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ABSTRACT

Too often computer applications try to supplant rather than augment human capabilities. As a result, there is a gap between the power of the computer and some difficult administrative problems; e.g., longrange planning. However, there is increasing interest in the use of computer simulation in planning. PLANTRAN II represents a completely new approach away from former attempts to develop computer planning techniques. With this system, the decisionmakers can play an active role in the development of models with reduced dependence on technical staff. PLANTRAN II, which requires no technical expertise from the user, uses a simple language that is almost the same as the clerical instructions used in manual methods. This simple language is presented to a computer compiler that translates the instructions into computer terms. The instructions are processed by the computer, and the results are presented in a format set by the user. This manual contains information not only on the uses of the system but also on planning in general. It has a programed instruction set on the PLANTRAN II language. (Parts of pages 4-7 may reproduce poorly.) (Author/WM)

PLANTRAN II

A
COMPUTER ASSISTED INSTITUTIONAL RESEARCH & PLANNING SYSTEM

MIDWEST RESEARCH INSTITUTE
425 Volker Boulevard
Kansas City, Missouri 64110

PLANTRAN II

A SIMULATION SYSTEM

FOR EDUCATIONAL PLANNING

PREFACE

American technology thrives on the solution of physical problems. We can mass produce "individualized" products. We can send men a quarter of a million miles through space and land them within several hundred yards of a pinpoint target. However, we are not able to cope as well with problems that have significant human elements.

The electronic computer is one of the tools produced by our technology. Unfortunately the hopes for a computer-led revolution in management have turned to disillusionment.

This disillusionment does not result from an inherent defect of the computer. It comes from the lack of humanly designed systems to simultaneously exploit the power of the computer and the judgment of the executive. Too often computer applications try to supplant rather than augment human capabilities. As a result there is a gap between the power of the computer and some very difficult administrative problems. Long range planning is one example.

There is increasing interest in the use of computer simulation in planning. Early attempts to develop computer planning techniques were validly criticized. Some techniques were so simple as to be trivial; others were so complex as to be impractical.

PLANTRAN II is a completely new approach. With this system the decision makers can play an active role in the development of models. It reduces their dependence upon a technical staff.

PLANTRAN II requires no technical expertise from the user. It uses a simple language that is almost the same as the clerical instructions used in manual methods. This simple language is presented to a computer compiler which translates the instructions into computer terms. The instructions are processed by the computer and the results presented in a format set by the user. PLANTRAN II never requires the planner to know or understand any of the technical aspects of the machine.

This manual contains information not only on the uses of the system but also on planning in general. It has a programmed instruction set on the PLANTRAN II language. A person will understand the fundamentals of planning and be able to use the system after a few hours of studying this manual.

The PLANTRAN II system and this manual were developed by the Economics and Management Science Division of Midwest Research Institute under the general supervision of Richard L. Salmon, Manager of Operations Analysis. Duane Dieckman, Dan Epp, James Miller, and William Pickett made major contributions.

Approved for:

MIDWEST RESEARCH INSTITUTE

John McKelvey, Vice President
Economics and Management Science
Division

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CHAPTER 1

PLANNING

I. The Case for Long Range Planning

Planning provides a systematic means for a college or educational system to develop a course of action to meet short range and intermediate goals and needs as well as long range ones. In addition, the short range needs--the problems at hand--can be satisfied within the framework of the long range objectives of the organization. An organization that has carefully developed plans is in a position to anticipate and react positively to external events rather than be controlled by them. Finally, proper planning can give an organization a realistic understanding of its capabilities and resources and permit the organization to experiment with alternatives open to it to determine what can and must be done.

II. The Planning Process

To be effective, planning must be approached in a systematic way. Effective planning demands a structured context for developing alternatives within a framework appropriate for policy and decision making. Figure 1-1 is a presentation of such a planning approach. The approach consists of six basic steps, reinforced by analysis and review.

The first and fundamental consideration is a careful examination of the philosophy of the organization--the why, the raison d'etre, the mission. All decisions, plans, and acts must be consistent with the organizational philosophy.

Objectives are the second consideration and describe where the organization is now and where it desires to be at various points in the future. Consideration of objectives also aids in establishing priorities--deciding what is of immediate concern and what may be deferred.

Programs, the next consideration, are the logical product of the establishment of objectives. Programs are actions, tasks and schedules required to achieve the objectives, and the planners must determine the scope and design of programs.

THE PLANNING APPROACH

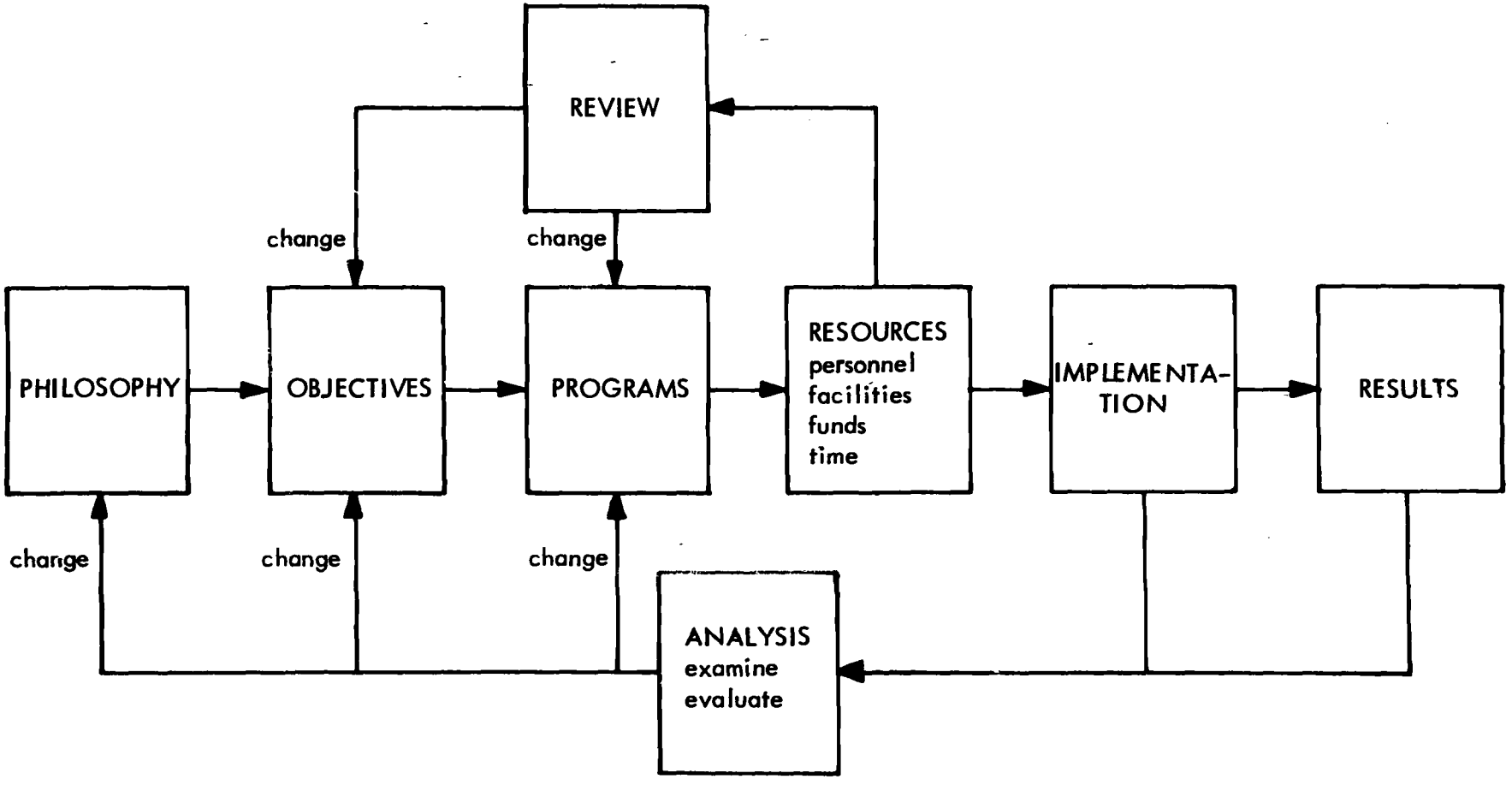


Figure 1-1

The fourth consideration--resources--brings reality into the planning process. Resources of personnel, facilities, funds, and time must be examined and matched with what is needed for the programs. The natural outcome of this matching will often be changes in the programs and, quite possibly, in the objectives. These changes may require that priorities be altered and that programs be modified.

The fifth consideration--implementation--concerns execution of the plan. Responsibilities are assigned and resources are provided for incorporating the plan into the organization. The plan is analyzed and results are continually examined so that changes can be made to enhance the actual operation of the plan. The final consideration--results--requires delineation of accomplishments under the plan. Measurement of the results permits the planner to observe what works and--more important--what does not work.

The final analysis of the overall plan is converted into changes that feedback into the planning approach, giving future phases of the plan a higher probability of success. This feedback process of continuous examination and evaluation enhances the achievement of objectives.

With the development of the electronic computer, a new technique, simulation, has evolved as a practical aid to planning. This technique employs logic and mathematics in the construction of a simulation model that represents an organization's functions. The simulation model will portray real or expected conditions in organizational operations. The representation will be based upon the planner's experience and observation of how the organization functions through time, and will be constructed by assigning quantitative values and relationships to the elements, or planning items, that characterize the organization.

Simulation is basically a technique for conducting experiments. It can be used to study problems where rules, policies, procedures, and other controlling aspects are under question and in which the number of variables and the uncertain nature of input make the problem difficult to analyze by conventional techniques. The products of simulation models are solutions to problems. These experiments at problem solving provide a method of determining cause-and-effect relationships without actually committing resources.

A simulation model that accurately reflects the complex and dynamic interrelationships of organization elements has several substantial advantages:

- Allows the consideration of more variables in the planning process;

- Considers the effect of interrelated variables;

- Permits experimentation with a wide variety of operating alternatives;

- Provides a communication link throughout the university by presenting a physical frame of reference;

- Enables an administrator to assess the long term impact of short term decisions;

- Helps define the need for information.

The following example illustrates the kind of situation in which computer simulation can be extremely helpful in quantifying and projecting the effects of change. In this example, the basic question that a simulation model can be used to solve is: "What will be the impact on student financial aid needs if a university increases its fees?"

A university has forecast a need to increase its fees over the next five years. This increase, of course, will provide more income, but it will also affect other parts of the operation--particularly student financial aid. Additional funds will be needed simply to enable the students who are now receiving aid to meet the increased fees.

At present 20 percent of the students receive some form of financial aid. As the tuition increases, however, a greater proportion of students will be unable to pay the fees in full, so that a greater percentage of students will need financial aid. Not only will the amount of aid for each student increase; the number of students needing aid will also increase. One result is that additional funds will have to be obtained from federal and other sources. Another result may be that the size and the structure of the student financial aid office will have to be changed. For instance, if the percentage of students needing aid increases from 20 percent to 25 percent, more personnel may be needed to administer the student aid program. For the student aid office the percentage increase in total number of students needing aid is not 5 percent but 25 percent. If additional personnel are needed, they may need more office space, and the financial aid operation itself will require additional funds for salaries, equipment, and expenses.

This simplified example shows how easily one apparently straightforward decision can quickly lead to a variety of other changes. It is in these kinds of rapidly pyramiding, cause-and-effect events that a computer simulation model can be most helpful. If appropriate information and data have been incorporated into the model (such as percentage of students needing aid, average amount of aid given, number of students served per professional employee), the computer can combine these figures with projected enrollment, future fees, and other relevant factors and calculate the additional aid money and operating expenses at various points in the future. The computer will also incorporate these figures into the more general areas of the model, such as total income and total salary expense.

