 2 the 400 level courses received more of his salary than did the lower level course as compared with the amounts they received in ITERATION 1. Consequently, the student major and level combination 10103 1L received less of instructor B's salary in ITERATION 2 than in ITERATION 1. The exact amounts of salary are shown in the ratio in the COSTS column, and the impact on this student major and level combination of the change in apportioning procedures is represented by the resultant quotient in the SENSITIVITY column.

Student major and level combinations with sensitivity ratios less than 1.0 indicate an increase in apportioned costs from ITERATION 1 to ITERATION 2. An example which is more difficult to track is the combination 10143 2U. This combination was made up of a number of enrollments spread over many courses and totaling 112 credit hours, as can be seen on the DEPARTMENT ENROLLMENT REPORT, dated 04/18/77 in Appendix D. Some enrollments in this combination received more apportioned costs in ITERATION 1 than in ITERATION 2, and others received less. Taken in sum, however, this combination received more apportioned costs in ITERATION 2 than in ITERATION 1, and two reasons account for this change. First, as previously discussed, those enrollments in 400 level courses received relatively more of the apportioned costs than those in courses of every other level in ITERATION 2. Second, the DEPARTMENT COST & APPORTIONING REPORT for both iterations, dated 06/06/77, shows that faculty member salaries vary greatly from one another. Faculty members who taught 400 level courses as well as courses in other levels, and whose salaries differed greatly from others, would provide greatly differing amounts of salaries to be apportioned to their respective courses. In ITERATION 2, higher salaried faculty members had greater amounts apportioned to their 400 level courses and less to all others than lower salaried members of the faculty who taught 400 level courses as well as courses in other levels.

The entry at the end of the SENSITIVITY-REPORT which compares ITERATION 1 with ITERATION 2 shows that the same data base was used with both iterations, 1188 hours, and that the same amount of costs was apportioned in each iteration, \$49,048.00.

This SENSITIVITY-REPORT is used to assess the impact of changes in system parameters (apportioning procedures) on cost study results. Each iteration represents a cost study. In this example system variables (costing sources) and the data base remained constant. The single parameter change of doubling the weight of 400 level courses caused costs in all 400 level courses to be amplified. The impact on some student major and level combinations was substantial, up to 18 percent, while the impact on other student major and level combinations was nonexistent. The argument may be advanced, however, that the parameter change modeled in this SENSITIVITY REPORT is sensitive to course level distinction for the two reasons mentioned above.

ITERATION 3 and ITERATION 4

The third iteration of costing sources and apportioning procedures selected for system demonstration is displayed in the DEPARTMENT COST & APPORTIONING REPORT, ITERATION 3, dated 06/06/77, and located in Appendix D. In this iteration direct department faculty salaries were slightly changed from those contained in the first two iterations, indirect department costs were included and indirect college level costs were included. The faculty salary modification concerned the chairperson's salary and it was split in half; one-half for each semester remained as faculty salary and was labeled .5 CHRMN SAL DIRECT, and one-half from each semester was combined in an academic year cost and was labeled .5 CHRMN SAL INDIRECT. This procedure is common in cost studies.

All direct department level costs were apportioned initially to individual courses. The first apportioning alternative was used and the subscript 2 denotes weights originally entered in columns 34 and 35 of the FACULTY-FILE. Next, these costs were apportioned further to individual STUDENT-FILE records using the second apportioning alternative, and the subscript 2 denotes the set of apportioning weights originally entered in columns 34 and 35 of the STUDENT-FILE. These STUDENT-FILE apportioning procedure weights were similar to the set of STUDENT-FILE weights used with the first two iterations except that graduate student enrollments in undergraduate courses received twice as much weight as all other enrollments.

Indirect costs in ITERATION 3 were apportioned on the basis of the fourth apportioning alternative which concerns all enrollments on a departmental basis. Here all enrollments in the department are considered as one group. The subscript 6 denotes those apportioning procedure weights, originally entered in columns 42 and 43 of the STUDENT-FILE, which weighted all enrollments equally.

Indirect departmental costs in ITERATION 3 included one-half of the department chairperson's academic year salary as previously discussed, total maintenance and operation costs budgeted to the department and labeled TOTAL DPT M&O INDIRECT, and contract salaries and wages budgeted to the department and labeled DPT CT SAL & WG INDIRECT (2, p. B-39).

Indirect college level costs for ITERATION 3 were taken as a percentage of the total budget for the office of the Dean of Arts and Sciences. This entry is labeled % A&S DEANS OFC INDIRECT. The actual cost amount, $1,308.12, was derived from the total budgeted amount for the Dean's office, $81,130.00 (2, p. B-104). The RRPM 1.6 study conducted on campus for the 1973-1974 academic year served as the basis for determining the percentage of the Dean's costs to be apportioned to the department (3). In the RRPM 1.6 study, total departmental costs were $111,034.00 (3, p. 13), and total costs for the college were $6,886,337.00 (3, p. 57). Departmental costs amounted to 1.61237 percent of college costs which was $1,308.12 of $81,130.00. Total costs for ITERATION 3 were $70,269.12. (See Appendix D.)

ITERATION 4 was identical to ITERATION 3 except that the cost amount for the office of the Dean of Arts and Sciences was apportioned differently. In the fourth iteration this amount was apportioned on the basis of weights originally entered in columns 44 and 45 of the STUDENT-FILE. This set of apportioning procedure weights was based on the assumption that more costs should be apportioned to higher level students. Corresponingly, lower level enrollments received weights of 020, upper level enrollments received weights of 040, and graduate enrollments received weights of 060.

ITERATION 3 and ITERATION 4 were run on the data base which reflected enrollment as of the twelfth class day. This data base is portrayed in the DEPARTMENT ENROLLMENT REPORT, dated 04/18/77. The final entry in the SENSITIVITY REPORT, dated 06/07/77, which compares ITERATION 3 with ITERATION 4 confirms that the same data base was used for both, 1,188 hours, and that equal costs were apportioned to both iterations, $70,269.12.

Examination of the SENSITIVITY REPORT for ITERATION 3 and ITERATION 4 shows the effect of weighting student enrollments on the basis of level. Of the total amount apportioned in both iterations, $70,269.12, only $1,308.12 was apportioned differently between the iterations. However, every student major and level combination in one iteration received an amount different from the corresponding amount apportioned in the other iteration. Also, a department-wide trend is evident with the student major codes. Major codes beginning with a 1 or a 2 signify bachelor level students; major codes beginning with a 4 or a 5 signify master's level students; major codes beginning with a 7 signify doctoral level students. Major codes beginning with a 9 are unknown, and those beginning with an 8 do not correspond to a degree level. Of course, major codes do not correspond directly with course level enrollments; however, it is reasonable to expect bachelor level students to be primarily enrolled in bachelor level course work. In like manner, most master's level student majors would be expected to enroll in master's level course work, and the same would be expected for doctoral level majors and courses. The comparison of ITERATION 3 with ITERATION 4 verifys this trend. Student major codes beginning with a 1 or a 2, with only three exceptions, show less cost apportioned to them in ITERATION 4 than in ITERATION 3. All ratios, except three, are greater than 1.0. This phenomenon is not inconsistent with the understanding that less cost was apportioned to lower level courses in ITERATION 4. As might be expected, the trend reverses itself with master's level major codes, the codes beginning with a 4 or a 5. Most of these student major codes show more costs being apportioned to them in ITERATION 4 than in ITERATION 3, and the same is true for doctoral level major codes. Examination of the DEPARTMENT

ENROLLMENT REPORT, dated 04/18/77, confirms the correspondence between the levels of student majors and course level enrollments.

This SENSITIVITY REPORT is used to assess the impact of changes in system parameters (apportioning procedures), related to college level costing sources, on cost study results. Again, system variables (costing sources) and the data base remained constant. The single parameter change previously discussed did impact every student major and level combination; however, the magnitude of the impact was slight. Each student major and level combination varied less than 2 percent from one iteration to the other. No doubt the small amount of cost, free to vary from ITERATION 3 to ITERATION 4, mitigated against any sizable cost excursions. This sensitivity test does confirm the common contention found in the literature that faculty salaries exert the major influence on unit costs. The possibility exists that the parameter change modeled in this sensitivity test would show definite sensitivity if paired with costing sources of greater magnitude; however, in this test, although a definite trend existed, the parameter change showed negligible sensitivity to changes in student level.

ITERATION 5 and ITERATION 6

The fifth iteration of costing sources and apportioning procedures selected for system demonstration is displayed in the DEPARTMENT COST & APPORTIONING REPORT, ITERATION 5, dated 06/07/77, and located in Appendix D. In this iteration costing sources and apportioning procedures down through the entry for the office of the Dean of Arts and Sciences, % A&S DEANS OFC INDIRECT, are identical to those in ITERATION 4. Additional costing sources selected for use in this iteration were considered indirect institutional level costing sources, and came from the offices of the President, Vice President for Academic Affairs, and the Dean of the Graduate School, plus the library. Each of these four institutional level units was budgeted funds for wages and salaries (W&S) and maintenance and operation (M&O). Each of these four institutional level units, therefore, represented two sources of costs. For example, a percentage of the funds budgeted to the President's office for maintenance and operation was included in ITERATION 5 as an indirect cost labeled PRSDNT OFC M&O INDIRECT. Similarly, a percentage of the funds budgeted to the President's office for wages and salaries was included in ITERATION 5 as an indirect cost labeled PRSDNT W&S INDIRECT.

The indirect institutional level costs for maintenance and operation were derived from local references (2, 3). The procedure for computing the percentage of the total for each institutional level unit to be included in ITERATION 5 was similar to the procedure used in ITERATION 4. The RRPM 1.6 study showed that total maintenance and operation costs for the department were $52,001.00 (3, p. 13). Total institutional maintenance and operation costs were $1,281,285.00 (3, p. 93). Departmental maintenance and operation costs constituted 4.0585 percent of institutional maintenance and operation costs. To compute the amount of M&O costs included in ITERATION 5 from the four indirect institutional level costing sources, each of their total budgeted amounts for M&O was multiplied by .040585 and the results were input to JP4 as documented by the DEPARTMENT COST & APPORTIONING REPORT for ITERATION 5. The total amounts of budgeted M&O funds for each of these four institutional level units were derived from the "1973-74 Budget, North Texas State University" (2, pp. B-3, B-7, B-103, B-125).

A similar procedure pertained to the computation of wage and salary costs included from each of the four institutional level units. In ITERATION 5 the percentage of department FTE faculty to institutional FTE faculty was used as the fraction for determining the amount of W&S costs to be included for this iteration from each of the institutional level costing sources. Department FTE was 3.21 (3, p. 13); institutional FTE was 801.02 (3, p. 93). The resulting percentage was 0.40073. The total amount of funds budgeted to each of these four institutional level units for wages and salaries was located in the 1973-1974 Budget, North Texas State University" (2, pp. B-3, B-7, B-103, B-125). The total amount of budgeted funds for wages and salaries for each of the institutional level units was multiplied by .0040073 to produce the amount of costs shown for each in the report.

All indirect college level and institutional level costs were apportioned on a departmental basis to individual enrollments using the set of apportioning procedure weights originally entered in columns 44 and 45 of the STUDENT-FILE, which weighted enrollments on a graduated basis by level as discussed in ITERATION 4. Other indirect and direct costs were apportioned as in ITERATION 4.

The total amount of costs apportioned in ITERATION 5 was $78,806.75. This amount was made up of institutional level, college level, and department level costs.

ITERATION 6 was identical to ITERATION 5 with regard to the sources of costs and apportioning procedures used within the department. The two iterations differed in that different amounts of institutional level costs for wages and salaries were used in each. The amounts of institutional level W&S costs to be included in ITERATION 6 were based on a percentage of total departmental faculty costs relative to total faculty costs for the institution, rather than on FTE as in ITERATION 5. Total departmental faculty salaries in the RRPM 1.6 study were $38,140.00 (3, p. 13). Total faculty salaries for the institution were $9,950,656.00 (3, p. 93). Department salaries represented 0.38329 percent of the total institutional faculty salaries. The total amount of budgeted funds for wages and salaries for each of the institutional level units was multiplied by .0038329 in ITERATION 6 to produce the amount of costs shown for each in the report. Since the costs for these units did not equal their respective costs in ITERATION 5, the total costs in each iteration differed. Total costs in ITERATION 6 were $78,633.83. (See Appendix D.)

The SENSITIVITY REPORT comparing ITERATION 5 and ITERATION 6 shows the effect of changes in institutional level costing sources to be negligible. Each student major and level combination received fewer of the apportioned costs in ITERATION 6 because there were fewer total costs for the iteration, and there were no changes in the apportioning procedures used as system parameters in each iteration. Although the same costing sources were used in both iterations, the amounts flowing to the department from four institutional level sources differed from one iteration to the other. The difference, in fact, resulted from the use of different apportioning procedures at the institutional level. In one iteration, faculty FTE was used; in the other iteration, total faculty salaries were used. Obviously, an individual department may receive costs from outside the department which differ from one iteration, or cost study, to another as a result of higher level apportioning procedures. The comparison of any two cost studies at the department level, therefore, need not assume that total costs will be the same even if identical costing sources are used.

The sensitivity test for the fifth and sixth iterations shows the cost study to be insensitive to changes in the amounts of institutional level costs apportioned to the department. Structurally, the two iterations were identical at the departmental level; the same apportioning procedures were used and the same data base was used. Although institutional level costs were sizable, the amounts eventually apportioned to the department were relatively small when compared to other costs included in both iterations. The small relative magnitude of these costs accounted for their negligible impact.

ITERATION 2 and ITERATION 7

The final example selected for demonstrating the prototype system's capability concerns a change in the data base itself. All previous iterations represented cost studies which pertained to enrollnents as of the twelfth class day in each semester, the date for official State reporting. The data based used with the first six iterations is shown in the DEPARTMENT ENROLLMENT REPORT, dated 04/18/77. (See Appendix D).

The actual enrollment in a department may change from day to day. Departmental enrollment at a semester's end may be quite different from that early in the semester. The review of literature in Chapter III, however, showed that little mention was made of actual enrollment representations.

Only Frisbee (1, p. 17) discussed this question of enrollment, and she considered the effects of dropouts to be of no consequence.

The prototype modeling system allows iterations applied to different data bases to be compared. Thus far the twelfth class day data base created originally in JP1 has been used exclusively. Apportioning procedure weights were entered on the FACULTY-FILE and the STUDENT-FILE in JP2. Once all of the sets of apportioning procedures were entered, both files were submitted to JP3 for the conversion of weights to percentages. Each of the previous six iterations originated in JP4 where each set of costing sources was read in and matched with existing sets of apportioning procedures to form six cost studies or iterations. Each iteration originating in JP4 was subsequently passed to JP5A or JP5B where it was entered on the SENSITIVITY-DATA-FILE.

The process of creating a new data base necessitates returning to JP1 and recreating all files except the SENSITIVITY-DATA-FILE. As discussed previously, the FACULTY-FILE and the STUDENT-FILE constitute the data base; therefore, JP1 was executed again using input files which reflected enrollment as of the end of each semester. The data base thus created is depicted in the DEPARTMENT ENROLLMENT REPORT, dated 06/07/77. (See Appendix D.) The total number of enrollments in this data base was 325 as opposed to 396 for the twelfth class day data base. This decrease represents the number of drops between the twelfth class day in each semester and the end of each semester.

A sensitivity test in which the effects of different data bases are to be modeled assumes commonality among costing sources, the amounts from those sources, and apportioning procedures. Since college and institutional level costing sources modeled in the third through the sixth iterations had negligible impacts on student major and level costs, they were excluded from consideration in this final sensitivity test. ITERATION 2 was selected as the basis of comparison for the different data bases. Consequently, the apportioning procedure weights used in ITERATION 2 were reentered in the new FACULTY-FILE and STUDENT-FILE. Both files were then resubmitted to JP3 for the conversion of weights to percentages. To maintain commonality with the second iteration, the same costing sources and their amounts were read into JP4 and were matched with the set of apportioning procedures previously entered in JP2. The resulting cost study was labeled ITERATION 7 and dated 06/08/77. (See Appendix D.) A comparison of the DEPARTMENT COST & APPORTIONING REPORT for both iterations confirms common apportioning procedures, costing sources, and cost amounts. From JP4, ITERATION 7 was submitted to JP5B via the STD-COST-FILE. JP5B did not recreate the SENSITIVITY-DATA-FILE; it added ITERATION 7 to the existing file. The preceding six iterations remained resident on the SENSITIVITY-DATA-FILE.

The COSTS PER MAJOR BY LEVEL report for ITERATION 7 confirms a different data base indeed. While the DEPARTMENT ENROLLMENT REPORT, dated 06/07/77, confirmed a reduction in the number of enrollments, the reduction in credit hours is shown in the COSTS PER MAJOR BY LEVEL report for ITERATION 7. The actual credit hours associated with enrollments which completed each semester dropped from 1,188 to 984. (See Appendix D.)

The SENSITIVITY REPORT in which the second and the seventh iterations are compared portrays the definite sensitivity of the cost study to a change in the data base. The final entry in the report confirms equal amounts of total costs and a resulting sensitivity quotient of 1.0; however, individual student major and level entries in the report show substantial excursions in their costs from one iteration to the other.

One characteristic of ITERATION 7, apparent in the SENSITIVITY REPORT, is that certain student major and level combinations did not complete their courses. For example, the first combination in the report, 10103 1L, was a single three hour enrollment that discontinued at some point after the twelfth class day. In the second iteration $70.58 was apportioned to this combination, while in the seventh iteration the combination did not exist. In cases where either the numerator or the denominator of the ratio is zero, P6 ceases that particular computation and inserts asterisks in the sensitivity column.

Another characteristic of ITERATION 7 is that not all of the remaining student major and level combinations received relatively more of the apportioned costs than they did in ITERATION 2. For example, the combination 13143 2U decreased from ten to eight hours and from $176.40 to $141.30. The reason for this situation was that the two hour enrollment which dropped was a single course enrollment with instructor C, ABCD 489 701 02 C 274. The other eight hours of enrollments in this student major and level combination were with other instructors whose courses experienced no change in the amounts apportioned to them and only slight change within courses. The slight increase in apportioned costs for the eight hours of this student major and level combination in ITERATION 7 did not equal the amount which had been apportioned to the other two hour enrollment in ITERATION 2. Consequently, the SENSITIVITY REPORT shows approximately 24 percent more costs associated with the combination in ITERATION 2 than in ITERATION 7.

A final characteristic of ITERATION 7 is the magnitude of the percentage change in some of the student major and level combinations. Excursions in apportioned costs exceeded 200 percent in the case of combination 20241 1L due in part to a dropout rate that cut hours from nineteen on the twelfth class days to seven by the end of both semesters. Again, the increase in costs apportioned to the seven hours remaining in

ITERATION 7 fell far short of equaling the amount of costs apportioned to the twelve hours in ITERATION 2.

The sensitivity test for ITERATION 2 and ITERATION 7 shows the cost study to be extremely sensitive to the modeled change in the data base. Large cost excursions of the type displayed in the report suggest that the enrollment representation, or data base, of a cost study may have a major influence on resultant costs. The assumption that dropouts would be of no consequence is not justified in this study.

Summary of System Operation

The prototype computer based modeling system developed in this study is based on design premises advanced in Chapter II and Chapter III. First, the system is based on the cost analysis concept. Other costing concepts considered in Chapter I were rejected for being too aggregative in nature and lacking consensus in terminology and application. Second, the individual course represents the disaggregated point of interface. Courses are the link between faculty members and course enrollments. The FACULTY-FILE and the STUDENT-FILE share the common course interface, and they constitute the system data base. Third, the system concerns only the commensurable unit costs. Fourth, department costs and student major costs computed by this system are consistent with costs computed by the more highly aggregated system, RRPM 1.6. Fifth, the unit cost measure used in this system is cost per semester credit hour. Sixth, this system assumes the basic educational purpose to be instruction--it does not address any other purpose--and it reduces instruction to credit hour generation. Seventh, this system yields cost information consistent with NCHEMS' approach. Student major and level cost information is derived from a disaggregated department level version of the ICLM. Finally, this system accommodates the concept of alternative apportioning hierarchies within a department. The four alternatives available in the system constitute a new variation on apportioning procedures, and serve to more clearly define the concept of apportioning procedures.

The prototype modeling system performs as proposed. The emphasis in this study is on sensitivity analysis, the comparison of any two cost studies. For Sheehan and Michaels (4) sensitivity analysis meant the sensitivity of a cost methodology to a selected change in it. Costs were originally computed for the methodology. A change was then made to the methodology and costs were recomputed. Recomputed costs were compared to the originally computed costs for the methodology prior to change. In effect two cost studies were performed in each sensitivity test: the unchanged methodology, and the methodology incorporating a change. Thus, for Sheehan and Michaels each sensitivity test concerned basically one cost study, the methodology, and its dependency on certain procedural steps which were changed and then analyzed by the use of a comparison cost study, the methodology incorporating a change.

The modeling system developed in this study provides for the comparison of any two cost studies which are resident on the SENSITIVITY-DATA-FILE. The actual selection of cost studies or iterations to be submitted for sensitivity analysis in this study followed the approach used by Sheehan and Michaels which was basically two similar cost studies that differed only in one characteristic at a time. Obviously, the more dissimilar two cost studies are, the more difficult the task will be to analyze the relationships between them.

Additionally, the prototype modeling system need not always be run completely through to sensitivity analysis. Jobs JP5A and JP5B can be selected as terminal points for system operation when it is simply desired to run multiple cost studies. Just because more than one cost study is performed does not mean that sensitivity analysis must follow.

Finally, the DEPARTMENT ENROLLMENT REPORT printed in JP1 may serve as a valuable supplementary tool for department administrators. The departmental data base is created in JP1 with the FACULTY-FILE and the STUDENT-FILE. These two files share courses as a point of interface. The DEPARTMENT ENROLLMENT REPORT displays this data base.

CHAPTER BIBLIOGRAPHY

1. Frisbee, Joan, "Analysis of Instructional Program Costs in a Small Liberal Arts College," unpublished doctoral dissertation, Department of Education, The University of Tennessee, Knoxville, Tennessee, 1970.

2. "1973-1974 Budget, North Texas State University," Denton, Texas, 1973.

3. Office of Institutional Analysis and Planning, North Texas State University, "Resource Requirements Prediction Model 1.6 (RRPM 1.6): Reports and Introductory Notes," Denton, Texas, 1974.

4. Sheehan, Bernard S. and Mervin G. Michaels, "Sensitivity Tests on a University Cost Study Methodology," Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

CHAPTER VI

IMPLICATIONS AND RECOMMENDATIONS

Preceding chapters have traced the development of this dissertation. The need for this type of study was established in Chapter I. The state of costing in higher education and the role of costing at the departmental level were described in Chapter II. Examples of cost studies were listed in Chapter III. Chapter IV focused on the design of the prototype system, and the system was demonstrated in Chapter V.

This study is developmental in nature, and, consequently, it adheres to few preconceived notions concerning format and logic. The format and resulting logic that now exists surfaced in their own reticular way. This chapter contains a brief review of the prototype modeling system, a discussion of implications drawn from the study, and recommendations resulting from the study. The direction for this chapter is provided by Exploratory Question 5 which concerns implications and recommendations.

Review of the Prototype Modeling System

The prototype modeling system developed in this study consists essentially of six computer jobs. Each job contains one or more job steps, but the primary step in each job is a computer program written in COBOL.

Job JP1 consists of program P1, other file maintenance job steps, and program P1A. The purpose of P1 is to access existing institutional interface files and produce the FACULTY-FILE and the STUDENT-FILE for subsequent system use. The FACULTY-FILE and the STUDENT-FILE constitute the system data base and together they tie faculty to student enrollments through the courses common to both. Program P1A is a simple report writer which displays the data base in report form, the DEPARTMENT ENROLLMENT REPORT.

Job JP2 provides the facility for entering one set of apportioning procedures at a time on either the FACULTY-FILE or the STUDENT-FILE. The structure of the data base is such that each file accommodates two separate apportioning alternatives: the first and third alternatives for the FACULTY-FILE and the second and fourth alternatives for the STUDENT-FILE. Each alternative is designated by five groups of two-byte fields on both files. A total of twenty sets of apportioning procedures, therefore, may be entered in the data base: ten on the FACULTY-FILE and ten on the STUDENT-FILE. Since only one set of apportioning procedures may be entered at a time, JP2 must be executed once for each set of apportioning procedures to be used.

The purpose of the third computer job, JP3, is to convert each set of apportioning procedure weights to percentages so that 100 percent of each costing source is apportioned to the student enrollments. Essentially JP3 consists of two distinct sets of job control language (JCL), but the same program, P3, is used with each. JP3 converts one file at a time, either the FACULTY-FILE or the STUDENT-FILE. Since each file must be sorted differently, separate JCL is required. JP3 must be executed at least twice.

The actual costing process takes place in JP4. At this point a set of costing sources is read into P4 and is combined with a set of apportioning procedure weights resident in the data base to form one cost study or costing iteration. Up to ten iterations may be created and JP4 must be executed once for each iteration. P4 produces the STD-COST-FILE which contains each costing iteration, and the DEPARTMENT COST & APPORTIONING REPORT which documents each costing iteration.

The purpose of jobs JP5A and JP5B is to sort the STD-COST-FILE from JP4, combine and sum subsets of its records, and write the combined and summed subsets as distinct record entries on the SENSITIVITY-DATA-FILE. The only difference between JP5A and JP5B is that the former is executed for the first costing iteration submitted, and it creates the SENSITIVITY-DATA-FILE. Each subsequent costing iteration is submitted to JP5B which updates the SENSITIVITY-DATA-FILE. JP5A is executed only once. JP5B may be executed up to nine additional times.

The combined and summed subsets of records from the STD-COST-FILE represent distinct record entries on the SENSITIVITY-DATA-FILE, and each entry corresponds to a unique student major and level combination. Documentation of the SENSITIVITY-DATA-FILE is provided by the COST PER MAJOR BY LEVEL report.

JP6 computes and displays a sensitivity test for any two costing iterations resident on the SENSITIVITY-DATA-FILE. Up to ten iterations may be on the file, and any two of them may be selected at one time for sensitivity testing.

Implications of the Relationship of Costing to Academic Quality

A number of questions were addressed in Chapter II which concerned the role of costing at the departmental level in higher education. Responses to those questions served to define the environment from which prototype system's specifications were formulated.

The literature reviewed in Chapter II confirmed that questions of accountability are often input-output in nature. Balderston was quoted: ". . . we are seeking now to link the resources used to the results achieved--in other words, to link inputs with outputs" (2, p. 11). The input-output, or black box approach, was shown to be rooted in economic theory (10, p. 93; 5, p. 19), and this theory suggests that as long as costs can be attached to input and output, actual costing does not require a detailed knowledge of a firm's operation.

Many authorities, however, criticize the use of an input-output approach with higher education. Brandl was of this view as he stated: ". . . economic theory has to do with maximization . . . of known objectives" (4, p. 86) and since higher education is typified by competing objectives, "Academic organization is, then, the institutional antithesis of the firm" (4, p. 87). In the firm, profit is usually the objective to be maximized. In higher education, however, the profit motive does not exist (8, p. 152).

Other criticisms in this same vein restrict the argument to the inability to define the end product of teaching. Specifically addressing cost-effectiveness analysis, Lovell saw the main problem in its application as being the inability to determine the final product of the teacher (14, p. 56).

Related criticisms focused on the value-added and the production function concepts in higher education. Lelong and Mann noted that the value-added concept was not adequately developed (13, p. 192). Miller noted that what contributes to a person's value-added might be the result of more than the formal academic experience (15, p. 108). Related to the value-added concept is the concept of production functions. Even if a cost study is restricted in scope to only the instructional process, the productivity of most faculty members is typified by joint production functions: they do more than teach. A good understanding of these functions and an acceptance of standard measures is lacking. Topping was explicit: "A good understanding of the production functions in the higher education process still does not exist" (22, p. 2).

The lack of common terminology and difficulties associated with the costing concepts themselves as well as the inherent high levels of aggregation forced the rejection of the cost-benefit, cost-effectiveness and cost-utility concepts from applicability in this study. Similar difficulties remained with a simple definition of cost and common acceptance of a cost analysis concept. Two leading authoritative sources in the field acknowledged the wide latitude which exists in cost definition (17, 22). Correspondingly, they recommended various approaches to meet local purposes. This view is supported by recent statements found in the literature. George Beatty, Associate Director of the Office of Budgeting and Institutional Studies at the University of Massachusetts, in a paper describing the use of cost information for decision making, wrote,

> Costs may be defined, and therefore computed, in a variety of ways according to the purpose for which information is required. It is therefore imperative that a clear definition of cost be established prior to selecting a costing methodology.
>
> For the purposes of this paper, a <u>cost</u> is defined as the value to an institution of the resources consumed in the delivery of a specific service, where the cost is determined in a specific manner and for a specific purpose. A <u>costing method</u> is a set of rules or procedures employed to compute for a specific purpose the value of resources consumed in the delivery of higher education services (3, pp. 88-89).

A definition of cost analysis by Sheehan and Gulko supported this theme: "Cost analysis attributes cost to selected cost objectives by means of various analytic formulations; usually it relates to specific management problems and purposes and often to specific institutions" (21, p. 57). These definitions show the tremendous flexibility advocated in the literature with regard to use of the term "cost" and the cost analysis concept. Such flexibility no doubt accounts for statements like the one made by Humphrey: "Cost-analysis is the basic element in the conduct of fiscal analysis and constitutes an essential ingredient therein" (11, p. 4).

The aforementioned problems associated with costing cast doubt on attempts to tie costs to academic quality. As documented in Chapter II, general agreement with regard to educational purposes usually concerns only instruction, research, and public service. Most cost studies disregard the latter two and address only instruction. Possibly by default, due to common use, the unit of measure in most cost studies is cost per semester credit hour.

From the preceding development in both areas, the basis for addressing quality through costing is most tenuous. The methodological instrument, the costing process, has been shown to be lacking in any consistently accepted form. The question of academic quality is equally illdefined. Although not previously addressed directly in this study, if educational purposes cannot be clarified beyond instruction, research, and public service, and if the output of higher education resists concise definition, then it follows that academic quality, which is based on both, remains inscrutable.

Attempts are sometimes made to use measures of productivity or student-faculty ratios as proxy measures of quality. Sheehan and Gulko discredited such practices:

> A common practice in education is to imply that the student-faculty ratio is an indicator of an educational system's instructional staffing policy. Typically, such a ratio is equated with class size, and occasionally it is regarded as an accepted measure of teaching excellence: a smaller ratio is assumed to indicate a greater probability of student-faculty classroom interaction--which implies (to some) superior educational opportunities. Most college and university educators recognize the fallacy of equating the student-faculty ratio with average class size or any other characteristics of a college or university operation; however, spurious comparisons are frequently drawn. Administrators, legislators, and faculty alike often refer to the student-faculty ratio in a context that implies that the ratio is a measure of average class size (21, pp. 61-62).

The authors then listed the following mathematical relationships:

$$\text{Average Class Size} = \frac{\text{Number of Students} \times \text{Average Student Load}}{\text{Number of Faculty} \times \text{Average Faculty Load}}$$

$$\text{Student-Faculty Ratio} = \frac{\text{Number of Students}}{\text{Number of Faculty}}$$

$$\text{Relative Faculty Load} = \frac{\text{Average Faculty Load}}{\text{Average Student Load}}$$

$$\text{Average Class Size} = \frac{\text{Student-Faculty Ratio}}{\text{Relative Faculty Load}}$$

(21, pp. 61-62). By rearranging the last equation, Student-Faculty Ratio is shown to be the product of Average Class Size and Relative Faculty Load. Thus, Sheehan and Gulko showed that for a given student-faculty ratio, average class size and relative faculty load could vary over a significant range (21, p. 63).

At this point in time there is simply no consensus that the costing process can be tied to questions about academic quality or that it can be used as a tool to address questions regarding academic quality. Peterson stated: "Assessing quantitative teaching output or efficiency at the departmental level is evidently still the subject of administrative, not scholarly research" (19, p. 29). He continued by noting that the departmental service function remains virtually unexamined. He concluded: "In summary, the quantity, efficiency, and objective quality of departmental outcomes are seldom analyzed" (19, p. 29).

Implications of the Study of Selected Costing Assumptions Modeled by the Prototype System

The development and application of the prototype modeling system has expanded upon the limited research in this area. This study was intended to shed more light on the impact of some costing assumptions commonly made in cost studies. The following implications document the completion of this project.

One implication regarding the nature of this study is that it is the kind of study recommended by Hopkins and Schroeder (9) in a recent issue of the New Directions for Institutional Research series entitled Applying Analytic Methods to Planning and Management. Issue editors David Hopkins and Roger Schroeder discussed four needs that pertain to modeling in the field of institutional research. First, they saw the need for actual applications rather than mathematical model formulations. Second, they pointed to the need for focusing on specific problems. Third, they suggested that "soft" approaches to modeling, including various types of data analysis and systems analysis, warrant attention in addition to sophisticated mathematical modeling approaches. Finally, they advocated the use of simple models to be expanded upon only as needed (9, p. xi).

The prototype modeling system developed in this study meets all four of the needs specified by Hopkins and Schroeder. The prototype system is an example of "soft" modeling, the development of which relied heavily upon systems analysis in the design specifications stage. Actual use of the system requires continual data analysis by the user for the study selected costing assumptions. The focus of this study was on a specific problem, costing assumptions. As might have been expected, the study did grow well beyond initial expectations as responses to the exploratory questions were developed. In this regard the prototype modeling system is an example of an actual application rather than a mathematical model formulation. Finally, even though the prototype modeling system appears to be complicated, it is actually based upon the simple relationships that exist at the disaggregated level at which it is intended for use. The mathematical relationships coded into the model do not exceed simple multiplication and division.

Another implication of this study has to do with the expansion on modeling capability in the area of costing assumptions. Cost studies were described in Chapter I as being typified by assumptions made in two dimensions: costing sources and apportioning procedures. These dimensions were portrayed in matrix form as a two dimensional matrix. A given cost study, therefore, could be viewed as consisting of one column and one row: one set of costing sources and one set of apportioning procedures.

The prototype modeling system allows for more than one set of costing sources and more than one set of apportioning procedures to be modeled. In effect the system allows for a conceptual matrix of more than one row and one column to be created. Each cell in the conceptual matrix represents the combined assumptions of a cost study, costing sources and apportioning procedures. Each conceptual cell in effect is input to JP4 which combines costing sources and apportioning procedures in a cost study or iteration.

The system is designed so that individual cost studies may be performed when there is no desire to subject any of them to sensitivity analysis. In this situation JP4 and JP5 would be executed for each cost study or each conceptual matrix cell. JP5 would serve as the terminal point of system use.

The capability to perform sensitivity analysis is provided by JP6. This job allows the user to select any two cost studies resident on the SENSITIVITY-DATA-FILE for sensitivity analysis. JP6 is the final computer job in the prototype modeling system. No comparable departmental level modeling system has been found in the literature.

Another implication concerns new and additional meaning that attaches to the term costing assumptions. Prior discussion of costing assumptions referred to costing sources and apportioning procedures. From the selective application of the prototype modeling system in Chapter V, cost sensitivity was shown to be affected by a number of assumptions. Upon closer examination it can be argued that the selection or omission of a costing source itself becomes an apportioning procedure of a higher order. The higher order apportioning procedure is based upon a binary relationship: a weight of 1 includes the costing source in the study; a weight of 0 excludes it. The basis for this argument is shown in the sensitivity test for the fifth and sixth iterations, which had unequal amounts of costs. The unequal amounts of costs in each iteration resulted from a difference in higher order apportioning procedures that pertained to institutional level costs. One iteration contained costs apportioned on the basis of FTE; the other contained costs apportioned on the basis of faculty salary. The point is that apportioning procedures pertaining to higher level costs affect what is eventually included or excluded at the lower levels in the same way that the selection or omission of a costing source affects lower level costs.

Similarly, a closer look at a given costing source shows that within the source, costs may be included or excluded; consequently, this act becomes an apportioning procedure. For example, the iterations which included college and institutional level costs were designed such that those costing sources were made up of the more detailed costs similar to those used in the RRPM 1.6 study conducted on campus (18). In other words the attempt was made to use the RRPM 1.6 study as a compatibility reference for costing sources used in the selective application of the prototype modeling system. No attempt was made, however, to duplicate the RRPM 1.6 study. The point is that, where applicable, each of these college and institutional level costing sources was comprised of contract salaries and wages, non-contract salaries and wages, and maintenance and operation costs. The inclusion or exclusion of any of these three subsources of costs represents an apportioning procedure.

The same relationship holds true for the individual faculty member costing source. In the selective application of the prototype modeling system, no attempt was made to account for the service functions of individual faculty members. A general concession is that far more than instruction occupies the time of a teacher. Many cost studies have been shown to disregard the other activities of a teacher and apportion all of a teacher's salary to instruction as was done in this study. Had some form of activity analysis been performed for each member of the faculty, then only a portion of each member's salary would have been included in this study. This is a form of inclusion or exclusion, as discussed above, and it represents an apportioning procedure.

With regard to apportioning procedures, the proposition is also advanced that any set of apportioning procedures reduces to a weighting scheme. Even a binary apportioning procedure, inclusion or exclusion, is a weighting scheme. Whether directly coded for input to the system through the APPORTION-FILE or implicitly coded as when disregarding faculty service functions, weighting schemes are involved. As previously discussed, these schemes affect resultant costs.

The capability provided by the four apportioning alternatives, through which the modeling system receives apportioning procedure weights, also affects resultant costs. These apportioning alternatives established the flow of costs within the system. Costs related to faculty could either be apportioned to the courses of each faculty member or to all courses on a departmental basis. Costs related to enrollments could either be apportioned to enrollments within individual courses or to all enrollments on a departmental basis. For these reasons, the four apportioning alternatives, which are hard coded in the system software, constitute apportioning assumptions and affect resultant costs.

Finally, costing assumptions must include consideration of the data base upon which a cost study is performed. The comparison of the second and seventh iterations, which focused solely on a change in the data base, showed the costing approach to be extremely sensitive to dropouts. The two data bases represented enrollments at specific points in time: twelfth class day enrollments and enrollments that actually completed course work. These two points in time represent the extremes of a semester; the twelfth class day is early in a semester as opposed to the final day of a semester. During those points in time, enrollment would be expected to vary as a result of dropouts, and the sensitivity analysis of those two iterations shows the impact of dropouts on the costing approach.

One other aspect of the data base that warrants consideration is the nature of the data base itself. The enrollment patterns within the data base also affect resultant costs. This is to say that, theoretically, for a given offering of courses and a given set of students, the resultant enrollment pattern is affected by many intangible factors like course conflicts, job conflicts, teachers in given courses, etc. Differing sets of these factors could, theoretically, produce differing enrollment patterns for the same set of course offerings and students. Different enrollment patterns would produce different resultant costs for the student major and level combinations.

Another implication of this study is that it confirms that department level costs, by their relative magnitude, exert the major influence on resultant student major and level combination costs. Also, faculty salaries represent the major department level cost. As is frequently found in the literature, other costs are often apportioned on the basis of faculty salaries, and this practice seems justified in light of the predominant influence that faculty salaries exert. Although college and institutional level costs can be sizable, the amounts which found their way to the department in this study were relatively small when compared to faculty salaries in the department.

Another implication concerns the interaction between costing sources, apportioning procedures, and the data base. As alluded to in Chapter V, any two costing iterations resident on the SENSITIVITY-DATA-FILE can be submitted to JP6 for sensitivity analysis, but the analysis itself becomes an increasingly difficult task as iterations become increasingly dissimilar. As discussed previously, the approach taken by Sheehan and Michaels (20) was to study one basic costing methodology. They would make one change at a time in the methodology and recompute costs for that change. The recomputed costs for each change in the methodology were compared, one at a time, with the costs from the methodology in sensitivity tests. Although each change in the methodology produced a new cost study, each new cost study differed from the methodology in that only one change at a time was made.

Sensitivity for Sheehan and Michaels, thus, meant the sensitivity of the original costing methodology to a single change at a time in the methodology. They did not make numerous changes at one time, producing a substantially different cost study from the original methodology, and then compare the two in sensitivity analysis.

The approach to sensitivity analysis used by Sheehan and Michaels is recommended from the application of the prototype modeling system in this study. The effects of multiple changes in costing sources, apportioning procedures, or the data base would be impossible to track in a sensitivity analysis. Therefore, the proposition is advanced that maximum utilization of sensitivity testing results from a single change at a time in a cost study. This single change is modeled in the form of another cost study which incorporates the change. Technically, two cost studies exist; but practically speaking, the intent of sensitivity analysis is to examine one cost study and the effects of a change on that cost study.

A final implication of this study is that costs computed by the prototype modeling system bear no relationship to the credit hour costs used in Coordinating Board formulas for institutional appropriations. In the State of Texas, State institutions receive the majority of their funding for a biennium from legislative appropriations through designated formulas. The formulas for faculty salaries, departmental operating expenses, and the library are based on credit hours. The formula for instructional administration is indirectly tied to credit hours in that it is based on the amount appropriated for faculty salaries. The formula for general administration is based on head-count (16, pp. 18-20). The amounts appropriated are derived from a preceding twelve-month base period.