Such a computer simulation model can free administrators and planners from innumerable time consuming and tedious calculations to determine the effects of various changes. In addition, the computer can effortlessly and accurately combine the thousands of bits of data that one change is likely to affect and produce an overall picture.

The elements of a simulation model to address this problem are shown in Figure 1-2. The operating budget, a conventional mathematical model, is the basis for the model structure. The model uses some of the budget line items and adds other items--number of students, number of faculty, etc. When the various elements of this model are projected into future years, the model simulates organizational behavior.

III. A Flexible Approach to Modeling and Simulation

The conventional approach to model design for institutional planning has been to look at the current problem situation, anticipate possible future problem situations, specify the factors that are important to these situations and build a model around these factors and their interrelationships.

There are two problems inherent in this approach. In order to adequately address future problem situations--the precise characteristics of which cannot be accurately known in advance--a large number of factors and relationships must be built into the model. The dilemma is that with too many factors extraneous to a specific problem situation, the model becomes complex, confusing and thus of limited value. With few factors--thus simple and straightforward--it becomes so narrow and simplistic that it has no value except for very special cases. The second problem is that regardless of how many factors have been included in a planning model--a situation will soon arise for which the model is not appropriate.

INSTITUTIONAL MODEL BASED ON BUDGET STRUCTURE

number of students

tuition

alumni

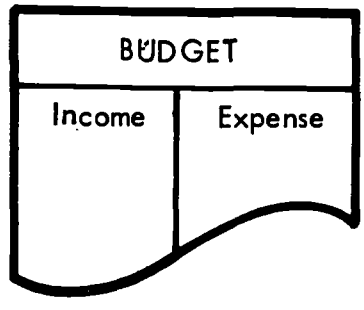
friends

corporations

special activities

investment portfolio

foundations and government



faculty and staff

departmental expenses

publications

travel

classrooms

square feet

library volumes

maintenance costs

Figure 1-2

For example, budgets are almost universally built from the bottom up. A planning model designed to produce alternative annual budgets probably would be structured the same way. However, a question often arises, "Suppose we were given a fixed amount for the total budget--what are the various alternatives for allocating this fixed budget and what consequences flow from each of these alternatives?"

This is a valid question for a policy maker to ask, yet it would be very difficult to answer with the "bottom-up" budget model. The model would have to be reprogrammed. This leads to several further arguments against the fixed, monolithic planning model. These arguments involve cost, communication and currency.

A. Cost

A comprehensive and useful planning model designed and programmed for a specific institution to meet its unique planning needs will involve 6-30 man-months of system analyst and programmer time. Staff turnover as well as the necessity to keep up with routine, day-to-day problems will further complicate matters.

B. Communication

The communication that will be required between the administrators and the executives on the one hand and the systems analysts and programmers on the other will be quite extensive. The only alternative will be to incur the major risk of producing a planning system out of tune with institutional needs. The question naturally arises at this point--"Is it easier to teach programmers how to plan or planners how to program?"

C. Currency

Once an acceptable model is designed and programmed, how long will it remain current? As indicated above, probably not very long. What then will be necessary to change it to better fit the current situation, the current planning issue? It will probably require reprogramming. The reprogramming effort required might range from minimal to massive. Will the original programmer be available for this effort? Will anybody be readily available?

Thus, there is a case for the flexible approach that relieves the planners and decision makers from dependency on the systems and programming staff and that can place computing power in their hands without requiring extensive computer expertise. This was the approach taken in the development of the PLANTRAN II System.

IV. Summary

This PLANTRAN System has been used by dozens of institutions and has proved itself to be a valuable aid in planning and analysis. This collective experience has underscored the following advantages:

--Facilitates the involvement of top level administrators which is essential to successful planning;

--Reduces the expense of planning by eliminating the costly programming and systems analysis work;

--Focuses attention on the critical data needs so that priorities can be established for institutional research;

--Begins where the organization is rather than requiring massive changes in the organization to accommodate a specific model or system;

--Permits the involvement of students and faculty in the evaluation of plans;

--Utilizes existing information systems;

--Provides usable results almost immediately;

--Allows rapid and easy modification of model structure, planning item specification, and report format;

--Allows the planner to grow toward more complicated and sophisticated methods of planning;

--Emphasizes what the planner knows about planning--not what he knows about computers.

CHAPTER 2

THE MODELING LANGUAGE

The heart of the PLANTRAN System is the modeling language. Projections and interrelationships of planning items are handled by this simple planning language. The language uses a small vocabulary, based largely on standard English. The language, called PLANTRAN II, is derived from PLANning TRANslator and is composed of model specification instructions. The key words of these instructions are illustrated in Table 2-1.

In our discussion we use the term "planning item." A planning item is one component of a model, and it is used to describe a particular planning element and the values associated with that planning element for each period of a six or twelve period planning horizon. Thus the term planning item is used to designate all the constituents of one planning element. It is important to note that there are no fixed planning items in the system. We use the term "planning period" rather than year because the planning horizon may be in terms of years, months, quarters or other useful time periods.

Planning items which are independent, i.e. that can be developed without involving other planning items, on one model might be dependent, i.e. involving other planning items, in another model. All planning items are specified by the planner, using the model specifications contained within the PLANTRAN II language.

I. The Planning Matrix

It may be useful to think of the planning system as a matrix (see Figure 2-2). Each row of the matrix represents the projection of a planning item over a 6 or 12 period planning horizon. These projections may be extensions of the current value of a planning item, such as current AVERAGE SALARY projected with a 5 percent increase per period. For example, TOTAL SALARY EXPENSE is projected by taking the period-by-period, or column, values of AVERAGE SALARY and multiplying them the by the period-by-period values of TOTAL STAFF. This dependent relationship, of course, enables the projections of both AVERAGE SALARY and TOTAL STAFF to have been projected in whatever manner the planner may have specified.

TABLE 2-1

KEYWORDS--MODEL SPECIFICATIONS

PERCENT	SUM	PROJECT
INCREASE	SHIFT	ACCUMULATIVE SUM
DECREASE	EQUATION	ACCUMULATIVE PRODUCT
GOAL	MAXIMUM	AVERAGE
DATA	MINIMUM	RETURN ON INVESTMENT
	FILL	

KEYWORDS--OUTPUT SPECIFICATIONS

PUNCH

PLOT

HEADING

THE PLANNING MATRIX

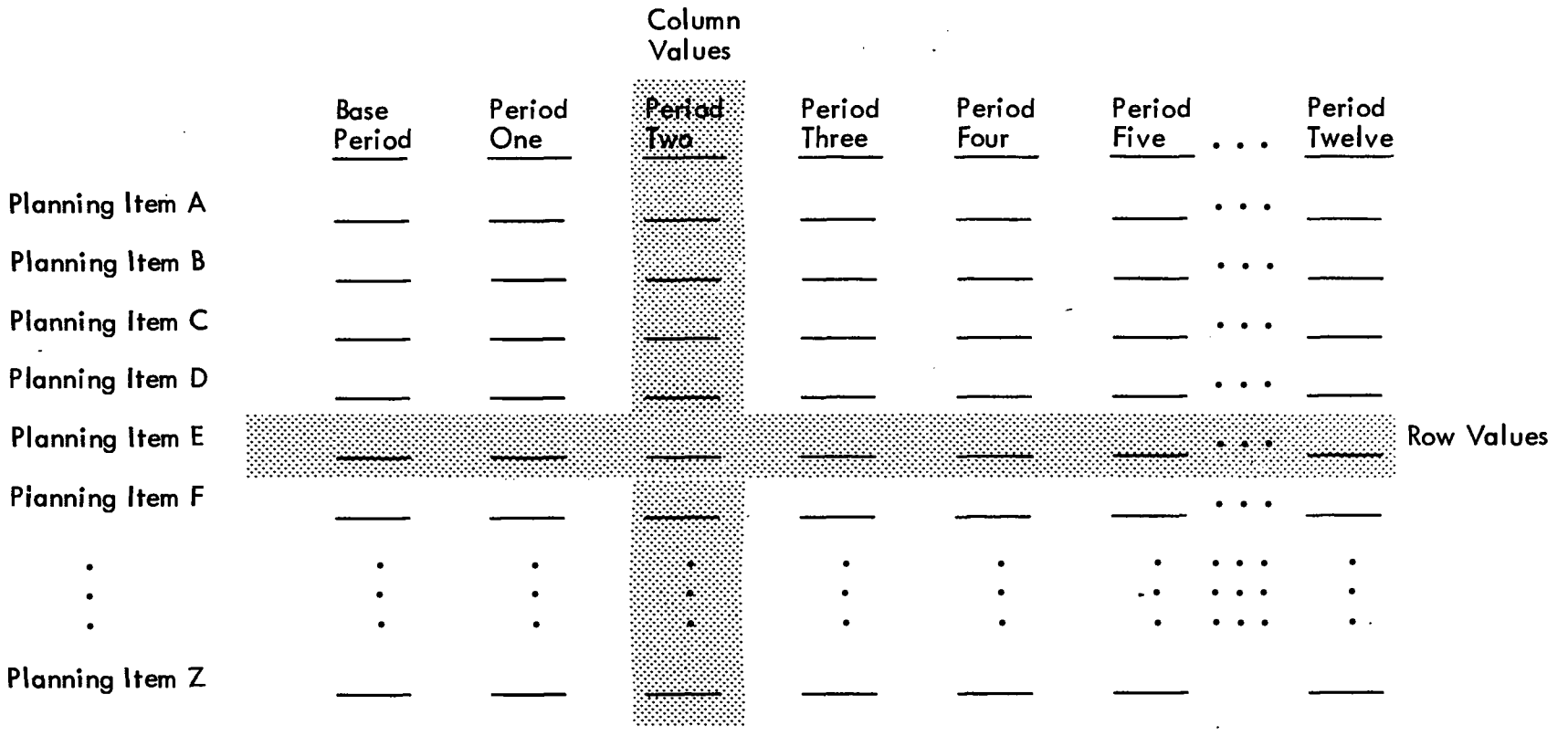


Figure 2-2

It is the process of specifying each of these planning items and determining how they are to be projected and how they are related to other planning items that constitutes model building. The ease and simplicity of specifying each of the planning items belies the complexity that the completed model may represent. The relatively simple static model becomes dynamic through changes in planning items values and relationships over time.

II. Types of Model Specification

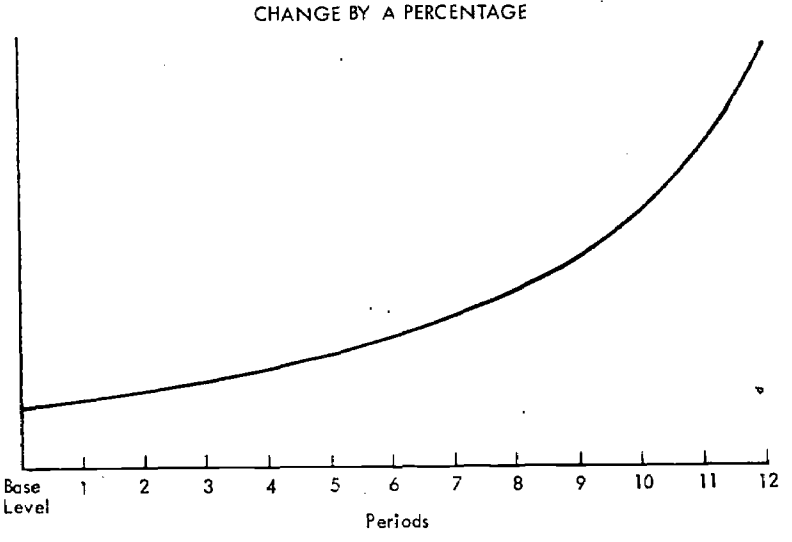
The PLANTRAN II language includes three general methods of model specification: independent methods of projection, dependent methods of projection, and headings or section titles. The planner uses these methods in a variety of ways to build a model of any desired complexity.