The prototype modeling system is designed to support the larger, institutional level, program oriented costing simulation system, RRPM 1.6. In RRPM 1.6, a typical program is synonymous with a student major. Similarly, the prototype modeling system computes costs through a disaggregated process for each student major by level combination. Total costs for the department are also computed.

Administrators may use this system to study the ramifications of institutional, college, and departmental level budgets on the instructional activities within a department. In so doing this prototype modeling system could serve as a useful tool for incorporating instructional service in the process of allocating resources as recommended by Dressel and Simon (6, p. 32).

Institutional budgets, being largely tied to Coordinating Board formulas, and departmental budgets simply do not reflect programs as defined in this study. Dressel and Simon pointed out that

> . . . precious little program budgeting has been done in higher education. It is not even clear what a program is at a departmental level, in that aside from graduate-degree programs, which may be entirely subsumed within a given department, most degree programs involve several departments and the use of general university resources (6, pp. 20-21).

The prototype modeling system is a useful tool for studying the relationship of programs and program budgets to conventional budgets.

Recommendations for Further Research

An initial recommendation for further research concerns the development of a comprehensive management information system (MIS) for departmental level use, or possibly a subsystem of a comprehensive institutional level MIS. No system as described was found in the literature. The discussion of management information systems in Chapter II concerned the role of costing in a MIS and each reference to a MIS in that chapter was to a system designed for institutional level use. Different levels of information within a MIS were defined: information for decision making, information for control, and information for operations (7, pp. 30-31). These levels, however, were described with the view of central administration in mind.

Departmental level management tools are in short supply. Johnson pointed out that "Recent trends in data collection have been oriented away from the department and toward such external agencies as state-wide boards, state legislators, accrediting associations, foundations, and federal agencies" (12, p. 62). Two reasons for these trends are the centralizing forces of increasing government financial support in higher education along with associated reporting needs, and the rapidly growing computer power which central administration sees as a tool to meet the pressure to develop central computer information systems (12, p. 63). The result at the department level is that few computer applications or reports exist which are designed for departmental level use. Examples of this situation are monthly accounting reports which are distributed to departments and contain various budgetary summaries. They are designed by people in central administration who have backgrounds in accounting, and they adhere to commonly accepted accounting terminology and format. The problem is that not many department chairmen are accountants, nor do they have the requisite background to understand the reports.

The prototype modeling system developed in this study could become one part of a multi-part departmental level information system including an intelligible budget reporting system, and a modeling or optimizing preregistration system.

A second recommendation concerns improving the capabilities of the prototype modeling system. Consistent with the needs of a typical department chairman as described by Johnson (12, pp. 69-70, p. 75), the design of the data base could be expanded to include relevant data about student enrollments, faculty members, and the courses that impact both. This system could be expanded to produce information over a given time period regarding the kind of course preparation students of various majors receive, grade point patterns of various majors or courses, the impact of socio-economic or other demographic characteristics on the department, and the characteristics of faculty members such as the number and type of graduate students assigned to each, the kind of research or other responsibilities being pursued, etc.

A third recommendation also concerns the data base. The selective application of the system in this study was based upon two representations of the data base at two specific points in time. In fact, however, the data base is dynamic, not static. This assertion is verified by the difference in enrollments represented by each data base.

There should be no difficulty in developing a static data base which relfects the relative participation of dropouts. One data base developed for use in Chapter V included dropouts, and the other excluded them. For costing purposes, a static representation accounting for their partial participation could be possible.

Another variation on the data base would include the possibility for true stochastic simulation over time for planning purposes. This effort would involve developing an acceptable historical data base comprehensive enough to yield probability distributions for enrollment patterns in the courses of the department. Once this historical data base was developed, the modeling system could be modified to incorporate the probability distributions at the point where the data base is created so that projective simulation would be possible. Of course, various changes in system variables or system parameters are currently possible. For example, the impact on an existing data base resulting from a modification to teaching assignments is possible with the prototype modeling system. However, this kind of modification remains tied to a static, historical data base.

A fourth recommendation builds upon the second and third recommendations in that it involves improving the capabilities of the modeling system by expanding the data base to include data that identifies potential dropouts. Research by Astin (1) has shown that some crude dropout predictor variables exist. An expanded data base could be used to simulate end-of-term cost patterns based upon anticipated dropouts. Departmental personnel could then encourage persistence in these potential dropouts. Astin (1, p. 2) pointed out that this may be the most fruitful area for resource investment in that it should directly contribute to increased enrollment. By modeling various dropout patterns, a modeling system incorporating this capability would allow researchers to anticipate future enrollment patterns. These patterns should be of interest to administrators since they directly impact budget requests. If encouraging persistence is successful, subsequent enrollments should be greater than they would be if persistence is not encouraged. Increased enrollment contributes to an increased budget, and the modeling system could be used as a planning tool in this area. In addition, a kind of opportunity cost could be computed for a dropout pattern. A modified modeling system could be used to predict various patterns and minimize the opportunity costs. Further research in this area is strongly encouraged.

A fifth recommendation concerns possible changes to the existing prototype software. Specifically, other apportioning alternatives exist which could be incorporated in the system. For example, in many of the more aggregated cost studies, costs are commonly apportioned to course levels. The prototype modeling system will accommodate such a scheme, but it would require a binary weighting scheme with zero coded in as a weight for courses of all other levels and a non-zero weight coded in the courses of the particular level of interest. This kind of weighting scheme would be necessary for each level of courses to receive costs. A more direct and expeditious way could be developed.

In like manner more flexibility could be provided for the blanket option in the APPORTION-FILE. Currently, weights are entered through the blanket option by the use of a simple mapping strategy. For the selection criterion chosen, CSE, SCTN, HRS, RANK, or FTE, weights are simply coded into appropriate FACULTY-FILE or STUDENT-FILE fields on the basis of ranges provided on the type 105 record. A more appropriate scheme might be to weight FACULTY-FILE or STUDENT-FILE records on the basis of multiple criteria. For example, this kind of flexibility could allow for both course level and student level to determine a resultant weight. This flexibility is currently provided through the individual option of the APPORTION-FILE; however, coding individual 105 record types can be a time-consuming and error-prone chore.

A sixth and final recommendation concerns potential system use. The focus in this study has been on the development of a prototype modeling system for use in the study of selected costing assumptions. The field of costing in higher education has been shown to be extensive and it consists of conflicting views. Even within a university, departments vary greatly and institutional level cost studies are often viewed as inequitable when some generalizations are considered inapplicable to some departments. A modeling system of the type developed in this study would allow individual departmental administrators to perform their own departmental cost studies from which one might be selected as most consistent with department goals. The results of individual departmental level cost studies could then be combined to produce an institutional level study. Those departments with characteristics considered unique for costing purposes could participate in this way; other departments could simply allow the aggregative tools and generalized costing sources and apportioning procedures to be applicable in their cases. In this way departmental administrators would have authority over the costing process as it impacts their departments. The proposition is advanced that an institutional level cost study of this type would have a number of positive effects including improved understanding of individual departmental profiles and characteristics, opportunities to bring together departmental and central administration for improved mutual understanding rather than abetting antagonistic work in relative isolation, and the likelihood of cost study results that would differ from those of a typical aggregative and generalized institutional level study. Such a study could not be criticized for ignoring departmental nuances.

The active involvment of departmental administrators with these tools will necessitate continued research on academic departments so that existing administrative tools may be modified or new ones developed. One readily apparent modification to the prototype modeling system would facilitate the study of the relationship of Coordinating Board formulas to departmental level costs. The prototype modeling system is designed to maintain a very low level of cost aggregation, and consequently departmental costs are computed primarily to verify accurate, total cost apportioning. However, Coordinating Board formulas which concern credit hours are, of course, aggregative and are based on degree levels. For example, one formula is for liberal arts and it includes many liberal arts departments with the only distinction being for credit hours generated at the bachelor, master's and doctoral levels. Correspondingly, the prototype modeling system should be expanded to compute summed costs by course level, degree level, and student level. The present system lacks this capability.

The development of the prototype modeling system has demonstrated the feasibility of constructing flexible tools for use at a very disaggregated level within a college or university. Tools of this type can be used for the study of assumptions as well as for supporting the day-to-day needs of departmental level management.

CHAPTER BIBLIOGRAPHY

1. Astin, Alexander W., Preventing Students from Dropping Out, San Francisco, Jossey-Bass, Inc., 1975.

2. Balderston, F. E., "Thinking About the Outputs of Higher Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

3. Beatty, George, Jr., "The Application of Costing Methodologies in Higher Education," in Applying Analytic Methods to Planning and Management, Vol. IV of New Directions for Institutional Research, (Spring, 1977), Jossey-Bass, Inc.

4. Brandl, John E., "Public Service Outputs of Higher Education: An Exploratory Essay," The Outputs of Higher Education: Their Identification, Measurement and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

5. Cary, Francis G., "Development of an Instructional Cost-Effectiveness Analysis Model for Use in School Districts," unpublished doctoral dissertation, Department of Educational Studies, State University of New York at Buffalo, Buffalo, New York, 1972.

6. Dressel, Paul and Lou Anna Kimsey Simon, Allocating Resources Among Departments, Vol. III of New Directions for Institutional Research, (Autumn, 1976), Jossey-Bass, Inc.

7. Dusseldorp, Ralph Van, "Some Principles for the Development of Management Information Systems," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke University Press, 1969.

8. Hansen, Bertrand L., "University Costing--The Ontario Experience," Reformation and Reallocation in Higher Education, edited by Clifford T. Stewart, Miami Beach, Florida, The Association for Institutional Research, 1972.

9. Hopkins, David S. P. and Roger G. Schroeder, "Editors' Notes," in Applying Analytic Methods to Planning and Management, Vol. IV of New Directions for Institutional Research, (Spring, 1977), Jossey-Bass, Inc.

10. Hough, Robbin R., "The Output of Undergraduate Education," The Outputs of Higher Education: Their Identification Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

11. Humphrey, David Allen, "The Development of an Instrument for Course Cost-Analysis in Higher Education," unpublished doctoral dissertation, Department of Education, State University of New York at Albany, Albany, New York, 1974.

12. Johnson, F. Craig, "Data Requirements for Academic Departments," in Examining Departmental Management, Vol III of New Directions for Institutional Research, (Summer, 1976), Jossey-Bass, Inc.

13. LeLong, Donald C. and William R. Mann, "Systems Analysis for Institutional Output Decisions," Institutional Research and Academic Outcomes, edited by Cameron Fincher, San Francisco, California, The Association for Institutional Research, 1968.

14. Lovell, Ned Broward, "Cost-Effectiveness Evaluation of Instructional Programs: A Development Design (K-12)," unpublished doctoral dissertation, The Florida State University, Tallahassee, Florida, 1971.

15. Miller, John Perry, "Outputs of Higher Education: Graduate Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

16. Miller, William A., Jr. and John L. Carter, Jr., Financing Public Senior Institutions of Higher Learning in the State of Texas, Denton, Texas, North Texas State Press, 1973.

17. National Association of College and University Business Officers, "Fundamental Considerations for Determining Cost Information in Higher Education," College and University Business Administration, 4:5, Washington, D. C., NACUBO, 1975.

18. Office of Institutional Analysis and Planning, North Texas State University, "Resource Requirements Prediction Model 1.6 (RRPM 1.6): Reports and Introductory Notes," Denton, Texas, 1974.

19. Peterson, Marvin W., "The Academic Department: Perspectives from Theory and Research," in Examining Departmental Management, Vol. III of New Directions for Institutional Research, (Summer, 1976), Jossey-Bass, Inc.

20. Sheehan, Bernard S. and Mervin G. Michaels, "Sensitivity Tests on a University Cost Study Methodology," Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

21. Sheehan, Bernard S. and Warren W. Gulko, "The Fundamental Cost Model," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

22. Topping, James R., Cost Analysis Manual, Technical Report 45, Boulder, Colorado, Western Interstate Commission for Higher Education, 1974.

APPENDIX A

PROGRAM LISTINGS

1

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010010 ID DIVISION.                                                          P1
010020 PROGRAM-ID. P1.                                                       P1
010030 AUTHOR. GOSE.                                                         P1
010040 DATE-WRITTEN. 3/77                                                    P1
010050 DATE-COMPILED. JUN  1,1977                                            P1
010060 REMARKS.                                                              P1
010070          THIS PROGRAM CREATES TWO ISAM FILES: FACULTY-FILE &          P1
010080     STUDENT-FILE.                                                     P1
010090                                                                       P1
010100 ENVIRONMENT DIVISION.                                                 P1
010110 CONFIGURATION SECTION.                                                P1
010120 INPUT-OUTPUT SECTION.                                                 P1
010130 FILE-CONTROL.                                                         P1
010140     SELECT  RANK-FTE-FILE        ASSIGN  UT-S-C13610.                 P1
010150     SELECT  COURSE-FILE          ASSIGN  UT-S-T13670.                 P1
010160     SELECT  NRLMNT-FILE          ASSIGN  UT-S-T13650.                 P1
010170     SELECT  FACULTY-FILE         ASSIGN  DA-I-D13621                  P1
010180             RECORD KEY IS FAC-KEY.                                    P1
010190     SELECT  STUDENT-FILE         ASSIGN  DA-I-D13623                  P1
010200             RECORD KEY IS STD-KEY.                                    P1
010210                                                                       P1
010220 DATA DIVISION.                                                        P1
010230 FILE SECTION.                                                         P1
010240 FD  RANK-FTE-FILE                                                     P1
010250     LABEL RECORDS STANDARD                                            P1
010260     BLOCK 80.                                                         P1
010270 01  RANK-FTE-RCD                 PIC X(80).                           P1
010280                                                                       P1
010290 FD  COURSE-FILE                                                       P1
010300     LABEL RECORDS STANDARD                                            P1
010310     BLOCK 0.                                                          P1
010320 01  COURSE-RCD                   PIC X(100).                          P1
010330                                                                       P1
010340 FD  NRLMNT-FILE                                                       P1
010350     LABEL RECORDS STANDARD                                            P1
010360     BLOCK 0.                                                          P1
010370 01  NRLMNT-RCD                   PIC X(65).                           P1
010380                                                                       P1
010390 FD  FACULTY-FILE                                                      P1
010400     LABEL RECORDS STANDARD                                            P1
010410     BLOCK 0.                                                          P1
010420 01  FACULTY-RCD.                                                      P1
010430     05  F                        PIC X.                               P1
010440     05  FAC-KEY                  PIC X(26).                           P1
010450     05  F                        PIC X(73).                           P1
010460                                                                       P1
010470 FD  STUDENT-FILE                                                      P1
010480     LABEL RECORDS STANDARD                                            P1
010490     BLOCK 0.                                                          P1
010500 01  STUDENT-RCD.                                                      P1
020010     05  F                        PIC X.                               P1
020020     05  STD-KEY                  PIC X(26).                           P1
020030     05  F                        PIC X(73).                           P1
020040
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2

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020050 WORKING-STORAGE SECTION.                                               P1
020060 01  FILLER COMP-3.                                                     P1
020070     05  SUB1                     PIC S999     VALUE ZERO.              P1
020080     05  SUB2                     PIC S999     VALUE ZERO.              P1
020090     05  NRLMNT-CTR               PIC S999     VALUE ZERO.              P1
020100     05  STUDENT-CTR              PIC S999     VALUE ZERO.              P1
020110     05  TTL-CTR                  PIC S999     VALUE ZERO.              P1
020120     05  MAXT1                    PIC S999     VALUE ZERO.              P1
020130     05  MAXT2                    PIC S999     VALUE ZERO.              P1
020140                                                                        P1
020150 01  FILLER.                                                            P1
020160     05  ERR-SW                   PIC X        VALUE SPACE.             P1
020170     05  ABND-IT                  PIC X        VALUE SPACE.             P1
020180     05  ABND-ITR REDEFINES ABND-IT PIC 9.                              P1
020190                                                                        P1
020200 01  WS-R-F.                                                            P1
020210     05  ID-R-F                   PIC X(10).                            P1
020220     05  F                        PIC X(9).                             P1
020230     05  RANK-R-F                 PIC X.                                P1
020240     05  F                        PIC XX.                               P1
020250     05  FTE-R-F                  PIC 999.                              P1
020260     05  F                        PIC X(55).                            P1
020270                                                                        P1
020280**** THIS TBL CONTAINS ONE ENTRY FOR EVERY FACULTY MEMBER               P1
020290 01  FILLER.                                                            P1
020300     05  TBL-1 OCCURS 20.                                               P1
020310         10  ID-1                 PIC X(10).                            P1
020320         10  RANK-1               PIC XX.                               P1
020330         10  FTE-1                PIC 999.                              P1
020340                                                                        P1
020350 01  WS-COURSE.                                                         P1
020360     05  CSE-INFO-COURSE          PIC X(13).                            P1
020370     05  NAME-COURSE              PIC X(16).                            P1
020380     05  F                        PIC X(22).                            P1
020390     05  SMYR-COURSE              PIC 999                    COMP-3.    P1
020400     05  F                        PIC X(47).                            P1
020410                                                                        P1
020420**** THIS TBL CONTAINS ALL SECTION-MSTR ENTRIES FOR THE DEPT            P1
020430 01  FILLER.                                                            P1
020440     05  TBL-2 OCCURS 250.                                              P1
020450         10  CSE-INFO-2           PIC X(13).                            P1
020460         10  SMYR-2               PIC 999                    COMP-3.    P1
020470         10  NAME-2               PIC X(10).                            P1
020480         10  CD-2                 PIC S999                   COMP-3.    P1
020490                                                                        P1
020500 01  WS-NRLMNT.                                                         P1
030010     05  F                        PIC X.                                P1
030020     05  SSN-NRLMNT               PIC X(9).                             P1
030030     05  CSE-INFO-NRLMNT          PIC X(13).                            P1
030040     05  F                        PIC X(28).                            P1
030050     05  SMYR-NRLMNT              PIC 999                    COMP-3.    P1
030060     05  CLASS-NRLMNT             PIC X.                                P1
030070     05  MAJOR-NRLMNT             PIC 9(5)                   COMP-3.    P1
030080     05  F                        PIC X(8).                             P1
030090                                                                        P1
030100**** WRITE BOTH OUTPUT FILES FROM THIS RECORD.                          P1
030110 01  WS-RCD.
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030120     05  F                          PIC X       VALUE SPACE.            P1
030130     05  CSE-INFO                   PIC X(13).                          P1
030140     05  SMYR                       PIC 999.                            P1
030150     05  IDNT                       PIC X(10).                          P1
030160     05  FS-1                       PIC XX.                             P1
030170     05  FS-2.                                                          P1
030180         10  FS-2N                  PIC S999               COMP-3.      P1
030190     05  NMBR.                                                          P1
030200         10  NMBR-N OCCURS 10       PIC S999               COMP-3.      P1
030210         10  PCT-N CCCURS 10        PIC S999V99            COMP-3.      P1
030220     05  F-1                        PIC X(11).                          P1
030230     05  MJR.                                                           P1
030240         10  MJR-N                  PIC S9(5)              COMP-3.      P1
030250     05  COST                       PIC S9(7)V99           COMP-3.      P1
030260                                                                        P1
030270 01  NMBR-TBL.                                                          P1
030280     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030290     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030300     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030310     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030320     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030330     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030340     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030350     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030360     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030370     05  F                          PIC S999     VALUE ZERO COMP-3.     P1
030380     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030390     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030400     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030410     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030420     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030430     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030440     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030450     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030460     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030470     05  F                          PIC S999V99  VALUE ZERO COMP-3.     P1
030480                                                                        P1
030490 PROCEDURE DIVISION.                                                    P1
030500     OPEN     INPUT RANK-FTE-FILE.                                      P1
040010     OPEN     INPUT COURSE-FILE.                                        P1
040020     OPEN     INPUT NRLMNT-FILE.                                        P1
040030     OPEN     OUTPUT FACULTY-FILE.                                      P1
040040     OPEN     OUTPUT STUDENT-FILE.                                      P1
040050                                                                        P1
040060***                                                                  ***P1
040070***   LOAD TBL-1 FROM RANK-FTE-FILE.                                 ***P1
040080***                                                                  ***P1
040090                                                                        P1
040100 READ-RANK-FTE-FILE.                                                    P1
040110     READ     RANK-FTE-FILE INTO WS-R-F                                 P1
040120              AT END  GO TO MOVE-MAXT1.                                 P1
040130                                                                        P1
040140     IF       (RANK-R-F < '1' OR > '5') OR                              P1
040150              (FTE-R-F NOT NUMERIC)                                     P1
040160              DISPLAY 'ERROR-1 ' WS-R-F                                 P1
040170              GO TO   CLOSE-FILES.                                      P1
040180                                                                        P1
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040190          ADD      +1 TO SUBI.                                          P1
040200          IF       SUBI > 20                                            P1
040210                   DISPLAY 'ERROR-2 ' WS-R-F ' ' SUBI                   P1
040220                   GO TO   CLOSE-FILES.                                 P1
040230          MOVE     ID-R-F TO ID-1 (SUBI).                               P1
040240          MOVE     RANK-R-F TO RANK-1 (SUBI).                           P1
040250          MOVE     FTE-R-F TO FTE-1 (SUBI).                             P1
040260          GO TO    READ-RANK-FTE-FILE.                                  P1
040270                                                                        P1
040280                                                                        P1
040290 MOVE-MAXT1.                                                            P1
040300          MOVE     SUBI TO MAXT1.                                       P1
040310          MOVE     ZERO TO SUBI.                                        P1
040320                                                                        P1
040330***                                                                  ***P1
040340***   LOAD TBL-2 FROM COURSE-FILE.                                   ***P1
040350***                                                                  ***P1
040360                                                                        P1
040370 READ-COURSE-FILE.                                                      P1
040380          READ     COURSE-FILE INTO WS-COURSE                           P1
040390                   AT END  GO TO MOVE-MAXT2.                            P1
040400                                                                        P1
040410          ADD      +1 TO SUBI.                                          P1
040420          IF       SUBI > 250                                           P1
040430                   DISPLAY 'ERROR-3 ' WS-COURSE ' ' SUBI                P1
040440                   GO TO   CLOSE-FILES.                                 P1
040450          MOVE     CSE-INFO-COURSE TO CSE-INFO-2 (SUBI).                P1
040460          MOVE     NAME-COURSE TO NAME-2 (SUBI).                        P1
040470          MOVE     SMYR-COURSE TO SMYR-2 (SUBI).                        P1
040480          MOVE     ZERO  TO CD-2 (SUBI).                                P1
040490          GO TO    READ-COURSE-FILE.                                    P1
040500                                                                        P1
050010                                                                        P1
050020 MOVE-MAXT2.                                                            P1
050030          MOVE     SUBI TO MAXT2.                                       P1
050040          MOVE     +0 TO SUBI.                                          P1
050050                                                                        P1
050060 READ-NRLMNT-FILE.                                                      P1
050070          READ     NRLMNT-FILE INTO WS-NRLMNT                           P1
050080                   AT END GO TO PROCESS-TBL-2.                          P1
050090                                                                        P1
050100          PERFORM NRLMNT-CSE-MATCH-RTN THRU N-C-M-R-X.                  P1
050110          IF       ERR-SW = '1'                                         P1
050120                   MOVE    SPACE TO ERR-SW                              P1
050130                   DISPLAY 'NO MATCH ' WS-NRLMNT                        P1
050140                   GO TO   READ-NRLMNT-FILE.                            P1
050150          ADD      +1 TO NRLMNT-CTR.                                    P1
050160          MOVE     SSN-NRLMNT TO IDNT.                                  P1
050170          MOVE     CSE-INFO-NRLMNT TO CSE-INFO.                         P1
050180          MOVE     SMYR-NRLMNT TO SMYR.                                 P1
050190          MOVE     CLASS-NRLMNT TO FS-1.                                P1
050200          MOVE     ZERO TO FS-2N.                                       P1
050210          MOVE     SPACES TO       F-1.                                 P1
050220          MOVE     NMBR-TBL TO NMBR.                                    P1
050230          MOVE     MAJOR-NRLMNT TO MJR-N.                               P1
050240          MOVE     ZERO TO COST.                                        P1
050250                                                                        P1
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050260        WRITE    STUDENT-RCD FROM WS-RCD                                        P1
050270                 INVALID KEY DISPLAY 'ABEND-1 ' WS-RCD                          P1
050280                 ADD      +1 TO ABND-ITR                                        P1
050290                 GO TO    CLOSE-FILES.                                          P1
050300        ADD      +1 TO STUDENT-CTR.                                             P1
050310        GO TO    READ-NRLMNT-FILE.                                              P1
050320                                                                                P1
050330                                                                                P1
050340                                                                                P1
050350 PROCESS-TBL-2.                                                                 P1
050360        MOVE     ZERO TO SUB2.                                                  P1
050370                                                                                P1
050380                                                                                P1
050390 LOOP-2.                                                                        P1
050400        ADD      +1 TO SUB2.                                                    P1
050410        IF       SUB2 > MAXT2                                                   P1
050420                 GO TO    CLOSE-FILES.                                          P1
050430                                                                                P1
050440        IF       CD-2 (SUB2) > ZERO                                             P1
050450                 MOVE     ZERO TO SUB1                                          P1
050460                 GO TO    LOOP-1.                                               P1
050470        GO TO    LOOP-2.                                                        P1
050480                                                                                P1
050490 LOOP-1.                                                                        P1
050500        ADD      +1 TO SUB1.                                                    P1
060010        IF       SUB1 > MAXT1                                                   P1
060020                 DISPLAY 'ERROR-5 ' TBL-2 (SUB2)                                P1
060030                 ADD      +1 TO ABND-ITR                                        P1
060040                 GO TO    CLOSE-FILES.                                          P1
060050                                                                                P1
060060        IF       NAME-2 (SUB2) = ID-1 (SUB1)                                    P1
060070                 ADD      CD-2 (SUB2) TO TTL-CTR                                P1
060080                 MOVE     CSE-INFO-2 (SUB2) TO CSE-INFO                         P1
060090                 MOVE     SMYR-2 (SUB2) TO SMYR                                 P1
060100                 MOVE     NAME-2 (SUB2) TO IDNT                                 P1
060110                 MOVE     RANK-1 (SUB1) TO FS-1                                 P1
060120                 MOVE     FTE-1  (SUB1) TO FS-2N                                P1
060130                 MOVE     NMBR-TBL TO NMBR                                      P1
060140                 MOVE     SPACES TO F-1 MJR                                     P1
060150                 MOVE     ZERO TO COST                                          P1
060160                 PERFORM WRITE-FACULTY-RCD THRU W-F-R-X                         P1
060170                 GO TO    LOOP-2.                                               P1
060180                                                                                P1
060190        GO TO    LOOP-1.                                                        P1
060200                                                                                P1
060210 CLOSE-FILES.                                                                   P1
060220        DISPLAY 'NRLMNT-CTR  ' NRLMNT-CTR.                                      P1
060230        DISPLAY 'STUDENT-CTR ' STUDENT-CTR.                                     P1
060240        DISPLAY 'TTL-CTR     ' TTL-CTR.                                         P1
060250                                                                                P1
060260        CLOSE    RANK-FTE-FILE.                                                 P1
060270        CLOSE    COURSE-FILE.                                                   P1
060280        CLOSE    NRLMNT-FILE.                                                   P1
060290        CLOSE    FACULTY-FILE.                                                  P1
060300        CLOSE    STUDENT-FILE.                                                  P1
060310        STOP RUN.                                                               P1
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060330 NRLMNT-CSE-MATCH-RTN.                                                    P1
060340     MOVE    ZERO TO SUB1.                                                P1
060350 MATCH-LOOP.                                                              P1
060360     ADD     +1 TO SUB1.                                                  P1
060370     IF      SUB1 > MAXT2                                                 P1
060380             DISPLAY 'ERROR-4 ' WS-NRLMNT                                 P1
060390             MOVE    '1' TO ERR-SW                                        P1
060400             GO TO   N-C-M-R-X.                                           P1
060410                                                                          P1
060420     IF      (CSE-INFO-NRLMNT = CSE-INFO-2 (SUB1)) AND                    P1
060430             (SMYR-NRLMNT = SMYR-2 (SUB1))                                P1
060440             ADD     +1 TO CD-2 (SUB1)                                    P1
061450             GO TO   N-C-M-R-X.                                           P1
060460                                                                          P1
060470     GO TO   MATCH-LOOP.                                                  P1
060480 N-C-M-R-X. EXIT.                                                         P1

060500 WRITE-FACULTY-RCD.                                                       P1
070010     WRITE   FACULTY-RCD FROM WS-RCD                                      P1
070020             INVALID KEY DISPLAY 'ABEND-2 ' WS-RCD                        P1
070030             ADD     +1 TO ABND-ITR                                       P1
070040             GO TO   CLOSE-FILES.                                         P1
070050 W-F-R-X. EXIT.                                                           P1
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010010 ID DIVISION.                                                   P1A
010020 PROGRAM-ID. P1A.                                               P1A
010030 AUTHOR. GOSE.                                                  P1A
010040 DATE-WRITTEN. 4/77                                             P1A
010050 DATE-COMPILED. APR 18,1977                                     P1A
010060 REMARKS.                                                       P1A
010070          THIS PROGRAM OUTPUTS THE DEPARTMENT ENROLLMENT REPORT. P1A
010080      THE REPORT LISTS THE ENROLLMENT IN EACH COURSE BY STUDENT P1A
010090      MAJOR AND LEVEL.                                          P1A
010100 ENVIRONMENT DIVISION.                                          P1A
010110 CONFIGURATION SECTION.                                         P1A
010120 INPUT-OUTPUT SECTION.                                          P1A
010130 FILE-CONTROL.                                                  P1A
010140      SELECT  FACULTY-FILE          ASSIGN  DA-I-D13621         P1A
010150              RECORD KEY IS FAC-KEY.                            P1A
010160      SELECT  STUDENT-FILE          ASSIGN  UT-S-D13623.        P1A
010170      SELECT  REPORT-FILE           ASSIGN  UT-S-R13610.        P1A
010180                                                                P1A
010190 DATA DIVISION.                                                 P1A
010200 FILE SECTION.                                                  P1A
010210 FD   FACULTY-FILE                                              P1A
010220      LABEL RECORDS STANDARD                                    P1A
010230      BLOCK 0.                                                  P1A
010240 01   FACULTY-RCD.                                              P1A
010250      05  F                         PIC X.                      P1A
010260      05  FAC-KEY.                                              P1A
010270          10  CSE-SMYR-FAC.                                     P1A
010280              15  F                 PIC X(4).                   P1A
010290              15  CSE-FAC           PIC X(4).                   P1A
010300              15  SCT-FAC           PIC XXX.                    P1A
010310              15  HRS-FAC           PIC 99.                     P1A
010320              15  SMYR-FAC          PIC XXX.                    P1A
010330          10  NAME-FAC              PIC X(10).                  P1A
010340      05  F                         PIC X(73).                  P1A
010350                                                                P1A
010360 FD   STUDENT-FILE                                              P1A
010370      LABEL RECORDS STANDARD                                    P1A
010380      BLOCK 0.                                                  P1A
010390 01   STUDENT-RCD                   PIC X(100).                 P1A
010400                                                                P1A
010410 FD   REPORT-FILE                                               P1A
010420      LABEL RECORDS STANDARD                                    P1A
010430      BLOCK 133.                                                P1A
010440 01   REPORT-RCD                    PIC X(133).                 P1A
010450                                                                P1A
010460 WORKING-STORAGE SECTION.                                       P1A
010470 01   FILLER COMP-3.                                            P1A
010480      05  PG-CTR                    PIC S9(3)   VALUE ZERO.     P1A
010490      05  LN-CTR                    PIC S9(5)   VALUE +60.      P1A
010500      05  ENRL-CTR-ML               PIC S9(5)   VALUE ZERO.     P1A
020010      05  ENRL-CTR-CSE              PIC S9(5)   VALUE ZERO.     P1A
020020      05  ENRL-CTR-DPT              PIC S9(5)   VALUE ZERO.     P1A
020030      05  FAC-CTR                   PIC S9(5)   VALUE ZERO.     P1A
020040                                                                P1A
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020050 01  FILLER.                                                      P1A
020060     05  SV-1.                                                    P1A
020070         10  MJR-SV-1           PIC 9(5).                         P1A
020080         10  LVL-SV-1           PIC XX.                           P1A
020090     05  SV-2.                                                    P1A
020100         10  MJR-SV-2           PIC 9(5).                         P1A
020110         10  LVL-SV-2           PIC XX.                           P1A
020120     05  END-SW                 PIC X        VALUE SPACE.         P1A
020130     05  ABND-IT                PIC X        VALUE SPACE.         P1A
020140     05  ABND-ITR REDEFINES ABND-IT PIC 9.                        P1A
020150                                                                  P1A
020160 01  HD-1.                                                        P1A
020170     05  F                      PIC X(53)    VALUE ' R-136-10'.   P1A
020180     05  F                      PIC X(69)    VALUE                P1A
020190         'DEPARTMENT ENROLLMENT REPORT'.                          P1A
020200     05  F                      PIC X(5)     VALUE 'PAGE '.       P1A
020210     05  PG-1                   PIC ZZ9.                          P1A
020220                                                                  P1A
020230 01  HD-2.                                                        P1A
020240     05  F                      PIC X        VALUE SPACE.         P1A
020250     05  DT-2                   PIC X(8).                         P1A
020260                                                                  P1A
020270 01  HD-3.                                                        P1A
020280     05  F                      PIC X(52)    VALUE                P1A
020290         '      DEPARTMENT COURSE SECTION HOURS     INSTRUCTOR'.  P1A
020300     05  F                      PIC X(4)     VALUE 'SMYR'.        P1A
020310 01  HD-4.                                                        P1A
020320     05  F                      PIC X(10)    VALUE SPACE.         P1A
020330     05  F                      PIC X(45)    VALUE                P1A
020340         'STUDENT MAJOR  STUDENT LEVEL  NUMBER ENROLLED'.         P1A
020350                                                                  P1A
020360 01  LN-1.                                                        P1A
020370     05  F                      PIC X(16)    VALUE                P1A
020380         '           ABCD'.                                       P1A
020390     05  CSE-1                  PIC X(3).                         P1A
020400     05  SCT-1                  PIC X(7).                         P1A
020410     05  HRS-1                  PIC 99.                           P1A
020420     05  F                      PIC X(7)     VALUE SPACE.         P1A
020430     05  INST-1                 PIC X(13).                        P1A
020440     05  SMYR-1                 PIC XXX.                          P1A
020450 01  LN-2.                                                        P1A
020460     05  F                      PIC X(14)    VALUE SPACE.         P1A
020470     05  MJR-AN-2.                                                P1A
020480         10  MJR-2              PIC 9(5).                         P1A
020490     05  F-2                    PIC X(12)    VALUE SPACE.         P1A
020500     05  LVL-2                  PIC X(13).                        P1A
030010     05  ENRL-CT-2              PIC Z(5).                         P1A
030020                                                                  P1A
030030 01  SPCR                       PIC X(133)   VALUE SPACE.         P1A
030040                                                                  P1A
030050 01  WS-STD.                                                      P1A
030060     05  F                      PIC X.                            P1A
030070     05  STD-KEY.                                                 P1A
030080         10  CSE-SMYR-STD.                                        P1A
030090             15  F              PIC X(4).                         P1A
030100             15  CSE-STD        PIC X(4).                         P1A
030110             15  SCT-STD        PIC XXX.                          P1A
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030120                 15  HRS-STD           PIC 99.                              PIA
030130                 15  SMYR-STD          PIC XXX.                             PIA
030140             10  F                     PIC X(10).                           PIA
030150         05  LVL-STD                   PIC XX.                              PIA
030160         05  F                         PIC X(63).                           PIA
030170         05  MJR-STD                   PIC 9(5)                  COMP-3.    PIA
030180         05  F                         PIC X(5).                            PIA
030190                                                                            PIA
030200 PROCEDURE DIVISION.                                                        PIA
030210     OPEN     INPUT FACULTY-FILE.                                           PIA
030220     OPEN     INPUT STUDENT-FILE.                                           PIA
030230     OPEN     OUTPUT REPORT-FILE.                                           PIA
030240     MOVE     CURRENT-DATE TO DT-2.                                         PIA
030250 READ-FACULTY-FILE.                                                         PIA
030260     READ     FACULTY-FILE                                                  PIA
030270              AT END GO TO CK-END-SW.                                       PIA
030280                                                                            PIA
030290     ADD      +1 TO FAC-CTR.                                                PIA
030300     PERFORM WRITE-FAC-RTN THRU W-F-R-X.                                    PIA
030310                                                                            PIA
030320 READ-STUDENT-FILE.                                                         PIA
030330     READ     STUDENT-FILE INTO WS-STD                                      PIA
030340              AT END                                                        PIA
030350              PERFORM WRITE-ENRL THRU W-E-X                                 PIA
030360              GO TO   CLOSE-FILES.                                          PIA
030370     ADD      +1 TO ENRL-CTR-DPT.                                           PIA
030380     ON 1     PERFORM INITIAL-CK THRU I-C-X.                                PIA
030390     IF       CSE-SMYR-FAC NOT = CSE-SMYR-STD                               PIA
030400              PERFORM WRITE-ENRL THRU W-E-X                                 PIA
030410              ADD     +1 TO ENRL-CTR-ML                                     PIA
030420              GO TO   READ-FACULTY-FILE.                                    PIA
030430                                                                            PIA
030440     MOVE     LVL-STD TO LVL-SV-2.                                          PIA
030450     MOVE     MJR-STD TO MJR-SV-2.                                          PIA
030460     IF       SV-1 NOT = SV-2                                               PIA
030470              PERFORM WRITE-ENRL THRU W-E-X.                                PIA
030480     ADD      +1 TO ENRL-CTR-ML.                                            PIA
030490     GO TO    READ-STUDENT-FILE.                                            PIA
030500                                                                            PIA
040010 CK-END-SW.                                                                 PIA
040020     IF       END-SW = '1'                                                  PIA
040030              GO TO   CLOSE-FILES.                                          PIA
040040     DISPLAY 'ERROR-2 ' FACULTY-RCD.                                        PIA
040050     ADD      +1 TO ABND-ITR.                                               PIA
040060                                                                            PIA
040070 CLOSE-FILES.                                                               PIA
040080     DISPLAY 'FACULTY RECORDS READ ' FAC-CTR.                               PIA
040090     MOVE     'TOTAL' TO MJR-AN-2.                                          PIA
040100     MOVE     SPACES TO LVL-2.                                              PIA
040110     MOVE     ENRL-CTR-DPT TO ENRL-CT-2.                                    PIA
040120     WRITE    REPORT-RCD FROM LN-2 AFTER POSITIONING 3.                     PIA
040130     CLOSE    FACULTY-FILE.                                                 PIA
040140     CLOSE    STUDENT-FILE.                                                 PIA
040150     CLOSE    REPORT-FILE.                                                  PIA
040160     STOP RUN.                                                              PIA
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040180 WRITE-FAC-RTN.                                                   P1A
040190     PERFORM HD-CK-RTN THRU H-C-R-X.                              P1A
040200                                                                  P1A
040210     MOVE    CSE-FAC TO CSE-1.                                    P1A
040220     MOVE    SCT-FAC TO SCT-1.                                    P1A
040230     MOVE    HRS-FAC TO HRS-1.                                    P1A
040240     MOVE    SMYR-FAC TO SMYR-1.                                  P1A
040250     MOVE    NAME-FAC TO IDNT-1.                                  P1A
040260     WRITE   REPORT-RCD FROM LN-1 AFTER POSITIONING 2.            P1A
040270     ADD     +2 TO LN-CTR.                                        P1A
040280 W-F-R-X. EXIT.                                                   P1A

040300 INITIAL-CK.                                                      P1A
040310     IF      CSE-SMYR-FAC NOT = CSE-SMYR-STD                      P1A
040320             DISPLAY 'ERROR-1 ' FACULTY-RCD    ' ' WS-STD         P1A
040330             GO TO   CLOSE-FILES.                                 P1A
040340     MOVE    MJR-STD TO MJR-SV-1.                                 P1A
040350     MOVE    LVL-STD TO LVL-SV-1.                                 P1A
040360 I-C-X. EXIT.                                                     P1A

040380 WRITE-ENRL.                                                      P1A
040390     PERFORM HD-CK-RTN THRU H-C-R-X.                              P1A
040400                                                                  P1A
040410     MOVE    MJR-SV-1 TO MJR-2.                                   P1A
040420     MOVE    LVL-SV-1 TO LVL-2.                                   P1A
040430     MOVE    ENRL-CTR-ML TO ENRL-CT-2.                            P1A
040440     WRITE   REPORT-RCD FROM LN-2 AFTER POSITIONING 1.            P1A
040450     ADD     +1 TO LN-CTR.                                        P1A
040460     MOVE    MJR-STD TO MJR-SV-1.                                 P1A
040470     MOVE    LVL-STD TO LVL-SV-1.                                 P1A
040480     MOVE    ZERO TO ENRL-CTR-ML.                                 P1A
040490 W-E-X. EXIT.                                                     P1A

050010 HD-CK-RTN.                                                       P1A
050020     IF      LN-CTR > +55                                         P1A
050030             ADD     +1 TO PG-CTR                                 P1A
050040             MOVE    PG-CTR TO PG-1                               P1A
050050             MOVE    +10 TO LN-CTR                                P1A
050060             WRITE   REPORT-RCD FROM HD-1 AFTER POSITIONING 0     P1A
050070             WRITE   REPORT-RCD FROM HD-2 AFTER POSITIONING 1     P1A
050080             WRITE   REPORT-RCD FROM HD-3 AFTER POSITIONING 3     P1A
050090             WRITE   REPORT-RCD FROM HD-4 AFTER POSITIONING 2     P1A
050100             WRITE   REPORT-RCD FROM SPCR AFTER POSITIONING 2.    P1A
050110 H-C-R-X. EXIT.                                                   P1A
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010010 ID DIVISION.                                                  P2
010020 PROGRAM-ID. P2.                                               P2
010030 AUTHOR. GUSE.                                                 P2
010040 DATE-WRITTEN. 3/77                                            P2
010050 DATE-COMPILED. JUN  1,1977                                    P2
010060 REMARKS.                                                      P2
010070           THIS PROGRAM ENTERS WEIGHTS, ONE ITERATION AT A TIME, ON P2
010080      EITHER THE FACULTY OR STUDENT FILE.  IT IS INTENDED THAT THISP2
010090      PROGRAM WILL BE EXECUTED A NUMBER OF TIMES--ONE TIME FOR EACHP2
010100      SET OF WEIGHTS AS DENOTED BY THE SUBSCRIPT ON THE HEADER    P2
010110      RECORD OF THE CONTROL FILE.                                 P2
010120                                                                  P2
010130                                                                  P2
010140 ENVIRONMENT DIVISION.                                            P2
010150 CONFIGURATION SECTION.                                           P2
010160 INPUT-OUTPUT SECTION.                                            P2
010170 FILE-CONTROL.                                                    P2
010180      SELECT  APPORTION-FILE      ASSIGN  UT-S-C13620.            P2
010190                                                                  P2
010200      SELECT  FACULTY-FILE        ASSIGN  DA-I-D13621             P2
010210              RECORD KEY IS FAC-KEY.                              P2
010220      SELECT  STUDENT-FILE        ASSIGN  DA-I-D13623             P2
010230              RECORD KEY IS STD-KEY.                              P2
010240                                                                  P2
010250 DATA DIVISION.                                                   P2
010260 FILE SECTION.                                                    P2
010270 FD   APPORTION-FILE                                              P2
010280      LABEL RECORDS STANDARD                                      P2
010290      BLOCK  0.                                                   P2
010300 01   APPORTION-RCD               PIC X(80).                      P2
010310                                                                  P2
010320 FD   FACULTY-FILE                                                P2
010330      LABEL RECORDS STANDARD                                      P2
010340      BLOCK 0.                                                    P2
010350 01   FACULTY-RCD.                                                P2
010360          05  F                   PIC X.                          P2
010370          05  FAC-KEY             PIC X(26).                      P2
010380          05  F                   PIC X(73).                      P2
010390                                                                  P2
010400 FD   STUDENT-FILE                                                P2
010410      LABEL RECORDS STANDARD                                      P2
010420      BLOCK 0.                                                    P2
010430 01   STUDENT-RCD.                                                P2
010440          05  F                   PIC X.                          P2
010450          05  STD-KEY             PIC X(26).                      P2
010460          05  F                   PIC X(73).                      P2
010470                                                                  P2
010480 WORKING-STORAGE SECTION.                                         P2
010490 01   FILLER COMP-3.                                              P2
010500          05  SUB1                PIC S999     VALUE ZERO.        P2
020010          05  SUB2                PIC S999     VALUE ZERO.        P2
020020          05  APRTN-CTR           PIC S999     VALUE ZERO.        P2
020030          05  FAC-CTR-I           PIC S999     VALUE ZERO.        P2
020040          05  FAC-CTR-O           PIC S999     VALUE ZERO.        P2
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020050    05  STD-CTR-I              PIC S999     VALUE ZERO.             P2
020060    05  STD-CTR-O              PIC S999     VALUE ZERO.             P2
020070    05  MAX-RNG                PIC S999     VALUE ZERO.             P2
020080                                                                    P2
020090 01 FILLER.                                                         P2
020100    05  FAC-OPEN               PIC X        VALUE SPACE.            P2
020110    05  STD-OPEN               PIC X        VALUE SPACE.            P2
020120    05  SKIP-READ              PIC X        VALUE SPACE.            P2
020130    05  SV-DATA-ITEM           PIC X(4)     VALUE SPACE.            P2
020140    05  UNPK.                                                       P2
020150        10  UNPK-FTE           PIC 9(3).                            P2
020160                                                                    P2
020170 01 WS-RCD.                                                         P2
020180    05  F                      PIC X.                               P2
020190    05  KEY-RCD.                                                    P2
020200        10  CSE-DATA.                                               P2
020210            15  DPT-RCD        PIC X(4).                            P2
020220            15  CSE-RCD        PIC X(4).                            P2
020230            15  SCTN-RCD       PIC XXX.                             P2
020240            15  HRS-RCD        PIC XX.                              P2
020250        10  SMYR               PIC 999.                             P2
020260        10  IDNT               PIC X(10).                           P2
020270    05  FS-1                   PIC XX.                              P2
020280    05  FS-2.                                                       P2
020290        10  FS-2N              PIC S999                 COMP-3.     P2
020300    05  NMBR.                                                       P2
020310        10  NMBR-N OCCURS 10   PIC S999                 COMP-3.     P2
020320        10  PCT-N  OCCURS 10   PIC S999V99              COMP-3.     P2
020330    05  F-1                    PIC X(11).                           P2
020340    05  MJR.                                                        P2
020350        10  MJR-N              PIC 9(5)                 COMP-3.     P2
020360    05  COST                   PIC S9(7)V99             COMP-3.     P2
020370                                                                    P2
020380 01 WS-APRTN-HDR.                                                   P2
020390    05  RCD-TYPE               PIC XXX.                             P2
020400        88  FAC-TYPE                        VALUE 'FAC'.            P2
020410        88  STD-TYPE                        VALUE 'STD'.            P2
020420    05  IB-CD                  PIC X.                               P2
020430        88  INDIVIDUAL-CD                   VALUE 'I'.              P2
020440        88  BLANKET-CD                      VALUE 'B'.              P2
020450    05  SORT-CD                PIC XXX.                             P2
020460        88  100-CD                          VALUE '100'.            P2
020470        88  105-CD                          VALUE '105'.            P2
020480    05  F                      PIC X.                               P2
020490    05  SBSCRPT                PIC 9.                               P2
020500    05  WT-CD                  PIC XXXX.                            P2
030010        88  CSE-CD                          VALUE 'CSE '.           P2
030020        88  SCTN-CD                         VALUE 'SCTN'.           P2
030030        88  HRS-CD                          VALUE 'HRS '.           P2
030040        88  RANK-CD                         VALUE 'RANK'.           P2
030050        88  FTE-CD                          VALUE 'FTE '.           P2
030060    05  F                      PIC X(67).                           P2
030070                                                                    P2
030080 01 WS-APRTN-I REDEFINES WS-APRTN-HDR.                              P2
030090    05  F                      PIC X(10).                           P2
030100    05  KEY-I                  PIC X(26).                           P2
030110    05  WT-I                   PIC 999.                             P2
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       05  F                           PIC X(41).                     P2
                                                                      P2
       01  WS-APRTN-B REDEFINES WS-APRTN-HDR.                         P2
           05  F                       PIC X(10).                     P2
           05  WT-DATA OCCURS  6.                                     P2
               10  LO-B                PIC X(4).                      P2
               10  HI-B                PIC X(4).                      P2
               10  WT-B                PIC 999.                       P2
           05  F                       PIC X(4).                      P2
                                                                      P2
                                                                      P2
       PROCEDURE DIVISION.                                            P2
           OPEN    INPUT APPORTION-FILE.                              P2
                                                                      P2
       READ-APPORTION-FILE.                                           P2
           READ    APPORTION-FILE INTO WS-APRTN-HDR                   P2
                   AT END  GO TO   CLOSE-FILES.                       P2
                                                                      P2
                                                                      P2
           ADD     +1 TO APRTN-CTR.                                   P2
           ON 1    PERFORM HDR-RTN THRU H-R-X                         P2
                   GO TO   READ-APPORTION-FILE.                       P2
                                                                      P2
           IF      SORT-CD NOT = '105'                                P2
                   DISPLAY 'ERROR-3 ' WS-APRTN-HDR                    P2
                   GO TO   CLOSE-FILES.                               P2
                                                                      P2
       IB-BRANCH.                                                     P2
           GO TO   ALTER-PARAGRAPHS.                                  P2
                                                                      P2
      ****                                                        ****P2
      ****         THE FOLLOWING CODE PROCESSES INDIVIDUAL FACULTY OR ****P2
      **** STUDENT WEIGHT TRANSACTIONS.                           ****P2
      ****                                                        ****P2
                                                                      P2
       ALTER-PARAGRAPHS.                                              P2
           GO TO   READ-D21.                                          P2
                                                                      P2
       READ-D21.                                                      P2
           IF      SKIP-READ = '1' MOVE SPACE TO SKIP-READ            P2
                   GO TO   COMPARE-FAC.                               P2
           READ    FACULTY-FILE INTO WS-RCD                           P2
                   AT END  DISPLAY 'ERROR-9A ' WS-APRTN-I             P2
                   GO TO   CLOSE-FILES.                               P2
           ADD     +1 TO FAC-CTR-I.                                   P2
       COMPARE-FAC.                                                   P2
           IF      KEY-I > KEY-RCD                                    P2
                   GO TO   READ-D21.                                  P2
                                                                      P2
           IF      KEY-I < KEY-RCD                                    P2
                   DISPLAY 'ERROR-5A ' WS-APRTN-I                     P2
                   MOVE    '1' TO SKIP-READ                           P2
                   GO TO   READ-APPORTION-FILE.                       P2
                                                                      P2
           MOVE    WT-I TO NMBR-N (SUB1).                             P2
           REWRITE FACULTY-RCD FROM WS-RCD.                           P2
           ADD     +1 TO FAC-CTR-O.                                   P2
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040190       GO TO    READ-APPORTION-FILE.                                  P2
040200                                                                      P2
040210 READ-D23.                                                            P2
040220       IF       SKIP-READ = '1' MOVE SPACE TO SKIP-READ              P2
040230                GO TO   COMPARE-STD.                                  P2
040240       READ     STUDENT-FILE INTO WS-RCD                              P2
040250                AT END  DISPLAY 'ERROR-9B ' WS-APRTN-I               P2
040260                GO TO   CLOSE-FILES.                                  P2
040270       ADD      +1 TO STD-CTR-I.                                      P2
040280 COMPARE-STD.                                                         P2
040290       IF       KEY-I > KEY-RCD                                       P2
040300                GO TO   READ-D23.                                     P2
040310                                                                      P2
040320       IF       KEY-I < KEY-RCD                                       P2
040330                DISPLAY 'ERROR-5B ' WS-APRTN-I                        P2
040340                MOVE    '1' TO SKIP-READ                              P2
040350                GO TO   READ-APPORTION-FILE.                          P2
040360                                                                      P2
040370       MOVE     WT-I TO NMBR-N (SUB1).                                P2
040380       REWRITE  STUDENT-RCD FROM WS-RCD.                              P2
040390       ADD      +1 TO STD-CTR-O.                                      P2
040400       GO TO    READ-APPORTION-FILE.                                  P2
040410                                                                      P2
040420****                                                              ****P2
040430****      THE FOLLOWING CODE PROCESSES BLANKET FACULTY OR         ****P2
040440**** STUDENT WEIGHT TRANSACTIONS.                                 ****P2
040450****                                                              ****P2
040460                                                                      P2
040470 EDIT-B105.                                                           P2
040480       PERFORM  EDIT-B105-RCD THRU E-B-R-X.                           P2
040490                                                                      P2
040500 READ-DISK.                                                           P2
050010       PERFORM  READ-DISK-RTN THRU R-D-R-X.                           P2
050020 PROCESS-B.                                                           P2
050030       GO TO    PARA-1.                                               P2
050040 PARA-1.                                                              P2
050050       MOVE     CSE-RCD TO SV-DATA-ITEM.                              P2
050060       GO TO    COMPUTE-RANGE.                                        P2
050070                                                                      P2
050080 PARA-2.                                                              P2
050090       MOVE     SCTN-RCD TO SV-DATA-ITEM.                             P2
050100       GO TO    COMPUTE-RANGE.                                        P2
050110                                                                      P2
050120 PARA-3.                                                              P2
050130       MOVE     HRS-RCD TO SV-DATA-ITEM.                              P2
050140       GO TO    COMPUTE-RANGE.                                        P2
050150                                                                      P2
050160 PARA-4.                                                              P2
050170       MOVE     FS-1 TO SV-DATA-ITEM.                                 P2
050180       GO TO    COMPUTE-RANGE.                                        P2
050190                                                                      P2
050200 PARA-5.                                                              P2
050210       MOVE     FS-2N TO UNPK-FTE.                                    P2
050220       MOVE     UNPK TO SV-DATA-ITEM.                                 P2
050230                                                                      P2
050240 COMPUTE-RANGE.                                                       P2
050250       MOVE     ZERO TO SUB2.                                         P2
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050260 LOOP-RANGE.                                                    P2
050270     ADD     +1 TO SUB2.                                        P2
050280     IF      SUB2 > MAX-RNG                                     P2
050290             DISPLAY 'ERROR-6 ' WS-RCD                          P2
050300             MOVE    ZERO TO NMBR-N (SUB1)                      P2
050310             PERFORM WRITE-DISK-RTN THRU W-D-R-X                P2
050320             GO TO   READ-DISK.                                 P2
050330                                                                P2
050340     IF      (SV-DATA-ITEM = LO-B (SUB2) OR > LO-B (SUB2)) AND  P2
050350             (SV-DATA-ITEM = HI-B (SUB2) OR < HI-B (SUB2))      P2
050360             MOVE    WT-B (SUB2) TO NMBR-N (SUB1)               P2
050370             PERFORM WRITE-DISK-RTN THRU W-D-R-X                P2
050380             GO TO   READ-DISK.                                 P2
050390                                                                P2
050400     GO TO   LOOP-RANGE.                                        P2
050410                                                                P2
050420 CLOSE-FILES.                                                   P2
050430     DISPLAY '# OF APPORTION RECORDS READ ' APRTN-CTR.          P2
050440     DISPLAY '# OF FACULTY RECORDS INPUT  ' FAC-CTR-I.          P2
050450     DISPLAY '# OF FACULTY RECORDS OUTPUT ' FAC-CTR-O.          P2
050460     DISPLAY '# OF STUDENT RECORDS INPUT  ' STD-CTR-I.          P2
050470     DISPLAY '# OF STUDENT RECORDS OUTPUT ' STD-CTR-O.          P2
050480                                                                P2
050490     IF      FAC-OPEN = '1' CLOSE FACULTY-FILE.                 P2
050500     IF      STD-OPEN = '1' CLOSE STUDENT-FILE.                 P2
060010     CLOSE   APPORTION-FILE.                                    P2
060020     STOP RUN.                                                  P2


060040 HDR-RTN.                                                       P2
060050     IF      (SBSCRPT < 0 OR >  9)                              P2
060060             DISPLAY 'ERROR-1 ' WS-APRTN-HDR                    P2
060070             GO TO   CLOSE-FILES.                               P2
060080     IF      SBSCRPT = 0                                        P2
060090             MOVE    +10 TO SUB1                                P2
060100             ELSE                                               P2
060110             MOVE    SBSCRPT TO SUB1.                           P2
060120                                                                P2
060130     IF      FAC-TYPE                                           P2
060140             OPEN    I-O FACULTY-FILE                           P2
060150             MOVE    '1' TO FAC-OPEN                            P2
060160             GO TO   FACULTY-ALTERS.                            P2
060170     IF      STD-TYPE                                           P2
060180             OPEN    I-O STUDENT-FILE                           P2
060190             MOVE    '1' TO STD-OPEN                            P2
060200             GO TO   STUDENT-ALTERS.                            P2
060210     DISPLAY 'ERROR-2 ' WS-APRTN-HDR.                           P2
060220     GO TO   CLOSE-FILES.                                       P2
060230                                                                P2
060240 FACULTY-ALTERS.                                                P2
060250     IF      INDIVIDUAL-CD                                      P2
060260             GO TO   H-R-X.                                     P2
060270*                                                               P2
060280* THE ABOVE CONDITION IS THE PGM LOGIC DEFAULT CONDITION        P2
060290*                                                               P2
060300                                                                P2
060310                                                                P2
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           IF        IB-CO NOT = 'B'                                   P2
                     DISPLAY 'ERROR-4A ' WS-APRTN-HDR                  P2
                     GO TO   CLOSE-FILES.                              P2
                                                                       P2
           ALTER     IB-BRANCH TO PROCEED TO EDIT-BIO5.                P2
           IF        CSE-CD  GO TO H-R-X.                              P2
           IF        SCTN-CD ALTER PROCESS-B TO PROCEED TO PARA-2      P2
                     GO TO   H-R-X.                                    P2
           IF        HRS-CD  ALTER PROCESS-B TO PROCEED TO PARA-3      P2
                     GO TO   H-R-X.                                    P2
           IF        RANK-CD ALTER PROCESS-B TO PROCEED TO PARA-4      P2
                     GO TO   H-R-X.                                    P2
           IF        FTE-CD  ALTER PROCESS-B TO PROCEED TO PARA-5      P2
                     GO TO   H-R-X.                                    P2
           DISPLAY 'ERROR-4B ' WS-APRTN-HDR.                           P2
           GO TO   CLOSE-FILES.                                        P2
       STUDENT-ALTERS.                                                 P2
           IF        INDIVIDUAL-CD                                     P2
                     ALTER   ALTER-PARAGRAPHS TO PROCEED TO READ-D23   P2
                     GO TO   H-R-X.                                    P2
           IF        IB-CD NOT = 'B'                                   P2
                     DISPLAY 'ERROR-4C ' WS-APRTN-HDR                  P2
                     GO TO   CLOSE-FILES.                              P2
           ALTER     IB-BRANCH TO PROCEED TO EDIT-BIO5.                P2
           ALTER     READ-1 TO PROCEED TO READ-STD.                    P2
           ALTER     WRITE-1 TO PROCEED TO RW-STD.                     P2
           IF        CSE-CD  GO TO H-R-X.                              P2
           IF        SCTN-CD ALTER PROCESS-B TO PROCEED TO PARA-2      P2
                     GO TO   H-R-X.                                    P2
           IF        HRS-CD  ALTER PROCESS-B TO PROCEED TO PARA-3      P2
                     GO TO   H-R-X.                                    P2
           IF        RANK-CD ALTER PROCESS-B TO PROCEED TO PARA-4      P2
                     GO TO   H-R-X.                                    P2
           DISPLAY 'ERROR-4D ' WS-APRTN-HDR.                           P2
           GO TO   CLOSE-FILES.                                        P2
       H-R-X. EXIT.                                                    P2

       EDIT-BIO5-RCD.                                                  P2
           MOVE      ZERO TO SUB2.                                     P2
       EDIT-LOOP.                                                      P2
           ADD       +1 TO SUB2.                                       P2
           IF        SUB2 > +6                                         P2
                     MOVE    +6 TO MAX-RNG                             P2
                     GO TO   TEST-MAX.                                 P2
           IF        WT-DATA (SUB2) = SPACES                           P2
                     COMPUTE MAX-RNG = SUB2 - 1                        P2
                     GO TO   TEST-MAX.                                 P2
           IF        WT-B (SUB2) NOT NUMERIC                           P2
                     DISPLAY 'ERROR-10 ' WS-APRTN-B ' ' SUB2           P2
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070380                GO TO   CLOSE-FILES.                        P2
070390        GO TO   EDIT-LOOP.                                  P2
070400                                                            P2
070410 TEST-MAX.                                                  P2
070420        IF      MAX-RNG < 1                                 P2
070430                DISPLAY 'ERROR-11 ' WS-APRTN-B ' ' MAX-RNG  P2
070440                GO TO   CLOSE-FILES.                        P2
070450 E-B-R-X. EXIT.                                             P2

070470 READ-DISK-RTN.                                             P2
070480 READ-1.                                                    P2
070490        GO TO   READ-FAC.                                   P2
070500 READ-FAC.                                                  P2
080010        READ    FACULTY-FILE INTO WS-RCD                    P2
080020                AT END                                      P2
080030                GO TO   CLOSE-FILES.                        P2
080040        ADD     +1 TO FAC-CTR-I.                            P2
080050        GO TO   R-D-R-X.                                    P2
080060                                                            P2
080070                                                            P2
080080 READ-STD.                                                  P2
080090        READ    STUDENT-FILE INTO WS-RCD                    P2
080100                AT END                                      P2
080110                GO TO   CLOSE-FILES.                        P2
080120        ADD     +1 TO STD-CTR-I.                            P2
080130                                                            P2
080140 R-D-R-X. EXIT.                                             P2