A. Independent Methods of Projection

There are four ways to specify independently projected planning items. These four methods are compatible with manual planning techniques.

1. Change by a percentage

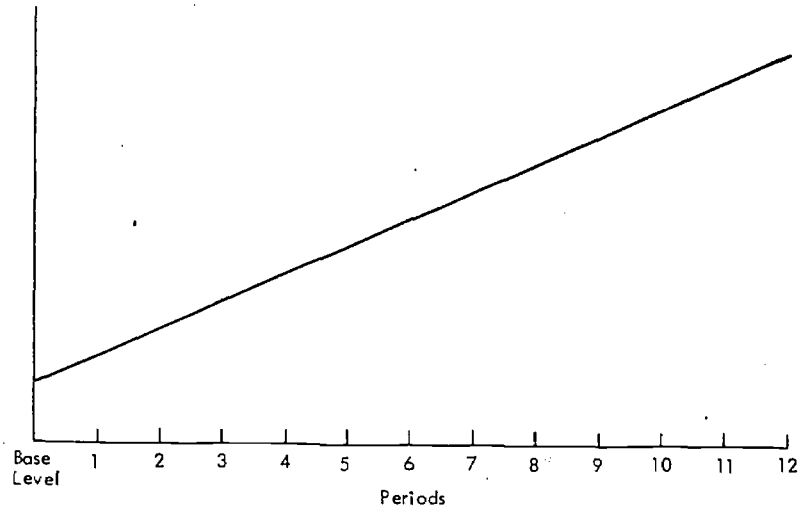
A planning item base level value may be changed (increased or decreased) by a specified percentage. This method generates a compound percentage increase or decrease for each planning period.



2. Change by an increment

A planning item base level value may be changed (increased or decreased) by a specified amount. This method generates an incremental value increase or decrease for each planning period.

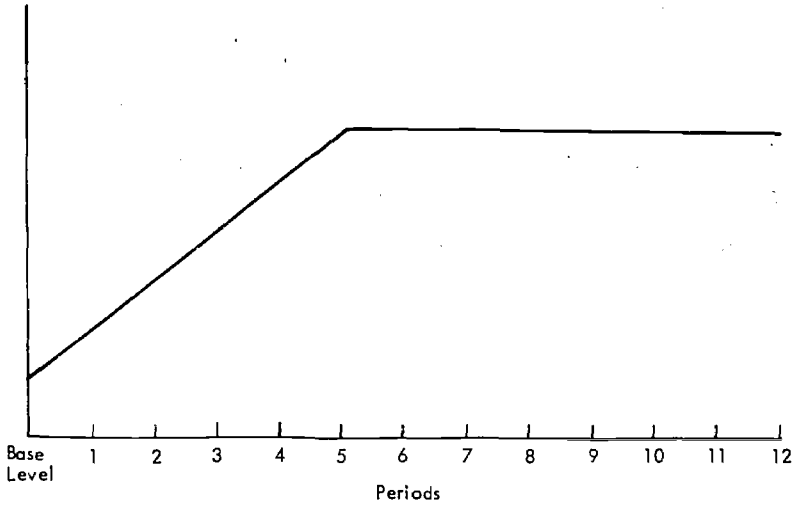
CHANGE BY AN INCREMENT



3. Change to achieve a goal

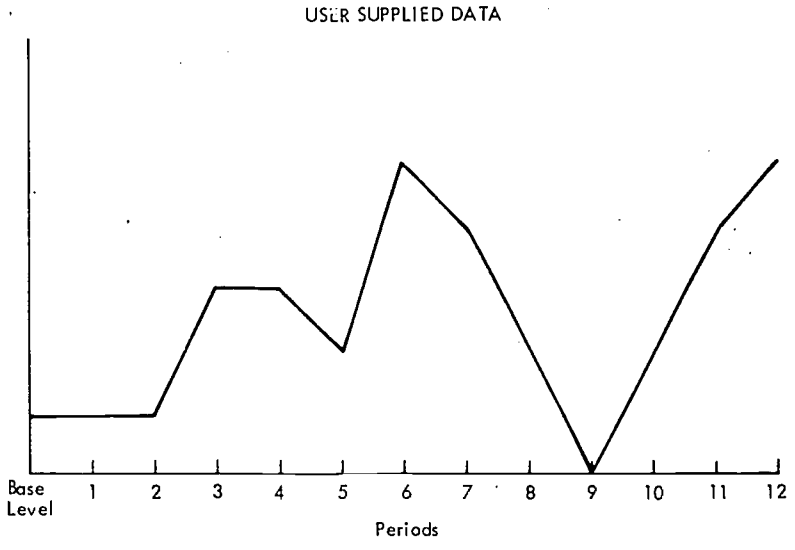
A planning item base level value may be changed (increased or decreased) to a specified goal value in a specified number of planning periods. The goal value, once achieved, is maintained for the remaining periods in the planning horizon.

CHANGE TO ACHIEVE A GOAL



4. User supplied data

The planning item values for the planning horizon may be inserted by the planner for any or all of the 12 planning periods.

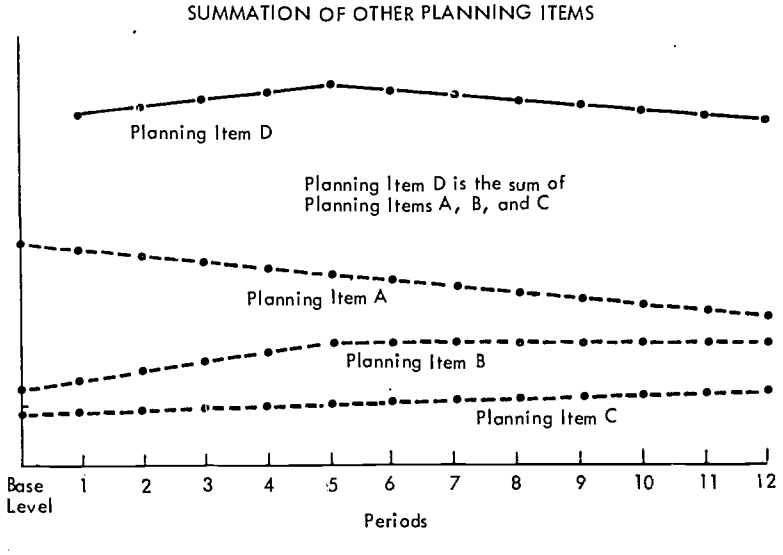


B. Dependent Methods of Projection

The dependent methods are the most powerful means of model specification. They are used to interrelate planning items in almost unlimited combinations.

1. Summation of other planning items

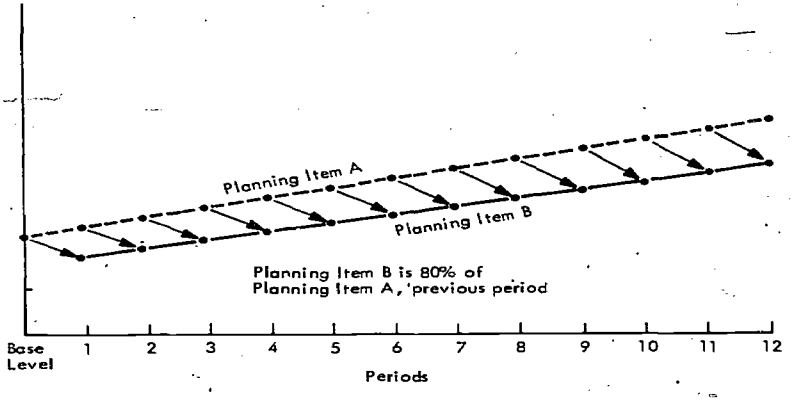
A planning item may be the summation of up to 15 other planning items.



2. Shift, or shifted function of another planning item

A planning item's values may be a function of another planning item's values that have been shifted forward of backward a specified number of periods.

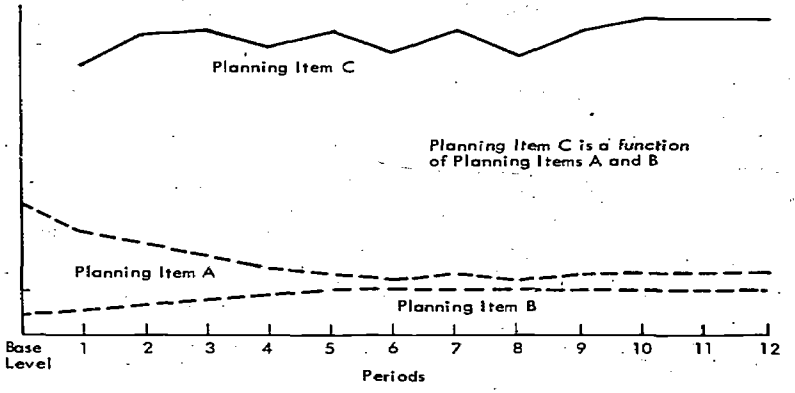
SHIFTED FUNCTION OF ANOTHER PLANNING ITEM



3. Function of other planning items

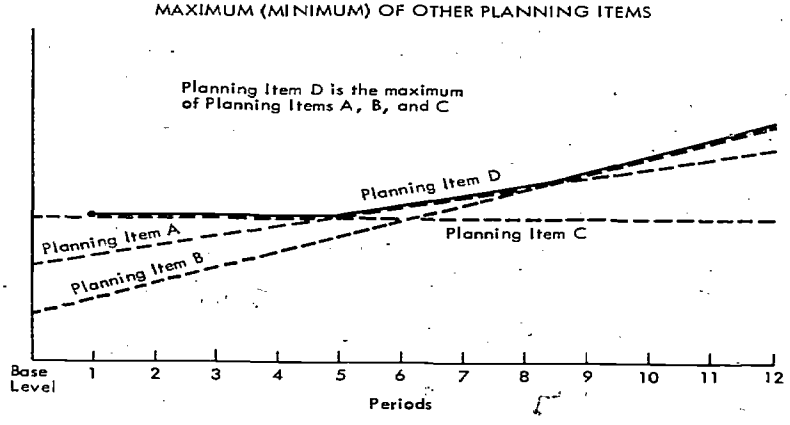
A planning item may be derived from a planner-specified equation. An equation may contain up to four other planning items, multiplied by optional constant values, in combinations of addition, subtraction, multiplication, division, and exponentiation. Parenthetical expressions are permitted.

FUNCTION OF OTHER PLANNING ITEMS



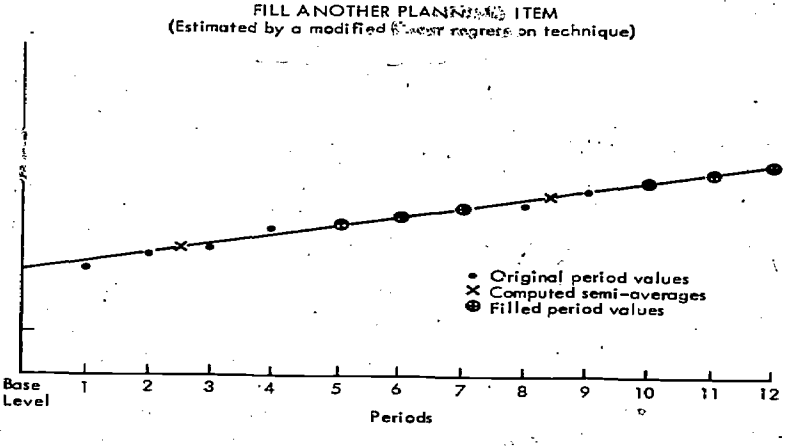
4. Maximum (or minimum) of other planning items

A planning item may be the maximum or minimum of up to four other planning items and a planner-specified constant, period by period, across the planning horizon.