080160 WRITE-DISK-RTN.                                            P2
080170 WRITE-1.                                                   P2
080180        GO TO   RW-FAC.                                     P2
080190 RW-FAC.                                                    P2
080200        REWRITE FACULTY-RCD FROM WS-RCD.                    P2
080210                                                            P2
080220        ADD     +1 TO FAC-CTR-O.                            P2
080230        GO TO   W-D-R-X.                                    P2
080240                                                            P2
080250 RW-STD.                                                    P2
080260        REWRITE STUDENT-RCD FROM WS-RCD.                    P2
080270                                                            P2
080280        ADD     +1 TO STD-CTR-O.                            P2
080290                                                            P2
080300 W-D-R-X. EXIT.                                             P2
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010010 ID DIVISION.                                                      P3
010020 PROGRAM-ID. P3.                                                   P3
010030 AUTHOR. GOSE.                                                     P3
010032 DATE-WRITTEN. 3/77                                                P3
010034 DATE-COMPILED. JUN  1,1977                                        P3
010040 REMARKS.                                                          P3
010050 ENVIRONMENT DIVISION.                                             P3
010060 CONFIGURATION SECTION.                                            P3
010070 INPUT-OUTPUT SECTION.                                             P3
010080 FILE-CONTROL.                                                     P3
010090         SELECT  EITHER-FILE-IN       ASSIGN  UT-S-D136IN.         P3
010100         SELECT  CONVERSION-FILE      ASSIGN  UT-S-C13630.         P3
010110         SELECT  EITHER-FILE-OT       ASSIGN  UT-S-D136OT.         P3
010120                                                                   P3
010130 DATA DIVISION.                                                    P3
010140 FILE SECTION.                                                     P3
010150 FD  EITHER-FILE-IN                                                P3
010160     LABEL RECORDS STANDARD                                        P3
010170     BLOCK 0.                                                      P3
010180 01  EITHER-RCD-IN.                                                P3
010190     05  EITHER-DLT               PIC X.                           P3
010200     05  EITHER-KEY               PIC X(26).                       P3
010210     05  F                        PIC X(73).                       P3
010220                                                                   P3
010230 FD  CONVERSION-FILE                                               P3
010240     LABEL RECORDS STANDARD                                        P3
010250     BLOCK 80.                                                     P3
010260 01  CONVERSION-RCD               PIC X(80).                       P3
010270                                                                   P3
010280 FD  EITHER-FILE-OT                                                P3
010290     LABEL RECORDS STANDARD                                        P3
010300     BLOCK 0.                                                      P3
010310 01  EITHER-RCD-OT                PIC X(100).                      P3
010320                                                                   P3
010330 WORKING-STORAGE SECTION.                                          P3
010340 01  FILLER            PIC X(15) VALUE 'WORKING STORAGE'.          P3
010350 01  FILLER COMP-3.                                                P3
010360     05  SUB1                     PIC S999     VALUE ZERO.         P3
010370     05  SUB1A                    PIC S999     VALUE ZERO.         P3
010380     05  SUB2                     PIC S999     VALUE ZERO.         P3
010390     05  SUB3                     PIC S999     VALUE ZERO.         P3
010400     05  SUB4                     PIC S999     VALUE ZERO.         P3
010410     05  COL-WT-SUB               PIC S999     VALUE ZERO.         P3
010420     05  COL-PCT-SUB              PIC S999     VALUE ZERO.         P3
010430     05  EITHER-CTR-IN            PIC S999     VALUE ZERO.         P3
010440     05  EITHER-CTR-OT            PIC S999     VALUE ZERO.         P3
010450     05  TBL-LIMIT                PIC S999     VALUE ZERO.         P3
010460     05  MAX-TBL                  PIC S999     VALUE +500.         P3
010470     05  SUM-WT                   PIC S9(7)    VALUE ZERO.         P3
010480     05  PCTG-STG OCCURS 500      PIC S9V9999999.                  P3
010490     05  FRCTN                    PIC S9V9999999 VALUE +.00005.    P3
010500     05  NMBR-ACCM                PIC S9V9999 VALUE ZERO.          P3
020010                                                                   P3
020020 01  FILLER.                                                       P3
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020030          05  SUB-KEY-SV               PIC X(13).                    P3
020040          05  SUB23-KEY-SV.                                          P3
                    10  CSE-DATA-SV          PIC X(13).                    P3
020050              10  SMYR-SV              PIC XXX.                      P3
020060          05  SUB23-KEY-TEMP.                                        P3
020070              10  CSE-DATA-TEMP        PIC X(13).                    P3
020080              10  SMYR-TEMP            PIC XXX.                      P3
020090          05  PCTG-HOLD                PIC 9V9999999.                P3
020100          05  PCTG-R REDEFINES PCTG-HOLD.                            P3
020110              10  PCTG-KEEP            PIC 9V9999.                   P3
020120              10  PCTG-DROP            PIC 999.                      P3
020130          05  ABND-IT                  PIC X        VALUE SPACE.     P3
020140          05  ABND-ITR REDEFINES ABND-IT PIC 9.                      P3
020150                                                                     P3
020160                                                                     P3
020170 01   FILLER-TBL.                                                    P3
020180      05  WS-RCD OCCURS 500.                                         P3
020190          10  F                            PIC X.                    P3
020200          10  KEY-RCD.                                               P3
020210              15  CSE-DATA         PIC X(13).                        P3
020220              15  SUB-KEY.                                           P3
020230                  20  SMYR                 PIC 999.                  P3
020240                  20  IDNT                 PIC X(10).                P3
020250          10  F                            PIC X(4).                 P3
020260          10  NMBR.                                                  P3
020270              15  NMBR-N OCCURS 10     PIC S999           COMP-3.    P3
020280              15  PCT-N OCCURS 10      PIC S9V9999        COMP-3.    P3
020290          10  F                            PIC X(19).                P3
020300                                                                     P3
020310 01   CTL-RCD.                                                       P3
020320      05  CTL-COL CCCURS 10                PIC X.                    P3
020330      05  F                                PIC X(5).                 P3
020340      05  WHICH-FILE                       PIC XXX.                  P3
020350      05  F                                PIC X(62).                P3
020360                                                                     P3
020370 PROCEDURE DIVISION.                                                 P3
020380      OPEN     INPUT  CONVERSION-FILE.                               P3
020390      OPEN     INPUT  EITHER-FILE-IN.                                P3
020400      OPEN     OUTPUT EITHER-FILE-OT.                                P3
020410                                                                     P3
020420 READ-CONVERSION-FILE.                                               P3
020430      READ     CONVERSION-FILE INTO CTL-RCD                          P3
020440                AT END  DISPLAY 'ERROR-1 NO CONVERSION RECORD'      P3
020450                GO TO   CLOSE-FILES.                                 P3
020460      DISPLAY 'CONVERSION RECORD ' CTL-RCD.                          P3
020470      IF       WHICH-FILE = 'STD'                                    P3
020480               ALTER   PARA-1  TO PROCEED TO PARA-3                  P3
020490               ALTER   PARA-1A TO PROCEED TO PARA-3A                 P3
020500               GO TO READ-EITHER-FILE-IN.                            P3
030010      IF       WHICH-FILE NOT = 'FAC'                                P3
030020               DISPLAY 'ERROR-1A ' GO TO CLOSE-FILES.                P3
030030                                                                     P3
030040                                                                     P3
030050****                                                             ****P3
030060****       READ EITHER-FILE-IN INTO CORE.                        ****P3
030070****                                                             ****P3
030080                                                                     P3
030090 READ-EITHER-FILE-IN.                                                P3
```

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030100     READ    EITHER-FILE-IN                                          P3
030110             AT END                                                  P3
030120             GO TO   SET-TBL-LIMIT.                                  P3
030130     ADD     +1 TO SUB1 EITHER-CTR-IN.                               P3
030140                                                                     P3
030150     IF      SUB1 > MAX-TBL                                          P3
030160             DISPLAY 'ERROR-2 TABLE SIZE EXCEEDED ' SUB1             P3
030170             GO TO   CLOSE-FILES.                                    P3
030180                                                                     P3
030190     MOVE    EITHER-RCD-IN TO WS-RCD (SUB1).                         P3
030200     GO TO   READ-EITHER-FILE-IN.                                    P3
030210                                                                     P3
030220 SET-TBL-LIMIT.                                                      P3
030230     MOVE    SUB1 TO TBL-LIMIT.                                      P3
030240                                                                     P3
030250                                                                     P3
030260****                                                             ****P3
030270****      THE FOLLOWING PORTION OF THIS PROGRAM CHECKS COLUMNS   ****P3
030280**** 1 THRU 10 OF THE CONTROL RECORD (ONE AT A TIME) FOR THE     ****P3
030290**** VALUE 'X'.  IF 'X' IS FOUND IN ANY COLUMN, THAT COLUMN      ****P3
030300**** NUMBER CORRESPONDS TO THE RESPECTIVE COLUMN OF NMBR-N       ****P3
030310**** WEIGHTS FOUND IN THE TABLE IN CORE (FILLER-TBL).            ****P3
030320****                                                             ****P3
030330                                                                     P3
030340     MOVE    ZERO TO SUB4.                                           P3
030350 CHECK-CONTROL-CARD.                                                 P3
030360     ADD     +1 TO SUB4.                                             P3
030370     IF      SUB4 > +10                                              P3
030380             GO TO   WRITE-OUTPUT.                                   P3
030390                                                                     P3
030400     IF      (CTL-COL (SUB4) = 'X') AND (SUB4 < 6)                   P3
030410             PERFORM COMPUTE-IND-PCTG THRU C-I-P-X                   P3
030420             GO TO   CHECK-CONTROL-CARD.                             P3
030430                                                                     P3
030440     IF      (CTL-COL (SUB4) = 'X') AND (SUB4 < 11)                  P3
030450             PERFORM COMPUTE-DPT-PCTG THRU C-D-P-X                   P3
030460             GO TO   CHECK-CONTROL-CARD.                             P3
030470                                                                     P3
030480     GO TO   CHECK-CONTROL-CARD.                                     P3
030490                                                                     P3
030500 WRITE-OUTPUT.                                                       P3
040010     MOVE    ZERO TO SUB1.                                           P3
040020 WRITE-LOOP.                                                         P3
040030     ADD     +1 TO SUB1.                                             P3
040040     IF      SUB1 > TBL-LIMIT                                        P3
040050             GO TO   CLOSE-FILES.                                    P3
040060                                                                     P3
040070     WRITE   EITHER-RCD-OT FROM WS-RCD (SUB1).                       P3
040080     ADD     +1 TO EITHER-CTR-OT.                                    P3
040090     GO TO   WRITE-LOOP.                                             P3
040100                                                                     P3
040110                                                                     P3
040120 CLOSE-FILES.                                                        P3
040130      DISPLAY 'TBL-LIMIT   ' TBL-LIMIT.                              P3
040140      DISPLAY 'INPUT RCDS  ' EITHER-CTR-IN.                          P3
040150      DISPLAY 'OUTPUT RCDS ' EITHER-CTR-OT.                          P3
040160                                                                     P3
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                                                                        P3
           CLOSE   CONVERSION-FILE.                                     P3
           CLOSE   EITHER-FILE-IN.                                      P3
           CLOSE   EITHER-FILE-OT.                                      P3
           STOP RUN.                                                    P3

       COMPUTE-IND-PCTG.                                                P3
           MOVE    SUB4 TO COL-WT-SUB CCL-PCT-SUE.                      P3
           MOVE    ZERO TC SUB1.                                        P3
           MOVE    +1 TO SUB2.                                          P3
       MOVE-KEY.                                                        P3
       PARA-1.                                                          P3
           GO TO   PARA-2.                                              P3
       PARA-2.                                                          P3
           MOVE    SUB-KEY (SUB2) TO SUB-KEY-SV.                        P3
           GO TO   COMPUTE-IND-LOOP.                                    P3
       PARA-3.                                                          P3
           MOVE    CSE-DATA (SUB2) TO CSE-DATA-SV.                      P3
           MOVE    SMYR (SUB2) TO SMYR-SV.                              P3
                                                                        P3
       COMPUTE-IND-LOCP.                                                P3
           ADD     +1 TC SUB1.                                          P3
           IF      SUB1 > TBL-LIMIT                                     P3
                   COMPUTE SUB3 = SUB1 - 1                              P3
                   PERFORM DECIMAL-ACCUMULATION-RTN THRU D-A-R-X        P3
                   GO TO   C-I-P-X.                                     P3
       PARA-1A.                                                         P3
           GO TO   PARA-2A.                                             P3
       PARA-2A.                                                         P3
           IF      SUB-KEY (SUB1) = SUB-KEY-SV                          P3
                   GC TC   COMPUTE-IND-LOCP.                            P3
           GO TO COMPUTE-SUB3.                                          P3
       PARA-3A.                                                         P3
           MOVE    CSE-CATA (SUB1) TO CSE-CATA-TEMP.                    P3
           MOVE    SMYR (SUB1) TO SMYR-TEMP.                            P3
           IF      SUB23-KEY-TEMP = SUB23-KEY-SV                        P3
                   GO TO   COMPUTE-IND-LOCP.                            P3
       COMPUTE-SUB3.                                                    P3
                                                                        P3
           COMPUTE SUB3 = SUB1 - 1.                                     P3
           PERFORM DECIMAL-ACCUMULATION-RTN THRU D-A-R-X.               P3
                                                                        P3
           MOVE    SUB1 TC SUB2.                                        P3
           GO TO   MOVE-KEY.                                            P3
       C-I-P-X. EXIT.                                                   P3

       COMPUTE-DPT-PCTG.                                                P3
           MOVE    SUB4 TO COL-WT-SUB CCL-PCT-SUB.                      P3
           MOVE    +1 TC SUB2.                                          P3
           MOVE    TBL-LIMIT TO SUB3.                                   P3
                                                                        P3
           PERFORM DECIMAL-ACCUMULATICN-RTN THRU D-A-R-X.               P3
                                                                        P3
       C-D-P-X. EXIT.                                                   P3
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050220****      SUB2 IS THE LOWER LIMIT & SUB3 IS THE UPPER LIMIT     ****P3
050230**** OF THE DECIMAL-ACCUMULATION-RTN.                           ****P3
050240 DECIMAL-ACCUMULATION-RTN.                                          P3
050250     COMPUTE SUB1A = SUB2 - 1. MOVE +.00005 TO FRCTN.               P3
050260     MOVE    ZERO TO SUM-WT NMBR-ACCM.                              P3
050270 ADD-LOOP.                                                          P3
050280     ADD     +1 TO SUB1A.                                           P3
050290     IF      SUB1A > SUB3                                           P3
050300             GO TO   CALC-PCTG.                                     P3
050310                                                                    P3
050320     ADD     NMBR-N (SUB1A, COL-WT-SUB) TO SUM-WT ON SIZE ERROR     P3
050330             DISPLAY 'ERROR-5 '                                     P3
050340             ADD     +1 TO ABND-ITR  GO TO CLOSE-FILES.             P3
050350     GO TO   ADD-LOOP.                                              P3
050360 CALC-PCTG.                                                         P3
050370     IF      SUM-WT = ZERO                                          P3
050380             DISPLAY 'NO WEIGHTS IN COLUMN ' COL-WT-SUB             P3
050390             GO TO   D-A-R-X.                                       P3
050400     COMPUTE SUB1A = SUB2 - 1.                                      P3
050410 CALC-LOOP.                                                         P3
050420     ADD     +1 TO SUB1A.                                           P3
050430     IF      SUB1A > SUB3                                           P3
050440             GO TO   CK-100.                                        P3
050450                                                                    P3
050460     COMPUTE PCTG-STG (SUB1A) ROUNDED =                             P3
050470            (NMBR-N (SUB1A, COL-WT-SUB) / SUM-WT)                   P3
050480             ON SIZE ERROR                                          P3
050490             DISPLAY 'ERROR-3, SIZE ERROR'                          P3
050500                     ADD     +1 TO ABND-ITR                         P3
060010                     GO TO   CLOSE-FILES.                           P3
060020     GO TO   CALC-LOOP.                                             P3
060030                                                                    P3
060040 CK-100.                                                            P3
060050     COMPUTE SUB1A = SUB2 - 1.                                      P3
060060 ROUND-LOOP.                                                        P3
060070     ADD     +1 TO SUB1A.                                           P3
060080     IF      SUB1A > SUB3                                           P3
060090             GO TO   TEST-100.                                      P3
060100     MOVE    PCTG-STG (SUB1A) TO PCTG-HOLD.                         P3
060110     ADD     FRCTN TO PCTG-HOLD ON SIZE ERROR                       P3
060120             DISPLAY 'ERROR-4, '                                    P3
060130             ADD     +1 TO ABND-ITR                                 P3
060140             GO TO   CLOSE-FILES.                                   P3
060150     MOVE    PCTG-KEEP  TO PCT-N  (SUB1A, COL-PCT-SUB).             P3
060160     ADD     PCTG-KEEP  TO NMBR-ACCM.                               P3
060170     MOVE    ZERO TO PCTG-KEEP.                                     P3
060180     MOVE    PCTG-HOLD TO FRCTN.                                    P3
060190     GO TO   ROUND-LOOP.                                            P3
060200 TEST-100.                                                          P3
060210     IF      NMBR-ACCM NOT = +1.0                                   P3
060220             DISPLAY NMBR-ACCM                                      P3
060230             DISPLAY 'ERROR-6'  ADD +1 TO ABND-ITR                  P3
060240             GO TO   CLOSE-FILES.                                   P3
060250                                                                    P3
060260 D-A-R-X. EXIT.                                                     P3
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010010 ID DIVISION.                                                       P4
010020 PROGRAM-ID. P4.                                                    P4
010030 AUTHOR. GOSE.                                                      P4
010040 DATE-WRITTEN. 3/77                                                 P4
010050 DATE-COMPILED. JUN  1,1977                                         P4
010060 REMARKS.                                                           P4
010070          THIS PROGRAM READS D13621A & D13623A INTO TABLES IN CORE.P4
010080      IT THEN READS COST SOURCES AND SUBSCRIPTS FOR APPORTIONING    P4
010090      PROCEDURES FROM THE COST-SOURCE-FILE AND APPORTIONS COSTS TO  P4
010100      THE INDIVIDUAL STUDENT RECORDS IN CORE.                       P4
010110          WHEN THE COSTS FOR ONE ITERATION ARE APPORTIONED,         P4
010120      THEY ARE OUTPUT ON A TAPE FILE FOR SUBSEQUENT PROCESSING      P4
010130      BY JP5A OR JP5B.                                              P4
010140                                                                    P4
010150                                                                    P4
010160 ENVIRONMENT DIVISION.                                              P4
010170 CONFIGURATION SECTION.                                             P4
010180 INPUT-OUTPUT SECTION.                                              P4
010190 FILE-CONTROL.                                                      P4
010200     SELECT  FACULTY-FILE        ASSIGN  UT-S-D13621A.              P4
010210     SELECT  STUDENT-FILE        ASSIGN  UT-S-D13623A.              P4
010220     SELECT  STD-COST-FILE       ASSIGN  UT-S-T13640.               P4
010230     SELECT  COST-SOURCE-FILE    ASSIGN  UT-S-C13640.               P4
010240     SELECT  RPT-FILE            ASSIGN  UT-S-R13640.               P4
010250 DATA DIVISION.                                                     P4
010260 FILE SECTION.                                                      P4
010270 FD  FACULTY-FILE                                                   P4
010280     LABEL RECORDS STANDARD                                         P4
010290     BLOCK 0.                                                       P4
010300 01  FACULTY-RCD.                                                   P4
010310     05  F                       PIC X.                             P4
010320     05  FAC-KEY                 PIC X(13).                         P4
010330     05  F                       PIC X(86).                         P4
010340                                                                    P4
010350 FD  STUDENT-FILE                                                   P4
010360     LABEL RECORDS STANDARD                                         P4
010370     BLOCK 0.                                                       P4
010380 01  STUDENT-RCD.                                                   P4
010390     05  F                       PIC X.                             P4
010400     05  STD-KEY                 PIC X(13).                         P4
010410     05  F                       PIC X(86).                         P4
010420                                                                    P4
010430 FD  COST-SOURCE-FILE                                               P4
010440     LABEL RECORDS STANDARD                                         P4
010450     BLOCK 80.                                                      P4
010460 01  COST-SOURCE-RCD             PIC X(80).                         P4
010470                                                                    P4
010480 FD  STD-COST-FILE                                                  P4
010490     LABEL RECORDS STANDARD                                         P4
010500     BLOCK 0.                                                       P4
020010 01  STD-COST-RCD                PIC X(25).                         P4
020020                                                                    P4
020030                                                                    P4
020040 FD  RPT-FILE
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020050     LABEL RECORDS STANDARD                                        P4
020060     BLOCK 133.                                                    P4
020070 01  RPT-RCD                         PIC X(133).                   P4
020080                                                                   P4
020090 WORKING-STORAGE SECTION.                                          P4
020100 01  FILLER COMP-3.                                                P4
020110     05  SUB                         PIC S999     VALUE ZERO.      P4
020120     05  SUBD                        PIC S999     VALUE ZERO.      P4
020130     05  SUBF                        PIC S999     VALUE ZERO.      P4
020140     05  SUBS                        PIC S999     VALUE ZERO.      P4
020150     05  SUB-HIT                     PIC S999     VALUE ZERO.      P4
020160     05  SUB-KEY                     PIC S999     VALUE ZERO.      P4
020170     05  SUB1                        PIC S999     VALUE ZERO.      P4
020180                                                                   P4
020190     05  SUM-FAC                     PIC S9(7)V99 VALUE ZERO.      P4
020200     05  SUM-STD                     PIC S9(7)V99 VALUE ZERO.      P4
020210     05  MAX-FAC                     PIC S9(5)    VALUE ZERO.      P4
020220     05  MAX-STD                     PIC S9(5)    VALUE ZERO.      P4
020230     05  RJCT-CTR                    PIC S9(5)    VALUE ZERO.      P4
020240     05  RJCT-FAC-CTR                PIC S9(5)    VALUE ZERO.      P4
020250     05  RJCT-STD-CTR                PIC S9(5)    VALUE ZERO.      P4
020260     05  TAPE-CTR                    PIC S9(5)    VALUE ZERO.      P4
020270                                                                   P4
020280     05  APRTN-COST                  PIC S9(7)V99 VALUE ZERO.      P4
020290     05  COST-DIF                    PIC S9(7)V99 VALUE ZERO.      P4
020300     05  COST-SV                     PIC S9(7)V99 VALUE ZERO.      P4
020310     05  COST-DIF-LS                 PIC  9(7)V99 VALUE ZERO.      P4
020320     05  COST-TTL                    PIC S9(7)V99 VALUE ZERO.      P4
020330                                                                   P4
020340     05  PG-CTR                      PIC S999     VALUE ZERO.      P4
020350     05  LN-CTR                      PIC S999     VALUE +60.       P4
020360                                                                   P4
020370                                                                   P4
020380 01  FILLER.                                                       P4
020390     05  SBSCR-SV                    PIC X(4)     VALUE SPACE.     P4
020400     05  FAC-MATCH                   PIC X        VALUE SPACE.     P4
020410     05  STD-MATCH                   PIC X        VALUE SPACE.     P4
020420     05  KEY-SV.                                                   P4
020430         10  CI-SV                   PIC X(13)    VALUE SPACE.     P4
020440         10  SMYR-SV                 PIC 999      VALUE ZERO.      P4
020450     05  ITERATION-H.                                              P4
020460         10  ITERATION-NO            PIC 99       VALUE ZERO.      P4
020470     05  ABND-IT                     PIC X        VALUE SPACE.     P4
020480     05  ABND-ITR REDEFINES ABND-IT  PIC 9.                        P4
020490                                                                   P4
020500 01  HD-1.                                                         P4
030010     05  F                           PIC X(48)    VALUE ' R-136-40'. P4
030020     05  F                           PIC X(75)    VALUE            P4
030030         'DEPARTMENT COST & APPORTIONING REPORT'.                  P4
030040     05  F                           PIC X(5)     VALUE 'PAGE '.   P4
030050     05  PG-1                        PIC ZZ9.                      P4
030060                                                                   P4
030070 01  HD-2.                                                         P4
030080     05  F                           PIC X        VALUE SPACE.     P4
030090     05  DI-2                        PIC X(60).                    P4
030100     05  F                           PIC X(10)    VALUE 'ITERATION '. P4
030110     05  ITR-2                       PIC Z9.                       P4
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030120                                                                      P4
030130 01  HD-3.                                                            P4
030140     05  F                        PIC X(4)     VALUE SPACE.           P4
030150     05  F                        PIC X(56)    VALUE                  P4
           'COST AMOUNT      APPORTIONING       APPORTIONING'.              P4
030170     05  F                        PIC X(35)    VALUE                  P4
030180     '----------- FUND SOURCE -----------'.                           P4
030190                                                                      P4
030200 01  HD-4.                                                            P4
030210     05  F                        PIC X(21)    VALUE SPACE.           P4
030220     05  F                        PIC X(43)    VALUE                  P4
030230         'SUBSCRIPTS              KEYS'.                              P4
030240     05  F                        PIC X(28)    VALUE                  P4
030250         'PRIMARY                SECONDARY'.                          P4
030260                                                                      P4
030270                                                                      P4
030280 01  LN-1.                                                            P4
030290     05  F                        PIC XX       VALUE SPACE.           P4
030300     05  COST-AMT-1               PIC $$,$$$,$99.99.                  P4
030310     05  F                        PIC X(6)     VALUE SPACE.           P4
030320     05  SD-1-1                   PIC X.                              P4
030330     05  F                        PIC X        VALUE SPACE.           P4
030340     05  SD-2-1                   PIC XX.                             P4
030350     05  F                        PIC XX       VALUE SPACE.           P4
030360     05  SD-3-1                   PIC X.                              P4
030370     05  F                        PIC X        VALUE SPACE.           P4
030380     05  SD-4-1                   PIC XX.                             P4
030390     05  F                        PIC X(4)     VALUE SPACE.           P4
030400     05  KEY-1                    PIC X(16).                          P4
030410     05  F                        PIC X(9)     VALUE SPACE.           P4
030420     05  PRIMARY-1                PIC X(15).                          P4
030430     05  F                        PIC X(5)     VALUE SPACE.           P4
030440     05  SECONDARY-1              PIC X(15).                          P4
030450                                                                      P4
030460 01  DSH.                                                             P4
030470     05  F                        PIC X(21)    VALUE SPACE.           P4
030480     05  F                        PIC X(39)    VALUE                  P4
030490         '-- -- - --      ----------------'.                          P4
030500     05  F                        PIC X(35)    VALUE                  P4
040010         '---------------    ---------------'.                        P4
040020                                                                      P4
040030 01  WS-RCD.                                                          P4
040040     05  F                        PIC X.                              P4
040050     05  KEY-RCD.                                                     P4
040060         10  CSE-DATA.                                                P4
040070             15  DPT-RCD          PIC X(4).                           P4
040080             15  CSE-RCD          PIC X(4).                           P4
040090             15  SCTN-RCD         PIC XXX.                            P4
040100             15  HRS-RCD          PIC XX.                             P4
040110         10  SMYR                 PIC 999.                            P4
040120         10  IDNT                 PIC X(10).                          P4
040130     05  FS-1                     PIC XX.                             P4
040140     05  FS-2.                                                        P4
040150         10  FS-2N                PIC S999              COMP-3.       P4
040160     05  F                        PIC X(20).                          P4
040170     05  PCT-RCD.                                                     P4
040180         10  PCT OCCURS 10        PIC S9V9999           COMP-3.       P4
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           05  F-1                        PIC X(11).                          P4
           05  MJR.                                                           P4
               10  MJR-N                  PIC S9(5)             COMP-3.       P4
           05  COST                       PIC S9(7)V99          COMP-3.       P4
                                                                              P4
       01  WS-DATA.                                                           P4
           05  COST-AMT.                                                      P4
               10  COST-AMT-DATA          PIC 9(7)V99.                        P4
           05  SBSCR-DATA.                                                    P4
               10  SD-1                   PIC 9.                              P4
               10  SD-2                   PIC 9.                              P4
               10  SD-3                   PIC 9.                              P4
               10  SD-4                   PIC 9.                              P4
           05  SBSCR-DATA-R REDEFINES SBSCR-DATA.                             P4
               10  SD-1AN                 PIC X.                              P4
               10  SD-2AN                 PIC X.                              P4
               10  SD-3AN                 PIC X.                              P4
               10  SD-4AN                 PIC X.                              P4
           05  KEY-FAC-DATA.                                                  P4
               10  SMYR-DATA              PIC 999.                            P4
               10  IDNT-DATA              PIC X(10).                          P4
               10  F                      PIC XXX.                            P4
           05  KEY-STD-DATA REDEFINES KEY-FAC-DATA.                           P4
               10  COURSE-INFO-STD        PIC X(13).                          P4
               10  SMYR-DATA              PIC 999.                            P4
           05  FUND-SOURCE-DATA.                                              P4
               10  PRIMARY-DATA           PIC X(15).                          P4
               10  SECONDARY-DATA         PIC X(15).                          P4
           05  COMMENTS-DATA              PIC X(21).                          P4
                                                                              P4
       01  FILLER.                                                            P4
           05  FAC-TBL OCCURS 100.                                            P4
               10  CI-FAC                 PIC X(13).                          P4
               10  KEY-FAC.                                                   P4
                   15  SMYR-FAC           PIC 999.                            P4
                   15  IDNT-FAC           PIC X(10).                          P4
               10  PCT-H.                                                     P4
                   15  PCT-FAC OCCURS 10 PIC S9V9999             COMP-3.      P4
               10  COST-FAC               PIC S9(7)V99           COMP-3.      P4
                                                                              P4
       01  FILLER.                                                            P4
           05  STD-TBL OCCURS 750.                                            P4
               10  KEY-STD.                                                   P4
                   15  CI-STD.                                                P4
                       20  F              PIC X(11).                          P4
                       20  HRS-STD        PIC 99.                             P4
                   15  SMYR-STD           PIC 999.                            P4
               10  IDNT-STD               PIC X(10).                          P4
               10  PCT-H1.                                                    P4
                   15  PCT-STD OCCURS 10 PIC S9V9999             COMP-3.      P4
               10  MJR-STD                PIC S9(5)              COMP-3.      P4
               10  COST-STD               PIC S9(7)V99           COMP-3.      P4
               10  LVL-STD                PIC XX.                             P4
                                                                              P4
       01  TAPE-HDR.                                                          P4
           05  F                          PIC X(10)   VALUE 'ITERATION '.     P4
           05  ITR-NO                     PIC 99.                             P4
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050260        05  F                          PIC X(4)     VALUE SPACE.            P4
050270        05  F                          PIC X        VALUE '1'.              P4
050280        05  DT-HDR                     PIC X(8).                            P4
050290                                                                            P4
050300                                                                            P4
050310 01  TAPE-RCD-WS.                                                           P4
050320        05  MJR-WS                     PIC 9(5).                            P4
050330        05  LVL-WS                     PIC XX.                              P4
050340        05  COST-WS                    PIC S9(7)V99.                        P4
050350        05  F                          PIC X        VALUE '2'.              P4
050360        05  HRS-WS                     PIC 99.                              P4
050370        05  F                          PIC X(6)     VALUE SPACE.            P4
050380                                                                            P4
050390                                                                            P4
050400 01  SBSCRPT-CK-TBL.                                                        P4
050410        05  F                          PIC X(4)     VALUE '1 1 '.           P4
050420        05  F                          PIC X(4)     VALUE '  1 '.           P4
050430        05  F                          PIC X(4)     VALUE ' 21 '.           P4
050440        05  F                          PIC X(4)     VALUE '   2'.           P4
050450 01  F-TBL REDEFINES SBSCRPT-CK-TBL.                                        P4
050460        05  CK-TBL OCCURS 4            PIC X(4).                            P4
050470                                                                            P4
050480                                                                            P4
050490 01  FILLER.                                                                P4
050500        05  POINTER OCCURS 20          PIC S999.                            P4
060010                                                                            P4
060020 PROCEDURE DIVISION.                                                        P4
060030        OPEN     INPUT FACULTY-FILE.                                        P4
060040        OPEN     INPUT STUDENT-FILE.                                        P4
060050        OPEN     INPUT COST-SOURCE-FILE.                                    P4
060060        OPEN     OUTPUT STD-COST-FILE.                                      P4
060070        OPEN     OUTPUT RPT-FILE.                                           P4
060080        PERFORM ACPT-ITR THRU A-I-X.                                        P4
060090                                                                        ****P4
060100****                                                                    ****P4
060110**** READ FACULTY-FILE INTO FAC-TBL                                     ****P4
060120****                                                                        P4
060130                                                                            P4
060140 READ-FACULTY-FILE.                                                         P4
060150        READ     FACULTY-FILE INTO WS-RCD                                   P4
060160                 AT END  GO TO SET-MAX-FAC.                                 P4
060170        ADD      +1 TO SUB.                                                 P4
060180        IF       SUB > +100                                                 P4
060190                 DISPLAY 'ERROR-1 ' WS-RCD ' ' SUB                          P4
060200                 GO TO   CLOSE-FILES.                                       P4
060210        MOVE     CSE-DATA TO CI-FAC (SUB).                                  P4
060220        MOVE     SMYR TO SMYR-FAC (SUB).                                    P4
060230        MOVE     IDNT TO IDNT-FAC (SUB).                                    P4
060240        MOVE     PCT-RCD TO PCT-H (SUB).                                    P4
060250        MOVE     ZERO TO COST-FAC (SUB).                                    P4
060260        GO TO    READ-FACULTY-FILE.                                         P4
060270 SET-MAX-FAC.                                                               P4
060280        MOVE     SUB TO MAX-FAC.                                            P4
060290        MOVE     ZERO TO SUB.                                               P4
060300                                                                        ****P4
060310****                                                                    ****P4
060320**** READ STUDENT FILE INTO STD-TBL
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060330****                                                          ****P4
060340                                                                  P4
060350 READ-STUDENT-FILE.                                               P4
060360      READ     STUDENT-FILE INTO WS-RCD                           P4
060370               AT END  GO TO SET-MAX-STD.                         P4
060380      ADD      +1 TO SUB.                                         P4
060390      IF       SUB > +750                                         P4
060400               DISPLAY 'ERROR-2 ' WS-RCD ' ' SUB                  P4
060410               GO TO   CLOSE-FILES.                               P4
060420      MOVE     CSE-DATA TO CI-STD (SUB).                          P4
060430      MOVE     SMYR TO SMYR-STD (SUB).                            P4
060440      MOVE     IDNT TO IDNT-STD (SUB).                            P4
060450      MOVE     PCT-RCD TO PCT-HL (SUB).                           P4
060460      MOVE     ZERO TO COST-STD (SUB).                            P4
060470      MOVE     MJR-N TO MJR-STD (SUB).                            P4
060480                                                                  P4
060490      IF       (FS-1 = '1 ' OR = '2 ') MOVE '1L' TO LVL-STD (SUB) P4
060500               GO TO   READ-STUDENT-FILE.                         P4
070010      IF       (FS-1 = '3 ' OR = '4 ') MOVE '2U' TO LVL-STD (SUB) P4
070020               GO TO   READ-STUDENT-FILE.                         P4
070030      IF       (FS-1 = '5 ') MOVE '3M' TO LVL-STD (SUB)           P4
070040               GO TO   READ-STUDENT-FILE.                         P4
070050      IF       (FS-1 = '6 ') MOVE '4D' TO LVL-STD (SUB)           P4
070060               GO TO   READ-STUDENT-FILE.                         P4
070070      MOVE     '1L' TO LVL-STD (SUB).                             P4
070080      GO TO    READ-STUDENT-FILE.                                 P4
070090                                                                  P4
070100 SET-MAX-STD.                                                     P4
070110      MOVE     SUB TO MAX-STD.                                    P4
070120      MOVE     ZERO TO SUB.                                       P4
070130                                                                  P4
070140****                                                          ****P4
070150****      THE PROGRAM ROOT SECTION FOLLOWS.  COST SOURCES AND ****P4
070160**** THEIR APPORTIONING PROCEDURES SUBSCRIPT(S) ARE INPUT     ****P4
070170**** THROUGH THE COST-SOURCE-FILE.                            ****P4
070180****                                                          ****P4
070190                                                                  P4
070200                                                                  P4
070210 READ-COST-SOURCE-FILE.                                           P4
070220      READ     COST-SOURCE-FILE INTO WS-DATA                      P4
070230               AT END  GO TO WRITE-FILES.                         P4
070240                                                                  P4
070250      EXAMINE COST-AMT       REPLACING ALL SPACES BY ZERO.        P4
070260      IF       COST-AMT-DATA NOT NUMERIC                          P4
070270               GO TO   DISPLAY-ERROR-3.                           P4
070280                                                                  P4
070290      MOVE     SBSCR-DATA TO SBSCR-SV.                            P4
070300      TRANSFORM SBSCR-SV FROM '1234567890' TO '1111122222'.       P4
070310                                                                  P4
070320                                                                  P4
070330 APPORTIONING-BRANCHES.                                           P4
070340      IF       SBSCR-SV = CK-TBL (1)                              P4
070350               PERFORM 1-BRANCH-RTN THRU 1-B-R-X                  P4
070360               PERFORM WRITE-RPT THRU W-R-X                       P4
070370               GO TO   READ-COST-SOURCE-FILE.                     P4
070380      IF       SBSCR-SV = CK-TBL (2)                              P4
070390               PERFORM 2-BRANCH-RTN THRU 2-B-R-X                  P4
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                    PERFORM WRITE-RPT THRU W-R-X                         P4
                    GO TO   READ-COST-SOURCE-FILE.                       P4
           IF       SBSCR-SV = CK-TBL (3)                                P4
                    PERFORM 3-BRANCH-RTN THRU 3-B-R-X                    P4
                    PERFORM WRITE-RPT THRU W-R-X                         P4
                    GO TO   READ-COST-SOURCE-FILE.                       P4
           IF       SBSCR-SV = CK-TBL (4)                                P4
                    PERFORM 4-BRANCH-RTN THRU 4-B-R-X                    P4
                    PERFORM WRITE-RPT THRU W-R-X                         P4
                    GO TO   READ-COST-SOURCE-FILE.                       P4
                                                                         P4
       DISPLAY-ERROR-3.                                                  P4
           DISPLAY 'ERROR-3 ' WS-DATA.                                   P4
           ADD      +1 TO RJCT-CTR.                                      P4
                                                                         P4
                                                                         P4
           GO TO    READ-COST-SOURCE-FILE.                               P4
       WRITE-FILES.                                                      P4
           MOVE     COST-TTL TO COST-AMT-1.                              P4
           MOVE     SPACES TO SD-1-1 SD-2-1 SD-3-1 SD-4-1 PRIMARY-1      P4
                    SECONDARY-1.                                         P4
           MOVE     'TOTAL COSTS' TO KEY-1.                              P4
           WRITE    RPT-RCD FROM LN-1 AFTER POSITIONING 3.               P4
       WRITE-TAPE-FILE.                                                  P4
           WRITE    STD-COST-RCD FROM TAPE-HDR.                          P4
           MOVE     ZERO TO SUB1.                                        P4
       WRITE-LOOP.                                                       P4
           ADD      +1 TO SUB1.                                          P4
           IF       SUB1 > MAX-STD                                       P4
                    GO TO   CLOSE-FILES.                                 P4
           MOVE     MJR-STD (SUB1) TO MJR-WS.                            P4
           MOVE     LVL-STD (SUB1) TO LVL-WS.                            P4
           MOVE     COST-STD (SUB1) TO COST-WS.                          P4
           MOVE     HRS-STD (SUB1) TO HRS-WS.                            P4
           WRITE    STD-COST-RCD FROM TAPE-RCD-WS.                       P4
           ADD      +1 TO TAPE-CTR                                       P4
           GO TO    WRITE-LOOP.                                          P4
       CLOSE-FILES.                                                      P4
           DISPLAY 'FAC TBL                ' MAX-FAC.                    P4
           DISPLAY 'STD TBL                ' MAX-STD.                    P4
           DISPLAY 'TAPE CTR               ' TAPE-CTR.                   P4
           DISPLAY 'DATA EDIT REJECTIONS ' RJCT-CTR.                     P4
           DISPLAY 'DATA FAC  REJECTIONS ' RJCT-FAC-CTR.                 P4
           DISPLAY 'DATA STD  REJECTIONS ' RJCT-STD-CTR.                 P4
                                                                         P4
           CLOSE    FACULTY-FILE.                                        P4
           CLOSE    STUDENT-FILE.                                        P4
           CLOSE    COST-SOURCE-FILE.                                    P4
           CLOSE    STD-COST-FILE.                                       P4
           CLOSE    RPT-FILE.                                            P4
           STOP RUN.                                                     P4

       1-BRANCH-RTN.                                                     P4
           MOVE     SD-1 TO SUBF.                                        P4
           MOVE     SD-3 TO SUBS.                                        P4
           MOVE     ZERO TO SUB SUB-HIT SUM-FAC SUM-STD.                 P4
```

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                                                                       P4
                                                                       P4
 1-LOOP.                                                               P4
     ADD      +1 TO SUB.                                               P4
     IF       (SUB >  MAX-FAC) AND (FAC-MATCH = '1')                   P4
              MOVE    SPACE TO FAC-MATCH                               P4
              PERFORM CK-DIF-FAC THRU C-D-F-X                          P4
              GO TO   1-PRCS-STD.                                      P4
     IF       SUB > MAX-FAC                                            P4
              GO TO   7-ERROR.                                         P4
                                                                       P4
                                                                       P4
     IF       KEY-FAC-DATA = KEY-FAC (SUB)                             P4
              ADD     +1 TO SUB-HIT                                    P4
              MOVE    '1' TO FAC-MATCH                                 P4
              PERFORM FAC-HIT THRU F-H-X                               P4
              MOVE    SUB TO POINTER (SUB-HIT)                         P4
              GO TO   1-LOOP.                                          P4
                                                                       P4
     IF       (KEY-FAC-DATA < KEY-FAC (SUB)) AND (FAC-MATCH = '1')     P4
              PERFORM CK-DIF-FAC THRU C-D-F-X                          P4
              MOVE    SPACE TO FAC-MATCH                               P4
              GO TO   1-PRCS-STD.                                      P4
                                                                       P4
     IF       KEY-FAC-DATA < KEY-FAC (SUB)                             P4
              GO TO   7-ERROR.                                         P4
                                                                       P4
     GO TO    1-LOOP.                                                  P4
                                                                       P4
 7-ERROR.                                                              P4
     DISPLAY 'ERROR-7 ' WS-DATA                                        P4
     GO TO    1-B-R-X.                                                 P4
                                                                       P4
                                                                       P4
 1-PRCS-STD.                                                           P4
     MOVE     ZERO TO SUB.                                             P4
                                                                       P4
 1-PRCS-LOOP.                                                          P4
     ADD      +1 TO SUB.                                               P4
     IF       SUB > SUB-HIT                                            P4
              GO TO   1-B-R-X.                                         P4
     MOVE     POINTER (SUB) TO SUB-KEY.                                P4
     MOVE     COST-FAC (SUB-KEY) TO COST-SV.                           P4
     MOVE     CI-FAC (SUB-KEY) TO CI-SV.                               P4
     MOVE     SMYR-FAC (SUB-KEY) TO SMYR-SV.                           P4
                                                                       P4
     PERFORM STD-SRCH-RTN THRU S-S-R-X.                                P4
     GO TO    1-PRCS-LOOP.                                             P4
                                                                       P4
 1-B-R-X. EXIT.                                                        P4

 2-BRANCH-RTN.                                                         P4
     MOVE     SD-3 TO SUBS.                                            P4
     MOVE     COST-AMT-DATA TO COST-SV.                                P4
     MOVE     KEY-STD-DATA TO KEY-SV.                                  P4
     MOVE     ZERO TO SUM-STD.                                         P4
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100020                                                          P4
100030      PERFORM STD-SRCH-RTN THRU S-S-R-X.                  P4
100040                                                          P4
100050 2-B-R-X. EXIT.                                           P4

100070 3-BRANCH-RTN.                                            P4
100080      IF       SD-2 = ZERO                                P4
100090               MOVE    +10 TO SUBF                        P4
100100               ELSE                                       P4
100110               MOVE    SD-2 TO SUBF.                      P4
100120      MOVE     SD-3 TO SUBS.                              P4
100130      MOVE     ZERO TO SUB SUM-FAC SUM-STD.               P4
100140                                                          P4
100150                                                          P4
100160 3-LOOP.                                                  P4
100170      ADD      +1 TO SUB.                                 P4
100180      IF       SUB > MAX-FAC                              P4
100190               PERFORM CK-DIF-FAC THRU C-D-F-X            P4
100200               GO TO   3-PRCS-STD.                        P4
100210                                                          P4
100220      PERFORM FAC-HIT THRU F-H-X.                         P4
100230      GO TO    3-LOOP.                                    P4
100240                                                          P4
100250 3-PRCS-STD.                                              P4
100260      MOVE     ZERO TO SUB.                               P4
100270                                                          P4
100280 3-PRCS-LOOP.                                             P4
100290      ADD      +1 TO SUB.                                 P4
100300      IF       SUB > MAX-FAC                              P4
100310               GO TO   3-B-R-X.                           P4
100320                                                          P4
100330      MOVE     COST-FAC (SUB) TO COST-SV.                 P4
100340      MOVE     CI-FAC (SUB) TO CI-SV.                     P4
100350      MOVE     SMYR-FAC (SUB) TO SMYR-SV.                 P4
100360                                                          P4
100370      PERFORM STD-SRCH-RTN THRU S-S-R-X.                  P4
100380      GO TO    3-PRCS-LOOP.                               P4
100390                                                          P4
100400 3-B-R-X. EXIT.                                           P4

100420 4-BRANCH-RTN.                                            P4
100430      IF       SD-4 = ZERO                                P4
100440               MOVE    +10 TO SUBS                        P4
100450               ELSE                                       P4
100460               MOVE    SD-4 TO SUBS.                      P4
100470      MOVE     ZERO TO SUB1 SUM-STD.                      P4
100480                                                          P4
100490      MOVE     COST-AMT-DATA TO COST-SV.                  P4
100500      MOVE     ALL '*' TO KEY-SV.                         P4
110010                                                          P4
110020 4-LOOP.                                                  P4
110030      ADD      +1 TO SUB1.                                P4
110040      IF       SUB1 > MAX-STD                             P4
110050               PERFORM CK-DIF-STD                         P4
110060               GO TO   4-B-R-X.                           P4
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110070                                                           P4
110080     PERFORM STD-HIT THRU S-H-X.                           P4
110090     GO TO   4-LOOP.                                       P4
110100                                                           P4
110110 4-B-R-X. EXIT.                                            P4

110130 FAC-HIT.                                                  P4
110140                                                           P4
110150     COMPUTE APRTN-COST      ROUNDED = COST-AMT-DATA *     P4
110160             PCT-FAC (SUB, SUBF)                           P4
110170             ON SIZE ERROR DISPLAY 'ERROR-4 ' WS-DATA      P4
110180                       ADD     +1 TC ABND-ITR              P4
110190                       GO TC   CLOSE-FILES.                P4
110200     ADD     APRTN-COST      TO SUM-FAC.                   P4
110210     MOVE    APRTN-CCST      TO COST-FAC (SUB).            P4
110220                                                           P4
110230 F-H-X. EXIT.                                              P4

110250                                                           P4
110260                                                           P4
110270 CK-DIF-FAC.                                               P4
110280     COMPUTE SUBD = SUB - 1.                               P4
110290                                                           P4
110300     IF      SUBD < +1                                     P4
110310             DISPLAY 'ERROR-5 '  WS-DATA ' ' SUBD          P4
110320                       ADD     +1 TO ABND-ITR              P4
110330                       GO TO   CLOSE-FILES.                P4
110340                                                           P4
110350     COMPUTE COST-DIF = COST-AMT-DATA - SUM-FAC.           P4
110360     MOVE    COST-DIF TC COST-DIF-US.                      P4
110370     IF      COST-DIF-US > 1.00                            P4
110380             DISPLAY 'ERROR-6 ' WS-DATA                    P4
110390             ADD     +1 TC ABND-ITR                        P4
110400             GO TC   CLOSE-FILES.                          P4
110410     ADD     COST-DIF TO COST-FAC (SUBD).                  P4
110420     MOVE    ZERO TC SUM-FAC.                              P4
110430                                                           P4
110440                                                           P4
110450 C-D-F-X. EXIT.                                            P4

110470 STD-HIT.                                                  P4
110480                                                           P4
110490     COMPUTE APRTN-COST ROUNDED = COST-SV * PCT-STD (SUB1, SUBS)  P4
110500             ON SIZE ERROR DISPLAY 'ERROR-4A ' KEY-SV ' ' COST-SV P4
120010                       ADD     +1 TC ABND-ITR              P4
120020                       GO TO   CLOSE-FILES.                P4
120030                                                           P4
120040     ADD     APRTN-COST TO SUM-STD.                        P4
120050     ADD     APRTN-COST TO COST-STD (SUB1).                P4
120060                                                           P4
120070 S-H-X. EXIT.                                              P4

120090 CK-DIF-STD.                                               P4
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           COMPUTE SUBD = SUB1 - 1.                                 P4
                                                                    P4
           IF      SUBD < +1                                        P4
                   DISPLAY 'ERROR-5A ' KEY-SV ' ' COST-SV           P4
                           ADD     +1 TC ABND-ITR                   P4
                           GO TO   CLOSE-FILES.                     P4
                                                                    P4
           COMPUTE COST-CIF = COST-SV - SUM-STD.                    P4
           MOVE    COST-CIF TC COST-DIF-US.                         P4
           IF      COST-CIF-US > 1.00                               P4
                   DISPLAY 'ERROR-6A ' KEY-SV ' ' COST-SV ' ' SUM-STD P4
                   ADD     +1 TO ABND-ITR                           P4
                   GO TO   CLOSE-FILES.                             P4
           ADD     COST-DIF TO COST-STD (SUBD).                     P4
           MOVE    ZERO TO SUM-STD.                                 P4
                                                                    P4
                                                                    P4
       C-D-S-X. EXIT.                                               P4

       STD-SRCH-RTN.                                                P4
           MOVE    ZERO TC SUB1.                                    P4
                                                                    P4
       STD-LOOP.                                                    P4
           ADD     +1 TO SUB1.                                      P4
           IF      (SUB1 > MAX-STD) AND (STD-MATCH = '1')           P4
                   MOVE    SPACE TO STD-MATCH                       P4
                   PERFORM CK-DIF-STD THRU C-D-S-X                  P4
                   GO TC   S-S-R-X.                                 P4
                                                                    P4
           IF      SUB1 > MAX-STD                                   P4
                   GO TO   8-ERROR.                                 P4
                                                                    P4
           IF      KEY-SV = KEY-STD (SUB1)                          P4
                   MOVE    '1' TO STD-MATCH                         P4
                   PERFORM STD-HIT THRU S-H-X                       P4
                   GC TO   STD-LOOP.                                P4
                                                                    P4
           IF      (KEY-SV < KEY-STD (SUB1)) ANC (STD-MATCH = '1')  P4
                   PERFORM CK-DIF-STD THRU C-D-S-X                  P4
                   MOVE    SPACE TO STD-MATCH                       P4
                   GC TO   S-S-R-X.                                 P4
                                                                    P4
                                                                    P4
           IF      KEY-SV < KEY-STD (SUB1)                          P4
                   GO TC   8-ERROR.                                 P4
                                                                    P4
           GO TO   STD-LCCP.                                        P4
                                                                    P4
       8-ERROR.                                                     P4
           DISPLAY 'ERRCR-8 ' KEY-SV ' ' COST-SV.                   P4
           ADD     +1 TO RJCT-STD-CTR.                              P4
                                                                    P4
                                                                    P4
       S-S-R-X. EXIT.                                               P4
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                                                                   P4
130150 ACPT-ITR.                                                   P4
130160      ACCEPT  ITERATION-H.                                   P4
130170      EXAMINE ITERATION-H  REPLACING LEADING SPACES BY ZERO. P4
130180      IF      ITERATION-NO NOT NUMERIC                       P4
130190              DISPLAY 'ERROR-9 ' ITERATION-NO                P4
130200              GO TO   CLOSE-FILES.                           P4
130210      IF      (ITERATION-NO > 10 OR < 1)                     P4
130220              DISPLAY 'ERROR-9A ' ITERATION-NO               P4
130230              GO TO   CLOSE-FILES.                           P4
130240                                                             P4
130250      MOVE    ITERATION-NO TO ITR-HDR ITR-2.                 P4
130260      MOVE    CURRENT-DATE TO DT-HDR DT-2.                   P4
130270 A-I-X. EXIT.