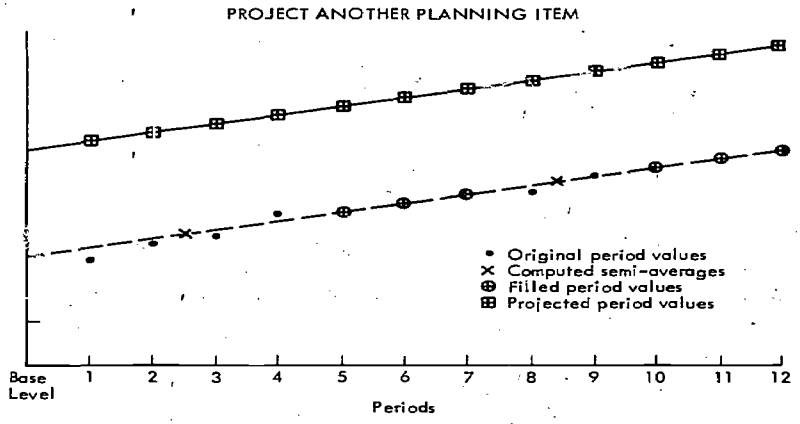
5. Fill another planning item

A planning item may be the completed series which results from filling missing data in another planning item. The missing data is estimated by a modified linear regression technique.



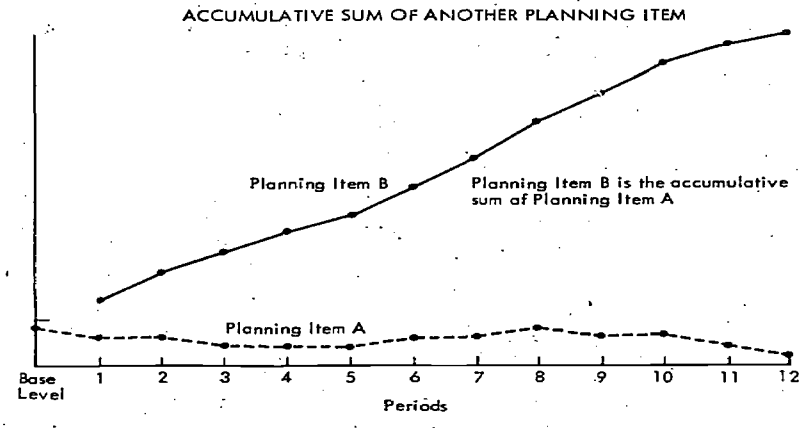
6. Project another planning item

The planning item may be the projection of another planning item. A trend associated with the planning item is developed and extrapolated for the next twelve periods.



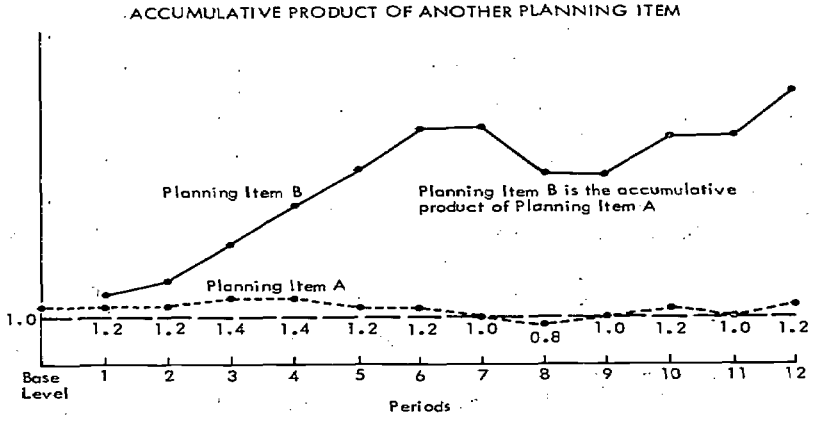
7. Accumulative sum of another planning item

A planning item may be the accumulative sum of the period values of another planning item.



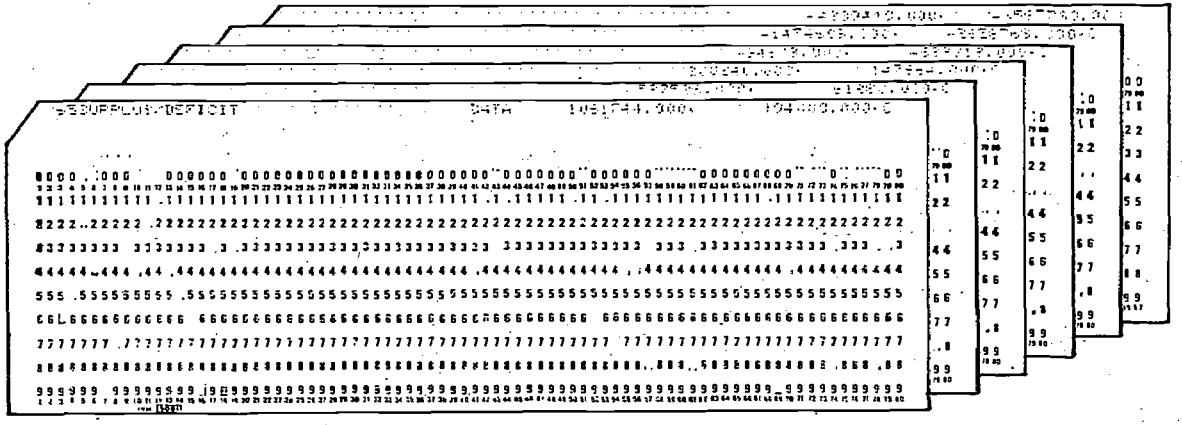
8. Accumulative product of another planning item

A planning item may be the accumulative product of the period values of another planning item.



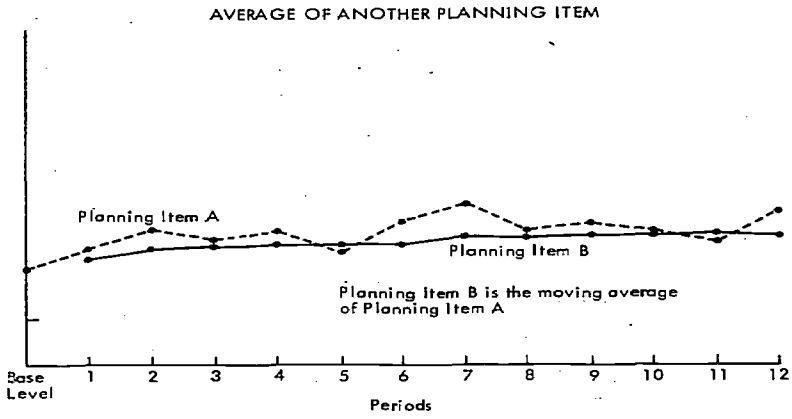
9. Punch cards of other planning items

A planning item may be reproduced as six punched cards in the format user supplied input.



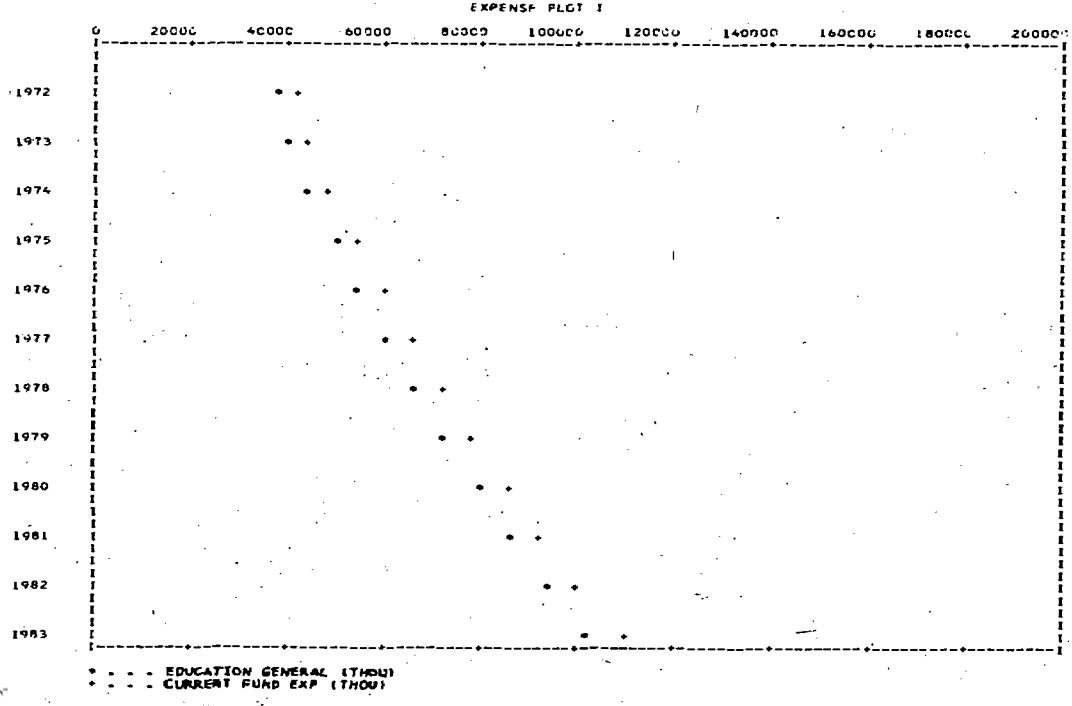
10. Average of another planning item

A planning item may be the moving average of another planning item, computed period by period across the planning horizon.



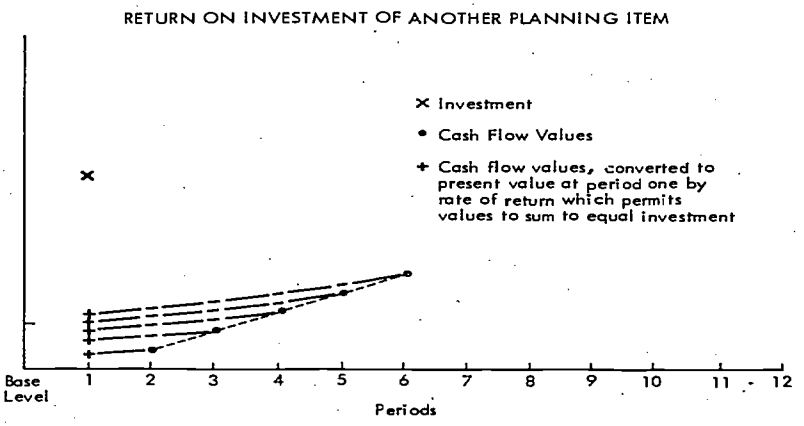
11. Printer plot of other planning items

Up to four planning items may be included in a printer plot.



12. Return on investment

A planning item may be the percentage return on investment which would result from a cash flow represented in another planning item.



C. Headings, or Section Titles

A planning item may be a heading, or section title, specified by the planner to separate planning items in the planning matrix.

III. Model Development

Up to this point we have described the various methods by which the planner can specify individual planning items in the PLANTRAN II language. Model building is the application of these methods to the data of an organization. In developing the model, there are five important considerations:

Data about the detail characteristics of the organization must be available.

Known and assumed facts that influence the operation of the organization should have quantifiable interrelationships.

Knowledge of the relationships among organizational components is less reliable than knowledge of the individual components.

Construction of a model and observation of the interaction of its factors provide greater understanding of the operation of the organization.

Results do not have to be perfect to be helpful.

In actually designing the model, a systematic approach is important. The following guide, "Steps in Model Design," is one way to approach the model building task.

Steps in Model Design

Specify the planning objectives: The choice of significant objectives depends on the planner's knowledge of his organization and on his ability to relate that knowledge to causes and effects. The final value to be derived from the model will be enhanced by the clarity of those objectives.

Relate boundaries to the objectives: There are limits to the objectives. These must be taken into account if a realistic model is to be constructed.

Identify items to be contained within the model: These are the organizational elements which have a significant bearing on the objective. The objective will determine the level of detail.

Determine relationships between interconnected elements: The relationship between planning items should reflect the relationships among elements of the organization. This must be done in a way that permits examination of the effects of the variables under study.

Set item values at realistic levels: The current values of the variables must be set at levels that are valid, or if not known, are at least within reason.

In designing a model, the normal procedure is to build upward from available knowledge about the individual planning items. In some cases, it may be desirable, or even necessary, to construct a variable by working backward from the known results.

Once the model output is obtained, the planner, by examination and evaluation, determines which variables he wants to alter. This process of "exercising the model" by noting the various effects on a check line provides a basis for changing the model.

The end products of the model program, the reports, are designed for maximum flexibility--again the planner designs his own reports and may even change the format of the report for each run. The information contained in any line of the planning model can be printed any number of times and in any sequence. The planner can create reports in the format that is suitable both to his specific planning needs and to the overall needs of his institution.

The east and flexibility of report design enable the planner to produce reports ranging from broad general summaries of the entire planning model to detail analyses of specific elements of particular concern. Because the report design is flexible, the planner can adapt the format to the unique requirements of his organization and he can change the emphasis of the report at any time, thus giving the report maximum usefulness in planning for the future.

The planner can use the planning system we have described to experiment with virtually every aspect of the organization. With such experimentation he assesses the consequences of various alternative actions. Figure 2-3 shows the concept of a "plan refining cycle"--the iterative process of developing a long-range plan. By examination and evaluation of the system output, needed changes are identified and modifications can be made to independent variable values or dependent variable relationships.

The planning system provides the planner with a number of alternatives in designing a model to represent his organization. However, the freedom in both model and report design requires that the objectives of the organization be used as a basis for the planning process.

Planning is a dynamic process. It must be responsive to frequent change. The current trends of growth and complexity in the administration of education demand that today's planning be more accurate, rapid, and extensive, than ever before. This computerized planning system provides a tool to meet that need.

PLAN REFINING CYCLE

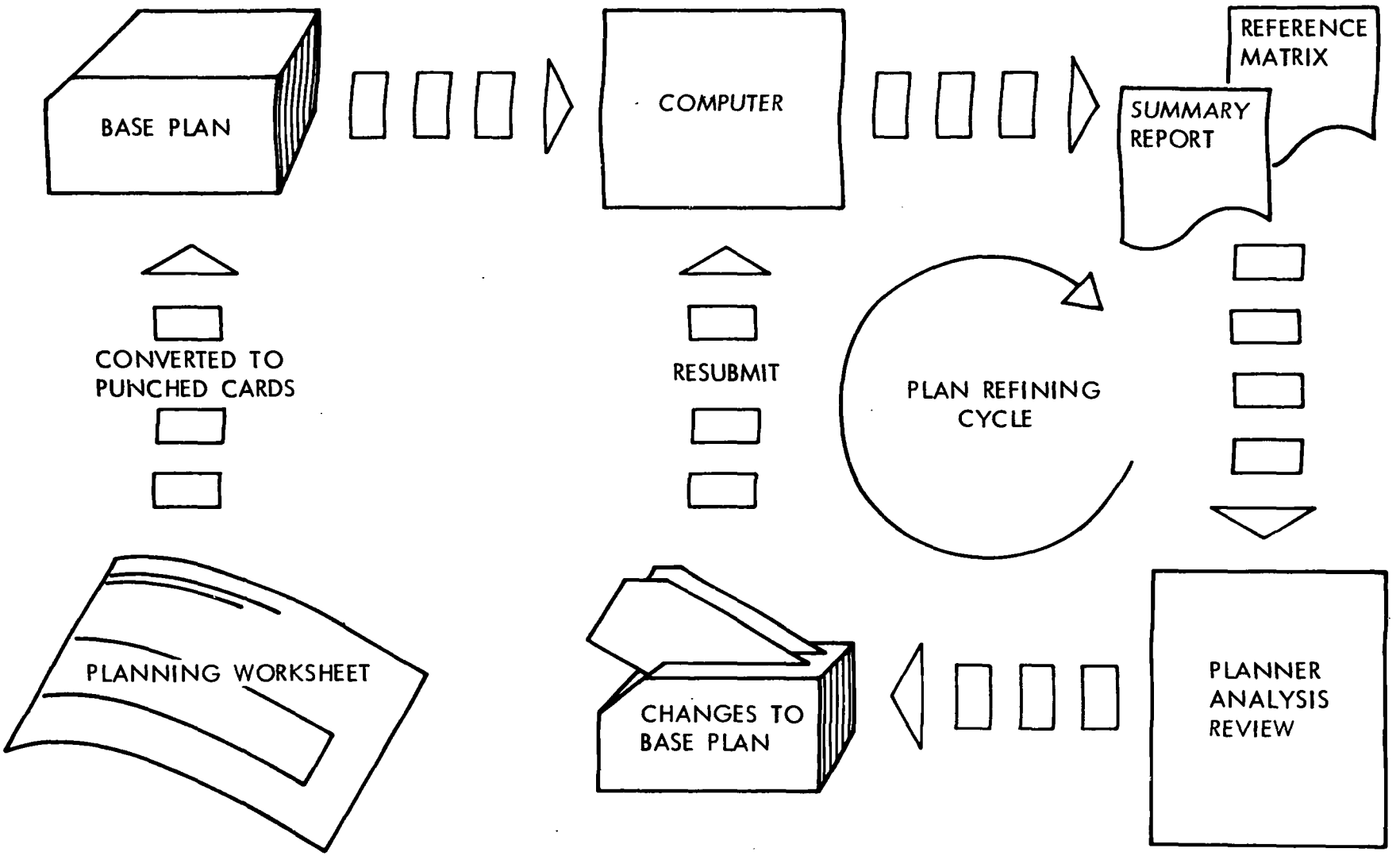


Figure 2-3

CHAPTER 3

BASIC ELEMENTS OF PLANTRAN II

PLANTRAN II utilizes four basic types of input for the development of models:

Type 1 - Identification Input

Type 2 - Columnar Headings Input (optional)

Type 3 - Model Specification Input

Type 4 - Summary Report Input

These four input types are shown below on the PLANTRAN II data sheet.

NAME _____ PLANTRAN II DATA SHEET PAGE ___ OF ___ MRI

IDENTIFICATION

ORGANIZATION (1–24)	MODEL DESCRIPTION (25–40)	DATE (41–56)	BASE PERIOD (57–60)	T (61)	H (63)	R (65)	T - TIME PERIOD H - HEADING R - REPLACEMENT	RUN NO (78–80)

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1 (1–6)	PERIOD 2 (7–12)	PERIOD 3 (13–18)	PERIOD 4 (19–24)	PERIOD 5 (25–30)	PERIOD 6 (31–36)	PERIOD 7 (37–42)	PERIOD 8 (43–48)	PERIOD 9 (49–54)	PERIOD 10 (55–60)	PERIOD 11 (61–66)	PERIOD 12 (67–72)	

MODEL SPECIFICATION

LINE NO (1–4)	PLANNING ITEM (5–28)	BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44)	(45–80)

SUMMARY REPORTS

REPORT TITLE (1–24)	FREEFORM REPORT LINES (25–80)

A discussion of each of the four input types follows:

I. Type 1 - IDENTIFICATION INPUT

The identification input is used to provide information for identifying the planning model. A sample of the identification input format is shown below:

IDENTIFICATION

ORGANIZATION	MODEL DESCRIPTION	DATE	BASE PERIOD	T	H	R		RUN NO
1 24	25 40	41 56	57 60	61	63	66	T - TIME PERIOD H - HEADING R - REPLACEMENT	76 80

The format consists of eight fields, each of which contains several columns.

Field 1 - Columns 1-24, ORGANIZATION. Contains the name of the organization. The name should begin with a non-numeric character to ensure that the first four characters cannot be interpreted as a numeric line number.

Field 2 - Columns 25-40, MODEL DESCRIPTION. Contains a brief description of the objective of the model. Any character (alphabetic, numeric, or special) is permitted.

Field 3 - Columns 41-56, DATE. Contains the date of the run. Any character (alphabetic, numeric, or special) is permitted.

Field 4 - Columns 57-60, BASE PERIOD. Contains the base period number, e.g., 1971--which is incremented by one for each period of the planning horizon, or, is an indication of the sequence in which user specified columnar headings (Type 2 input) are to be reflected in the planning horizon. Only numeric data are permitted, and if less than four characters are present, they must be right-adjusted.

Field 5 - Columns 61-62, T. Contains an indicator to specify the number of planning periods. A "T" or other character in either column generates a six-period planning horizon, and if the field is left blank, a 12-period planning horizon is assumed.

Field 6 - Columns 63-64, H. Contains an indicator to specify that user supplied columnar headings are provided. The "H" or other character in either column indicates that headings are provided, and if the "H" is present, the columnar heading input (Type 2) must follow. If the field is left blank, columnar headings are

generated in the system by incrementing the base period by one for each period. If the "H" field is left blank, the columnar heading input, Type 2, must not be included.

Field 7 - Columns 65-66, R. Contains an indicator to specify whether the model is a "stand alone" run or replacement data for an immediately preceding model. The "R" or other character in either column indicates that the data which follow are a revision of the previous model. If the field is left blank, the system treats the data as a "stand alone" model.

Field 8 - Columns 78-80, RUN NUMBER. Contains a character identifying the run. Both alphabetic and numeric data are permitted.

In summary, the identification input (Type 1) is used by the planner to provide information for identifying the planning model run.

II. Type 2 - COLUMNAR HEADINGS INPUT (OPTIONAL)

The optional columnar heading input allows the planner to specify columnar headings other than values incremented from the base period. A sample of the columnar heading input format is shown below.

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1	PERIOD 2	PERIOD 3	PERIOD 4	PERIOD 5	PERIOD 6	PERIOD 7	PERIOD 8	PERIOD 9	PERIOD 10	PERIOD 11	PERIOD 12
1 6	7 12	13 18	19 24	25 30	31 36	37 42	43 48	49 54	55 60	61 66	67 72

The format consists of 12 fields of six columns each:

Field 1 - Columns 1-6, PERIOD 1.

Field 2 - Columns 7-12, PERIOD 2.

Field 3 - Columns 13-18, PERIOD 3.

Field 4 - Columns 19-24, PERIOD 4.

Field 5 - Columns 25-30, PERIOD 5.

Field 6 - Columns 31-36, PERIOD 6.

Field 7 - Columns 37-42, PERIOD 7.

Field 8 - Columns 43-48, PERIOD 8.

Field 9 - Columns 49-54, PERIOD 9.

Field 10 - Columns 55-60, PERIOD 10.

Field 11 - Columns 61-66, PERIOD 11.

Field 12 - Columns 67-72, PERIOD 12.

Note that there are three relationships between the columnar heading input and the identification input.

First, the H field of the identification must contain the character "H" to initiate the planner specified columnar headings.