                                                                   P4
130290 WRITE-RPT.                                                  P4
130300      IF      LN-CTR > +55                                   P4
130310              ADD     +1 TO PG-CTR                           P4
130320              MOVE    PG-CTR TO PG-1                         P4
130330              MOVE    +10 TO LN-CTR                          P4
130340              WRITE   RPT-RCD FROM HD-1 AFTER POSITIONING 0  P4
130350              WRITE   RPT-RCD FROM HD-2 AFTER POSITIONING 1  P4
130360              WRITE   RPT-RCD FROM HD-3 AFTER POSITIONING 3  P4
130370              WRITE   RPT-RCD FROM HD-4 AFTER POSITIONING 1  P4
130380              WRITE   RPT-RCD FROM DSH  AFTER POSITIONING 1. P4
130390                                                             P4
130400      MOVE    COST-AMT-DATA TO COST-AMT-1.                   P4
130410      IF SD-1AN NOT NUMERIC MOVE SPACES TO SD-1-1 GO TO WR2. P4
130420      MOVE    SD-1 TO SD-1-1.                                P4
130430 WR2.                                                        P4
130440      IF SD-2AN NOT NUMERIC MOVE SPACES TO SD-2-1 GO TO WR3. P4
130450      IF      SD-2 = 0 MOVE '10' TO SD-2-1 ELSE MOVE SD-2 TO SD-2-1.P4
130460 WR3.                                                        P4
130470      IF SD-3AN NOT NUMERIC MOVE SPACES TO SD-3-1 GO TO WR4. P4
130480      MOVE    SD-3 TO SD-3-1.                                P4
130490 WR4.                                                        P4
130500      IF SD-4AN NOT NUMERIC MOVE SPACES TO SD-4-1 GO TO WR.  P4
140010      IF      SD-4 = 0 MOVE '10' TO SD-4-1 ELSE MOVE SD-4 TO SD-4-1.P4
140020 WR.                                                         P4
140030      MOVE    KEY-FAC-DATA TO KEY-1.                         P4
140040      MOVE    PRIMARY-DATA TO PRIMARY-1.                     P4
140050      MOVE    SECONDARY-DATA TO SECONDARY-1                  P4
140060                                                             P4
140070      WRITE   RPT-RCD FROM LN-1 AFTER POSITIONING 2.         P4
140080      ADD     +2 TO LN-CTR.                                  P4
140090      ADD     COST-AMT-DATA TO COST-TTL.                     P4
140100 W-R-X. EXIT.
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010010 ID DIVISION.                                                    P5A
010020 PROGRAM-ID. P5A.                                                P5A
010030 AUTHOR. GOSE.                                                   P5A
010040 DATE-WRITTEN. 3/77                                              P5A
010050 DATE-COMPILED. JUN  1,1977                                      P5A
010060 REMARKS.                                                        P5A
010070           THIS PROGRAM READS THE INPUT STD-COST-FILE FROM P-4, SUMSP5A
010080      STUDENT MAJORS BY LEVEL, AND CREATES AN OUTPUT INDEXED     P5A
010090      SEQUENTIAL FILE, THE SENSITIVITY-DATA-FILE.  THE OUTPUT FILE P5A
010100      CONTAINS THE FIRST ITERATION OF COST SOURCES & APPORTIONING  P5A
010110      PROCEDURES.                                                P5A
010120           SUBSEQUENT ITERATIONS (UP TO 9 MORE)   OF SELECTED COST  P5A
010130      SOURCES & APPORTIONING PROCEDURES MAY BE INPUT TO THE      P5A
010140      SENSITIVITY-DATA-FILE THROUGH P-5B, AN UPDATE PROGRAM.     P5A
010150           P-5A & P-5B ARE BASICALLY IDENTICAL: THEY BOTH ACCEPT THEP5A
010160      TAPE FILE INPUT  FROM P-4, AND THE BOTH CREATE DISTINCT COST P5A
010170      ITERATIONS ON THE SENSITIVITY-DATA-FILE.  THE DIFFERENCE IS  P5A
010180      THAT P-5A      CREATES THE OUTPUT FILE AND MUST, THEREFORE,  P5A
010190      BE EXECUTED ONLY ONCE WHILE P-5B IS EXECUTED FOR EACH      P5A
010200      SUBSEQUENT ITERATION OR UPDATE OF THE FILE.                P5A
010210                                                                 P5A
010220                                                                 P5A
010230 ENVIRONMENT DIVISION.                                           P5A
010240 CONFIGURATION SECTION.                                          P5A
010250 INPUT-OUTPUT SECTION.                                           P5A
010260 FILE-CONTROL.                                                   P5A
010270      SELECT  STD-COST-FILE         ASSIGN  UT-S-T13640.         P5A
010280      SELECT  RPT-FILE              ASSIGN  UT-S-R13650.         P5A
010290      SELECT  SENSITIVITY-DATA-FILE                              P5A
010300                                    ASSIGN  DA-I-D13650          P5A
010310                RECORD KEY IS MJR-KEY.                           P5A
010320                                                                 P5A
010330                                                                 P5A
010340 DATA DIVISION.                                                  P5A
010350 FILE SECTION.                                                   P5A
010360 FD   STD-COST-FILE                                              P5A
010370      LABEL RECORDS STANDARD                                     P5A
010380      BLOCK 0.                                                   P5A
010390 01   STD-COST-RCD                 PIC X(25).                    P5A
010400                                                                 P5A
010410 FD   RPT-FILE                                                   P5A
010420      LABEL RECORDS STANDARD                                     P5A
010430      BLOCK 133.                                                 P5A
010440 01   RPT-RCD                      PIC X(133).                   P5A
010450                                                                 P5A
010460 FD   SENSITIVITY-DATA-FILE                                      P5A
010470      LABEL RECORDS STANDARD                                     P5A
010480      BLOCK 0.                                                   P5A
010490 01   SENSITIVITY-DATA-RCD.                                      P5A
010500      05  DLT-CD                   PIC X.                        P5A
020010      05  MJR-KEY.                                               P5A
020020          10  MJR                  PIC X(5).                     P5A
020030          10  LVL                  PIC XX.                       P5A
020040      05  COST-OCCURRENCES OCCURS 10.                            P5A
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020050             10  HRS                  PIC S999                   COMP-3.   P5A
020060             10  COSTS                PIC S9(7)V99               COMP-3.   P5A
020070         05  F                        PIC XX.                              P5A
020080 01  SENSITIVITY-HDR-RCD.                                                  P5A
020090         05  DLT-CD-R                 PIC X.                               P5A
020100         05  MJR-KEY-R                PIC X(7).                            P5A
020110         05  SUB-OCCUR OCCURS 10.                                          P5A
020120             10  SUB-R                PIC S999                   COMP-3.   P5A
020130             10  DATE-R               PIC S9(9)                  COMP-3.   P5A
020140         05  F                        PIC XX.                              P5A
020150                                                                           P5A
020160 WORKING-STORAGE SECTION.                                                  P5A
020170 01  FILLER COMP-3.                                                        P5A
020180         05  PG-CTR                   PIC S999     VALUE ZERO.             P5A
020190         05  LN-CTR                   PIC S999     VALUE +60.              P5A
020200         05  INPT-RCD-CTR             PIC S9(5)    VALUE ZERO.             P5A
020210         05  OTPT-RCD-CTR             PIC S9(5)    VALUE ZERO.             P5A
020220         05  SKIP-RCD-CTR             PIC S9(5)    VALUE ZERO.             P5A
020230         05  SUB                      PIC S999     VALUE ZERO.             P5A
020240         05  COSTS-SUM                PIC S9(7)V99 VALUE ZERO.             P5A
020250         05  COSTS-SUM-TTL            PIC S9(9)V99 VALUE ZERO.             P5A
020260         05  HRS-SUM                  PIC S9(5)    VALUE ZERO.             P5A
020270         05  HRS-SUM-TTL              PIC S9(5)    VALUE ZERO.             P5A
020280 01  FILLER.                                                               P5A
020290         05  MJR-SV-WS.                                                    P5A
020300             10  MJR-SV               PIC 9(5).                            P5A
020310             10  LVL-SV               PIC XX.                              P5A
020320                                                                           P5A
020330         05  DT-SV.                                                        P5A
020340             10  MM-SV                PIC 99.                              P5A
020350             10  F                    PIC X.                               P5A
020360             10  DD-SV                PIC 99.                              P5A
020370             10  F                    PIC X.                               P5A
020380             10  YY-SV                PIC 99.                              P5A
020390         05  DT-UNPK                  PIC 9(9).                            P5A
020400         05  DT-REDEF  REDEFINES DT-UNPK.                                  P5A
020410             10  F-R                  PIC 999.                             P5A
020420             10  MM-R                 PIC 99.                              P5A
020430             10  DD-R                 PIC 99.                              P5A
020440             10  YY-R                 PIC 99.                              P5A
020450                                                                           P5A
020460 01  TAPE-HDR.                                                             P5A
020470         05  F-1                      PIC X(10).                           P5A
020480         05  ITR-HDR                  PIC 99.                              P5A
020490         05  F                        PIC X(4).                            P5A
020500         05  F-2                      PIC X.                               P5A
030010         05  DT-HDR                   PIC X(8).                            P5A
030020                                                                           P5A
030030 01  TAPE-RCD-WS REDEFINES TAPE-HDR.                                       P5A
030040         05  MJR-RCD-WS.                                                   P5A
030050             10  MJR-WS               PIC 9(5).                            P5A
030060             10  LVL-WS               PIC XX.                              P5A
030070         05  COST-WS                  PIC S9(7)V99.                        P5A
030080         05  F-3                      PIC X.                               P5A
030090         05  HRS-WS                   PIC 99.                              P5A
030100         05  F                        PIC X(6).                            P5A
030110                                                                           P5A
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030120 01  ZERO-RCD.                                             P5A
030130     05  F                    PIC X(8)      VALUE SPACE.   P5A
030140     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030150     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030160     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030170     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030180     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030190     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030200     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030210     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030220     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030230     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030240     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030250     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030260     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030270     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030280     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030290     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030300     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030310     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030320     05  F                    PIC S999      VALUE ZERO COMP-3.  P5A
030330     05  F                    PIC S9(7)V99  VALUE ZERO COMP-3.  P5A
030340     05  F                    PIC XX        VALUE SPACE.   P5A
030350                                                           P5A
030360 01  HD-1.                                                 P5A
030370     05  F                    PIC X(55)     VALUE ' R-136-50A'.  P5A
030380     05  F                    PIC X(68)     VALUE          P5A
030390         'COSTS PER MAJOR BY LEVEL'.                       P5A
030400     05  F                    PIC X(5)      VALUE 'PAGE '. P5A
030410     05  PG-1                 PIC ZZ9.                     P5A
030420                                                           P5A
030430 01  HD-2.                                                 P5A
030440     05  F                    PIC X         VALUE SPACE.   P5A
030450     05  DT-2                 PIC X(60).                   P5A
030460     05  F                    PIC X(10)     VALUE 'ITERATION '.  P5A
030470     05  ITP-2                PIC 99.                      P5A
030480                                                           P5A
030490                                                           P5A
030500 01  HD-3.                                                 P5A
040010     05  F                    PIC X(39)     VALUE          P5A
040020         '    MAJOR      LEVEL    HOURS         COSTS'.    P5A
040030                                                           P5A
040040 01  LN-1.                                                 P5A
040050     05  F                    PIC XXX       VALUE SPACE.   P5A
040060     05  MJR-1                PIC 9(5).                    P5A
040070     05  F                    PIC X(7)      VALUE SPACE.   P5A
040080     05  LVL-1                PIC XX.                      P5A
040090     05  F                    PIC X(4)      VALUE SPACE.   P5A
040100     05  HRS-1                PIC ZZZZ.                    P5A
040110     05  F                    PIC X(3)      VALUE SPACE.   P5A
040120     05  COST-1               PIC $$$,$$$,$$$.99.          P5A
040130                                                           P5A
040140 01  LN-2.                                                 P5A
040150     05  F                    PIC X(20)     VALUE ' TOTAL COSTS'.P5A
040160     05  HRS-2                PIC ZZZZ9.                   P5A
040170     05  F                    PIC X         VALUE SPACE.   P5A
040180     05  COST-2               PIC $$,$$$,$$$,$$$.99.       P5A
```

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                                                                   P5A
       PROCEDURE DIVISION.                                         P5A
           OPEN    INPUT STD-COST-FILE.                            P5A
           OPEN    OUTPUT RPT-FILE.                                P5A
           OPEN    OUTPUT SENSITIVITY-DATA-FILE.                   P5A
                                                                   P5A
       INITIAL-READ.                                               P5A
           READ    STD-COST-FILE INTO TAPE-HDR                     P5A
                   AT END                                          P5A
                   DISPLAY 'ERROR-1 NO INPUT TAPE FILE'            P5A
                   GO TO   CLOSE-FILES.                            P5A
                                                                   P5A
           IF      (F-1 NOT = 'ITERATION ') OR (F-2 NOT = '1')     P5A
                   DISPLAY 'ERROR-2 TAPE FILE OUT OF SEQUENCE ' TAPE-HDRP5A
                   GO TO   CLOSE-FILES.                            P5A
                                                                   P5A
           IF      (ITR-HDR NOT NUMERIC) OR                        P5A
                   (ITR-HDR > 10 OR < 1)                           P5A
                   DISPLAY 'ERROR-3 ' TAPE-HDR                     P5A
                   GO TO   CLOSE-FILES.                            P5A
                                                                   P5A
           MOVE    ITR-HDR TO SUB ITR-2.                           P5A
           MOVE    DT-HDR TO DT-2 DT-SV.                           P5A
           MOVE    MM-SV TO MM-R.                                  P5A
           MOVE    DD-SV TO DD-R.                                  P5A
           MOVE    YY-SV TO YY-R.                                  P5A
           MOVE    ZERO TO F-R.                                    P5A
                                                                   P5A
           MOVE    ZERO-RCD TO SENSITIVITY-HDR-RCD.                P5A
           MOVE    ITR-HDR TO SUB-R (SUB).                         P5A
           MOVE    DT-UNPK TO DATE-R (SUB).                        P5A
                                                                   P5A
           WRITE   SENSITIVITY-DATA-RCD                            P5A
                   INVALID KEY DISPLAY 'ERROR-4A ' SENSITIVITY-DATA-RCD P5A
                   GO TO   CLOSE-FILES.                            P5A
                                                                   P5A
       CONTINUE-READ.                                              P5A
           READ    STD-COST-FILE INTO TAPE-HDR                     P5A
                   AT END                                          P5A
                   PERFORM SUM-LVL-RTN THRU S-L-R-X                P5A
                   PERFORM FINAL-PRINT THRU F-P-X                  P5A
                   GO TO   CLOSE-FILES.                            P5A
           ON 1    MOVE MJR-WS  TO MJR-SV                          P5A
                   MOVE LVL-WS  TO LVL-SV.                         P5A
                                                                   P5A
           IF      (MJR-RCD-WS = MJR-SV-WS) AND (COST-WS > ZERO)   P5A
                   ADD     COST-WS  TO COSTS-SUM COSTS-SUM-TTL     P5A
                   ADD     HRS-WS  TO HRS-SUM HRS-SUM-TTL          P5A
                   ADD     +1 TO INPT-RCD-CTR                      P5A
                   GO TO   CONTINUE-READ.                          P5A
                                                                   P5A
           IF      MJR-RCD-WS = MJR-SV-WS                          P5A
                   ADD     +1 TO SKIP-RCD-CTR                      P5A
                   GO TO   CONTINUE-READ.                          P5A
                                                                   P5A
           PERFORM SUM-LVL-RTN THRU S-L-R-X.                       P5A
           MOVE    MJR-WS  TO MJR-SV.                              P5A
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050260         MOVE      LVL-WS  TO LVL-SV.                                 P5A
050270                                                                      P5A
050280         MOVE      HRS-WS  TO HRS-SUM.                                P5A
050290         ADD       HRS-WS  TO HRS-SUM-TTL.                            P5A
050300         MOVE      COST-WS  TO COSTS-SUM.                             P5A
050310         ADD       COST-WS  TO COSTS-SUM-TTL.                         P5A
050320         IF        COST-WS > ZERO                                     P5A
                         ADD      +1 TO INPT-RCD-CTR                        P5A
050340                   ELSE                                               P5A
050350                   ADD      +1 TO SKIP-RCD-CTR.                       P5A
050360         GO TO     CONTINUE-READ.                                     P5A
050370                                                                      P5A
050380 CLOSE-FILES.                                                         P5A
050390         DISPLAY 'NUMBER OF INPUT  RECORDS ' INPT-RCD-CTR.            P5A
050400         DISPLAY 'NUMBER OF OUTPUT RECORDS ' OTPT-RCD-CTR.            P5A
050410                                                                      P5A
050420         CLOSE     STD-COST-FILE.                                     P5A
050430         CLOSE     RPT-FILE.                                          P5A
050440         CLOSE     SENSITIVITY-DATA-FILE.                             P5A
050450         STOP RUN.                                                    P5A

050470 SUM-LVL-RTN.                                                         P5A
050480         MOVE      ZERO-RCD TO SENSITIVITY-DATA-RCD.                  P5A
050490         MOVE      MJR-SV TO MJR MJR-1.                               P5A
050500         MOVE      LVL-SV TO LVL LVL-1.                               P5A
060010         MOVE      HRS-SUM TO HRS (SUB) HRS-1.                        P5A
060020         MOVE      COSTS-SUM TO COSTS (SUB) COST-1.                   P5A
060030         MOVE      SPACES    TO DLT-CD.                               P5A
060040                                                                      P5A
060050         WRITE     SENSITIVITY-DATA-RCD                               P5A
060060                   INVALID KEY DISPLAY 'ERROR-4 ' SENSITIVITY-DATA-RCD P5A
060070                   GO TO   CLOSE-FILES.                               P5A
060080         ADD       +1 TO OTPT-RCD-CTR.                                P5A
060090                                                                      P5A
060100         IF        LN-CTR > +58                                       P5A
060110                   ADD      +1 TO PG-CTR                              P5A
060120                   MOVE     PG-CTR TO PG-1                            P5A
060130                   MOVE     +8  TO LN-CTR                             P5A
060140                   WRITE    RPT-RCD FROM HD-1 AFTER POSITIONING 0     P5A
060150                   WRITE    RPT-RCD FROM HD-2 AFTER POSITIONING 1     P5A
060160                   WRITE    RPT-RCD FROM HD-3 AFTER POSITIONING 3.    P5A
060170                                                                      P5A
060180         WRITE     RPT-RCD FROM LN-1 AFTER POSITIONING 2.             P5A
060190         ADD       +2 TO LN-CTR.                                      P5A
060200 S-L-R-X. EXIT.                                                       P5A

060220 FINAL-PRINT.                                                         P5A
060230         MOVE      HRS-SUM-TTL TO HRS-2.                              P5A
060240         MOVE      COSTS-SUM-TTL TO COST-2.                           P5A
060250                                                                      P5A
060260         WRITE     RPT-RCD FROM LN-2 AFTER POSITIONING 2.             P5A
060270 F-P-X. EXIT.                                                         P5A
```

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ID DIVISION.
PROGRAM-ID. P5B.
AUTHOR. GOSE.
DATE-WRITTEN. 3/77
DATE-COMPILED. APR 19,1977
REMARKS.
        THIS PROGRAM READS THE INPUT STD-COST-FILE FROM P-4, SUMS
    STUDENT MAJORS BY LEVEL, AND UPDATES AN EXISTING INDEXED
    SEQUENTIAL FILE, THE SENSITIVITY-DATA-FILE.

ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT  STD-COST-FILE        ASSIGN  UT-S-T13640.
    SELECT  RPT-FILE             ASSIGN  UT-S-R13650.
    SELECT  SENSITIVITY-DATA-FILE
                                 ASSIGN  DA-I-D13650
             ACCESS IS  RANDOM NOMINAL KEY IS MJR-SV-WS
             RECORD KEY IS MJR-KEY.

I-O-CONTROL.
    APPLY   CORE-INDEX ON SENSITIVITY-DATA-FILE.

DATA DIVISION.
FILE SECTION.
FD  STD-COST-FILE
    LABEL RECORDS STANDARD
    BLOCK 0.
01  STD-COST-RCD                 PIC X(25).

FD  RPT-FILE
    LABEL RECORDS STANDARD
    BLOCK 133.
01  RPT-RCD                      PIC X(133).

FD  SENSITIVITY-DATA-FILE
    LABEL RECORDS STANDARD
    BLOCK CONTAINS 90 RECORDS
    RECORDING MODE IS F.
01  SENSITIVITY-DATA-RCD.
    05  DLT-CD                   PIC X.
    05  MJR-KEY.
        10  MJR                  PIC X(5).
        10  LVL                  PIC XX.
    05  COST-OCCURRENCES OCCURS 10.
        10  HRS                  PIC S999          COMP-3.
        10  COSTS                PIC S9(7)V99      COMP-3.
    05  F                        PIC XX.
01  SENSITIVITY-HDR-RCD.
    05  DLT-CD-R                 PIC X.
    05  MJR-KEY-R                PIC X(7).
    05  SUB-OCCUR OCCURS 10.
        10  SUB-R                PIC S999          COMP-3.
```

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            10  DATE-R                   PIC S9(9)             COMP-3.  P5B
        05  F                            PIC XX.                        P5B
                                                                        P5B
WORKING-STORAGE SECTION.                                                P5B
01  FILLER COMP-3.                                                      P5B
    05  PG-CTR                           PIC S999    VALUE ZERO.        P5B
    05  LN-CTR                           PIC S999    VALUE +60.         P5B
    05  INPT-RCD-CTR                     PIC S9(5)   VALUE ZERO.        P5B
    05  OTPT-RCD-CTR                     PIC S9(5)   VALUE ZERO.        P5B
    05  SKIP-RCD-CTR                     PIC S9(5)   VALUE ZERO.        P5B
    05  SUB                              PIC S999    VALUE ZERO.        P5B
    05  COSTS-SUM                        PIC S9(7)V99 VALUE ZERO.       P5B
    05  COSTS-SUM-TTL                    PIC S9(9)V99 VALUE ZERO.       P5B
    05  HRS-SUM                          PIC S9(5)   VALUE ZERO.        P5B
    05  HRS-SUM-TTL                      PIC S9(5)   VALUE ZERO.        P5B
01  FILLER.                                                             P5B
    05  MJR-SV-WS.                                                      P5B
        10  MJR-SV                       PIC 9(5).                      P5B
        10  LVL-SV                       PIC XX.                        P5B
                                                                        P5B
    05  DT-SV.                                                          P5B
        10  MM-SV                        PIC 99.                        P5B
        10  F                            PIC X.                         P5B
        10  DD-SV                        PIC 99.                        P5B
        10  F                            PIC X.                         P5B
        10  YY-SV                        PIC 99.                        P5B
    05  DT-UNPK                          PIC 9(9).                      P5B
    05  DT-REDEF  REDEFINES DT-UNPK.                                    P5B
        10  F-R                          PIC 999.                       P5B
        10  MM-R                         PIC 99.                        P5B
        10  DD-R                         PIC 99.                        P5B
        10  YY-R                         PIC 99.                        P5B
                                                                        P5B
    05  ABND-IT                          PIC X       VALUE SPACE.       P5B
    05  ABND-ITR  REDEFINES ABND-IT  PIC 9.                             P5B
01  TAPE-HDR.                                                           P5B
    05  F-1                              PIC X(10).                     P5B
    05  ITR-HDR                          PIC 99.                        P5B
    05  F                                PIC X(4).                      P5B
    05  F-2                              PIC X.                         P5B
    05  DT-HDR                           PIC X(8).                      P5B
                                                                        P5B
01  TAPE-RCD-WS REDEFINES TAPE-HDR.                                     P5B
    05  MJR-RCD-WS.                                                     P5B
        10  MJR-WS                       PIC 9(5).                      P5B
        10  LVL-WS                       PIC XX.                        P5B
    05  CUST-WS                          PIC S9(7)V99.                  P5B
    05  F-3                              PIC X.                         P5B
    05  HRS-WS                           PIC 99.                        P5B
    05  F                                PIC X(6).                      P5B
                                                                        P5B
01  ZERO-RCD.                                                           P5B
    05  F                                PIC X(8)     VALUE SPACE.      P5B
    05  F                                PIC S999     VALUE ZERO COMP-3.  P5B
    05  F                                PIC S9(7)V99 VALUE ZERO COMP-3.  P5B
    05  F                                PIC S999     VALUE ZERO COMP-3.  P5B
    05  F                                PIC S9(7)V99 VALUE ZERO COMP-3.  P5B
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030120        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030130        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030140        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030150        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030160        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030170        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030180        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030190        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030200        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030210        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030220        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030230        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030240        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030250        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030260        05  F                            PIC S999       VALUE ZERO COMP-3.   P5B
030270        05  F                            PIC S9(7)V99 VALUE ZERO COMP-3.     P5B
030280        05  F                            PIC XX       VALUE SPACE.           P5B
030290                                                                             P5B
030300 01  HD-1.                                                                   P5B
030310        05  F                            PIC X(55)    VALUE ' R-136-50B'.    P5B
030320        05  F                            PIC X(68)    VALUE                  P5B
030330            'COSTS PER MAJOR BY LEVEL'.                                      P5B
030340        05  F                            PIC X(5)     VALUE 'PAGE '.         P5B
030350        05  PG-1                         PIC ZZ9.                            P5B
030360                                                                             P5B
030370 01  HD-2.                                                                   P5B
030380        05  F                            PIC X        VALUE SPACE.           P5B
030390        05  DT-2                         PIC X(60).                          P5B
030400        05  F                            PIC X(10)    VALUE 'ITERATION '.    P5B
030410        05  ITR-2                        PIC 99.                             P5B
030420                                                                             P5B
030430 01  HD-3.                                                                   P5B
030440        05  F                            PIC X(39)    VALUE                  P5B
030450            '    MAJOR      LEVEL    HOURS          COSTS'.                  P5B
030460                                                                             P5B
030470 01  LN-1.                                                                   P5B
030480        05  F                            PIC XXX      VALUE SPACE.           P5B
030490        05  MJR-1                        PIC 9(5).                           P5B
030500        05  F                            PIC X(7)     VALUE SPACE.           P5B
040010        05  LVL-1                        PIC XX.                             P5B
040020        05  F                            PIC X(4)     VALUE SPACE.           P5B
040030        05  HRS-1                        PIC ZZZZ.                           P5B
040040        05  F                            PIC X(3)     VALUE SPACE.           P5B
040050        05  COST-1                       PIC $$$,$$$,$$$.99.                 P5B
040060        05  F                            PIC X(5)     VALUE SPACE.           P5B
040070        05  NEW-RCD-1                    PIC X        VALUE SPACE.           P5B
040080                                                                             P5B
040090 01  LN-2.                                                                   P5B
040100        05  F                            PIC X(20)    VALUE ' TOTAL COSTS'.P5B
040110        05  HRS-2                        PIC ZZZZ9.                          P5B
040120        05  F                            PIC X        VALUE SPACE.           P5B
040130        05  COST-2                       PIC $$,$$$,$$$,$$$.99.              P5B
040140                                                                             P5B
040150 PROCEDURE DIVISION.                                                         P5B
040160        OPEN    INPUT STD-COST-FILE.                                         P5B
040170        OPEN    OUTPUT RPT-FILE.                                             P5B
040180        OPEN    I-O     SENSITIVITY-DATA-FILE.                               P5B
```

```
                                                                        P5B
 INITIAL-READ.                                                          P5B
     READ     STD-COST-FILE INTO TAPE-HDR                               P5B
              AT END                                                    P5B
              DISPLAY 'ERROR-1 NO INPUT TAPE FILE'                      P5B
              GO TO   CLOSE-FILES.                                      P5B
                                                                        P5B
     IF       (F-1 NOT = 'ITERATION ') OR (F-2 NOT = '1')               P5B
              DISPLAY 'ERROR-2 TAPE FILE OUT OF SEQUENCE ' TAPE-HDRP5B
              GO TO   CLOSE-FILES.                                      P5B
                                                                        P5B
     IF       (ITR-HDR NOT NUMERIC) OR                                  P5B
              (ITR-HDR > 10 OR < 1)                                     P5B
              DISPLAY 'ERROR-3 ' TAPE-HDR                               P5B
              GO TO   CLOSE-FILES.                                      P5B
                                                                        P5B
     MOVE     ITR-HDR TO SUB ITR-2.                                     P5B
 INITIAL-DISK-READ.                                                     P5B
     MOVE     SPACES    TO MJR-SV-WS.                                   P5B
     READ     SENSITIVITY-DATA-FILE                                     P5B
              INVALID KEY DISPLAY 'ERROR-5'                             P5B
              GO TO CLOSE-FILES.                                        P5B
     IF       SUB-R (SUB) = ITR-HDR                                     P5B
              DISPLAY 'ERROR-6 ATTEMPT TO WRITE OVER ITR ' ITR-HDR P5B
              GO TO   CLOSE-FILES.                                      P5B
     MOVE     DT-HDR TO DT-2 DT-SV.                                     P5B
     MOVE     MM-SV TO MM-R.                                            P5B
     MOVE     DD-SV TO DD-R.                                            P5B
     MOVE     YY-SV TO YY-R.                                            P5B
     MOVE     ZERO TO F-R.                                              P5B
                                                                        P5B
     MOVE     ITR-HDR TO SUB-R (SUB).                                   P5B
     MOVE     DT-UNPK TO DATE-R (SUB).                                  P5B
                                                                        P5B
     REWRITE  SENSITIVITY-DATA-RCD.                                     P5B
                                                                        P5B
 CONTINUE-READ.                                                         P5B
     READ     STD-COST-FILE INTO TAPE-HDR                               P5B
              AT END                                                    P5B
              PERFORM SUM-LVL-RTN THRU S-L-R-X                          P5B
              PERFORM FINAL-PRINT THRU F-P-X                            P5B
              GO TO   CLOSE-FILES.                                      P5B
     ON 1     MOVE MJR-WS  TO MJR-SV                                    P5B
              MOVE LVL-WS  TO LVL-SV.                                   P5B
                                                                        P5B
     IF       (MJR-RCD-WS = MJR-SV-WS) AND (COST-WS > ZERO)             P5B
              ADD     COST-WS  TO COSTS-SUM COSTS-SUM-TTL               P5B
              ADD     HRS-WS  TO HRS-SUM HRS-SUM-TTL                    P5B
              ADD     +1 TO INPT-RCD-CTR                                P5B
              GO TO   CONTINUE-READ.                                    P5B
                                                                        P5B
     IF       MJR-RCD-WS = MJR-SV-WS                                    P5B
              ADD     +1 TO SKIP-RCD-CTR                                P5B
              GO TO   CONTINUE-READ.                                    P5B
                                                                        P5B
     PERFORM  SUM-LVL-RTN THRU S-L-R-X.                                 P5B
     MOVE     MJR-WS  TO MJR-SV.                                        P5B
```

```
050260        MOVE     LVL-WS  TO LVL-SV.                                     P5B
050270                                                                        P5B
050280        MOVE     HRS-WS  TO HRS-SUM.                                    P5B
050290        ADD      HRS-WS  TO HRS-SUM-TTL.                                P5B
050300        MOVE     COST-WS  TO COSTS-SUM.                                 P5B
050310        ADD      COST-WS  TO COSTS-SUM-TTL.                             P5B
050320        IF       COST-WS > ZERO                                         P5B
                       ADD      +1 TO INPT-RCD-CTR                            P5B
050340                 ELSE                                                   P5B
050350                 ADD      +1 TO SKIP-RCD-CTR.                           P5B
050360        GO TO    CONTINUE-READ.                                         P5B
050370                                                                        P5B
050380 CLOSE-FILES.                                                           P5B
050390        DISPLAY 'NUMBER OF INPUT  RECORDS ' INPT-RCD-CTR.               P5B
050400        DISPLAY 'NUMBER OF OUTPUT RECORDS ' OTPT-RCD-CTR.               P5B
050410                                                                        P5B
050420        CLOSE    STD-COST-FILE.                                         P5B
050430        CLOSE    RPT-FILE.                                              P5B
050440        CLOSE    SENSITIVITY-DATA-FILE.                                 P5B
050450        STOP RUN.                                                       P5B


050470 SUM-LVL-RTN.                                                           P5B
050480 READ-DISK.                                                             P5B
050490        READ     SENSITIVITY-DATA-FILE                                  P5B
050500                 INVALID KEY GO TO WRITE-DISK.                          P5B
060010        MOVE     MJR-SV TO MJR-1.                                       P5B
060020        MOVE     LVL-SV TO LVL-1.                                       P5B
060030        MOVE     HRS-SUM TO HRS (SUB) HRS-1.                            P5B
060040        MOVE     COSTS-SUM TO COSTS (SUB) COST-1.                       P5B
060050        MOVE     SPACE TO NEW-RCD-1.                                    P5B
060060        REWRITE SENSITIVITY-DATA-RCD.                                   P5B
060070        ADD      +1 TO OTPT-RCD-CTR.                                    P5B
060080        GO TO    WRITE-RPT.                                             P5B
060090 WRITE-DISK.                                                            P5B
060100        MOVE     ZERO-RCD TO SENSITIVITY-DATA-RCD.                      P5B
060110        MOVE     MJR-SV TO MJR MJR-1 MJR.                               P5B
060120        MOVE     LVL-SV TO LVL LVL-1 LVL.                               P5B
060130        MOVE     HRS-SUM TO HRS (SUB) HRS-1.                            P5B
060140        MOVE     COSTS-SUM TO COSTS (SUB) COST-1.                       P5B
060150        MOVE     SPACES     TO DLT-CD.                                  P5B
060160        MOVE     'X' TO NEW-RCD-1.                                      P5B
060170        WRITE    SENSITIVITY-DATA-RCD                                   P5B
060180                 INVALID KEY DISPLAY 'ERROR-4 ' SENSITIVITY-DATA-RCD    P5B
060190                 GO TO   CLOSE-FILES.                                   P5B
060200        ADD      +1 TO OTPT-RCD-CTR.                                    P5B
060210                                                                        P5B
060220 WRITE-RPT.                                                             P5B
060230        IF       LN-CTR > +58                                           P5B
060240                 ADD      +1 TO PG-CTR                                  P5B
060250                 MOVE     PG-CTR TO PG-1                                P5B
060260                 MOVE     +8  TO LN-CTR                                 P5B
060270                 WRITE    RPT-RCD FROM HD-1 AFTER POSITIONING 0         P5B
060280                 WRITE    RPT-RCD FROM HD-2 AFTER POSITIONING 1         P5B
060290                 WRITE    RPT-RCD FROM HD-3 AFTER POSITIONING 3.        P5B
060300                                                                        P5B
060310        WRITE    RPT-RCD FROM LN-1 AFTER POSITIONING 2.                 P5B
```

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060320           ADD     +2 TO LN-CTR.                                        P5B
060330 S-L-R-X. EXIT.                                                         P5B

060350 FINAL-PRINT.                                                           P5B
060360           MOVE    HRS-SUM-TTL TO HRS-2.                                P5B
060370           MOVE    COSTS-SUM-TTL TO COST-2.                             P5B
060380                                                                        P5B
060390           WRITE   RPT-RCD FROM LN-2 AFTER POSITIONING 2.               P5B
060400 F-P-X. EXIT.                                                           P5B
```

1

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ID DIVISION.                                                          P6
PROGRAM-ID. P6.                                                       P6
AUTHOR. GOSE.                                                         P6
DATE-WRITTEN. 3/77                                                    P6
DATE-COMPILED. APR 19,1977                                            P6
REMARKS.                                                              P6
          THIS PROGRAM IS A REPORT WRITER WHICH GENERATES THE        P6
      SENSITIVITY REPORT.  ANY TWO COST ITERATIONS OF THE TEN        P6
      CONTAINED ON THE SENSITIVITY DATA FILE MAY BE SELECTED FOR     P6
      SENSITIVITY ANALYSIS PURPOSES.  THE FIRST ITERATION SELECTIONP6
      IS USED AS THE NUMERATOR; THE SECOND ITERATION SELECTION IS    P6
      USED AS THE DENOMINATOR OF THE SENSITIVITY RATIOS. A RATIO     P6
      IS DISPLAYED FOR EVERY STUDENT MAJOR CATEGORY ENROLLED IN THEP6
      DEPARTMENT.                                                     P6
                                                                      P6
                                                                      P6
ENVIRONMENT DIVISION.                                                 P6
CONFIGURATION SECTION.                                                P6
INPUT-OUTPUT SECTION.                                                 P6
FILE-CONTROL.                                                         P6
    SELECT  SENSITIVITY-DATA-FILE                                     P6
                                ASSIGN  DA-I-D13650                   P6
                RECORD KEY IS MJR-KEY.                                P6
    SELECT  SELECTION-FILE      ASSIGN  UT-S-C13660.                  P6
    SELECT  RPT-FILE            ASSIGN  UT-S-R13660.                  P6
                                                                      P6
DATA DIVISION.                                                        P6
FILE SECTION.                                                         P6
FD  SENSITIVITY-DATA-FILE                                             P6
    LABEL RECORDS STANDARD                                            P6
    BLOCK 0.                                                          P6
01  SENSITIVITY-DATA-RCD.                                             P6
    05  DLT-CD                  PIC X.                                P6
    05  MJR-KEY.                                                      P6
        10  MJR                 PIC X(5).                             P6
        10  LVL                 PIC XX.                               P6
    05  COST-OCCURRENCES OCCURS 10.                                   P6
        10  HRS                 PIC S999             COMP-3.          P6
        10  COSTS               PIC S9(7)V99         COMP-3.          P6
    05  F                       PIC XX.                               P6
01  SENSITIVITY-HDR-RCD.                                              P6
    05  DLT-CD-R                PIC X.                                P6
    05  MJR-KEY-R               PIC X(7).                             P6
    05  SUB-OCCUR OCCURS 10.                                          P6
        10  SUB-R               PIC S999             COMP-3.          P6
        10  DATE-R              PIC S9(9)            COMP-3.          P6
    05  F                       PIC XX.                               P6
                                                                      P6
FD  SELECTION-FILE                                                    P6
    LABEL RECORDS STANDARD                                            P6
    BLOCK 80.                                                         P6
01  SELECTION-RCD               PIC X(80).                            P6
                                                                      P6
FD  RPT-FILE                                                          P6
```

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020050        LABEL RECORDS STANDARD                                          P6
020060        BLOCK 133.                                                      P6
020070 01   RPT-RCD                          PIC X(133).                      P6
020080                                                                        P6
020090 WORKING-STORAGE SECTION.                                               P6
020100 01   FILLER COMP-3.                                                    P6
020110          05  LN-CTR                   PIC S999      VALUE ZERO.        P6
020120          05  PG-CTR                   PIC S999      VALUE +1.          P6
020130          05  C-1                      PIC S9(9)V99 VALUE ZERO.         P6
020140          05  C-2                      PIC S9(9)V99 VALUE ZERO.         P6
020150          05  COSTS-1SV                PIC S9(9)V99 VALUE ZERO.         P6
020160          05  COSTS-2SV                PIC S9(9)V99 VALUE ZERO.         P6
020170          05  RATIO-HOLD               PIC S9(4)V9(5) VALUE ZERO.       P6
020180          05  H-1                      PIC S9(4)     VALUE ZERO.        P6
020190          05  H-2                      PIC S9(4)     VALUE ZERO.        P6
020200 01   FILLER.                                                           P6
020210          05  DT-SV.                                                    P6
020220              10  MM-SV                PIC 99.                          P6
020230              10  F                    PIC X         VALUE '/'.         P6
020240              10  DD-SV                PIC 99.                          P6
020250              10  F                    PIC X         VALUE '/'.         P6
020260              10  YY-SV                PIC 99.                          P6
020270          05  DT-UNPK                  PIC 9(9).                        P6
020280          05  DT-REDEF  REDEFINES DT-UNPK.                              P6
020290              10  F                    PIC 999.                         P6
020300              10  MM-R                 PIC 99.                          P6
020310              10  DD-R                 PIC 99.                          P6
020320              10  YY-R                 PIC 99.                          P6
020330 01   WS-SLCTN.                                                         P6
020340          05  INPT-SUB1                PIC 99.                          P6
020350          05  F                        PIC X(4).                        P6
020360          05  INPT-SUB2                PIC 99.                          P6
020370          05  F                        PIC X(72).                       P6
020380                                                                        P6
020390 01   HD-1.                                                             P6
020400          05  F                        PIC X(58)   VALUE ' R-136-60'.   P6
020410          05  F                        PIC X(65)   VALUE                P6
020420              'SENSITIVITY REPORT'.                                     P6
020430          05  F                        PIC X(5)    VALUE 'PAGE '.       P6
020440          05  PG-1                     PIC ZZ9.                         P6
020450                                                                        P6
020460                                                                        P6
020470 01   HD-2.                                                             P6
020480          05  F                        PIC X         VALUE SPACE.       P6
020490          05  DT-2                     PIC X(8).                        P6
020500                                                                        P6
030010                                                                        P6
030020 01   HD-3.                                                             P6
030030          05  F                        PIC X(23)   VALUE SPACE.         P6
030040          05  F                        PIC X(11)   VALUE 'ITERATION  '. P6
030050          05  ITR-3                    PIC ZZ.                          P6
030060          05  F                        PIC X(16)   VALUE                P6
030070              '   DATE CREATED: '.                                      P6
030080          05  DT-3                     PIC X(8).                        P6
030090                                                                        P6
030100 01   HD-4.                                                             P6
030110          05  F                        PIC X(27)   VALUE                P6
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030120            ' MAJOR  LEVEL HOURS'.                                       P6
030130        05  F                            PIC X(28)    VALUE              P6
030140            'COSTS             SENSITIVITY'.                             P6
030150                                                                         P6
030160                                                                         P6
030170 01  LN-1.                                                               P6
030180        05  F                            PIC X        VALUE SPACE.       P6
030190        05  MJR-1                        PIC XXXXX.                      P6
030200        05  F                            PIC X(4)     VALUE SPACE.       P6
030210        05  LVL-1                        PIC XX.                         P6
030220        05  F                            PIC XX       VALUE SPACE.       P6
030230        05  HRS-1                        PIC ZZZZ.                       P6
030240        05  F                            PIC X(3)     VALUE SPACE.       P6
030250        05  COSTS-1                      PIC  $$$$,$$$,$$$.99.           P6
030260                                                                         P6
030270                                                                         P6
030280 01  DASH-1.                                                             P6
030290        05  F                            PIC X(20)    VALUE SPACE.       P6
030300        05  F                            PIC X(13)    VALUE              P6
030310            '---------  --'.                                             P6
030320 01  DASH-2.                                                             P6
030330        05  F                            PIC X(14)    VALUE SPACE.       P6
030340        05  F                            PIC X(29)    VALUE              P6
030350            '          -------------     =  '.                           P6
030360        05  COSTS-2-AN.                                                  P6
030370            10  COSTS-2                  PIC Z,ZZZ.99999.                P6
030380                                                                         P6
030390 PROCEDURE DIVISION.                                                     P6
030400        OPEN     INPUT SENSITIVITY-DATA-FILE.                            P6
030410        OPEN     INPUT SELECTION-FILE.                                   P6
030420        OPEN     OUTPUT RPT-FILE.                                        P6
030430                                                                         P6
030440        MOVE     CURRENT-DATE TO DT-2.                                   P6
030450                                                                         P6
030460 EDIT-SELECTION-RCD.                                                     P6
030470        READ     SELECTION-FILE INTO WS-SLCTN                            P6
030480                 AT END                                                  P6
030490                 DISPLAY 'ERROR-1, NO SELECTION RECORD'                  P6
030500                 GO TO   CLOSE-FILES.                                    P6
040010                                                                         P6
040020        IF       (INPT-SUB1 NOT NUMERIC) OR                              P6
040030                 (INPT-SUB1 < 1 OR > 10)                                 P6
040040                 DISPLAY 'ERROR-2 ' WS-SLCTN                             P6
040050                 GO TO   CLOSE-FILES.                                    P6
040060                                                                         P6
040070        IF       (INPT-SUB2 NOT NUMERIC) OR                              P6
040080                 (INPT-SUB2 < 1 OR > 10)                                 P6
040090                 DISPLAY 'ERROR-2A ' WS-SLCTN                            P6
040100                 GO TO   CLOSE-FILES.                                    P6
040110                                                                         P6
040120        IF       INPT-SUB1 = INPT-SUB2                                   P6
040130                 DISPLAY 'ERROR-3 ' WS-SLCTN                             P6
040140                 GO TO   CLOSE-FILES.                                    P6
040150                                                                         P6
040160                                                                         P6
040170                                                                         P6
040180 READ-DISK-HDR.                                                          P6
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040190     READ     SENSITIVITY-DATA-FILE                                    P6
040200              AT END                                                   P6
040210              DISPLAY 'ERROR-4 DISK FILE EMPTY '                       P6
040220              GO TO   CLOSE-FILES.                                     P6
040230                                                                       P6
040240     IF       MJR-KEY-R NOT = SPACES                                   P6
040250              DISPLAY 'ERROR-5 ' SENSITIVITY-DATA-RCD                  P6
040260              GO TO   CLOSE-FILES.                                     P6
040270                                                                       P6
040280     IF       (SUB-R (INPT-SUB1) = ZERO) OR                            P6
040290              (SUB-R (INPT-SUB2) = ZERO)                               P6
040300              DISPLAY 'ERROR-6 ITERATIONS REQUESTED DO NOT EXIST'     P6
040310                      SENSITIVITY-DATA-RCD                             P6
040320              GO TO   CLOSE-FILES.                                     P6
040330                                                                       P6
040340     MOVE     DATE-R (INPT-SUB1) TO DT-UNPK.                           P6
040350     MOVE     MM-R TO MM-SV.                                           P6
040360     MOVE     DD-R TO DD-SV.                                           P6
040370     MOVE     YY-R TO YY-SV.                                           P6
040380     MOVE     DT-SV TO DT-3.                                           P6
040390     MOVE     INPT-SUB1 TO ITR-3.                                      P6
040400     MOVE     PG-CTR TO PG-1.                                          P6
040410     WRITE    RPT-RCD FROM HD-1   AFTER POSITIONING 0.                 P6
040420     WRITE    RPT-RCD FROM HD-2   AFTER POSITIONING 1.                 P6
040430     WRITE    RPT-RCD FROM HD-3   AFTER POSITIONING 3.                 P6
040440     WRITE    RPT-RCD FROM DASH-1 AFTER POSITIONING 1.                 P6
040450                                                                       P6
040460     MOVE     DATE-R (INPT-SUB2) TO DT-UNPK.                           P6
040470     MOVE     MM-R TO MM-SV.                                           P6
040480     MOVE     DD-R TO DD-SV.                                           P6
040490     MOVE     YY-R TO YY-SV.                                           P6
040500     MOVE     DT-SV TO DT-3.                                           P6
050010     MOVE     INPT-SUB2 TO ITR-3.                                      P6
050020                                                                       P6
050030     WRITE    RPT-RCD FROM HD-3   AFTER POSITIONING 1.                 P6
050040     WRITE    RPT-RCD FROM HD-4   AFTER POSITIONING 2.                 P6
050050     MOVE     +13 TO LN-CTR.                                           P6
050060                                                                       P6
050070 READ-SENSITIVITY-FILE.                                                P6
050080     READ     SENSITIVITY-DATA-FILE                                    P6
050090              AT END                                                   P6
050100              PERFORM TOTAL-RATIO THRU T-R-X                           P6
050110              GO TO   CLOSE-FILES.                                     P6
050120                                                                       P6
050130 CK-LN.                                                                P6
050140     IF       LN-CTR > +50                                             P6
050150              ADD     +1 TO PG-CTR                                     P6
050160              MOVE    PG-CTR TO PG-1                                   P6
050170              WRITE   RPT-RCD FROM HD-1   AFTER POSITIONING 0          P6
050180              WRITE   RPT-RCD FROM HD-2   AFTER POSITIONING 1          P6
050190              WRITE   RPT-RCD FROM HD-4   AFTER POSITIONING 3          P6
050200              MOVE    +8 TO LN-CTR.                                    P6
050210 CK-LN-X.                                                              P6
050220 MAKE-MOVES.                                                           P6
050230     MOVE     MJR TO MJR-1.                                            P6
050240     MOVE     LVL TO LVL-1.                                            P6
050250     MOVE     HRS (INPT-SUB1) TO HRS-1.                                P6
```

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          MOVE    COSTS (INPT-SUB1) TO COSTS-1 COSTS-1SV.                P6
          WRITE   RPT-RCD FROM LN-1   AFTER POSITIONING 3.                P6
          ADD     COSTS (INPT-SUB1) TO C-1.                               P6
          ADD     HRS (INPT-SUB1) TO H-1.                                 P6
                                                                          P6
          MOVE    SPACES TO MJR-1 LVL-1.                                  P6
          MOVE    HRS (INPT-SUB2) TO HRS-1.                               P6
          MOVE    COSTS (INPT-SUB2) TO COSTS-1 COSTS-2SV.                 P6
          ADD     COSTS (INPT-SUB2) TO C-2.                               P6
          ADD     HRS (INPT-SUB2) TO H-2.                                 P6
          IF      COSTS-2SV = ZERO                                        P6
                  MOVE    ALL '*' TO COSTS-2-AN                           P6
                  GO TO   PRINT-SENSITIVITY.                              P6
                                                                          P6
          COMPUTE RATIO-HOLD ROUNDED = COSTS-1SV / COSTS-2SV              P6
                  ON SIZE ERROR                                           P6
                  MOVE    ALL '*' TO COSTS-2-AN                           P6
                  GO TO   PRINT-SENSITIVITY.                              P6
                                                                          P6
          MOVE    RATIO-HOLD TO COSTS-2.                                  P6
                                                                          P6
     PRINT-SENSITIVITY.                                                   P6
          WRITE   RPT-RCD FROM DASH-2 AFTER POSITIONING 1.                P6
          WRITE   RPT-RCD FROM LN-1   AFTER POSITIONING 1.                P6
          ADD     +5 TO LN-CTR.                                           P6
          GO TO   READ-SENSITIVITY-FILE.                                  P6
                                                                          P6
     CLOSE-FILES.                                                         P6
          CLOSE   SENSITIVITY-DATA-FILE.                                  P6
          CLOSE   SELECTION-FILE                                          P6
          CLOSE   RPT-FILE.                                               P6
          STOP RUN.                                                       P6


     TOTAL-RATIO.                                                         P6
          PERFORM CK-LN THRU CK-LN-X.                                     P6
                                                                          P6
          MOVE    'TOTAL' TO MJR-1.                                       P6
          MOVE    SPACES TO LVL-1.                                        P6
          MOVE    H-1 TO HRS-1.                                           P6
          MOVE    C-1 TO COSTS-1 COSTS-1SV.                               P6
                                                                          P6
          WRITE   RPT-RCD FROM LN-1   AFTER POSITIONING 3.                P6
                                                                          P6
          MOVE    SPACES TO MJR-1 LVL-1.                                  P6
          MOVE    H-2 TO HRS-1.                                           P6
          MOVE    C-2 TO COSTS-1 COSTS-2SV.                               P6
                                                                          P6
          IF      COSTS-2SV = ZERO                                        P6
                  MOVE    ALL '*' TO COSTS-2-AN                           P6
                  GO TO   FINAL-PRINT.                                    P6
                                                                          P6
          COMPUTE RATIO-HOLD ROUNDED = COSTS-1SV / COSTS-2SV              P6
                  ON SIZE ERROR                                           P6
                  MOVE    ALL '*' TO COSTS-2-AN                           P6
                  GO TO   FINAL-PRINT.                                    P6
```