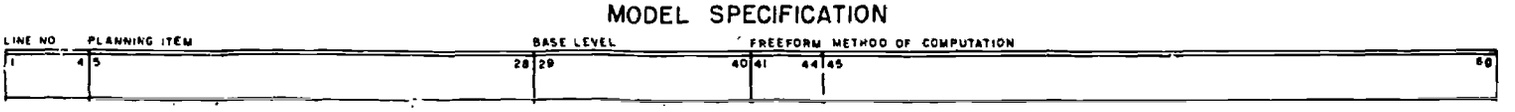
Second, the BASE PERIOD field of the identification input can be used to specify which of the columnar headings is to be printed as the first period on the reports. For example, if the columnar headings contain the months of the year beginning with January, and if the BASE PERIOD field contains a "6" then the PERIOD 6 entry (June) will be considered as the base period and PERIOD 7 (July) will be printed as the first planning period. This capability enables a plan to be updated by simply changing the identification input.

Finally, the T field indicates whether 6 or 12 columnar headings will be printed, i.e., blank indicates 12 periods, T indicates 6 periods.

III. Type 3 - MODEL SPECIFICATION INPUT

The model specification input is used to build the model--that is, to project and interrelate planning items. This simple set of model specification instructions reflects projection techniques in common use and uses an English-like syntax. A sample of the model specification input format is shown below:

MODEL SPECIFICATION



The format consists of four fields. An explanation of their use follows.

Field 1 - Columns 1-4, LINE NUMBER. Contains a line number associated with a planning item. Only numeric data are permitted, and the number may be placed anywhere in the four columns.

Field 2 - Columns 5-28, PLANNING ITEM. Contains a description of the values associated with the row of the planning matrix. Any characters (alphabetic, numeric, or special) are permitted.

Field 3 - Columns 29-40, BASE LEVEL. Contains the value for the base period of the planning item which may be an integer or a real number; that is, a decimal point is optional.

The data must be numeric, with the exception of the decimal point (.) and the plus (+) or minus (-) signs.

Commas are not permitted!

Field 4 - Columns 41-80, FREEFORM METHOD OF COMPUTATION. Contains an English-like statement which develops a projection, or expresses the relationship between this and other planning items. Each method of model specification has certain required elements, reserved characters, and optional elements which are discussed below. The length of an individual entry is limited by the number of columns on a single punched card. If a certain model specification method exceeds the limit of one card (80 columns), a notation must be made to indicate that the statement is continued on the following card. This notation is a "C" which appears on the last card entry.

The planning item row values may be simple extensions of the current or base value of an item. These values are based on independent methods of projection.

The planning item row values may also be functions of other planning item row values, with interrelationships specified by the planner. These values are determined by dependent methods of projection.

It is the process of specifying each of these planning items--determining how they are to be projected and how they are related to other planning items--that constitutes model building. The ease and simplicity of specifying each of the planning items belies the complexity that the completed model may represent. The relatively simple static model is made complex by dynamic changes in planning items through time, and even by dynamic changes in relationships among items.

Planners can use the model specifications to deal with individual planning items with ease and simplicity. At the same time, they may combine these items in an almost endless variety of ways to build a model of any desired complexity.

A. Independent Methods of Projection

Independent planning items can be projected in one of four ways. These four methods are compatible with manual planning techniques.

1. Change by a percentage

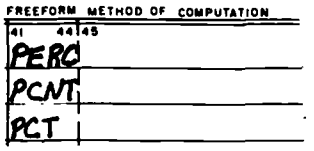
A planning item may be changed (either increased or decreased) by a specified percentage. This method generates a compound percentage increase or decrease for each planning period. An optional feature allows the planner to specify the period in which the percentage change begins.

a. Required elements

The BASE LEVEL field must contain a value.

The FREEFORM METHOD OF COMPUTATION field must contain:

- One of the following terms in the first four positions of the field;



- A reserved character "I", "D", or "-" after column 44, where:

I - represents an increase

D - represents a decrease

(-)- a minus represents a decrease. This symbol is to be placed immediately preceding the percent value. If none of the above characters are used, an increase is assumed.

- A percentage value, which may be an integer or a real number. (Note that this value is expressed as a percent value, i.e., 6 percent, rather than the 0.06 decimal equivalent.)

An instruction to maintain a constant value throughout each planning period (increase by zero percent) may be indicated by inserting a zero (0) as the percentage value or by leaving this field blank in the FREEFORM METHOD OF COMPUTATION. Another instruction which will result in the same projection uses a CONS (for constant) in the first four positions (Columns 41-44) of the FREEFORM METHOD OF COMPUTATION with the remainder of the field left blank. The BASE LEVEL field must contain the constant value that is to be maintained throughout each period. Example (3) illustrates trates alternative instructions to maintain a constant value in each planning period.

b. Optional elements

The percentage increase or decrease may be delayed through use of the "beginning in" operand, and the specification of the period in which the change is to begin. To use this option, the planner must use a term

containing the reserved character "B" after the percent value and prior to an integer specifying the period in which the change is to occur. The default option is to begin the change in period 1.

Examples:

(1) Percentage increase of 10 percent per period.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000.	PERCENT INCREASE OF 10 PCT PER PERIOD
1000	PCNT INCR OF 10/PERIOD
1000.	PCT 10%/PERIOD
1000	PCT 10

(2) Percentage decrease of 5 percent per year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000.	PERCENT DECREASE OF 5 PER PERIOD
1000	PCNT DECR OF 5%/PERIOD
1000.	PCT -5%/PERIOD
1000	PCT -5

(3) Constant value of 1000 to be maintained each period.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000	PERCENT INCREASE OF 0 PER PERIOD
1000.	CONSTANT VALUE MAINTAINED EACH PERIOD
1000	CONS

(4) Percentage increase of 7.5 percent per year beginning in third year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000.	PERCENT INCREASE 7.5 PCT BEGIN 3RD PERIOD
1000	PCNT INCR 7.5% BEGIN 3RD PERIOD
1000.	PCT 7.5% B3
1000	PCT 7.5 B3

(5) Percentage decrease of 3.47 percent per year beginning in sixth year.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1000.	PERCENT DECREASE 3.47 PCT BEGIN 6TH PERIOD
1000	PCNT DECR 3.47 % BEGIN 6TH PERIOD
1000.	PCT -3.47 % B 6
1000	PCT -3.47 B 6

(Notes on reserved characters.)

The characters "I" (Increase), "D" (Decrease), or "-" have meaning prior to the percent value. The character "B" (Beginning in) has meaning between the percent value and the beginning period value.

2. Change by an increment

A planning item base value may be changed (either increased or decreased) by a specified incremental amount. This method generates an incremental value increase or decrease for each planning period. The beginning period in which the incremental change occurs may be specified.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain one of the following terms:

FREEFORM METHOD OF COMPUTATION
DECR
INCR

The FREEFORM METHOD OF COMPUTATION field must contain an incremental value, which may be an integer or a decimal number.

b. Optional elements

If the BASE LEVEL field contains no value, a value of zero is assumed.

The incremental increase or decrease may be delayed through use of the "beginning in" term and the specification of the period in which the change is to begin. To use this option the planner must use a term containing the reserved character "B" after the incremental value and prior to an integer specifying in which period the change is to occur. The default option is to begin the change in period 1.

Examples:

(1) Incremental increase of 100 per year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000.	INCREASE BY 100 PER PERIOD
1000	INCR BY 100 / PERIOD
1000.	INCR 100 / PERIOD
1000	INCR 100

(2) Incremental decrease of 50 per year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000.	DECREASE BY 50 PER PERIOD
1000	DECR BY 50 / PERIOD
1000.	DECR 50 / PERIOD
1000	DECR 50

(3) Incremental increase of 35.5 per year beginning in fifth year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000.	INCREASE BY 35.5/PERIOD BEGIN 5TH PERIOD
1000	INCR BY 35.5 BEGIN 5TH PERIOD
1000.	INCR 35.5 BEGIN 5TH
1000	INCR 35.5 B 5

(4) Incremental decrease of 72.37 per year beginning in fourth year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 / 45–80)
1000.	DECREASE BY 72.37/PER. BEGIN 4TH PERIOD
1000	DECR BY 72.37 BEGIN 4TH PERIOD
1000.	DECR 72.37 BEGIN 4TH
1000	DECR 72.37 B 4

(Notes on reserved characters.)

The character "B" initiating the "beginning in" option, has meaning between the incremental value and the beginning period value.

3. Change to achieve goal

A planning item base value may be changed (either increased or decreased) to a specific goal value, which may be an integer or a decimal number, in a specific number of planning periods. This method generates values which increase or decrease from the base value to the goal value, then retain the goal value for the remaining periods in the planning horizon. The period in which the increase or decrease change begins may be specified. The base value and/or the goal value may be negative, specified by a minus sign (-) preceding the number.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain the following term:

FREEFORM METHOD OF COMPUTATION
41 44 45
GOAL

The FREEFORM METHOD OF COMPUTATION field must also contain a goal value, which may be an integer or a decimal number, and an integer which specifies the period in which the goal is to be achieved. A blank space or non-numeric character must separate the goal value and the integer, noting the period in which the goal is achieved.

b. Optional elements

If the BASE LEVEL field contains no value, a value of zero is assumed. The change from the base value to the goal value may be delayed through use of the "BEGINNING IN" term, and the specification of the period in which the change is to begin. To use this option the planner must use a term containing the reserved character "B" after specifying the period in which the goal is to be achieved and prior to an integer specifying the period in which the change is to occur. The default option is to begin the change in Period 1. Note that if a negative goal value is specified, the difference between the base and goal values will be the algebraic difference.

Examples:

(1) Change to a goal of 1500 in fifth year.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
1000.	GOAL OF 1500 IN 5TH PERIOD
1000.	GOAL 1500 IN 5TH PERIOD
1000	GOAL 1500 5TH
1000	GOAL 1500 5

(2) Change to a goal of 720 in 6 years.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 | 45–80)
1000.	GOAL OF 720 IN 6TH PERIOD
1000	GOAL 720 IN 6TH PERIOD
1000.	GOAL 720 6TH
1000	GOAL 720 6

(3) Change to a goal of 2100 in 8 years beginning in fourth year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 | 45–80)
1000	GOAL OF 2100 IN 8TH PERIOD BEGIN IN 4TH
1000.	GOAL 2100 IN 8TH BEGIN 4TH
1000	GOAL 2100 8TH BEGIN 4TH
1000	GOAL 2100 8 B 4

(4) Change to a goal of 933.3 in 5 years beginning in second year.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44 | 45–80)
1000	GOAL OF 933.3 IN 5TH PERIOD BEGIN IN 2ND
1000	GOAL 933.3 IN 5TH BEGIN 2ND
1000	GOAL 933.3 5TH BEGIN 2ND
1000	GOAL 933.3 5 B 2

(Notes on reserved characters.)

The minus sign (-) notes that the goal value is negative. The character "B" (Beginning in) has meaning between the period in which the goal is achieved and the beginning period value.

4. User supplied data

The planning item values may be inserted for any or all of the 12 planning periods. This method permits the planner to insert irregular or known data, integers or decimal numbers, into the appropriate periods of the planning horizon.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain the following term:

FREEFORM METHOD OF COMPUTATION (41–44 | 45–80)
DATA

The remaining portion of the FREEFORM METHOD OF COMPUTATION field is then used by the planner to insert period values, either integer or decimal numbers, into the appropriate planning periods. The comma (,) is used to separate planning period values. If no value is provided between commas, a zero is assumed for that period. If adequate space is not present in the FREEFORM METHOD OF COMPUTATION field on one line, the character "C" is used to continue the data to column 45 of the FREEFORM METHOD OF COMPUTATION field on the next line. The "C" may be inserted following a period value or a comma delimiter but must not be used to split a data item from one line to the next.

b. Optional elements

The base level value is not required. Negative period values may be specified by preceding the period value with a minus sign (-).