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060320       MOVE    RATIO-HOLD TO COSTS-2.                                     P6
060330                                                                          P6
060340 FINAL-PRINT.                                                             P6
060350       WRITE   RPT-RCD FROM DASH-2 AFTER POSITIONING 1.                   P6
060360       WRITE   RPT-RCD FROM LN-1   AFTER POSITIONING 1.                   P6
060370                                                                          P6
060380 T-R-X. EXIT.                                                             P6
```

APPENDIX B

FILE FORMATS

FACULTY-FILE

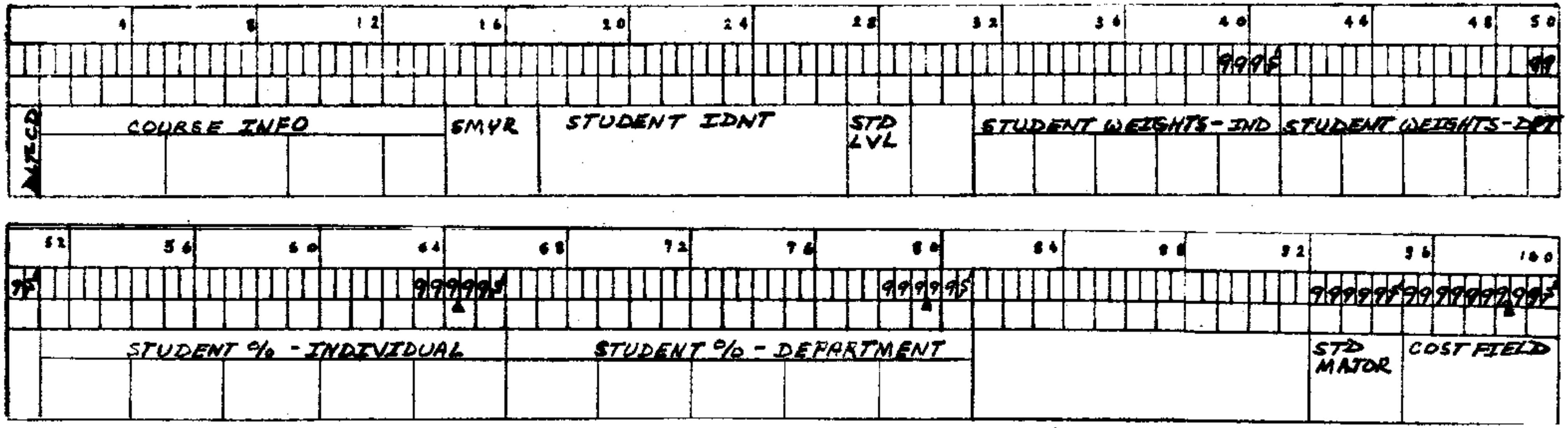
T13621 or D13621

4	8	12	16	20	24	28	32	36	40	44	48	50
							999S		999S			99
COURSE INFO			SMYR	FAC IDNT		FAC RANK	FAC FTE	FAC MBR WEIGHTS - IND		FAC MBR WEIGHTS - DPT		

52	56	60	64	68	72	76	80	84	88	92	96	100
9S			9999S				9999S				99999	
FAC MBR % - INDIVIDUAL				FAC MBR % - DEPARTMENT							COST FIELD	

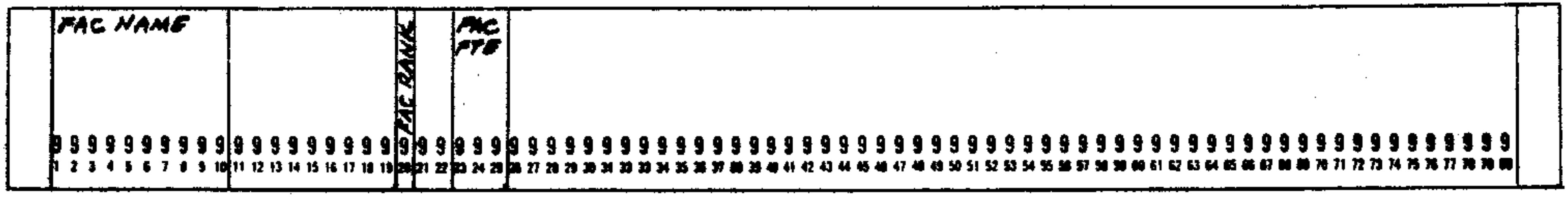
STUDENT-FILE

T13623 or D13623



RANK-FTE-FILE

C13610



APPORTION-FILE

C13620

Type 100

FAC	B	100		SUBSCRIPT	CSE SCTN HRS RANK FTE	
1–3	4	5–7	8	9	10–13	14–80

Type 105

	105				WEIGHT RANGE OCCURS 6																	
					LO	HI	WT	LO	HI	WT	LO	HI	WT	LO	HI	WT	LO	HI	WT	LO	HI	WT	
							999			999			999			999			999			999	
1–4	5–7	8	9	10	11–14	15–18	19–21	22–25	26–29	30–32	33–36	37–40	41–43	44–47	48–51	52–54	55–58	59–62	63–65	66–69	70–73	74–76	77–80

APPORTION-FILE

C13620

Type 100

Columns	1–3	4	5–7	8	9	10–80
Field	FAC	I	100		SUBSCRIPT	
Punch	999	9	999	9	9	9999999999999999999999999999999999999999999999999999999999999999999999

Type 105

Columns	1–4	5–7	8	9–10	11–23	24–26	27–36	37–39	40–80
Field		105			KEY: COURSE INFO	KEY: SMHR	KEY: IDNT	UNT 999	
Punch	9999	999	9	99	9999999999999	999	9999999999	999	99999999999999999999999999999999999999999

APPORTION-FILE

C13620

Type 100

1–3	STD
4	B
5–7	100
8	
9	SUBSCRIPT
10–13	CSE SCTN HRS RANK
14–80	

Type 105

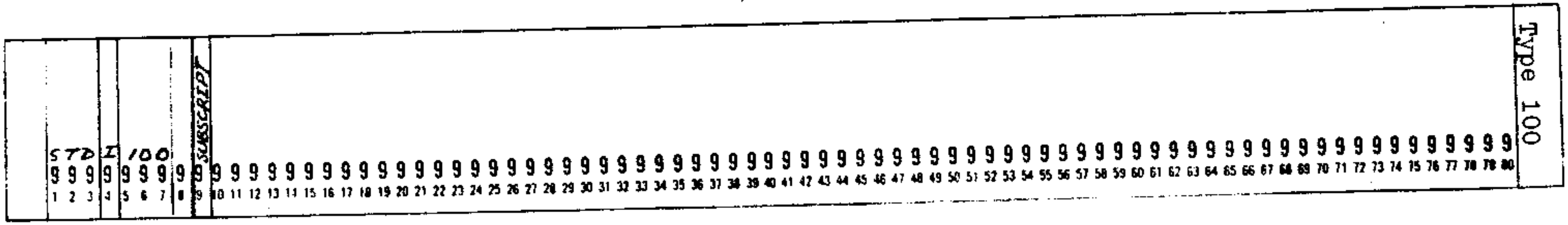
1–4	
5–7	105
8	
9–10	
11–76	WEIGHT RANGE OCCURS 6
77–80	

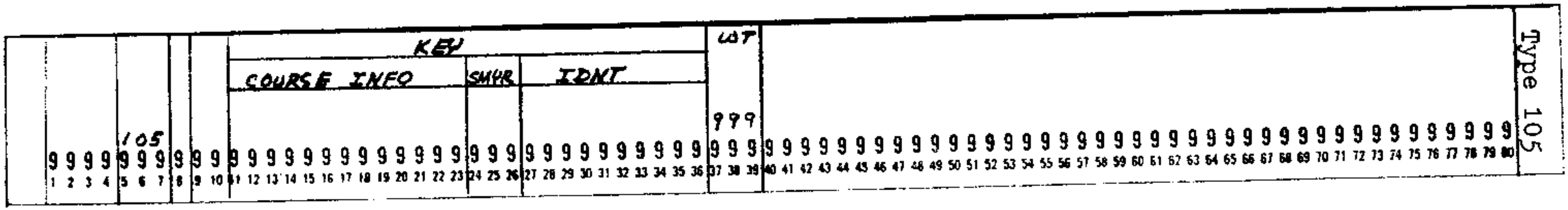
WEIGHT RANGE OCCURS 6:

	LO	HI	WT
1	11–14	15–18	19–21 (999)
2	22–25	26–29	30–32 (999)
3	33–36	37–40	41–43 (999)
4	44–47	48–51	52–54 (999)
5	55–58	59–62	63–65 (999)
6	66–69	70–73	74–76 (999)

APPORTION-FILE

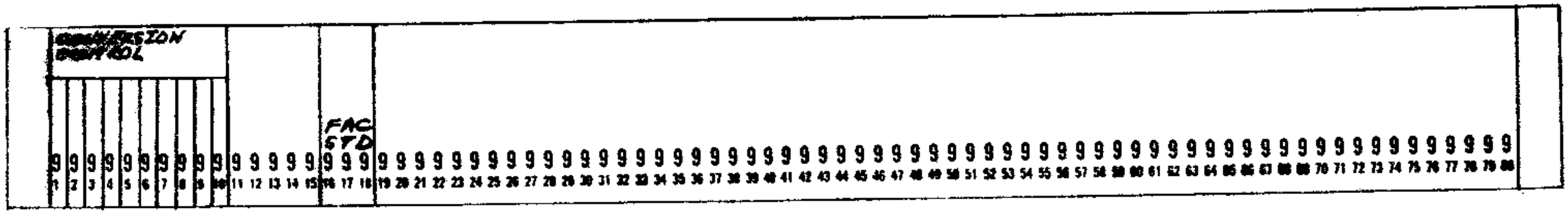
C13620





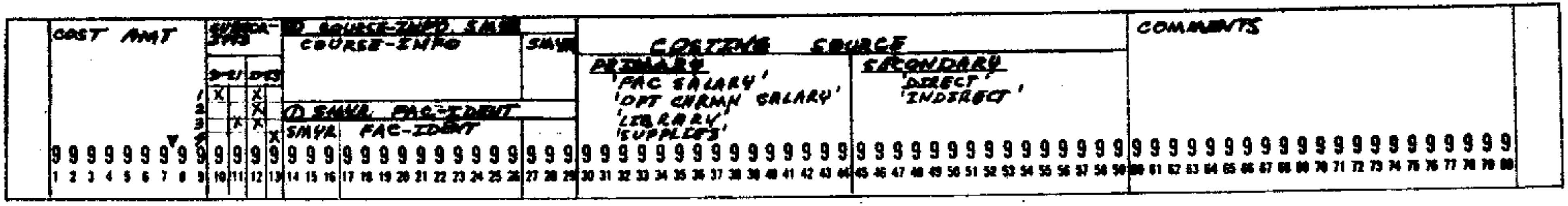
CONVERSION-FILE

C13630

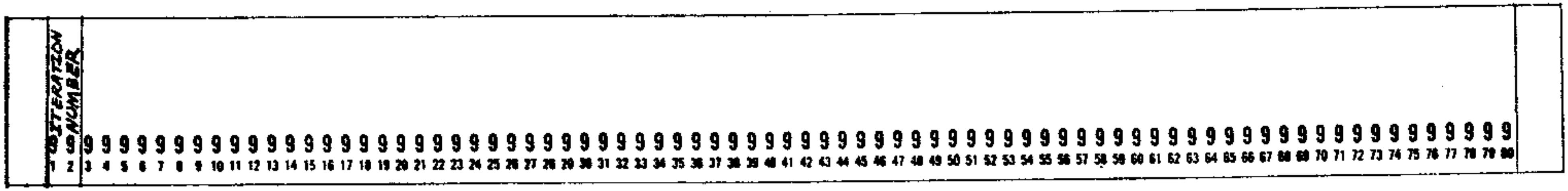


COST-SOURCE-FILE

C13640

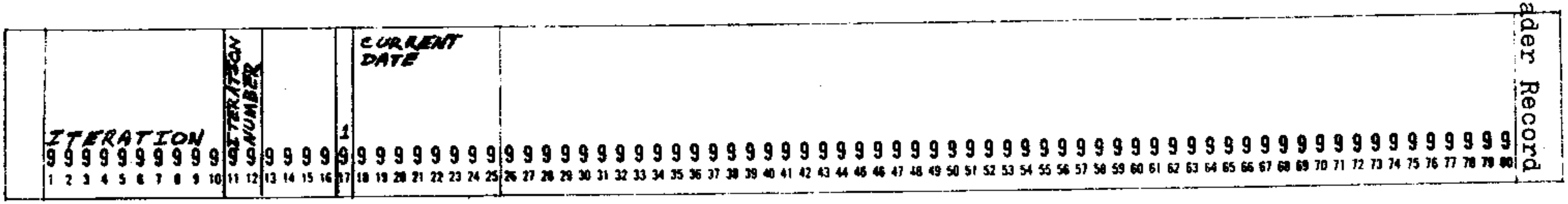


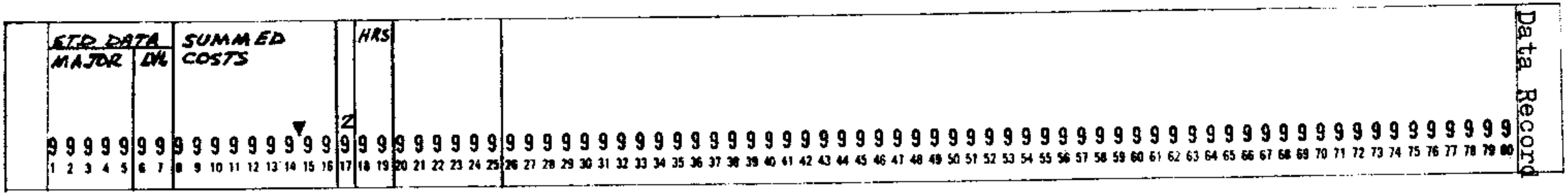
SYSIN



STD-COST-FILE

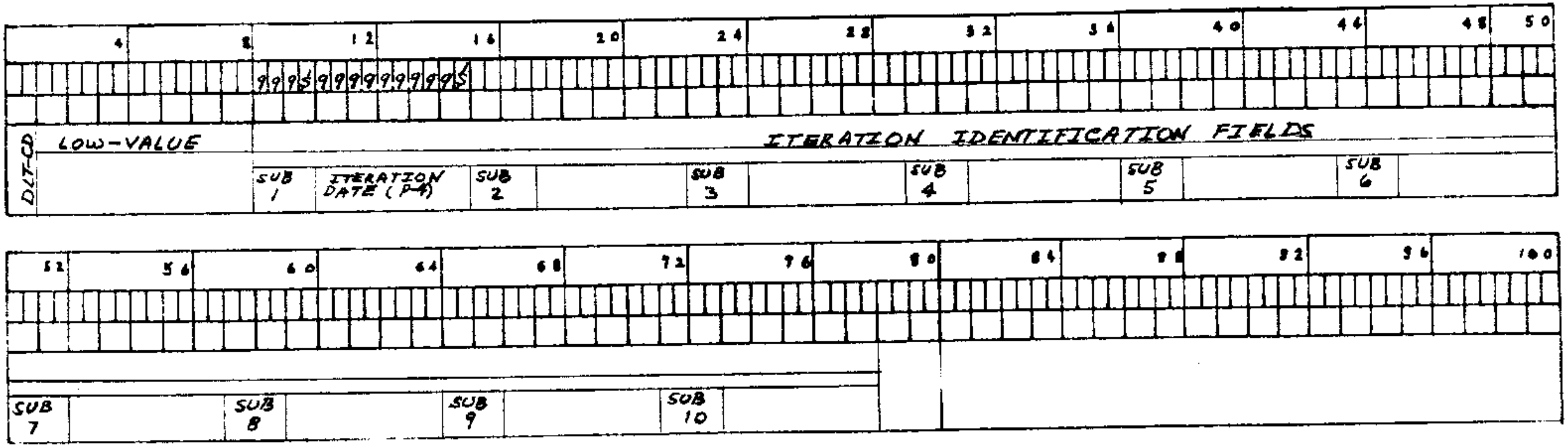
T13640





SENSITIVITY-DATA-FILE

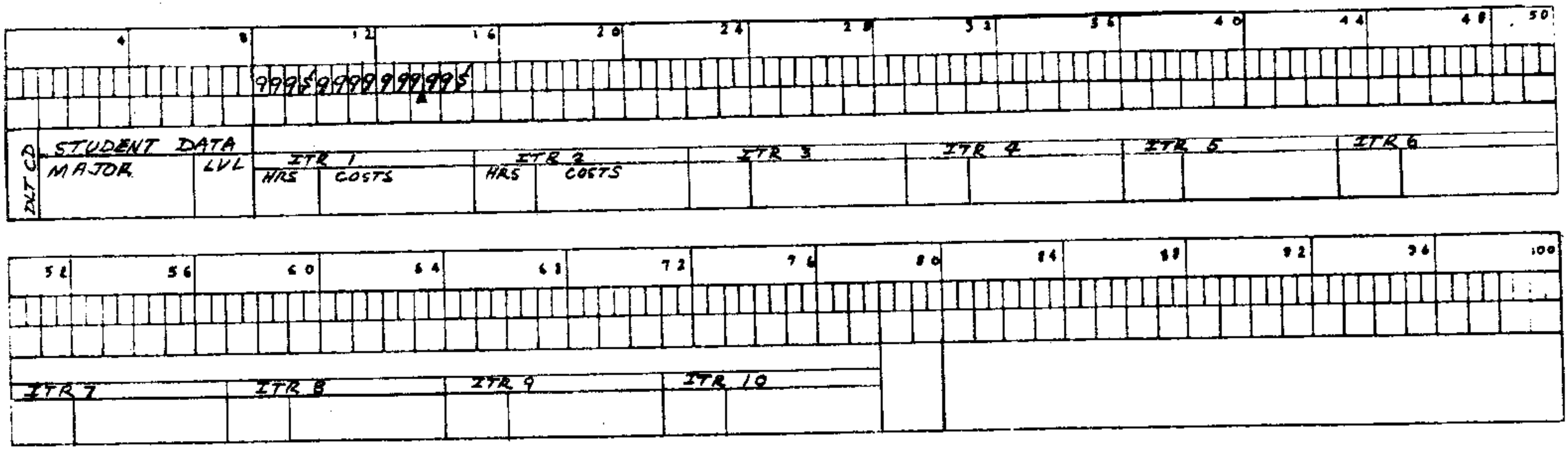
D13650



Header Record

SENSITIVITY-DATA-FILE

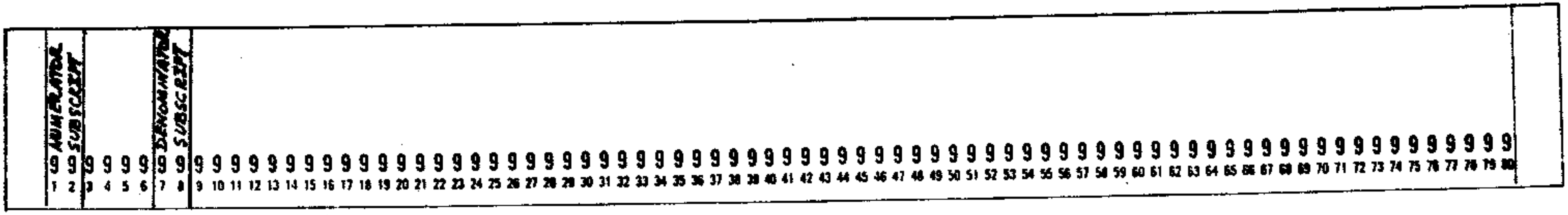
D13650



Data Record

SELECTION-FILE

C13660



APPENDIX C

JOB CONTROL LANGUAGE

```
//JP1 JOB (2064-1136,2,2),'GOSE',CLASS=I,MSGLEVEL=(1,1)
// EXEC MOD
//DD1 DD UNIT=2314,VOL=SER=USPVOL,DISP=OLD
//SYSIN  DD *
 SCRATCH DSNAME=USER2.D2064.P1136.D13621,VOL=2314=USRVOL
 SCRATCH DSNAME=USER2.D2064.P1136.D13623,VOL=2314=USRVOL
//CPY50 EXEC PGM=IEBGENER
//SYSIN DD DUMMY
//SYSPRINT DD SYSOUT=A
//SYSUT1    DD DSN=USER.D2064.P1136.T13650,DISP=(OLD,KEEP),
// UNIT=TAPE9,VOLUME=(PRIVATE,RETAIN,SER=(500056)),
// DCB=(RECFM=FB,LRECL=65,BLKSIZE=3250),LABEL=(3,SL)
//SYSUT2    DD DSN=USER.D2064.P1136.T13650,DISP=(,PASS),UNIT=2314,
// DCB=*.SYSUT1,SPACE=(CYL,(1,1))
//MOD1 EXEC PGM=IEBGENER
//SYSIN DD DUMMY
//SYSPRINT DD SYSOUT=A
//SYSUT1    DD DSN=USER.D2064.P1136.T13650,DISP=(OLD,KEEP),
// UNIT=TAPE9,VOL=REF=*.CPY50.SYSUT1,
// DCB=*.CPY50.SYSUT1,LABEL=(4,SL)
//SYSUT2    DD DSN=USER.D2064.P1136.T13650,DISP=(MOD,PASS),
// DCB=*.CPY50.SYSUT1
//CPY70 EXEC PGM=IEBGENER
//SYSIN DD DUMMY
//SYSPRINT DD SYSOUT=A
//SYSUT1    DD DSN=USER.D2064.P1136.T13670,DISP=(OLD,KEEP),
// UNIT=TAPE9,VOLUME=(PRIVATE,RETAIN,SER=(500095)),
// DCB=(RECFM=FB,LRECL=100,BLKSIZE=7200),LABEL=(1,SL)
//SYSUT2    DD DSN=USER.D2064.P1136.T13670,DISP=(,PASS),UNIT=2314,
// DCB=*.SYSUT1,SPACE=(CYL,(1,1))
//MOD2 EXEC PGM=IEBGENER
//SYSIN DD DUMMY
//SYSPRINT DD SYSOUT=A
//SYSUT1    DD DSN=USER.D2064.P1136.T13670,DISP=(OLD,KEEP),
// UNIT=TAPE9,VOL=REF=*.CPY70.SYSUT1,
// DCB=*.CPY70.SYSUT1,LABEL=(2,SL)
//SYSUT2    DD DSN=USER.D2064.P1136.T13670,DISP=(MOD,PASS),
// DCB=*.CPY70.SYSUT1
//SORT50 EXEC ADSORT01
//SYSIN     DD *
 SORT FIELDS=(11,13,CH,A,52,2,PD,A,2,9,CH,A),SIZE=E600
//SORTIN    DD DSN=USER.D2064.P1136.T13650,DISP=(OLD,DELETE),
// DCB=*.CPY50.SYSUT1
//SORTOUT  DD DSN=&&TEMP50,DISP=(,PASS),UNIT=2314,VOL=SER=WRKPAK,
// SPACE=(TRK,(8,1)),DCB=*.SORTIN
//SORT70 EXEC ADSORT01
//SYSIN     DD *
 SORT FIELDS=(1,13,CH,A,52,2,PD,A,14,16,CH,A),SIZE=E300
//SORTIN    DD DSN=USER.D2064.P1136.T13670,DISP=(OLD,DELETE),
// DCB=*.CPY70.SYSUT1
//SORTOUT  DD DSN=&&TEMP70,DISP=(,PASS),UNIT=2314,VOL=SER=WRKPAK,
// SPACE=(TRK,(4,1)),DCB=*.SORTIN
//P1 EXEC COBCLG
//GO.C13610     DD *   RANK-FTE-FILE
//GO.T13670     DD DSN=&&TEMP70,DISP=(OLD,DELETE)
//GO.T13650     DD DSN=&&TEMP50,DISP=(OLD,DELETE)
```

```
//GO.D13621     DD DSN=USER2.D2064.P1136.D13621(INDEX),UNIT=2314,
//           DISP=(,KEEP),SPACE=(CYL,(1,1)),VOL=SER=USRVOL,
//           DCB=(DSORG=IS,RECFM=FB,LRECL=100,BLKSIZE=7200)
//              DD DSN=USER2.D2064.P1136.D13621(PRIME),UNIT=2314,
//           DISP=(,KEEP),SPACE=(CYL,(1,1)),VOL=SER=USRVOL,
//           DCB=(DSORG=IS,RECFM=FB,LRECL=100,BLKSIZE=7200)
//GO.D13623     DD DSN=USER2.D2064.P1136.D13623(INDEX),UNIT=2314,
//           DISP=(,KEEP),SPACE=(CYL,(01,1)),VOL=SER=USRVOL,
//           DCB=(DSORG=IS,RECFM=FB,LRECL=100,BLKSIZE=7200)
//              DD DSN=USER2.D2064.P1136.D13623(PRIME),UNIT=2314,
//           DISP=(,KEEP),SPACE=(CYL,(01,1)),VOL=SER=USRVOL,
//           DCB=(DSORG=IS,RECFM=FB,LRECL=100,BLKSIZE=7200)
//GO.SYSUDUMP  DD SYSOUT=A
//COPY23 EXEC PGM=P50722
//PRINT         DD SYSOUT=A
//SYSUDUMP      DD SYSOUT=A
//DISKIN        DD DSN=USER2.D2064.P1136.D13623,DCB=DSORG=IS,UNIT=2314,
//           VOL=SER=USRVOL,DISP=(SHR,KEEP)
//TAPEOUT       DD DSN=&&ISAMCPY,UNIT=2314,DISP=(,PASS),
//           DCB=(RECFM=FB,LRECL=100,BLKSIZE=7200),SPACE=(TRK,(8,1))
//SYSIN         DD *
 NECCC0201?
/*
// EXEC ADSORT01
//SYSIN         DD *
 SORT FIELDS=(2,15,CH,A,93,3,PD,A,28,2,CH,A),SIZE=E600
//SORTIN        DD DSN=&&ISAMCPY,DISP=(OLD,DELETE)
//SORTOUT       DD DSN=&&STUDENT,UNIT=2314,DISP=(,PASS),
//           DCB=*.COPY23.TAPEOUT,SPACE=(TRK,(8,1))
//P1A EXEC COBCLG
//GO.D13621     DD DSN=USER2.D2064.P1136.D13621,DISP=(SHR,KEEP),
//           UNIT=2314,VOL=SER=USRVOL
//GO.D13623     DD DSN=&&STUDENT,DISP=(OLD,DELETE)
//GO.R13610     DD SYSOUT=A
//GO.SYSUDUMP  DD SYSOUT=A
```

```
/JP2 JCB (2364-1136),'G?SE',CLASS=A,MSGLEVEL=(1,1)
/SORTS1 EXEC ADSORT01
/SYSIN          DD *
SORT FIELDS=(5,3,CH,A,11,26,CH,A),SIZE=E500
/SORTOUT        DD DSN=&&CARD,DISP=(,PASS),UNIT=2314,VOL=SER=WRKPAK,
/            SPACE=(TRK,(10,1)),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
/SORTIN         DD -   APPORTION-FILE
//P2 EXEC COBCLG
//GO.D13621     DD DSN=USER2.D2064.P1136.D13621,DISP=(SHR,KEEP),
//           UNIT=2314,VOL=SER=USRVOL
//GO.D13623     DD DSN=USER2.D2064.P1136.D13623,DISP=(SHR,KEEP),
//           UNIT=2314,VOL=SER=USRVOL
//GO.C13620     DD DSN=&&CARD,DISP=(OLD,DELETE)
//GO.SYSUDUMP   DD SYSOUT=A
```

```
//JP3 JOB (2064-1136,1),'GOSE',CLASS=A,MSGLEVEL=(1,1)
// EXEC MOD
//DD1 DD UNIT=2314,VOL=SER=USRLIB,DISP=OLD
//SYSIN  DD *
 SCRATCH DSNAME=USER2.D2064.P1136.D13623A,VOL=2314=USRLIB
//J3CPY EXEC PGM=P50722
//PRINT         DD SYSOUT=A
//SYSUDUMP      DD SYSOUT=A
//DISKIN        DD DSN=USER2.D2064.P1136.D13623,DCB=DSORG=IS,UNIT=2314,
//            VOL=SER=USRVOL,DISP=SHR
//TAPEOUT       DD DSN=&&ISAMCPY,UNIT=2314,DISP=(,PASS),
//           DCB=(RECFM=FB,LRECL=100,BLKSIZE=7200),SPACE=(TRK,(8,1))
//SYSIN         DD *
 NE0000201?
/
// EXEC ADSORT01
//SYSIN         DD *
 SORT FIELDS=(02,16,CH,A),SIZE=E500
//SORTIN        DD DSN=&&ISAMCPY,DISP=(OLD,DELETE)
//SORTOUT       DD DSN=&&EITHER,UNIT=2314,DISP=(,PASS),
//           DCB=*.J3CPY.TAPEOUT,SPACE=(TRK,(8,1))
//P3 EXEC COBCLG
//GO.D136IN     DD DSN=&&EITHER,DISP=(OLD,DELETE)
//GO.D136OUT    DD DSN=USER2.D2064.P1136.D13623A,SPACE=(TRK,(8,1)),
//           UNIT=2314,VOL=SER=USRLIB,DCB=*.J3CPY.TAPEOUT,DISP=(,KEEP)
//GO.C13630     DD     CONVERSION-FILE
//GO.SYSUDUMP   DD SYSOUT=A
```

```
//JP3 JOB (2064-1136,1),'GOSE',CLASS=A,MSGLEVEL=(1,1)
// EXEC MOD
//DD1 DD UNIT=2314,VOL=SER=USRLIB,DISP=OLD
//SYSIN  DD *
 SCRATCH DSNAME=USER2.D2064.P1136.D13621A,VOL=2314=USRLIB
//J3CPY EXEC PGM=P50722
//PRINT          DD SYSOUT=A
//SYSUDUMP       DD SYSOUT=A
//DISKIN         DD DSN=USER2.D2064.P1136.D13621,DCB=DSORG=IS,UNIT=2314,
//           VOL=SER=USRVOL,DISP=SHR
//TAPEOUT        DD DSN=&&ISAMCPY,UNIT=2314,DISP=(,PASS),
//           DCB=(RECFM=FB,LRECL=100,BLKSIZE=7200),SPACE=(TRK,(8,1))
//SYSIN          DD *
 NE0000201?
/*
// EXEC ADSORT01
//SYSIN          DD *
 SORT FIELDS=(15,13,CH,A),SIZE=E500
//SORTIN         DD DSN=&&ISAMCPY,DISP=(OLD,DELETE)
//SORTOUT        DD DSN=&&EITHER,UNIT=2314,DISP=(,PASS),
//           DCB=*.J3CPY.TAPEOUT,SPACE=(TRK,(8,1))
//P3 EXEC COBCLG
//GO.D136IN      DD DSN=&&EITHER,DISP=(OLD,DELETE)
//GO.D136OT      DD DSN=USER2.D2064.P1136.D13621A,SPACE=(TRK,(4,1)),
//           UNIT=2314,VOL=SER=USRLIB,DCB=*.J3CPY.TAPEOUT,DISP=(,KEEP)
//GO.C13630      DD *  CONVERSION-FILE
//GO.SYSUDUMP    DD SYSOUT=A
```

```
//JP4 JOB (2064-1136),'GOSE',MSGLEVEL=(1,1),CLASS=B
//P4 EXEC COBLG
//LKED.SYSIN DD *
//GO.D13621A    DD DSN=USER2.D2064.P1136.D13621A,UNIT=2314,
//          DISP=(OLD,KEEP),VOL=SER=USRLIB
//GO.D13623A    DD DSN=USER2.D2064.P1136.D13623A,UNIT=2314,
//          DISP=(OLD,KEEP),VOL=SER=USRLIB
//GO.T13640     DD DSN=USER2.D2064.P1136.T13640,UNIT=TAPE9,
//          DISP=(,KEEP),VOL=SER=500114,
//          DCB=(RECFM=FB,LRECL=25,BLKSIZE=2500)
//GO.R13640     DD SYSOUT=A
//GO.C13640     DD *     COST-SOURCE-FILE
//GO.SYSIN      DD *     ITERATION NUMBER FOLLOWS
//GO.SYSLDUMP   DD SYSOUT=A
```

```
//JP5A JOB (2064-1136),'GOSE',CLASS=A,MSGLEVEL=(1,1)
// EXEC MOD
//DD1 DD UNIT=2314,VOL=SER=USRVOL,DISP=OLD
//SYSIN  DD
 SCRATCH DSNAME=USER2.D2064.P1136.D13650,VOL=2314=USRVOL
//SORT5 EXEC ADSORT01
//SYSIN         DD
 SORT FIELDS=(17,1,CH,A,1,6,CH,A),SIZE=E500
//SORTIN        DD DSN=USER2.D2064.P1136.T13640,UNIT=TAPE9,
//           DISP=(OLD,KEEP),VOL=SER=500114,
//           DCB=(RECFM=FB,LRECL=25,BLKSIZE=2500)
//SORTOUT       DD DSN=&&SCF,UNIT=2314,DISP=(,PASS),
//           DCB=*.SORTIN,SPACE=(TRK,(8,1))
//P5A EXEC COBCLG
//GO.T13640     DD DSN=&&SCF,DISP=(OLD,DELETE)
//GO.R13651     DD SYSOUT=A
//GO.D13650     DD DSN=USER2.D2064.P1136.D13650(INDEX),UNIT=2314,
//           DISP=(,KEEP),SPACE=(CYL,(1,1)),VOL=SER=USRVOL,
//           DCB=(DSORG=IS,RECFM=FB,LRECL=080,BLKSIZE=7200)
//              DD DSN=USER2.D2064.P1136.D13650(PRIME),UNIT=2314,
//           DISP=(,KEEP),SPACE=(CYL,(1,1)),VOL=(,REF=*.D13650),
//           DCB=*.D13650
//              DD DSN=USER2.D2064.P1136.D13650(OVFLOW),UNIT=2314,
//           DISP=(,KEEP),SPACE=(CYL,(1,1)),VOL=(,REF=*.D13650),
//           DCB=*.D13650
//GO.SYSUDUMP   DD SYSOUT=A
```

```
//JP5B JOB (2064-1136),'GESL',CLASS=A,MSGLEVEL=(1,1)
//SORT5 EXEC ADSORT01
//SYSIN         DD *
 SORT FIELDS=(17,1,CH,A,1,6,CH,A),SIZE=E500
//SORTIN        DD DSN=USER2.D2064.P1136.T13640,UNIT=TAPES,
//           DISP=(OLD,KEEP),VOL=SER=500114,
//           DCB=(RECFM=FB,LRECL=25,BLKSIZE=2500)
//SORTOUT       DD DSN=&&SCF,UNIT=2314,DISP=(,PASS),
//           DCB=*.SORTIN,SPACE=(TRK,(8,1))
//P5B EXEC COBCLG
//GO.T13640     DD DSN=&&SCF,DISP=(OLD,DELETE)
//GO.R13650     DD SYSOUT=A
//GO.D13650     DD DSN=USER2.D2064.P1136.D13650,UNIT=2314,
//           DISP=SHR,VOL=SER=USRVOL
//GO.SYSUDUMP   DD SYSOUT=A
```

```
//JP6 JOB (2064-1136),'GOSE',CLASS=A,MSGLEVEL=(1,1)
//P6 EXEC COBCLG
//GO.D13650     DD DSN=USER2.D2064.P1136.D13650,UNIT=2314,
//           DISP=SHR,VOL=SER=USRVOL
//GO.C13660     DD *  SELECTION-FILE
//GO.P13660     DD SYSOUT=A
//GO.SYSUDUMP   DD SYSOUT=A
```

APPENDIX D

REPORTS

DEPARTMENT COURSE SECTION HOURS INSTRUCTOR SMYR

STUDENT MAJOR STUDENT LEVEL NUMBER ENROLLED

ABCD	101	001	03	F		173
	10129		1		1	
	10138		2		1	
	10143		1		2	
	10143		2		2	
	10143		4		1	
	10152		1		1	
	10158		2		1	
	10170		3		1	
	10197		2		2	
	16336		1		1	
	20201		1		1	
	20201		2		2	
	20204		2		1	
	20241		1		1	
	27103		2		1	
	99199		2		1	
ABCD	201	001	03	A		173
	10106		4		2	
	10108		4		1	
	10128		4		1	
	10143		3		1	
	10143		4		1	
	10154		1		1	
	10157		1		1	
	10197		1		1	
	10197		5		1	
	11106		4		1	
	13143		2		1	
	20225		2		2	
	20225		4		2	
	20241		2		2	
	20241		3		1	
	20242		1		1	
	28511		4		1	
	58674		5		3	
	58674		5		1	
ABCD	201	001	03	A		274
	10106		3		1	
	10108		4		1	
	10117		2		1	
	10129		2		1	
	10133		4		1	

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	10143		2		2	
	10143		3		2	
	10143		4		2	
	10158		1		1	
	10158		3		1	
	10197		1		1	
	11106		4		1	
	12108		4		1	
	20241		2		1	
	20241		3		1	
	28311		3		1	
	28511		4		1	
	40606		5		1	
	50640		5		1	
	58674		5		1	
ABCD	236	001	03	G		173
	10106		4		1	
	10108		2		1	
	10143		1		1	
	10143		3		2	
	10143		4		2	
	10154		2		1	
	10197		2		2	
	11106		3		1	
	11106		4		1	
	12108		1		1	
	12108		3		1	
	12108		4		1	
	13143		2		1	
	13143		3		1	
	20241		2		1	
	20241		4		1	
	22319		3		1	
	22363		1		1	
ABCD	236	001	03	B		274
	10103		2		1	
	10117		3		1	
	10129		2		1	
	10143		1		1	
	10143		2		1	
	10143		4		2	
	10154		3		1	
	13143		2		1	
	15154		1		1	

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	15154		3		1	
	15154		4		1	
	22363		5		1	
	23353		2		1	
	28511		1		1	
ABCD	303	001	04	B		173
	10143		3		1	
	10143		4		5	
	10154		4		1	
	11106		4		1	
	12108		4		1	
	20225		2		1	
	20225		4		1	
	20241		2		1	
ABCD	387	501	02	G		274
	10106		4		1	
	10143		3		1	
	10143		4		1	
	13143		4		1	
ABCD	387	502	03	G		274
	10106		4		1	
	15154		3		1	
ABCD	387	700	02	B		173
	10157		1		1	
ABCD	387	700	03	B		173
	10143		2		1	
	10143		4		2	
ABCD	404	001	04	C		274
	10143		2		1	
	10143		4		4	
	10154		3		1	
	10197		2		1	
	10197		5		1	
	11106		4		1	
	12108		4		2	
	13143		2		1	
	20201		4		1	
	20225		4		2	
	20241		3		2	
	20241		4		7	

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	28511		4		1	
	58674		5		3	
ABCD	430	001	03	E		173
	10143		4		1	
	10154		4		1	
	10197		5		1	
	13143		2		1	
	20225		3		1	
	20225		4		6	
	20241		4		3	
	58608		3		1	
	58674		5		2	
	58674		6		1	
ABCD	440	001	03	C		173
	10143		4		1	
	10197		1		1	
	12108		4		1	
	58674		5		5	
	58674		6		1	
ABCD	451	001	03	B		274
	10128		4		1	
	10143		4		3	
	15154		4		1	
	20201		3		1	
	20225		4		2	
	20241		3		1	
	20241		4		8	
	58674		5		1	
ABCD	488	700	03	B		274
	13143		4		1	
ABCD	489	700	02	A		173
	10143		4		1	
	13143		2		1	
ABCD	489	700	03	A		173
	20225		4		1	
	20241		4		1	
ABCD	489	700	03	A		274
	10197		2		1	
ABCD	489	701	02	C		274

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	10143		4		1	
ABCD	487	701	03	C		173
	10143		4		1	
	20225		2		1	
	20241		4		1	
	23511		4		1	
ABCD	489	701	04	C		173
	99199		1		1	
ABCD	489	702	03	B		173
	10154		5		1	
ABCD	490	700	03	A		173
	10154		4		1	
	15154		4		1	
ABCD	490	701	03	E		274
	10129		4		1	
	10143		4		1	
	10197		2		1	
	20225		4		2	
	20241		4		1	
ABCD	491	700	03	A		274
	15154		4		1	
ABCD	501	001	03	B		173
	10197		5		1	
	28551		5		1	
	42641		5		1	
	42642		5		1	
	46614		5		1	
	56508		5		1	
	56657		5		1	
	56674		5		2	
	58674		6		1	
	78613		6		1	
	76640		6		1	
	76659		5		1	
	76659		6		1	
	76657		5		3	
	89648		6		1	
ABCD	502	001	03	B		173

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	42641		5		1	
	58608		5		1	
	58643		5		1	
	89698		6		1	
ABCD	502	001	03	E		274
	10197		5		1	
	58608		5		1	
	58674		5		2	
	74610		6		1	
	78610		6		1	
	78643		5		1	
	78659		6		1	
	89698		5		1	
ABCD	521	001	03	C		173
	42641		5		1	
	52611		5		1	
	58674		5		6	
	58674		6		1	
	78608		5		1	
	89697		5		1	
ABCD	525	001	03	B		274
	40643		5		1	
	58608		5		1	
	58643		5		1	
	58674		5		6	
	89697		5		1	
ABCD	543	001	03	D		173
	40643		5		1	
	58608		5		1	
	58674		5		5	
	89697		5		1	
ABCD	547	001	04	B		274
	42641		5		1	
	58674		5		2	
	78610		6		2	
ABCD	554	001	03	B		173
	42601		5		1	
	58674		5		4	
ABCD	555	001	03	C		173

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	42601		5		1	
	58674		5		9	
	58674		6		1	
ABCD	555	001	03	C		274
	58608		5		1	
	58674		5		12	
	89697		5		1	
ABCD	561	001	03	A		274
	10128		4		1	
	58674		5		5	
ABCD	570	001	03	C		274
	10128		4		1	
	10197		5		1	
	42641		5		1	
	58674		5		3	
	78641		6		3	
ABCD	587	500	02	B		173
	58674		5		3	
	58674		6		1	
ABCD	587	500	02	B		274
	58674		5		1	
ABCD	587	500	03	B		173
	58674		7		1	
	89697		5		1	
ABCD	587	502	03	G		274
	42641		5		1	
	58674		5		1	
ABCD	589	001	02	A		173
	58674		5		2	
	58674		6		2	
	78608		5		1	
	78654		6		2	
ABCD	589	003	03	C		173
	42601		5		1	
	58674		5		8	
	58674		6		2	
	78654		6		1	

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	89697		5		1	
ABCD	589	701	03	C		274
	78654		6		1	
ABCD	589	701	04	C		274
	58674		5		1	
ABCD	589	702	03	B		274
	78632		6		1	
ABCD	590	700	03	A		173
	58674		5		1	
	58674		7		1	
ABCD	590	700	03	C		274
	78654		6		1	
ABCD	590	701	03	E		274
	10126		4		1	
	58674		5		1	
	78659		6		1	
ABCD	590	702	03	B		274
	78610		6		1	
ABCD	591	700	01	A		274
	58674		5		2	
ABCD	592	700	02	A		274
	58674		5		1	
ABCD	592	701	03	C		173
	58674		5		2	
	70611		6		1	
ABCD	594	001	01	A		173
	58674		5		8	
	58674		6		2	
	58674		7		1	
ABCD	595A	700	03	A		173
	58674		5		1	
ABCD	595A	700	03	A		274
	58674		5		2	

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	58674		5		1	
ABCD	595A	701	03	C		173
	58674		6		1	
ABCD	595A	701	03	C		274
	58674		5		1	
ABCD	595B	700	03	A		173
	58674		5		1	
ABCD	595B	700	03	A		274
	58674		5		1	
ABCD	595B	701	03	C		274
	58674		6		1	
	TOTAL				396	

DEPARTMENT COST & APPORTIONING REPORT
ITERATION 1

COST AMOUNT	APPORTIONING SUBSCRIPTS		APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$10,023.00	1	1	173A	FACULTY SALARY	DIRECT
$6,930.00	1	1	173B	FACULTY SALARY	DIRECT
$5,020.00	1	1	173C	FACULTY SALARY	DIRECT
$900.00	1	1	173D	FACULTY SALARY	DIRECT
$900.00	1	1	173E	FACULTY SALARY	DIRECT
$500.00	1	1	173F	FACULTY SALARY	DIRECT
$500.00	1	1	173G	FACULTY SALARY	DIRECT
$10,023.00	1	1	274A	FACULTY SALARY	DIRECT
$6,930.00	1	1	274B	FACULTY SALARY	DIRECT
$5,020.00	1	1	274C	FACULTY SALARY	DIRECT
$1,700.00	1	1	274E	FACULTY SALARY	DIRECT
$602.00	1	1	274G	FACULTY SALARY	DIRECT
$49,048.00			TOTAL COSTS		

DEPARTMENT COST & APPORTIONING REPORT
ITERATION 2

COST AMOUNT	APPORTIONING SUBSCRIPTS		APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$10,023.00	2	1	173A	FACULTY SALARY	DIRECT
$6,930.00	2	1	173B	FACULTY SALARY	DIRECT
$5,020.00	2	1	173C	FACULTY SALARY	DIRECT
$900.00	2	1	173D	FACULTY SALARY	DIRECT
$900.00	2	1	173E	FACULTY SALARY	DIRECT
$500.00	2	1	173F	FACULTY SALARY	DIRECT
$500.00	2	1	173G	FACULTY SALARY	DIRECT
$10,023.00	2	1	274A	FACULTY SALARY	DIRECT
$6,930.00	2	1	274B	FACULTY SALARY	DIRECT
$5,020.00	2	1	274C	FACULTY SALARY	DIRECT
$1,700.00	2	1	274E	FACULTY SALARY	DIRECT
$602.00	2	1	274G	FACULTY SALARY	DIRECT
$49,048.00			TOTAL COSTS		

COSTS PER MAJOR BY LEVEL
ITERATION 01

MAJOR	LEVEL	HOURS	COSTS
10103	1L	3	$83.29
10106	2U	17	$485.08
10108	1L	3	$23.80
10108	2U	6	$217.82
10117	1L	3	$124.57
10117	2U	3	$83.17
10128	2U	15	$935.15
10129	1L	9	$232.86
10129	2U	3	$47.24
10133	2U	3	$124.57
10136	1L	3	$25.00
10143	1L	34	$639.00
10143	2U	112	$2,489.14
10152	1L	3	$25.00
10154	1L	6	$117.05
10154	2U	14	$303.04
10154	3M	6	$138.73
10157	1L	5	$148.69
10158	1L	6	$149.57
10158	2U	3	$124.57
10170	2U	3	$25.00
10197	1L	31	$656.48
10197	3M	19	$491.75
11106	2U	20	$402.16
12108	1L	3	$23.85
12108	2U	24	$459.52

MAJOR	LEVEL	HOURS	COSTS
13143	1L	18	$410.97
13143	2U	10	$198.15
15154	1L	3	$83.29
15154	2U	18	$595.96
16336	1L	3	$25.00
20201	1L	9	$75.00
20201	2U	7	$113.70
20204	1L	3	$25.00
20225	1L	13	$326.68
20225	2U	54	$1,067.84
20241	1L	19	$452.23
20241	2U	90	$1,626.31
20242	1L	3	$93.25
22319	2U	3	$23.85
22363	1L	3	$23.80
22363	3M	3	$83.29
23353	1L	3	$83.17
27103	1L	3	$25.00
28511	1L	3	$83.17
28511	2U	16	$434.10
28551	3M	3	$61.54
40606	3M	3	$124.57
40643	3M	6	$237.38
42601	3M	9	$382.18
42641	3M	19	$913.45
42642	3M	3	$61.65

COSTS PER MAJOR BY LEVEL
ITERATION 01

MAJOR	LEVEL	HOURS	COSTS
46614	3M	3	$61.65
50640	3M	3	$124.57
52611	3M	3	$86.93
58608	3M	21	$819.61
58643	3M	6	$402.08
58659	3M	3	$61.65
58674	1L	7	$1,348.65
58674	3M	303	$20,880.41
58674	4D	41	$3,059.14
70611	4D	3	$239.09
74610	4D	3	$104.92
78608	3M	5	$419.85
78610	4D	14	$916.29
78613	4D	3	$61.63
78632	4D	3	$312.54
78640	4D	3	$61.54
78641	4D	9	$413.10
78643	3M	3	$104.92
78654	4D	13	$1,235.19
78659	3M	3	$61.54
78659	4D	9	$324.02
78667	4D	9	$184.95
89697	3M	18	$1,040.75
89698	3M	3	$104.92
89698	4D	6	$338.74
99199	1L	7	$72.69
TOTAL COSTS		1188	$49,048.00

COSTS PER MAJOR BY LEVEL
ITERATION 02

MAJOR	LEVEL	HOURS	COSTS
10103	1L	3	$70.58
10106	2U	17	$485.08
10108	1L	3	$23.80
10108	2U	6	$217.82
10117	1L	3	$124.57
10117	2U	3	$70.48
10128	2U	15	$956.13
10129	1L	9	$220.15
10129	2U	3	$47.24
10133	2U	3	$124.57
10138	1L	3	$25.00
10143	1L	34	$640.36
10143	2U	112	$2,779.52
10152	1L	3	$25.00
10154	1L	6	$117.05
10154	2U	14	$329.74
10154	3M	6	$126.02
10157	1L	5	$148.69
10158	1L	6	$149.57
10166	2U	3	$124.57
10170	2U	3	$25.00
10197	1L	31	$755.40
10197	3M	19	$491.31
11106	2U	20	$428.86
12108	1L	3	$23.85
12108	2U	24	$585.21

COSTS PER MAJOR BY LEVEL
ITERATION 02

MAJOR	LEVEL	HOURS	COSTS
13143	1L	18	$424.96
13143	2U	10	$176.40
15154	1L	3	$70.58
15154	2U	18	$618.72
16336	1L	3	$25.00
20201	1L	9	$75.00
20201	2U	7	$188.60
20204	1L	3	$25.00
20225	1L	13	$319.02
20225	2U	54	$1,217.78
20241	1L	19	$452.23
20241	2U	90	$2,292.48
20242	1L	3	$93.25
22319	2U	3	$23.85
22363	1L	3	$23.80
22363	3M	3	$70.58
23353	1L	3	$70.48
27103	1L	3	$25.00
28511	1L	3	$70.48
28511	2U	16	$453.14
28551	3M	3	$61.54
40606	3M	3	$124.57
40643	3M	6	$218.32
42631	3M	9	$356.54
42641	3M	19	$834.19
42642	3M	3	$61.65

MAJOR	LEVEL	HOURS	COSTS
46614	3M	3	$61.65
50640	3M	3	$124.57
52611	3M	3	$73.01
58608	3M	21	$783.00
58643	3M	6	$383.02
58659	3M	3	$61.65
58674	1L	7	$1,348.65
58674	3M	303	$20,219.64
58674	4D	41	$2,992.66
70611	4D	3	$200.78
74610	4D	3	$104.92
78608	3M	5	$405.93
78610	4D	14	$792.93
78613	4D	3	$61.63
78632	4D	3	$264.03
78640	4D	3	$61.54
78641	4D	9	$331.44
78643	3M	3	$104.92
78654	4D	13	$1,125.50
78659	3M	3	$61.54
78659	4D	9	$324.02
78667	4D	9	$184.95
85657	3M	18	$978.47
89698	3M	3	$104.92
89698	4D	6	$338.74
99159	1L	7	$65.16
TOTAL COSTS		1188	$49,048.00

SENSITIVITY REPORT

ITERATION 1 DATE CREATED: 06/06/77
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ITERATION 2 DATE CREATED: 06/06/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10103	1L	3	$83.29	=	1.18008
		3	$70.58		
10106	2U	17	$485.08	=	1.00000
		17	$485.08		
10108	1L	3	$23.80	=	1.00000
		3	$23.80		
10108	2U	6	$217.82	=	1.00000
		6	$217.82		
10117	1L	3	$124.57	=	1.00000
		3	$124.57		
10117	2U	3	$83.17	=	1.18005
		3	$70.48		
10128	2U	15	$935.15	=	.97806
		15	$956.13		
10129	1L	9	$232.86	=	1.05773
		9	$220.15		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10129	2U	3	$47.24	=	1.00000
		3	$47.24		
10133	2U	3	$124.57	=	1.00000
		3	$124.57		
10138	1L	3	$25.00	=	1.00000
		3	$25.00		
10143	1L	34	$639.00	=	.99788
		34	$640.36		
10143	2U	112	$2,489.14	=	.89553
		112	$2,779.52		
10152	1L	3	$25.00	=	1.00000
		3	$25.00		
10154	1L	6	$117.05	=	1.00000
		6	$117.05		
10154	2U	14	$303.04	=	.91903
		14	$329.74		
10154	3M	6	$138.73	=	1.10086
		6	$126.02		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10157	1L	5	$148.69	=	1.00000
		5	$148.69		
10158	1L	6	$149.57	=	1.00000
		6	$149.57		
10158	2U	3	$124.57	=	1.00000
		3	$124.57		
10170	2U	3	$25.00	=	1.00000
		3	$25.00		
10197	1L	31	$656.48	=	.86905
		31	$755.40		
10197	3M	19	$491.75	=	1.00090
		19	$491.31		
11106	2U	20	$402.16	=	.93774
		20	$428.86		
12108	1L	3	$23.85	=	1.00000
		3	$23.85		
12108	2U	24	$459.52	=	.78522
		24	$585.21		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
13143	1L	18	$410.97	=	.96708
		18	$424.96		
13143	2U	10	$198.15	=	1.12330
		10	$176.40		
15154	1L	3	$83.29	=	1.18008
		3	$70.58		
15154	2U	18	$595.96	=	.96321
		18	$618.72		
16336	1L	3	$25.00	=	1.00000
		3	$25.00		
20201	1L	9	$75.00	=	1.00000
		9	$75.00		
20201	2U	7	$113.70	=	.60286
		7	$188.60		
20204	1L	3	$25.00	=	1.00000
		3	$25.00		
20225	1L	13	$326.68	=	1.02401
		13	$319.02		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
20225	2U	54	$1,067.84	=	.87687
		54	$1,217.78		
20241	1L	19	$452.23	=	1.00000
		19	$452.23		
20241	2U	90	$1,626.31	=	.70941
		90	$2,292.48		
20242	1L	3	$93.25	=	1.00000
		3	$93.25		
22319	2U	3	$23.85	=	1.00000
		3	$23.85		
22363	1L	3	$23.80	=	1.00000
		3	$23.80		
22363	3M	3	$83.29	=	1.18008
		3	$70.58		
23353	1L	3	$83.17	=	1.18005
		3	$70.48		
27103	1L	3	$25.00	=	1.00000
		3	$25.00		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
28511	1L	3	$83.17	=	1.18005
		3	$73.48		
28511	2J	16	$434.10	=	.95798
		16	$453.14		
28551	3M	3	$61.54	=	1.00000
		3	$61.54		
40636	3M	3	$124.57	=	1.00000
		3	$124.57		
40643	3M	6	$237.38	=	1.08730
		6	$218.32		
42601	3M	9	$382.18	=	1.07191
		9	$356.54		
42641	3M	19	$913.45	=	1.09501
		19	$834.19		
42642	3M	3	$61.65	=	1.00000
		3	$61.65		
46614	3M	3	$61.65	=	1.00000
		3	$61.65		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
50640	3M	3	$124.57	=	1.00000
		3	$124.57		
52611	3M	3	$86.93	=	1.19066
		3	$73.01		
58608	3M	21	$819.61	=	1.04676
		21	$783.00		
58643	3M	6	$402.08	=	1.04976
		6	$383.02		
58659	3M	3	$61.65	=	1.00000
		3	$61.65		
58674	1L	7	$1,348.65	=	1.00000
		7	$1,348.65		
58674	3M	303	$20,880.41	=	1.03268
		303	$20,219.64		
58674	4D	41	$3,059.14	=	1.02221
		41	$2,992.66		
70611	4D	3	$239.09	=	1.19081
		3	$200.78		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
74610	40	3 / 3	$104.92 / $104.92	=	1.00000
78608	3M	5 / 5	$419.85 / $405.93	=	1.03429
78610	4D	14 / 14	$916.29 / $792.93	=	1.15557
78613	4D	3 / 3	$61.63 / $61.63	=	1.00000
78632	4D	3 / 3	$312.54 / $264.03	=	1.18373
78640	4D	3 / 3	$61.54 / $61.54	=	1.00000
78641	4D	9 / 9	$413.10 / $331.44	=	1.24638
78643	3M	3 / 3	$104.92 / $104.92	=	1.00000
78654	4D	13 / 13	$1,235.19 / $1,125.50	=	1.09746

SENSITIVITY REPORT

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
78659	3M	3	$61.54	=	1.00000
		3	$61.54		
78659	4D	9	$324.02	=	1.00000
		9	$324.02		
78667	4D	9	$184.95	=	1.00000
		9	$184.95		
89697	3M	18	$1,043.75	=	1.06365
		18	$978.47		
89698	3M	3	$104.92	=	1.00000
		3	$104.92		
89698	4D	6	$338.74	=	1.00000
		6	$338.74		
99199	1L	7	$72.69	=	1.11556
		7	$65.16		
TOTAL		1188	$49,048.00	=	1.00000
		1188	$49,048.00		

DEPARTMENT COST & APPORTIONING REPORT
ITERATION 3

COST AMOUNT	APPORTIONING SUBSCRIPTS		APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$5,011.50	2	2	173A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	173B	FACULTY SALARY	DIRECT
$5,020.00	2	2	173C	FACULTY SALARY	DIRECT
$900.00	2	2	173D	FACULTY SALARY	DIRECT
$900.00	2	2	173E	FACULTY SALARY	DIRECT
$500.00	2	2	173F	FACULTY SALARY	DIRECT
$500.00	2	2	173G	FACULTY SALARY	DIRECT
$5,011.50	2	2	274A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	274B	FACULTY SALARY	DIRECT
$5,020.00	2	2	274C	FACULTY SALARY	DIRECT
$1,700.00	2	2	274E	FACULTY SALARY	DIRECT
$602.00	2	2	274G	FACULTY SALARY	DIRECT
$10,023.00		6		.5 CHRMN SAL	INDIRECT
$13,937.00		6		TOTAL DPT M&O	INDIRECT
$5,976.00		6		DPT CT SAL & WG	INDIRECT
$1,308.12		6		% A&S DEANS OFC	INDIRECT
$70,269.12			TOTAL COSTS		

DEPARTMENT COST & APPORTIONING REPORT
ITERATION 4

COST AMOUNT	APPORTIONING SUBSCRIPTS		APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$5,011.50	2	2	173A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	173B	FACULTY SALARY	DIRECT
$5,020.00	2	2	173C	FACULTY SALARY	DIRECT
$900.00	2	2	173D	FACULTY SALARY	DIRECT
$900.00	2	2	173E	FACULTY SALARY	DIRECT
$500.00	2	2	173F	FACULTY SALARY	DIRECT
$500.00	2	2	173G	FACULTY SALARY	DIRECT
$5,011.50	2	2	274A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	274B	FACULTY SALARY	DIRECT
$5,020.00	2	2	274C	FACULTY SALARY	DIRECT
$1,700.00	2	2	274E	FACULTY SALARY	DIRECT
$602.00	2	2	274G	FACULTY SALARY	DIRECT
$10,023.00		6		.5 CHRMN SAL	INDIRECT
$13,937.00		6		TOTAL DPT M&O	INDIRECT
$5,976.00		6		DPT CT SAL & WG	INDIRECT
$1,308.12		7		% A&S DEANS OFC	INDIRECT
$70,269.12			TOTAL COSTS		

COSTS PER MAJOR BY LEVEL
ITERATION 03

MAJOR	LEVEL	HOURS	COSTS
10103	1L	3	$143.46
10106	2U	17	$778.82
10108	1L	3	$101.91
10108	2U	6	$253.15
10117	1L	3	$133.23
10117	2U	3	$143.46
10128	2U	15	$1,050.36
10129	1L	9	$376.78
10129	2U	3	$125.35
10133	2U	3	$133.09
10138	1L	3	$103.11
10143	1L	34	$1,341.30
10143	2U	112	$4,931.68
10152	1L	3	$106.24
10154	1L	6	$218.95
10154	2U	14	$570.67
10154	3M	6	$342.37
10157	1L	5	$253.61
10158	1L	6	$236.20
10158	2U	3	$136.36
10170	2U	3	$106.24
10197	1L	31	$1,276.39
10197	3M	19	$1,028.94
11106	2U	20	$768.02
12108	1L	3	$101.96
12108	2U	24	$976.12

MAJOR	LEVEL	HOURS	COSTS
13143	1L	18	$753.08
13143	2U	10	$498.23
15154	1L	3	$140.44
15154	2U	18	$934.74
16336	1L	3	$103.11
20201	1L	9	$312.46
20201	2U	7	$332.87
20204	1L	3	$103.11
20225	1L	13	$535.23
20225	2U	54	$2,296.87
20241	1L	19	$748.95
20241	2U	90	$4,063.54
20242	1L	3	$116.93
22319	2U	3	$101.96
22363	1L	3	$105.04
22363	3M	3	$202.66
23353	1L	3	$140.33
27103	1L	3	$103.11
28511	1L	3	$140.33
28511	2U	16	$645.17
28551	3M	3	$139.65
40606	3M	3	$188.36
40643	3M	6	$377.67
42601	3M	9	$590.87
42641	3M	19	$1,302.85
42642	3M	3	$139.76

COSTS PER MAJOR BY LEVEL
ITERATION 03

MAJOR	LEVEL	HOURS	COSTS
46614	3M	3	$139.76
51640	3M	3	$188.21
52611	3M	3	$151.12
58608	3M	21	$1,364.38
58643	3M	6	$539.24
58659	3M	3	$139.76
58674	1L	7	$1,185.86
58674	3M	303	$24,213.42
58674	4D	41	$3,471.49
70611	4D	3	$278.89
74610	4D	3	$186.16
78608	3M	5	$398.82
78610	4D	14	$1,111.63
78613	4D	3	$139.74
78632	4D	3	$342.14
78640	4D	3	$139.65
78641	4D	9	$568.90
78643	3M	3	$183.03
78654	4D	13	$1,189.27
78659	3M	3	$142.78
78659	4D	9	$558.35
78667	4D	9	$422.41
89697	3M	18	$1,456.52
89698	3M	3	$183.33
89698	4D	6	$498.09
99199	1L	7	$221.38
TOTAL COSTS		1138	$70,269.12

MAJOR	LEVEL	HOURS	COSTS
10103	1L	3	$141.63
10106	2U	17	$771.24
10108	1L	3	$100.21
10108	2U	6	$249.36
10117	1L	3	$131.53
10117	2U	3	$141.63
10128	2U	15	$1,052.07
10129	1L	9	$371.42
10129	2U	3	$125.09
10133	2U	3	$131.39
10138	1L	3	$101.41
10143	1L	34	$1,324.44
10143	2U	112	$4,902.95
10152	1L	3	$104.28
10154	1L	6	$215.42
10154	2U	14	$569.37
10154	3M	6	$340.02
10157	1L	5	$251.52
10158	1L	6	$232.67
10158	2U	3	$134.53
10170	2U	3	$104.26
10197	1L	31	$1,264.37
10197	3M	19	$1,030.52
11106	2U	20	$760.31
12108	1L	3	$100.26
12108	2U	24	$969.72

MAJOR	LEVEL	HOURS	COSTS
13143	1L	18	$747.20
13143	2U	10	$495.23
15154	1L	3	$138.61
15154	2U	18	$930.30
16336	1L	3	$101.41
20201	1L	9	$307.10
20201	2U	7	$332.35
20204	1L	3	$101.41
20225	1L	13	$530.92
20225	2U	54	$2,289.31
20241	1L	19	$739.54
20241	2U	90	$4,051.81
20242	1L	3	$115.10
22319	2U	3	$100.26
22363	1L	3	$103.21
22363	3M	3	$200.96
23353	1L	3	$138.63
27103	1L	3	$101.28
28511	1L	3	$138.50
28511	2U	16	$639.29
28551	3M	3	$140.96
40606	3M	3	$186.66
40643	3M	6	$380.03
42601	3M	9	$594.67
42641	3M	19	$1,310.45
42642	3M	3	$140.94

COSTS PER MAJOR BY LEVEL
ITERATION 04

MAJOR	LEVEL	HOURS	COSTS
46614	3M	3	$140.94
50640	3M	3	$186.51
52611	3M	3	$152.43
58608	3M	21	$1,371.46
58643	3M	6	$541.86
58659	3M	3	$140.94
58674	1L	7	$1,189.79
58674	3M	303	$24,318.96
58674	4D	41	$3,484.42
73611	4D	3	$280.20
74610	4D	3	$187.34
78608	3M	5	$401.31
78610	4D	14	$1,116.61
78613	4D	3	$141.05
78632	4D	3	$343.45
78640	4D	3	$140.96
78641	4D	9	$572.70
78643	3M	3	$184.34
78654	4D	13	$1,195.56
78659	3M	3	$143.96
78659	4D	9	$562.28
78667	4D	9	$426.21
89697	3M	18	$1,463.73
89698	3M	3	$184.34
89698	4D	6	$500.58
99199	1L	7	$219.42
TOTAL COSTS		1188	$70,269.12

ITERATION 3 DATE CREATED: 06/06/77
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ITERATION 4 DATE CREATED: 06/06/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10103	1L	3	$143.46		
			--------------	=	1.01292
		3	$141.63		
10106	2U	17	$778.82		
			--------------	=	1.00983
		17	$771.24		
10108	1L	3	$101.91		
			--------------	=	1.01696
		3	$100.21		
10108	2U	6	$253.15		
			--------------	=	1.01520
		6	$249.36		
10117	1L	3	$133.23		
			--------------	=	1.01292
		3	$131.53		
10117	2U	3	$143.46		
			--------------	=	1.01292
		3	$141.63		
10128	2U	15	$1,050.36		
			--------------	=	.99837
		15	$1,052.07		
10129	1L	9	$376.78		
			--------------	=	1.01443
		9	$371.42		

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SENSITIVITY REPORT

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10129	2U	3	$125.35	=	1.00208
		3	$125.09		
10133	2U	3	$133.09	=	1.01294
		3	$131.39		
10138	1L	3	$103.11	=	1.01676
		3	$101.41		
10143	1L	34	$1,341.30	=	1.01273
		34	$1,324.44		
10143	2U	112	$4,931.68	=	1.00586
		112	$4,902.95		
10152	1L	3	$106.24	=	1.01880
		3	$104.28		
10154	1L	6	$218.95	=	1.01639
		6	$215.42		
10154	2U	14	$570.67	=	1.00228
		14	$569.37		
10154	3M	6	$342.37	=	1.00691
		6	$340.02		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10157	1L	5	$253.61	=	1.00831
		5	$251.52		
10158	1L	6	$236.20	=	1.01517
		6	$232.67		
10158	2U	3	$136.36	=	1.01360
		3	$134.53		
10170	2U	3	$106.24	=	1.01880
		3	$104.28		
10197	1L	31	$1,276.39	=	1.00951
		31	$1,264.37		
10197	3M	19	$1,028.94	=	.99847
		19	$1,030.52		
11106	2U	20	$768.02	=	1.01014
		20	$760.31		
12108	1L	3	$101.96	=	1.01696
		3	$100.26		
12108	2U	24	$976.12	=	1.00660
		24	$969.72		

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
13143	1L	18 / 18	\$753.08 / \$747.20	=	1.00787
13143	2U	10 / 10	\$498.23 / \$495.23	=	1.00606
15154	1L	3 / 3	\$140.44 / \$138.61	=	1.01320
15154	2U	18 / 18	\$934.74 / \$930.30	=	1.00477
16336	1L	3 / 3	\$103.11 / \$101.41	=	1.01676
20201	1L	9 / 9	\$312.46 / \$307.10	=	1.01745
20201	2U	7 / 7	\$332.87 / \$332.35	=	1.00156
20204	1L	3 / 3	\$103.11 / \$101.41	=	1.01676
20225	1L	13 / 13	\$535.23 / \$530.92	=	1.00812

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
20225	2U	54	$2,296.87	=	1.00330
		54	$2,289.31		
20241	1L	19	$748.95	=	1.01272
		19	$739.54		
20241	2U	90	$4,063.54	=	1.00290
		90	$4,051.81		
20242	1L	3	$116.93	=	1.01590
		3	$115.10		
22319	2U	3	$101.96	=	1.01696
		3	$100.26		
22363	1L	3	$105.04	=	1.01773
		3	$103.21		
22363	3M	3	$202.66	=	1.00846
		3	$200.96		
23353	1L	3	$140.33	=	1.01226
		3	$138.63		
27103	1L	3	$103.11	=	1.01807
		3	$101.28		

SENSITIVITY REPORT

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MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
28511	1L	3 / 3	$140.33 / $138.50	=	1.01321
28511	2U	16 / 16	$645.17 / $639.29	=	1.00920
28551	3M	3 / 3	$139.65 / $140.96	=	.99071
40606	3M	3 / 3	$188.36 / $186.66	=	1.00911
40643	3M	6 / 6	$377.67 / $380.03	=	.99379
42601	3M	9 / 9	$590.87 / $594.67	=	.99361
42641	3M	19 / 19	$1,302.85 / $1,310.45	=	.99420
42642	3M	3 / 3	$139.76 / $140.94	=	.99163
46614	3M	3 / 3	$139.76 / $140.94	=	.99163

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
50640	3M	3	$188.21	=	1.00911
		3	$186.51		
52611	3M	3	$151.12	=	.99141
		3	$152.43		
58608	3M	21	$1,364.38	=	.99484
		21	$1,371.46		
58643	3M	6	$539.24	=	.99516
		6	$541.86		
58659	3M	3	$139.76	=	.99163
		3	$140.94		
58674	1L	7	$1,185.86	=	.99670
		7	$1,189.79		
58674	3M	303	$24,213.42	=	.99566
		303	$24,318.96		
58674	4D	41	$3,471.49	=	.99629
		41	$3,484.42		
70611	4D	3	$278.89	=	.99532
		3	$281.20		

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SENSITIVITY REPORT

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
74610	4D	3	$186.16	=	.99370
		3	$187.34		
78608	3M	5	$398.82	=	.99380
		5	$401.31		
78610	4D	14	$1,111.63	=	.99554
		14	$1,116.61		
78613	4D	3	$139.74	=	.99071
		3	$141.05		
78632	4D	3	$342.14	=	.99619
		3	$343.45		
78640	4D	3	$139.65	=	.99071
		3	$140.96		
78641	4D	9	$568.90	=	.99336
		9	$572.70		
78643	3M	3	$183.03	=	.99289
		3	$184.34		
78654	4D	13	$1,189.27	=	.99474
		13	$1,195.56		

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SENSITIVITY REPORT

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
78659	3M	3	$142.78	=	.99180
		3	$143.96		
78659	4D	9	$558.35	=	.99301
		9	$562.28		
78667	4D	9	$422.41	=	.99108
		9	$426.21		
89697	3M	18	$1,456.52	=	.99507
		18	$1,463.73		
89698	3M	3	$183.03	=	.99289
		3	$184.34		
89698	4D	6	$498.09	=	.99503
		6	$500.58		
99199	1L	7	$221.38	=	1.00893
		7	$219.42		
TOTAL		1188	$70,269.12	=	1.00000
		1188	$70,269.12		

DEPARTMENT COST & APPORTIONING REPORT
ITERATION 5

COST AMOUNT	APPORTIONING SUBSCRIPTS		APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$5,011.50	2	2	173A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	173B	FACULTY SALARY	DIRECT
$5,020.00	2	2	173C	FACULTY SALARY	DIRECT
$900.00	2	2	173D	FACULTY SALARY	DIRECT
$900.00	2	2	173E	FACULTY SALARY	DIRECT
$500.00	2	2	173F	FACULTY SALARY	DIRECT
$500.00	2	2	173G	FACULTY SALARY	DIRECT
$5,011.50	2	2	274A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	274B	FACULTY SALARY	DIRECT
$5,020.00	2	2	274C	FACULTY SALARY	DIRECT
$1,700.00	2	2	274E	FACULTY SALARY	DIRECT
$602.00	2	2	274G	FACULTY SALARY	DIRECT
$10,023.00		6		.5 CHRMN SAL	INDIRECT
$13,937.00		6		TOTAL DPT M&O	INDIRECT
$5,976.00		6		DPT CT SAL & WG	INDIRECT
$1,338.12		7		% A&S DEANS OFC	INDIRECT
$676.96		7		PRSDNT OFC M&O	INDIRECT
$462.67		7		VP AA OFC M&O	INDIRECT
$263.15		7		DEAN G.S. M&O	INDIRECT
$3,161.36		7		LIBRARY M&O	INDIRECT
$197.44		7		PRSDNT W & S	INDIRECT
$300.98		7		VP AA W & S	INDIRECT
$236.81		7		DEAN G.S. W & S	INDIRECT

DEPARTMENT COST & APPORTIONING REPORT
ITERATION 5

COST AMOUNT	APPORTIONING SUBSCRIPTS	APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$3,237.76	7		LIBRARY W & S	INDIRECT
$78,806.75		TOTAL COSTS		

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DEPARTMENT COST & APPORTIONING REPORT
ITERATION 6

COST AMOUNT	APPORTIONING SUBSCRIPTS		APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$5,011.50	2	2	173A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	173B	FACULTY SALARY	DIRECT
$5,020.00	2	2	173C	FACULTY SALARY	DIRECT
$900.00	2	2	173D	FACULTY SALARY	DIRECT
$900.00	2	2	173E	FACULTY SALARY	DIRECT
$500.00	2	2	173F	FACULTY SALARY	DIRECT
$500.00	2	2	173G	FACULTY SALARY	DIRECT
$5,011.50	2	2	274A	.5 CHRMN SAL	DIRECT
$6,930.00	2	2	274B	FACULTY SALARY	DIRECT
$5,020.00	2	2	274C	FACULTY SALARY	DIRECT
$1,700.00	2	2	274E	FACULTY SALARY	DIRECT
$602.00	2	2	274G	FACULTY SALARY	DIRECT
$10,023.00		6		.5 CHRMN SAL	INDIRECT
$13,937.00		6		TOTAL DPT M&O	INDIRECT
$5,976.00		6		DPT CT SAL & WG	INDIRECT
$1,308.12		7		% A&S DEANS OFC	INDIRECT
$676.96		7		PRSDNT OFC M&O	INDIRECT
$462.67		7		VP AA OFC M&O	INDIRECT
$263.15		7		DEAN G.S. M&O	INDIRECT
$3,161.86		7		LIBRARY M&O	INDIRECT
$188.84		7		PRSDNT W & S	INDIRECT
$287.88		7		VP AA W & S	INDIRECT
$226.50		7		DEAN G.S. W & S	INDIRECT

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DEPARTMENT COST & APPORTIONING REPORT
ITERATION 6

COST AMOUNT	APPORTIONING SUBSCRIPTS	APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$3,396.85	7		LIBRARY W & S	INDIRECT
$78,633.83		TOTAL COSTS		

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COSTS PER MAJOR BY LEVEL
ITERATION 05

MAJOR	LEVEL	HOURS	COSTS
10103	1L	3	$151.88
10106	2U	17	$850.64
10108	1L	3	$110.46
10108	2U	6	$268.14
10117	1L	3	$141.78
10117	2U	3	$151.86
10128	2U	15	$1,170.73
10129	1L	9	$400.45
10129	2U	3	$144.72
10133	2U	3	$141.64
10138	1L	3	$111.66
10143	1L	34	$1,450.78
10143	2U	112	$5,466.30
10152	1L	3	$113.67
10154	1L	6	$235.06
10154	2U	14	$647.89
10154	3M	6	$369.04
10157	1L	5	$281.40
10158	1L	6	$252.31
10158	2U	3	$144.78
10170	2U	3	$113.67
10197	1L	31	$1,403.52
10197	3M	19	$1,169.66
11106	2U	20	$838.85
12108	1L	3	$110.51
12108	2U	24	$1,078.13

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COSTS PER MAJOR BY LEVEL
ITERATION 05

MAJOR	LEVEL	HOURS	COSTS
13143	1L	18	$836.84
13143	2U	10	$563.51
15154	1L	3	$148.00
15154	2U	18	$1,029.31
16336	1L	3	$111.66
20201	1L	9	$336.99
20201	2U	7	$372.46
20204	1L	3	$111.66
20225	1L	13	$591.53
20225	2U	54	$2,609.36
20241	1L	19	$807.84
20241	2U	90	$4,554.51
20242	1L	3	$124.49
22319	2U	3	$110.51
22363	1L	3	$113.46
22363	3M	3	$211.21
23353	1L	3	$148.88
27103	1L	3	$110.67
28511	1L	3	$147.89
28511	2U	16	$708.44
28551	3M	3	$170.84
40606	3M	3	$196.91
40643	3M	6	$438.93
42601	3M	9	$683.45
42641	3M	19	$1,488.01
42642	3M	3	$169.96

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COSTS PER MAJOR BY LEVEL
ITERATION 05

MAJOR	LEVEL	HOURS	COSTS
46614	3M	3	$169.96
5C640	3M	3	$196.76
52611	3M	3	$182.31
58608	3M	21	$1,568.65
58643	3M	6	$601.62
58659	3M	3	$169.96
58674	1L	7	$1,279.43
58674	3M	303	$27,334.08
58674	4D	41	$3,919.23
70611	4D	3	$310.08
74610	4D	3	$217.22
78608	3M	5	$461.07
78610	4D	14	$1,236.13
78613	4D	3	$170.93
78632	4D	3	$373.33
78640	4D	3	$170.84
78641	4D	9	$662.34
78643	3M	3	$214.22
78654	4D	13	$1,344.96
78659	3M	3	$173.84
78659	4D	9	$651.92
78667	4D	9	$515.85
89697	3M	13	$1,641.29
89698	3M	3	$214.22
89698	4D	6	$560.34
99199	1L	7	$249.30

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COSTS PER MAJOR BY LEVEL
ITERATION 06

MAJOR	LEVEL	HOURS	COSTS
10103	1L	3	$151.68
10106	2U	17	$849.06
10108	1L	3	$110.26
10108	2U	6	$267.78
10117	1L	3	$141.58
10117	2U	3	$151.68
10128	2U	15	$1,168.34
10129	1L	9	$399.89
10129	2U	3	$144.32
10133	2U	3	$141.44
10138	1L	3	$111.46
10143	1L	34	$1,448.30
10143	2U	112	$5,454.94
10152	1L	3	$113.49
10154	1L	6	$234.68
10154	2U	14	$646.29
10154	3M	6	$368.46
10157	1L	5	$280.80
10158	1L	6	$251.93
10158	2U	3	$144.58
10170	2U	3	$113.49
10197	1L	31	$1,400.74
10197	3M	19	$1,166.85
11106	2U	20	$837.29
12108	1L	3	$110.31
12108	2U	24	$1,075.95

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COSTS PER MAJOR BY LEVEL
ITERATION 06

MAJOR	LEVEL	HOURS	COSTS
13143	1L	18	$835.04
13143	2U	10	$562.13
15154	1L	3	$147.82
15154	2U	18	$1,027.31
16336	1L	3	$111.46
20231	1L	9	$336.41
20231	2U	7	$371.64
20204	1L	3	$111.46
20225	1L	13	$590.31
20225	2U	54	$2,602.84
20241	1L	19	$806.50
20241	2U	90	$4,544.29
20242	1L	3	$124.31
22319	2U	3	$110.31
22363	1L	3	$113.26
22363	3M	3	$211.01
23353	1L	3	$148.68
27103	1L	3	$110.49
28511	1L	3	$147.71
28511	2U	16	$737.06
28551	3M	3	$170.24
40606	3M	3	$196.71
40643	3M	6	$437.74
42601	3M	9	$681.66
42641	3M	19	$1,484.43
42642	3M	3	$169.37

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COSTS PER MAJOR BY LEVEL
ITERATION 06

MAJOR	LEVEL	HOURS	COSTS
46614	3M	3	$169.37
50640	3M	3	$196.56
52611	3M	3	$181.71
58608	3M	21	$1,564.67
58643	3M	6	$600.42
58659	3M	3	$169.37
58674	1L	7	$1,277.63
58674	3M	303	$27,273.33
58674	4D	41	$3,909.29
70611	4D	3	$309.48
74610	4D	3	$216.62
78608	3M	5	$459.87
78610	4D	14	$1,233.73
78613	4D	3	$170.33
78632	4D	3	$372.73
78640	4D	3	$170.24
78641	4D	9	$660.54
78643	3M	3	$213.62
78654	4D	13	$1,341.96
78659	3M	3	$173.24
78659	4D	9	$650.12
78667	4D	9	$514.05
89697	3M	18	$1,637.71
89698	3M	3	$213.62
89698	4D	6	$559.14
99199	1L	7	$248.70

SENSITIVITY REPORT

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ITERATION 5 DATE CREATED: 06/07/77
ITERATION 6 DATE CREATED: 06/07/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10103	1L	3	$151.88	=	1.00132
		3	$151.68		
10106	2U	17	$850.64	=	1.00186
		17	$849.06		
10108	1L	3	$110.46	=	1.00181
		3	$110.26		
10108	2U	6	$268.14	=	1.00134
		6	$267.78		
10117	1L	3	$141.78	=	1.00141
		3	$141.58		
10117	2U	3	$151.88	=	1.00132
		3	$151.68		
10128	2U	15	$1,170.73	=	1.00205
		15	$1,168.34		
10129	1L	9	$400.45	=	1.00140
		9	$399.89		

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MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10129	2U	3	$144.72	=	1.00277
		3	$144.32		
10133	2U	3	$141.64	=	1.00141
		3	$141.44		
10138	1L	3	$111.66	=	1.00179
		3	$111.46		
10143	1L	34	$1,450.78	=	1.00171
		34	$1,448.30		
10143	2U	112	$5,466.30	=	1.00208
		112	$5,454.94		
10152	1L	3	$113.67	=	1.00159
		3	$113.49		
10154	1L	6	$235.06	=	1.00162
		6	$234.68		
10154	2U	14	$647.85	=	1.00248
		14	$646.25		
10154	3M	6	$369.04	=	1.00157
		6	$368.46		

SENSITIVITY REPORT

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MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10157	1L	5	$281.40	=	1.00214
		5	$280.80		
10158	1L	6	$252.31	=	1.00151
		6	$251.93		
10158	2U	3	$144.78	=	1.00138
		3	$144.58		
10170	2U	3	$113.67	=	1.00159
		3	$113.49		
10197	1L	31	$1,403.52	=	1.00198
		31	$1,400.74		
10197	3M	19	$1,169.66	=	1.00241
		19	$1,166.85		
11106	2U	20	$838.85	=	1.00186
		20	$837.29		
12108	1L	3	$110.51	=	1.00181
		3	$110.31		
12108	2U	24	$1,078.13	=	1.00203
		24	$1,075.95		

SENSITIVITY REPORT

R-136-60
06/07/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
13143	1L	18	$836.84	=	1.00216
		18	$835.04		
13143	2U	10	$563.51	=	1.00245
		10	$562.13		
15154	1L	3	$148.00	=	1.00122
		3	$147.82		
15154	2U	18	$1,029.31	=	1.00195
		18	$1,027.31		
16336	1L	3	$111.66	=	1.00179
		3	$111.46		
20201	1L	9	$336.99	=	1.00172
		9	$336.41		
20201	2U	7	$372.46	=	1.00221
		7	$371.64		
20204	1L	3	$111.66	=	1.00179
		3	$111.46		
20225	1L	13	$591.53	=	1.00207
		13	$590.31		

SENSITIVITY REPORT

R-136-60
06/07/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
20225	2U	54	$2,609.36	=	1.00250
		54	$2,602.84		
20241	1L	19	$807.84	=	1.00166
		19	$806.50		
20241	2U	90	$4,554.51	=	1.00225
		90	$4,544.29		
20242	1L	3	$124.49	=	1.00145
		3	$124.31		
22319	2U	3	$110.51	=	1.00181
		3	$110.31		
22363	1L	3	$113.46	=	1.00177
		3	$113.26		
22363	3M	3	$211.21	=	1.00095
		3	$211.01		
23353	1L	3	$148.88	=	1.00135
		3	$148.68		
27103	1L	3	$110.67	=	1.00163