Examples:

(1) Insert the following values--base value 1.0.

Period 1 - 1.06	Period 7 - 1.08
Period 2 - 1.05	Period 8 - 1.09
Period 3 - 1.04	Period 9 - 1.09
Period 4 - 1.04	Period 10 - 1.10
Period 5 - 1.06	Period 11 - 1.09
Period 6 - 1.07	Period 12 - 1.08

BASE LEVEL (20–40)	FREEFORM METHOD OF COMPUTATION (41–44)	(45–80)
1.0	DATA	1.06, 1.05, 1.09, 1.09, 1.06, 1.07, C
		1.08, 1.09, 1.09, 1.1, 1.09, 1.08

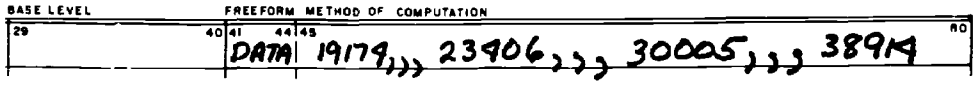
(2) Insert the following values--no base value.

Period 1 - 105	Period 7 - 0
Period 2 - 0	Period 8 - 141.9
Period 3 - 115.5	Period 9 - 150
Period 4 - 121.3	Period 10 - 163.2
Period 5 - 122	Period 11 - 0
Period 6 - 138	Period 12 - 170

BASE LEVEL (20–40)	FREEFORM METHOD OF COMPUTATION (41–44)	(45–80)
	DATA	105,, 115.5, 121.3, 122, 138, 0, C
		141.9, 150, 163.2,, 170

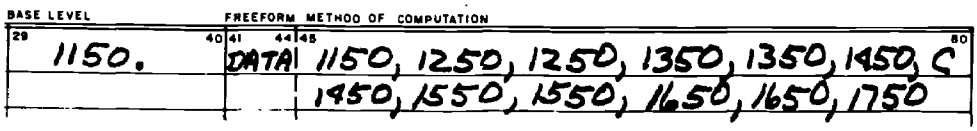
(3) Insert the following values--no base value.

Period 1 - 19174	Period 7 - 30005
Period 2 - 0	Period 8 - 0
Period 3 - 0	Period 9 - 0
Period 4 - 23406	Period 10 - 38914
Period 5 - 0	Period 11 - 0
Period 6 - 0	Period 12 - 0



(4) Insert the following values--base value 1150.

Period 1 - 1150	Period 7 - 1450
Period 2 - 1250	Period 8 - 1550
Period 3 - 1250	Period 9 - 1550
Period 4 - 1350	Period 10 - 1650
Period 5 - 1350	Period 11 - 1650
Period 6 - 1450	Period 12 - 1750



(Notes on reserved characters.)

The reserved characters for the DATA method are the comma ","--used to delimit or separate planning period values--and the character "C"--indicating a continuation of the data to the next card.

The range of the data to be inserted is ± 999 999 999 999.9999 .

B. Dependent Methods of Projections

The methods of generating dependent planning items are the most powerful means of model specification. The ten methods of dependent projection may be used to interrelate planning items in almost unlimited combinations.

1. Summation of other planning items

A planning item may be the summary of up to 15 other planning items. This method permits totals, subtotals, etc., to be pyramided. The summation planning item provides the appropriate summed values for each period in the planning horizon.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain the following term:

FREEFORM METHOD OF COMPUTATION	
41 44	45
SUM	

Note that column 44 must be blank.

The FREEFORM METHOD OF COMPUTATION field must contain the line numbers of the planning items to be summed. A total of up to 15 planning items line numbers, separated by a comma (,) may be summed.

b. Optional elements

Use of the BASE LEVEL field is optional. The planning item line numbers may be preceded by the character "L", for example L 14, L 19, L 29, etc. If the length of the FREEFORM METHOD OF COMPUTATION field is not sufficient to contain all of the line numbers, the character "C" may be used to continue the line numbers to the next data sheet format, beginning in Column 45.

Examples:

(1) Summation of lines 26, 84, 18, 39, and 45.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION	
29 40	41 44	45 80
1000.	SUM	OF LINES 26, 84, 19, 39, 45
1000	SUM	LINES 26, 84, 19, 39, 45
1000.	SUM	OF L26, L84, L19, L39, L 45
1000	SUM	26, 84, 19, 39, 45

(2) Summation of lines 2, 7, 12, 14, 15, 26, 31, 47, 86, 103.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION	
29 40	41 44	45 80
	SUM	OF LINES 2, 7, 12, 14, 15, 26, 31, C
		47, 86, 103
	SUM	L2, L7, L12, L14, L15, L26, L31, C
		L 47, L86, L103
	SUM	2, 7, 12, 14, 15, 26, 31, 47, 86, 103

(Notes on reserved characters.)

The comma "," and the character "C" have significance, the comma being the delimiter between line numbers, and the "C" indicating that additional lines are to be included in the sum and are specified in column 45 of the next card.

2. Shift, or shifted function, of a previous or future planning item value:

A planning item may be a shift, or shifted function, of another planning item which is shifted forward or backwards a specified number of periods along the planning horizon.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain the following term:

FREEFORM METHOD OF COMPUTATION		
41	44	45
SHIF		

The character "L" must be used, preceding the line number of the planning item which is to be shifted. The default option produces a shift of the specified planning item value one period forward, or to the right. The BASE LEVEL value, if present, is included in the shift.

b. Optional elements

The shifted values may reflect a planner specified function, i.e., a signed constant value times the value of the shifted line. The absence of a sign before the constant is understood to mean a positive factor, and a minus sign (-) indicates a negative multiplier. The constant value may be an integer or a decimal number.

For a shift of more than one period forward (right), or for a shift backward (left) of one or more periods, the reserved characters "F" or "B", or a term containing these characters may be used. These characters must be followed by an integer specifying the number of periods forward or backward that the planning item values are to be shifted. The use of the optional constant function with the "F" or "B" reserved characters is the same as with the one period forward shift.

Examples:

(1) Shift line 31 forward (right) one period.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1000.	SHIFT LINE 31
1000.	SHIFT L31
1000.	SHIF L 31

(2) Shift line 16 forward (right) 3 periods.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1000.	SHIFT LINE 16 FORWARD 3 PERIODS
1000	SHIFT L16 FORWARD 3 PERIODS
1000	SHIFT L16 FORWARD 3
1000	SHIF L16 F3

(3) Shift 0.75 times line 31 backward (left) 6 periods.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1000.	SHIFT .75 LINE 31 BACKWARD 6 PERIODS
1000.	SHIFT .75 L31 BACK 6 PERIODS
1000.	SHIFT .75 L31 BACK 6
1000.	SHIF .75 L31 B 6

(4) Shift 1.043 times line 86 forward (right) 2 periods.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1000.	SHIFT 1.043 LINE 86 FORWARD 2 PERIODS
1000.	SHIFT 1.043 L86 FORWARD 2 PERIODS
1000.	SHIFT 1.043 L86 FORWARD 2
1000	SHIF 1.043 L86 F 2

(Notes on reserved characters.)

The character "L" must be used preceding the line number, and between the planner specified constant and line number if that option is desired.

The minus (-) must be used with a constant if a negative constant is desired.

The "F" must be used if a shift forward of more than one period is desired, and must be between the line number and the integer specifying the number of periods to the right.

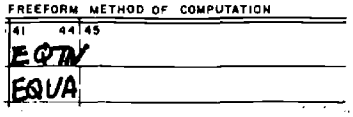
The "B" must be used if a shift backward is desired and must be between the line number and the integer specifying the number of periods to be shifted.

3. User supplied equation or function of other planning item values

A planning item may be a planner specified equation or function of up to four other planning items times optional constant values, in combinations of addition, subtraction, multiplication, division and exponentiation. Use of parentheses is permitted.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain one of the following terms:



The equation is specified to the planner, and it is developed through use of the following form:

$$C_1\ L_1 \left[\begin{pmatrix} + \\ - \\ * \\ / \\ ** \end{pmatrix}\right] C_2\ L_2 \left[\begin{pmatrix} + \\ - \\ * \\ / \\ ** \end{pmatrix}\right] C_3\ L_3 \left[\begin{pmatrix} + \\ - \\ * \\ / \\ ** \end{pmatrix}\right] C_4\ L_4$$

where C is the constant value,

L is the line number,

+ indicates addition,

- indicates subtraction,

* indicates multiplication,

/ indicates division,

and ** indicates exponentiation.

The hierarchy of operations in solving an equation is performed sequentially from left to right in the following order:

1st - C L, the implied multiplication of a constant times a line number.

2nd - ( ), the operation specified between parentheses.

3rd - **, exponentiation.

4th - * and /, multiplication and division.

5th - + and -, addition and subtraction.

Double nested parentheses, e.g., L 16 * (L 14 * (1.043 + L 19)) are not permitted. An implied multiplication before an expression in parentheses, e.g., 10 (L 71 - L 43) is not permitted.

b. Optional elements

Use of the BASE LEVEL field is optional. Base level values are not used in the specified operations. The character "C" may be used to continue the equation to column 45 of the next line of the data sheet.

Examples:

(1) Multiply line 71 by the sum of lines 84 and 86.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44	45–80)
1000.	EQTN	LINE 71 *(LINE 84 + LINE 86)
1000	EQTN	L 71 * (L84 + L86)
1000.	EQTN	L71*(L84+L86)

(2) Divide line 19 by line 6 and multipy the result by 1.005.

BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–44	45–80)
	EQTN	(LINE 19 / LINE 6) * 1.005
	EQTN	L 19 / L 6 * 1.005
	EQTN	L19/L6*1.005

(3) Multiply a constant of 94.32 by line 63 and subtract line 104 from the product.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	EQTN 94.32 * LINE 63 - LINE 104
	EQTN 94.32 LINE 63 - LINE 104
	EQTN 94.32 L63 - L 104

(4) Square the values of line 163.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	EQTN LINE 163 ** 2
	EQTN L163 ** 2
	EQTN L163**2

(Notes on reserved characters.)

The character "L" must precede a line number, and must separate the constant and the line number in an implied multiplication of a constant times a line.

Only three of the arithmetic operators, "+", "-", "*", "/", and "**" may be used in one equation statement.

The decimal "." may only be used in conjunction with a constant value.

The continuation indicator "C", if used, must be the last character on the data line. In using a continuation, the equation cannot be separated between the double asterisks "**" or between the character "L" and the line number.

4. Maximum or minimum of up to four other planning items and a constant:

A planning item may be the maximum or minimum of up to four other planning items and a given constant, period by period, across the planning horizon.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain one of the following terms:

FREEFORM METHOD OF COMPUTATION (41–44 / 45)	
MAXI	To produce the maximum.
MAX	
MINI	To produce the minimum.
MIN	

The balance of the FREEFORM METHOD OF COMPUTATION must contain at least two planning item line numbers, or one planning item line number and a constant value. The line numbers must be preceded by the character "L." The comma "," must be used to separate line numbers and/or the constant value.

b. Optional elements

Up to four line numbers may be compound. The optional constant value may be signed, and it may be an integer or a real number.

Examples:

(1) Maximum of lines 18, 27, 36, and 45.

BASE LEVEL (29)	FREEFORM METHOD OF COMPUTATION (41–44 / 45) (80)
	MAXImum OF L18, L27, L36, L45
	MAXI OF L18, L27, L36, L45
	MAX L18, L27, L36, L45

(2) Maximum of lines 26, 47, and a constant value of 2500.

BASE LEVEL (29)	FREEFORM METHOD OF COMPUTATION (41–44 / 45) (80)
	MAXImum OF L26, L47, 2500
	MAXI OF L26, L47, 2500
	MAX L26, L47, 2500

(3) Minimum of lines 104, 127, 139, 182.