		3	$110.49		

SENSITIVITY REPORT

R-136-60
06/07/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
28511	1L	3	$147.89	=	1.00122
		3	$147.71		
28511	2U	16	$708.44	=	1.00195
		16	$707.06		
28551	3M	3	$170.84	=	1.00352
		3	$170.24		
40606	3M	3	$196.91	=	1.00102
		3	$196.71		
40643	3M	6	$438.93	=	1.00272
		6	$437.74		
42601	3M	9	$683.45	=	1.00263
		9	$681.66		
42641	3M	19	$1,488.01	=	1.00241
		19	$1,484.43		
42642	3M	3	$169.96	=	1.00348
		3	$169.37		
46614	3M	3	$169.96	=	1.00348
		3	$169.37		

SENSITIVITY REPORT

R-136-60
06/07/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
50640	3M	3	$196.76	=	1.00102
		3	$196.56		
52611	3M	3	$182.31	=	1.00330
		3	$181.71		
58608	3M	21	$1,568.65	=	1.00254
		21	$1,564.67		
58643	3M	6	$601.62	=	1.00200
		6	$600.42		
58659	3M	3	$169.96	=	1.00348
		3	$169.37		
58674	1L	7	$1,279.43	=	1.00141
		7	$1,277.63		
58674	3M	303	$27,334.08	=	1.00223
		303	$27,273.33		
58674	4D	41	$3,919.23	=	1.00254
		41	$3,909.29		
70611	4D	3	$310.08	=	1.00194
		3	$309.48		

SENSITIVITY REPORT

R-136-60
06/07/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
74610	4D	3	$217.22	=	1.00277
		3	$216.62		
78608	3M	5	$461.07	=	1.00261
		5	$459.87		
78610	4D	14	$1,236.13	=	1.00195
		14	$1,233.73		
78613	4D	3	$170.93	=	1.00352
		3	$170.33		
78632	4D	3	$373.33	=	1.00161
		3	$372.73		
78640	4D	3	$170.84	=	1.00352
		3	$170.24		
78641	4D	9	$662.34	=	1.00273
		9	$660.54		
78643	3M	3	$214.22	=	1.00281
		3	$213.62		
78654	4D	13	$1,344.56	=	1.00224
		13	$1,341.56		

SENSITIVITY REPORT

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06/07/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
78659	3M	3	$173.84	=	1.00346
		3	$173.24		
78659	4D	9	$651.92	=	1.00277
		9	$650.12		
78667	4D	9	$515.85	=	1.00350
		9	$514.05		
89657	3M	18	$1,641.29	=	1.00219
		18	$1,637.71		
89698	3M	3	$214.22	=	1.00281
		3	$213.62		
89698	4D	6	$560.34	=	1.00215
		6	$559.14		
99199	1L	7	$249.30	=	1.00241
		7	$248.70		
TOTAL		1188	$78,806.75	=	1.00220
		1188	$78,633.83		

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DEPARTMENT ENROLLMENT REPORT

DEPARTMENT COURSE SECTION HOURS INSTRUCTOR SMYR

STUDENT MAJOR STUDENT LEVEL NUMBER ENROLLED

ABCD	101	001	03	F		173
	10129		1		1	
	10138		2		1	
	10143		1		2	
	10143		2		2	
	10143		4		1	
	10158		2		1	
	10197		2		1	
	20201		1		1	
	20201		2		1	
	20204		2		1	
	20241		1		1	
	99199		2		1	
ABCD	201	001	03	A		173
	10106		4		2	
	10108		4		1	
	10128		4		1	
	10143		3		1	
	10143		4		1	
	10154		1		1	
	10157		1		1	
	10197		5		1	
	11106		4		1	
	13143		2		1	
	20225		4		1	
	20241		3		1	
	28511		4		1	
	58674		5		3	
	58674		6		1	
ABCD	201	001	03	A		274
	10108		4		1	
	10129		2		1	
	10143		3		2	
	10143		4		2	
	10158		1		1	
	10158		3		1	
	10197		1		1	
	11106		4		1	
	28511		3		1	
	40606		5		1	
ABCD	236	001	03	G		173
	10106		4		1	

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DEPARTMENT ENROLLMENT REPORT

DEPARTMENT COURSE SECTION HOURS INSTRUCTOR SMYR

STUDENT MAJOR STUDENT LEVEL NUMBER ENROLLED

	10143		1		1	
	10143		3		1	
	10143		4		2	
	10197		2		1	
	11106		3		1	
	11106		4		1	
	12108		1		1	
	12108		3		1	
	13143		2		1	
	13143		3		1	
	22363		1		1	
ABCD	236	C01	03	B		274
	10117		3		1	
	10129		2		1	
	10143		2		1	
	10143		4		2	
	13143		2		1	
	15154		1		1	
	15154		4		1	
	22363		5		1	
	23353		2		1	
ABCD	303	001	04	B		173
	10143		3		1	
	10143		4		5	
	10154		4		1	
	11106		4		1	
	12108		4		1	
	20225		2		1	
	20225		4		1	
	20241		2		1	
ABCD	387	501	02	G		274
	10106		4		1	
	10143		3		1	
	10143		4		1	
	13143		4		1	
ABCD	387	502	03	G		274
	10106		4		1	
ABCD	387	700	02	B		173
	10157		1		1	
ABCD	387	700	03	B		173

DEPARTMENT ENROLLMENT REPORT

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DEPARTMENT COURSE SECTION HOURS INSTRUCTOR SMYR

STUDENT MAJOR STUDENT LEVEL NUMBER ENROLLED

	10143		2		1	
	10143		4		2	
ABCD	404	001	04	C		274
	10143		2		1	
	10143		4		4	
	10154		3		1	
	10197		2		1	
	10197		5		1	
	11106		4		1	
	12108		4		2	
	13143		2		1	
	20201		4		1	
	20225		4		2	
	20241		3		2	
	20241		4		6	
	28511		4		1	
	58674		5		3	
ABCD	430	001	03	E		173
	10143		4		1	
	10154		4		1	
	10197		5		1	
	13143		2		1	
	20225		3		1	
	20225		4		6	
	20241		4		2	
	58608		5		1	
	58674		5		1	
	58674		6		1	
ABCD	440	001	03	C		173
	10143		4		1	
	10197		1		1	
	12108		4		1	
	58674		5		4	
	58674		6		1	
ABCD	451	001	03	B		274
	10128		4		1	
	10143		4		3	
	15154		4		1	
	20201		3		1	
	20225		4		2	
	20241		3		1	
	20241		4		6	

DEPARTMENT ENROLLMENT REPORT

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DEPARTMENT COURSE SECTION HOURS INSTRUCTOR SMYR

STUDENT MAJOR STUDENT LEVEL NUMBER ENROLLED

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	58674		5		1	
ABCD	488	700	03	B		274
	13143		4		1	
ABCD	489	700	02	A		173
	10143		4		1	
	13143		2		1	
ABCD	489	700	03	A		173
	20225		4		1	
	20241		4		1	
ABCD	489	700	03	A		274
	10197		2		1	
ABCD	489	701	03	C		173
	10143		4		1	
	20225		2		1	
	20241		4		1	
	28511		4		1	
ABCD	489	701	04	C		173
	99199		1		1	
ABCD	490	700	03	A		173
	10154		4		1	
	15154		4		1	
ABCD	490	701	03	E		274
	10143		4		1	
	10197		2		1	
	20225		4		2	
	20241		4		1	
ABCD	491	700	03	A		274
	15154		4		1	
ABCD	501	001	03	B		173
	10197		5		1	
	42642		5		1	
	58608		5		1	
	58659		5		1	
	58674		5		2	
	58674		6		1	
	78640		6		1	

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DEPARTMENT ENROLLMENT REPORT

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	78659		5		1	
	78659		6		1	
	78667		6		2	
	89698		6		1	
ABCD	502	001	03	B		173
	42641		5		1	
	58608		5		1	
	58643		5		1	
	89698		6		1	
ABCD	502	001	03	E		274
	10197		5		1	
	58608		5		1	
	58674		5		1	
	74610		6		1	
	78610		6		1	
	78643		5		1	
	78659		6		1	
	89698		5		1	
ABCD	521	001	03	C		173
	42641		5		1	
	52611		5		1	
	58674		5		6	
	58674		6		1	
	78608		5		1	
	89697		5		1	
ABCD	525	001	03	B		274
	58608		5		1	
	58643		5		1	
	58674		5		5	
	89697		5		1	
ABCD	543	001	03	D		173
	40643		5		1	
	58608		5		1	
	58674		5		4	
	89697		5		1	
ABCD	547	001	04	B		274
	42641		5		1	
	58674		5		2	
	78610		6		2	
ABCD	554	001	03	B		173

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENRCLLED	SMYR
	42601		5		1	
	58674		5		3	
ABCD	555	001	03	C		173
	42601		5		1	
	58674		5		8	
	58674		6		1	
ABCD	555	001	03	C		274
	58608		5		1	
	58674		5		12	
	89697		5		1	
ABCD	561	001	03	A		274
	10128		4		1	
	58674		5		5	
ABCD	570	001	03	C		274
	10128		4		1	
	10197		5		1	
	42641		5		1	
	58674		5		3	
	78641		6		3	
ABCD	587	500	02	B		173
	58674		5		2	
	58674		6		1	
ABCD	587	500	02	B		274
	58674		5		1	
ABCD	587	502	03	G		274
	42641		5		1	
ABCD	589	001	02	A		173
	58674		5		1	
	58674		6		1	
	78608		5		1	
	78654		6		2	
ABCD	589	003	03	C		173
	42601		5		1	
	58674		5		7	
	58674		6		2	
	78654		6		1	
ABCD	589	701	03	C		274

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06/C7/77

DEPARTMENT ENROLLMENT REPORT

DEPARTMENT	COURSE / STUDENT MAJOR	SECTION	HOURS / STUDENT LEVEL	INSTRUCTOR	NUMBER ENROLLED	SMYR
	78654		6		1	
ABCD	589	701	04	C		274
	58674		5		1	
ABCD	589	702	03	B		274
	78632		6		1	
ABCD	590	700	03	A		173
	58674		5		1	
ABCD	590	700	03	C		274
	78654		6		1	
ABCD	590	701	03	E		274
	10128		4		1	
	58674		5		1	
	78659		6		1	
ABCD	590	702	03	B		274
	78610		6		1	
ABCD	591	700	01	A		274
	58674		5		1	
ABCD	592	700	02	A		274
	58674		5		1	
ABCD	592	701	03	C		173
	58674		5		2	
ABCD	594	301	01	A		173
	58674		5		7	
	58674		6		2	
ABCD	595A	700	03	A		173
	58674		5		1	
ABCD	595A	700	03	A		274
	58674		5		2	
	58674		6		1	
ABCD	595A	701	03	C		173
	58674		6		1	
ABCD	595A	701	03	C		274

DEPARTMENT ENROLLMENT REPORT

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06/07/77

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DEPARTMENT COURSE SECTION HOURS     INSTRUCTOR  SMYR
       STUDENT MAJOR  STUDENT LEVEL  NUMBER ENRCLLED

                                          1
         58674             5
                                                 173
ABCD       5958   700     03       A
         58674             5              1
                                                 274
ABCD       5958   700     03       A
         58674             5              1
                                                 274
ABCD       5958   701     03       C
         58674             6              1

                                         325
          TOTAL
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R-136-40
06/C8/77

DEPARTMENT COST & APPORTIONING REPORT
ITERATION 7

COST AMCUNT	APPORTIONING SUBSCRIPTS		APPORTIONING KEYS	FUND SOURCE PRIMARY	FUND SOURCE SECONDARY
$10,023.00	2	1	173A	FACULTY SALARY	DIRECT
$6,930.00	2	1	173B	FACULTY SALARY	DIRECT
$5,020.00	2	1	173C	FACULTY SALARY	DIRECT
$900.00	2	1	173D	FACULTY SALARY	DIRECT
$900.00	2	1	173E	FACULTY SALARY	DIRECT
$500.00	2	1	173F	FACULTY SALARY	DIRECT
$500.00	2	1	173G	FACULTY SALARY	DIRECT
$10,023.00	2	1	274A	FACULTY SALARY	DIRECT
$6,930.00	2	1	274B	FACULTY SALARY	DIRECT
$5,020.00	2	1	274C	FACULTY SALARY	DIRECT
$1,700.00	2	1	274E	FACULTY SALARY	DIRECT
$602.00	2	1	274G	FACULTY SALARY	DIRECT
$49,048.00			TOTAL COSTS		

R-136-508
06/08/77

COSTS PER MAJOR BY LEVEL
ITERATION 07

MAJOR	LEVEL	HOURS	COSTS
10106	2U	14	$548.06
10108	2U	6	$368.44
10117	2U	3	$105.82
10128	2U	15	$1,008.20
10129	1L	9	$380.11
10138	1L	3	$35.75
10143	1L	25	$428.35
10143	2U	109	$3,640.59
10154	1L	3	$129.62
10154	2U	14	$357.83
10157	1L	5	$195.92
10158	1L	6	$274.24
10158	2U	3	$238.54
10197	1L	22	$788.33
10157	3M	19	$592.00
11106	2U	20	$630.85
12108	1L	3	$38.50
12108	2U	18	$498.86
13143	1L	18	$520.91
13143	2U	8	$141.30
15154	1L	3	$105.82
15154	2U	12	$497.64
20201	1L	6	$71.45
20201	2U	7	$206.53
20204	1L	3	$35.75
20225	1L	7	$151.17

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06/08/77

CCSTS PER MAJOR BY LEVEL
ITERATION 07

MAJOR	LEVEL	HOURS	COSTS
20225	2U	51	$1,277.92
20241	1L	7	$146.70
20241	2U	71	$1,975.96
22363	1L	3	$38.50
22363	3M	3	$105.82
23353	1L	3	$105.82
28511	2U	13	$482.62
40606	3M	3	$238.51
40643	3M	3	$128.52
42601	3M	9	$486.49
42641	3M	16	$930.03
42642	3M	3	$102.48
52611	3M	3	$73.01
58608	3M	21	$942.51
58643	3M	6	$465.41
58659	3M	3	$102.48
58674	3M	267	$20,852.29
58674	4D	39	$3,191.79
74610	4D	3	$118.04
78608	3M	5	$539.28
78610	4D	14	$806.05
78632	4D	3	$264.03
78640	4D	3	$102.48
78641	4D	9	$334.62
78643	3M	3	$118.04
78654	4D	13	$1,407.23

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06/08/77

COSTS PER MAJOR BY LEVEL
ITERATION 07

MAJOR	LEVEL	HOURS	COSTS
78659	3M	3	$102.48
78659	4D	9	$377.93
78667	4D	6	$205.09
89697	3M	12	$405.59
89698	3M	3	$118.07
89698	4D	6	$435.77
99199	1L	7	$75.86
TOTAL COSTS		984	$49,048.00

SENSITIVITY REPORT

R-136-60
06/09/77

ITERATION 2 DATE CREATED: 06/06/77
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ITERATION 7 DATE CREATED: 06/08/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10103	1L	3	$70.58	=	***********
			$.00		
10106	2U	17	$485.08	=	.88509
		14	$548.06		
10108	1L	3	$23.80	=	***********
			$.00		
10108	2U	6	$217.82	=	.59120
		6	$363.44		
10117	1L	3	$124.57	=	***********
			$.00		
10117	2U	3	$70.48	=	.66604
		3	$105.82		
10128	2U	15	$956.13	=	.94835
		15	$1,008.20		
10129	1L	9	$220.15	=	.57917
		9	$380.11		

SENSITIVITY REPORT

R-136-60
06/09/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10129	2U	3	$47.24 / $.00	=	***********
10133	2U	3	$124.57 / $.00	=	***********
10138	1L	3 / 3	$25.00 / $35.75	=	.69930
10143	1L	34 / 25	$640.36 / $428.35	=	1.49495
10143	2U	112 / 109	$2,779.52 / $3,640.59	=	.76348
10152	1L	3	$25.00 / $.00	=	***********
10154	1L	6 / 3	$117.05 / $129.62	=	.90302
10154	2U	14 / 14	$329.74 / $357.83	=	.92150
10154	3M	5	$126.32 / $.00	=	***********

SENSITIVITY REPORT

R-136-60
06/09/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
10157	1L	5	$143.69	=	.75893
		5	$195.92		
10158	1L	6	$149.57	=	.54540
		6	$274.24		
10158	2U	3	$124.57	=	.52222
		3	$238.54		
10170	2U	3	$25.00	=	***********
			$.00		
10197	1L	31	$755.40	=	.95823
		22	$788.33		
10197	3M	19	$491.31	=	.82992
		19	$592.00		
11106	2U	20	$428.86	=	.67981
		20	$630.85		
12108	1L	3	$23.85	=	.61948
		3	$38.50		
12108	2U	24	$585.21	=	1.17309
		18	$498.86		

SENSITIVITY REPORT

R-156-00
06/03/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
13143	1L	13	$424.96	=	.81580
		18	$520.91		
13143	2U	10	$176.40	=	1.24841
		8	$141.30		
15154	1L	3	$70.58	=	.66698
		3	$105.82		
15154	2U	18	$618.72	=	1.24331
		12	$497.64		
16336	1L	3	$25.00	=	**********
			$.00		
20201	1L	9	$75.00	=	1.04969
		6	$71.45		
20201	2U	7	$188.00	=	.91318
		7	$205.53		
20204	1L	5	$25.00	=	.69930
		5	$35.75		
20245	1L	15	$319.02	=	2.11034
		7	$151.17		

SENSITIVITY REPORT

K-136-60
06/09/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
20225	2U	54	$1,217.78	=	.95294
		51	$1,277.92		
20241	1L	19	$452.23	=	3.08269
		7	$146.70		
20241	2U	90	$2,292.48	=	1.16019
		71	$1,975.96		
20242	1L	3	$93.25	=	***********
			$.00		
22319	2U	3	$23.85	=	***********
			$.00		
22363	1L	3	$23.80	=	.61818
		3	$38.50		
22363	3M	3	$70.58	=	.66698
		3	$105.82		
23353	1L	3	$70.48	=	.66604
		3	$105.82		
27103	1L	3	$25.00	=	***********
			$.00		

SENSITIVITY REPORT

R-136-60
06/09/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
28511	1L	3	$71.48	=	**********
			$.00		
28511	20	16	$453.14	=	.93892
		13	$482.62		
28551	3M	3	$61.54	=	**********
			$.00		
40636	3M	3	$124.57	=	.52228
		3	$238.51		
40643	3M	5	$213.32	=	1.65872
		3	$128.52		
42601	3M	9	$356.54	=	.73288
		9	$486.49		
42641	3M	19	$834.19	=	.89695
		16	$930.03		
42642	3M	3	$61.65	=	.60158
		3	$102.48		
40614	3M	3	$61.65	=	**********
			$.00		

SENSITIVITY REPORT

R-136-60
06/09/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
50640	3M	3	$124.57	=	***********
			$.00		
52611	3M	3	$73.01	=	1.00000
		3	$73.01		
58608	3M	21	$783.00	=	.83076
		21	$942.51		
58643	3M	6	$383.02	=	.82297
		6	$465.41		
58659	3M	3	$61.65	=	.60158
		3	$102.48		
58674	1L	7	$1,348.65	=	***********
			$.00		
58674	3M	303	$20,219.64	=	.96966
		267	$20,852.29		
58674	40	41	$2,992.66	=	.93761
		39	$3,191.79		
70611	40	3	$200.78	=	***********
			$.00		

R-136-60
06/09/77

SENSITIVITY REPORT

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
74610	40	3	$104.92	=	.88885
		3	$118.04		
78608	3M	5	$405.93	=	.75273
		5	$539.28		
78610	40	14	$792.93	=	.98372
		14	$806.05		
78613	40	3	$61.63	=	***********
			$.00		
78632	40	3	$264.03	=	1.00000
		3	$264.03		
78640	40	3	$61.54	=	.60051
		3	$102.48		
78641	40	9	$331.44	=	.99050
		9	$334.62		
78643	3M	3	$104.92	=	.88885
		3	$118.04		
78654	40	13	$1,125.50	=	.79980
		13	$1,407.23		

SENSITIVITY REPORT

R-136-60
06/09/77

MAJOR	LEVEL	HOURS	COSTS		SENSITIVITY
78659	3M	3	$61.54	=	.60051
		3	$102.48		
78659	40	9	$324.02	=	.85735
		9	$377.93		
78667	40	9	$184.95	=	.90180
		6	$205.09		
89697	3M	18	$978.47	=	2.41246
		12	$405.59		
89698	3M	3	$104.92	=	.88863
		3	$118.07		
89698	4D	6	$338.74	=	.77734
		5	$435.77		
99199	1L	7	$65.16	=	.85895
		7	$75.86		
TOTAL		1188	149,048.00	=	1.00000
		954	$149,043.00		

BIBLIOGRAPHY

Books

Astin, Alexander W., Preventing Students from Dropping Out, San Francisco, Jossey-Bass, Inc., 1975.

Crowningshield, Gerald R., Cost Accounting: Principles and Managerial Applications, Boston, Houghton Mifflin Company, 1969.

Hussain, Khateeb M., Development of Information Systems for Education, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1973.

Meeth, L. Richard, Quality Education for Less Money, San Francisco, California, Jossey-Bass, Inc., 1974.

Meigs, Walter B., A. N. Mosich, and Charles E. Johnson, Accounting: The Basis for Business Decisions, New York, McGraw-Hill Book Company, 1972.

Miller, David W. and Martin K. Starr, Executive Decisions and Operations Research, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1969.

Miller, William A., Jr., Planning and Program Management, Denton, Texas, North Texas State Press, 1975.

Miller, William A., Jr. and John L. Carter, Jr., Financing Public Senior Institutions of Higher Learning in the State of Texas, Denton, Texas, North Texas State Press, 1973.

Moore, William, Jr., Blind Man on a Freeway, San Francisco, Jossey-Bass, Inc., 1971.

Murad, Anatol, Economics: Principles and Problems, Totowa, New Jersey, Littlefield, Adams and Co., 1963.

Rourke, Francis E. and Glenn E. Brooks, The Managerial Revolution in Higher Education, Baltimore, Maryland, The Johns Hopkins Press, 1966.

Verry, Donald and Bleddyn Davies, University Costs and Outputs, Amsterdam, Elsevier Scientific Publishing Company, 1976.

Articles

Baughman, George W. and Ronald Brady, "Towards a Theory of University Management," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke University Press, 1969.

Beatty, George, Jr., "The Application of Costing Methodologies in Higher Education," in Applying Analytic Methods to Planning and Management, Vol. IV of New Directions for Institutional Research, (Spring, 1977), Jossey-Bass, Inc.

Bowen, Howard R. and Gordon K. Douglass, "Cutting Instructional Costs," Efficient College Management, edited by William W. Jellema, San Francisco, California, Jossey-Bass, Inc., 1972.

Craven, Eugene C., "Information Decision Systems in Higher Education: A Conceptual Framework," Journal of Higher Education, XLVI (March/April, 1975), 125-139.

Dresch, Stephen P., "A Critique of Planning Models for Post-secondary Education: Current Feasibility, Potential Relevance, and a Prospectus for Further Research," Journal of Higher Education, XLVI (May/June, 1975), 245-286.

Dressel, Paul and Lou Anna Kimsey Simon, Allocating Resources Among Departments, Vol. III of New Directions for Institutional Research, (Autumn, 1976), Jossey-Bass, Inc.

Dusseldorp, Ralph Van, "Some Principles for the Development of Management Information Systems," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke University Press, 1969.

Hansen, W. Lee and David R. Witmer, "Economics Benefits of Universal Higher Education," Universal Higher Education, edited by Logan Wilson and Olive Mills, Washington, D. C., American Council on Education, 1972.

Hausman, Louis, "Pressures, Benefits, and Options," Universal Higher Education, edited by Logan Wilson and Olive Mills, Washington, D. C., American Council on Education, 1972.

Hopkins, David S. P. and Roger G. Schroeder, "Editors' Notes," in Applying Analytic Methods to Planning and Management, Vol. IV of New Directions for Institutional Research, (Spring, 1977), Jossey-Bass, Inc.

Iyell, Edward H., "Higher Education Modeling at the State and National Levels," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

Johnson, F. Craig, "Data Requirements for Academic Departments," in Examining Departmental Management, Vol. III of New Directions for Institutional Research, (Summer, 1976), Jossey-Bass, Inc.

Keniston, Kenneth and Mark Gerzon, "Human and Social Benefits," Universal Higher Education, edited by Logan Wilson and Olive Mills, Washington, D. C., American Council on Education, 1972.

Krampf, Robert F. and Albert C. Heinlein, "The Effectiveness of Simulation Models in Academic Administration," Decision Models in Academic Administration, edited by Albert C. Heinlein, Kent, Ohio, Decision Sciences Institute, 1974.

Lawrence, Ben, "The Western Interstate Commission for Higher Education Management Information Systems Program," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke University Press, 1969.

LeLong, Donald C., "Allocating and Utilizing Resources," Institutional Research in the University: A Handbook, edited by Paul Dressel and Associates, San Francisco, California, Jossey-Bass, Inc., 1971.

Mason, Thomas, "Developing and Using Information Systems," Institutional Research in the University: A Handbook, edited by Paul Dressel and Associates, San Francisco, California, Jossey-Bass, Inc., 1971.

Mason, Thomas R., "New Directions for Modeling?," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research (Spring, 1976), Jossey-Bass, Inc.

Peterson, Marvin W., "The Academic Department: Perspectives from Theory and Research," in Examining Departmental Management, Vol. III of New Directions for Institutional Research, (Summer, 1976), Jossey-Bass, Inc.

Plourde, Paul J., "Institutional Use of Models; Hope or Continued Frustration?," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

Scheerer, Anne E., "A Formula for Determining Instructional Costs." College Management, VII (November, 1972), 25-29.

Sheehan, Bernard S. and Warren W. Gulko, "The Fundamental Cost Model," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

Suslow, Sidney, "Induced Course Load Matrix: Conception and Use," in Assessing Computer-Based Systems Models, Vol. III of New Directions for Institutional Research, (Spring, 1976), Jossey-Bass, Inc.

Temkin, Sanford, "Making Sense of Benefit-Cost Analysis and Cost-Effectiveness Analysis," Improving Human Performance, III (Summer, 1974), 39-48.

Thackrey, Russell I., "If You're Confused About Higher Education Statistics, Remember: So Are the People Who Produce Them," Phi Delta Kappan, LVI (February, 1975), 415-419.

Wallhaus, Robert A., "Modeling for Higher Education Administration and Management," Management Information Systems in Higher Education: the State of the Art, edited by Charles B. Johnson and William G. Katzenmeyer, Durham, North Carolina, Duke University Press, 1969.

________________, "The Many Dimensions of Productivity," Measuring and Increasing Academic Productivity, Vol. II of New Directions for Institutional Research, (Winter, 1975), Jossey-Bass, Inc.

Weiss, Edmond H., "Apples, Oranges and College Administration," College Management, VIII (November/December, 1973), 26-27.

Williams, Robert L., "The Cost of Educating One College Student," The Educational Record, XLII (October, 1961), 322-329.

Wilson, Logan, "Analyzing and Evaluating Costs in Higher Education," The Educational Record, XLII (April, 1961), 99-105.

Witmer, David R., "Cost Studies in Higher Education," Review of Educational Research, XLII (Winter, 1972), 99-127.

Reports

Astin, Alexander W., "Measuring Student Outputs in Higher Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Balderston, F. E., "Thinking about the Outputs of Higher Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Baughman, George W., "Evaluating the Performance and Effectiveness of University Management Information Systems," Management Information Systems: Their Development and Use in the Administration of Higher Education, edited by John Minter and Ben Lawrence, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

Brandl, John E., "Public Service Outputs of Higher Education: An Exploratory Essay," The Outputs of Higher Education: Their Identification, Measurement and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Brown, David G., "A Scheme for Measuring the Output of Higher Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Carnegie Commission on Higher Education, Institutional Aid: Federal Support to Colleges and Universities, A Report and Recommendations by The Carnegie Commission on Higher Education, McGraw-Hill Book Company, 1972.

Carnegie Commission on Higher Education, Priorities for Action: Final Report of the Carnegie Commission on Higher Education, A Report and Recommendations by The Carnegie Commission on Higher Education, McGraw-Hill Book Company, 1973.

Clark, David G., Robert A. Huff, Michael J. Haight, and William J. Collard, Introduction to the Resource Requirements Prediction Model 1.6, Technical Report 34A, Boulder, Colorado, Western Interstate Commission for Higher Education, 1973.

Collier, Douglas J., Higher Education Finance Manual, Boulder, Colorado, Western Interstate Commission for Higher Education, 1975.

Enthoven, Alain C., "Measures of the Outputs of Higher Education: Some Practical Suggestions for Their Development and Use," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Gulko, Warren W., Program Classification Structure, Technical Report No. 27, Boulder, Colorado, Western Interstate Commission for Higher Education, 1972.

Gwynn, John, "The Data Base Approach to a Management Information System," Management Information Systems: Their Development and Use in the Administration of Higher Education, edited by John Minter and Ben Lawrence, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

Hough, Robbin R., "The Outputs of Undergraduate Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Huff, Robert A. and Michael E. Young, A Blueprint for RRPM 1.6 Application, Boulder, Colorado, Western Interstate Commission for Higher Education, 1973.

Kornfeld, Leo L., "Advanced Applied Management Information Systems in Higher Education," Management Information Systems: Their Development and Use in the Administration of Higher Education, edited by John Minter and Ben Lawrence, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

Lawrence, Ben, George Weathersby, and Virginia W. Patterson, editors, The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Miller, John Perry, "Outputs of Higher Education: Graduate Education," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Minter, John and Ben Lawrence, editors, Management Information Systems: Their Development and Use in the Administration of Higher Education, Boulder, Colorado, Western Interstate Commission for Higher Education, 1969.

Miyataki, Glen K. and Maureen L. Byers, Academic Unit Planning and Management, Technical Report 75, Boulder, Colorado, Western Interstate Commission for Higher Education, 1976.

Mood, Alexander M., Colin Bill, Helen Brownlee, Lawrence Bogard, and Joseph McCloskey, Papers on Efficiency in the Management of Higher Education, A Technical Report Sponsored by the Carnegie Commission on Higher Education, Berkeley, California, The Carnegie Commission on Higher Education, 1972.

O'Neill, June, Resource Use in Higher Education: Trends in Output and Inputs, 1930 to 1967, A Report Prepared for The Carnegie Commission on Higher Education, Berkeley, California, The Carnegie Commission on Higher Education, 1971.

Topping, James R., Cost Analysis Manual, Technical Report 45, Boulder, Colorado, Western Interstate Commission for Higher Education, 1974.

Vaizey, John, "The Outputs of Higher Education: Their Proxies, Measurement and Evaluation," The Outputs of Higher Education: Their Identification, Measurement, and Evaluation, edited by Ben Lawrence, George Weathersby, and Virginia W. Patterson, Boulder, Colorado, Western Interstate Commission for Higher Education, 1970.

Publications of Learned Organizations

AASA Commission on Administrative Technology, Administrative Technology and the School Executive, edited for the American Association of School Administrators by Stephen J. Knezevich, Washington, D. C., American Association of School Administrators, 1969.

Bogue, E. G., "An Inquiry into the Relationship between Instructional Cost Patterns and Assumptions Influencing Analysis of Basic Data in Unit Cost Studies," Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

__________, "Method and Meaning in Faculty Activity Analysis," Reformation and Reallocation in Higher Education, edited by Clifford T. Stewart, Miami Beach, Florida, The Association for Institutional Research, 1972.

Cash, Webster C., "Resource Prediction Models: A Do-It-Yourself Approach for Institutional Researchers," Tomorrow's Imperatives Today, edited by Robert G. Cope, Vancouver, British Columbia, The Association for Institutional Research, 1973.

College and University Business Administration, Washington, D. C., American Council on Education, 1968.

Committee on College and University Accounting and Auditing, Audits of Colleges and Universities, New York, American Institute of Certified Public Accountants, 1973.

Corcoran, Mary and Douglas H. Anderson, "Rationale for Using Micro-Analytic Approaches in Predicting the Character and Size of College Student Enrollments," Institutional Research and Academic Outcomes, edited by Cameron Fincher, San Francisco, California, The Association for Institutional Research, 1968.

Dressel, Paul L., "Relating Benefits and Costs in Higher Education," Institutional Research and Academic Outcomes, edited by Cameron Fincher, San Francisco, California, The Association for Institutional Research, 1968.

Hansen, Bertrand L., "University Costing--The Ontario Experience," Reformation and Reallocation in Higher Education, edited by Clifford T. Stewart, Miami Beach, Florida, The Association for Institutional Research, 1972.

Hume, Harold A. and Joe L. Saupe, "The Allocation of Publically Controlled Resources in Missouri," Public Policy: Issues and Analyses, edited by Robert G. Cope, Washington, D. C., The Association for Institutional Research, 1974.

LeLong, Donald C. and William R. Mann, "Systems Analysis for Institutional Output Decisions," Institutional Research and Academic Outcomes, edited by Cameron Fincher, San Francisco, California, The Association for Institutional Research, 1968.

National Association of College and University Business Officers, "Budgets and Budgetary Accounting," College and University Business Administration, 4:3, Washington, D. C., NACUBO, 1974.

National Association of College and University Business Officers, "Fundamental Considerations for Determining Cost Information in Higher Education," College and University Business Administration, 4:5, Washington, D. C., NACUBO, 1975.

National Association of College and University Business Officers, "Management Information Systems and Data Processing," College and University Business Administration, 2:2, Washington, D. C., NACUBO, 1974.

National Committee to Revise Volumes I and II, College and University Business Administration, College and University Business Administration, Washington, D. C., American Council on Education, 1968.

Sheehan, Bernard S. and Marvin G. Michaels, "Academic Program Analysis for Budgeting," Public Policy: Issues and Analyses, edited by Robert G. Cope, Washington, D. C., The Association for Institutional Research, 1974.

Sheehan, Bernard S. and Mervin G. Michaels, "Sensitivity Tests on a University Cost Study Methodology," Institutional Research and Institutional Policy Formulation, edited by Clifford T. Stewart, Denver, Colorado, The Association for Institutional Research, 1971.

Trotter, Bernard and Mario Creet, "Accountability: Subjective Imperative," Tomorrow's Imperatives Today, edited by Robert G. Cope, Vancouver, British Columbia, The Association for Institutional Research, 1973.

Public Documents

Newman, Frank and others, Report on Higher Education, Washington, D. C., Government Printing Office, 1971.

Unpublished Materials

Bogue, E. Grady, Personal Letter, April 15, 1976.

Bruegman, Donald C., "Conflict in Cost Analysis Experiences with Three Different Cost Models," unpublished paper presented at The Association for Institutional Research, Los Angeles, California, May 2-6, 1976.

Cary, Francis G., "Development of an Instructional Cost-Effectiveness Analysis Model for Use in School Districts," unpublished doctoral dissertation, Department of Educational Studies, State University of New York at Buffalo, Buffalo, New York, 1972.

David, Jean Margaret, "A Model for the Efficient Allocation of Resources in a State University," unpublished doctoral dissertation, Department of Economics, The Florida State University, Tallahassee, Florida, 1972.

Frisbee, Joan, "Analysis of Instructional Program Costs in a Small Liberal Arts College," unpublished doctoral dissertation, Department of Education, The University of Tennessee, Knoxville, Tennessee, 1970.

Hankins, Russell L., "Disconcerting Conclusions Drawn from the Literature of Cost Analysis," unpublished paper presented at The Association for Institutional Research, Los Angeles, California, May 2-6, 1976.

Harris, Marshall A., "A Benefit--Cost Analysis of Selected Vocational Education Programs in Florida," unpublished doctoral dissertation, Department of Educational Administration, The Florida State University, Tallahassee, Florida, 1972.

Humphrey, David Allen, "The Development of an Instrument for Course Cost-Analysis in Higher Education," unpublished doctoral dissertation, Department of Education, State University of New York at Albany, Albany, New York, 1974.

Lovell, Ned Broward, "Cost-Effectiveness Evaluation of Instructional Programs: A Development Design (K-12)," unpublished doctoral dissertation, The Florida State University, Tallahassee, Florida, 1971.

"1973-1974 Budget, North Texas State University," Denton, Texas, 1973.

Office of Institutional Analysis and Planning, North Texas State University, "Resource Requirements Prediction Model 1.6 (RRPM 1.6): Reports and Introductory Notes," Denton, Texas, 1974.

Raichle, Henry Frederick, "A Cost-Utility Analysis of a Selected Post-Secondary Vocational-Technical Education Program," unpublished doctoral dissertation, The Florida State University, Tallahassee, Florida, 1969.

Thackrey, Russell I., Personal Letter, March 13, 1976.

Tuscher, LeRoy Joseph, "Cost-Utility Analysis: An Evaluation and Resource Allocation Model for Educational Programs," unpublished doctoral dissertation, Department of Educational Administration, The Florida State University, Tallahassee, Florida, 1971.

Ziegler, Clayton L., "An Implementation of a Matrix Cost Model at the Course Section Level to Determine Academic Program Costs in a Community and Technical College," unpublished doctoral dissertation, Department of Educational Administration and Supervision, Bowling Green State University, Bowling Green, Ohio, 1975.