BASE LEVEL (29)	FREEFORM METHOD OF COMPUTATION (41–44 / 45) (80)
	MINImum OF L104, L127, L139, L182
	MINI OF L104, L127, L139, L182
	MIN L104, L127, L139, L182

(4) Minimum of lines 206, 239, and a constant value of -14.63.

BASE LEVEL (29)	FREEFORM METHOD OF COMPUTATION (41–44 / 45) (80)
	MINImum OF L206, L239, -14.63
	MINI OF L206, L239, -14.63
	MIN L206, L239, -14.63

(Notes on reserved characters.)

The character "L" must precede all line numbers.

The comma "," must be used to separate line numbers and/or the constant value.

The minus "-" preceding the constant value indicates a negative number. The absence of the minus sign denotes a positive constant value.

5. Filling gaps in a specified data planning item or projecting another planning item

FILL A planning item may be the complete series which results from filling the gaps in data specified in another planning item.

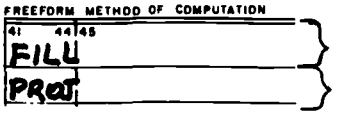
PROJECT A planning item may be the projection of another planning item, resulting in a linear forecast.

Both of these options use a technique of semi-averaging, in which input data are separated into two parts and the data averaged in each part. A trend line is then calculated between these two averages. Missing data in the FILL option are derived and corresponding values inserted in the planning periods. For PROJECT, the trend line values are extrapolated for the next 12 periods.

Special note: These methods are applicable only when the trend is linear or approximately linear!

a. Required elements

The first four positions in the FREEFORM METHOD OF COMPUTATION field must contain one of the following terms:



To fill in missing data.

To project data.

The FREEFORM METHOD OF COMPUTATION field must contain the line number of the planning item to be filled or projected.

b. Optional elements

Use of the BASE LEVEL field is optional. The character "L" may be used to precede the line number.

Examples:

(1) Fill missing data in line 73.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	FILL LINE 73
	FILL L73
	FILL 73

(2) Project data in line 106.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	PROJECT LINE 106
	PROJ LINE 106
	PROJ L 106
	PROJ 106

Notes: These methods develop a time series very similar to that resulting from use of a linear regression routine.

6. Accumulative sum or accumulative product of another planning item

A planning item may be the accumulative sum or product of the period values of another planning item across the planning horizon.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain one of the following terms:

FREEFORM METHOD OF COMPUTATION	
41 44 45	
ACCS	For accumulating the sum
ACCU ... S	
ACCP	For accumulating the product
ACCU ... P	

The FREEFORM METHOD OF COMPUTATION field must contain the required characters "S," indicating sum, or "P," indicating product, if the "ACCU" term is used.

The line number of the planning item must be present in the field.

b. Optional elements

Use of the BASE LEVEL field is optional. If values are present in the field of the planning item line being accumulated, they will be included in the computation. In using the accumulated product option, if no value is reflected in the BASE LEVEL field of the planning item line being accumulated, a value of one is inserted by the system.

The character "L" may be used to precede the line number.

Examples:

(1) Accumulate the sum of line 43.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	ACCUMULATE THE SUM OF LINE 43
	ACCUMULATE SUM LINE 43
	ACCU SUM L 43
	ACCS L43
	ACCS 43

(2) Accumulate the product of line 47.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	ACCUMULATE THE PRODUCT OF LINE 47
	ACCUMULATE PRODUCT LINE 47
	ACCU PRODUCT L47
	ACCP L47
	ACCP 47

(Notes on reserved characters.)

The "S" or "P" may either be included in the form "ACCS" or "ACCP" in columns 41-44, or they may be in any term in the FREEFORM METHOD OF COMPUTATION field.

7. Punch planning item line values

The planning items may be specified to be output on punched cards in the format of the user supplied DATA input. Up to 15 planning item lines may be specified. The resulting DATA cards are generated, using the specified line numbers with two period values per card.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain the following term:

FREEFORM METHOD OF COMPUTATION
41 44 45
PUNC

The FREEFORM METHOD OF COMPUTATION field must contain the line numbers of the planning item, lines to be punched, separated by a comma.

b. Optional elements

The BASE LEVEL field is optional, and if specified will be punched in the appropriate field in the output card.

The planner may specify that the planning items be given different line numbers by using the "AS" option. This instruction permits a statement such as:

FREEFORM METHOD OF COMPUTATION	
41 44 45	80
PUNCH LINES 3, 17, 24 AS 107, 141, 190	

This statement generates cards which contain the planning item terms and period values so that line 3 becomes line 107, line 17 becomes line 141, and line 24 becomes line 190. This capability is significant if the output from one model is to serve as input to another. In such a case, the line number of the data generated by the PUNC instruction in the first model is determined by its intended sequence in the second model. (There must be the same number of line numbers specified on each side of the "AS" term.)

The planning item line numbers may be preceded by the character "L." If the length of the field is not sufficient to contain all of the line numbers, the character "C" may be used to continue the data to column 45 of the next data line.

Examples:

(1) Punch lines 2, 3, 4, 5, 6, 7, 8, 9, and 10.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION	
29 40	41 44 45	80
	PUNCH LINES 2, 3, 4, 5, 6, 7, 8, 9, 10	
	PUNCH L2, L3, L4, L5, L6, L7, L8, L9, L10	
	PUNC 2, 3, 4, 5, 6, 7, 8, 9, 10	

(2) Punch lines 20, 22, 26, as lines 91, 107, 114.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	PUNCH LINES 20,22,26 AS LINES 91,107,119
	PUNCH L20,L22,L26 AS L91,L107,L119
	PUNCH 20,22,26 A 91,107,119

(3) Punch lines 109, 131, 146, 152, 180, as lines 31, 46, 16, 9, 71.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	PUNCH LINES 109,131,146,152,180 AS C
	LINES 31,46,16,9,71
	PUNCH L109,L131,L146,L152,L180 AS C
	L31,L46,L16,L9,L71
	PUNCH 109,131,146,152,180 A 31,46,16,9,71

(Notes on reserved characters.)

The comma "," is the delimiter between line numbers.

The character "C" indicates that the line numbers are continued, beginning in column 45 of the next card image.

The character "A" indicates that the line numbers are to be replaced by user specified sequence of line numbers following the "A."

8. Average of another planning item

A planning item may be the accumulated average of another planning item, computed period by period across the planning horizon.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain the following term:

FREEFORM METHOD OF COMPUTATION
41 44 45
AVER

The FREEFORM METHOD OF COMPUTATION field must also contain the line number of the planning item to be averaged.

b. Optional elements

Use of the BASE LEVEL field in the line to be averaged is optional. If a BASE LEVEL value is provided, this value will be included in the computation, developing an average based on 7 or 13 values (depending on whether there are six or twelve planning periods). If the BASE LEVEL value is not provided, the running average is based only on data contained in the actual planning periods.

The line number may be preceded by the character "L".

Examples:

Running average of line 17.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29	AVERAGE OF LINE 17
	AVERAGE OF L17
	AVER L17
	AVER 17

9. Plot of up to four planning items

A printer plot of up to four planning items may be specified. The plot is developed with the vertical axis at zero or a self-scaling feature may be specified which has the effect of shifting the plot toward the vertical axis. Negative numbers in a planning item can be included in a printer plot by use of the self-scaling feature.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain the following term:

FREEFORM METHOD OF COMPUTATION
PLOT

The FREEFORM METHOD OF COMPUTATION FIELD must contain the line numbers of the planning item lines to be plotted, specified as integers. A maximum of four planning item line numbers may be plotted and must be separated by a comma "," in the FREEFORM METHOD OF COMPUTATION field.

b. Optional elements

The reserved character "S," or a term containing that character, may be specified by the planner to note that the actual value of negative numbers is to be reflected or that the vertical axis is to have a value other than zero. The "S" indicates that self-scaling is to be generated by the system.

The planning item line numbers may be preceded by the character "L".

Examples:

(1) Plot line 14, line 15, and line 16.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	PLOT LINE 14, LINE 15, LINE 16
	PLOT L14, L15, L16
	PLOT 14,15, 16

(2) Plot line 27, line 43, line 12, and line 91 using the self-scaling feature.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	PLOT LINES 27,43, 12, 91 SELF SCALING
	PLOT L27, L43, L12, L91 S
	PLOT 27, 43, 12, 91 S

(Notes on reserved characters.)

The comma "," and the character "S" have significance, the comma being the delimiter between line numbers and the "S" indicating that the self-scaling feature is desired.

10. Return on investment

A planning item may be the percentage return on investment which would result from a cash flow represented in another planning item line.

a. Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain one of the following terms:

FREEFORM METHOD OF COMPUTATION
41 44 45
RETU
ROI

The FREEFORM METHOD OF COMPUTATION field must also contain:

- An integer indicating the number of periods over which the return on investment is to be calculated; (the number of periods cannot exceed the number of planning periods defined in the Plan Identification Card.)

- The line number of the cash flow planning item for which the return on investment is to be calculated;

- A character "B" or a term containing that character and an integer specifying the period in which the return on investment calculation is to begin. The "B" must appear after the line number and prior to the integer specifying the beginning period. If the base period is to be included, this integer should be zero.

If the values of the cash flow line do not contain at least one negative value and one positive value, the number "-9999.99" will appear in each period of the resulting return on investment line, indicating invalid input.

Examples:

(1) Return on investment over 12 years on line 73.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	RETURN OVER 12 PERIODS LINE 73 BEGIN 1ST
	RETURN 12 PERIODS L73 BEGIN 1
	RETU 12 L73 B1
	ROI 12 73 B1

(2) Return on investment over 9 periods for line 87 beginning in the second period.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION
29 40	41 44 45 80
	RETURN OVER 9 PERIODS LINE 87 BEGIN 2ND
	RETURN 9 PERIODS L87 BEGIN 2
	RETU 9 L87 B2
	ROI 9 87 B2

(Notes on reserved characters.)

The sequence of characters must be as follows:

First - an integer showing the number of periods over which the computation is to be calculated;

Second - an integer showing the line number or the planning item for which the computation is to be made;

Third - the character "B" or a term containing "B";

Fourth - an integer showing the planning period in which the computation is to begin.

C. Headings or Section Titles

In addition to the independent and dependent methods of projection, there is the capability of separating report sections with headings or section titles.

Required elements

The first four positions of the FREEFORM METHOD OF COMPUTATION field must contain blanks or the following term:

FREEFORM METHOD OF COMPUTATION (41 44 45)
HEAD

This instruction places the data contained in the PLANNING ITEM field in the center of the report output. The heading or section title planning item is referenced in a Summary Report input format (see type 4 below) by specifying the line number of the planning item containing the heading or section title.

Examples:

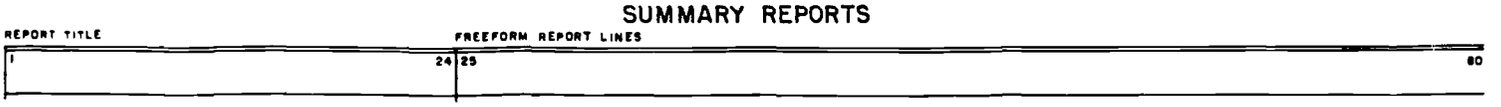
A heading with a title of "SAMPLE OF HEADING USE" and line number 123.

LINE NO (1 4)	PLANNING ITEM (5 28)	BASE LEVEL (29 40)	FREEFORM METHOD OF COMPUTATION (41 44 45) (80)
123	SAMPLE OF HEADING USE		HEAD

IV. Type 4 - SUMMARY REPORT INPUT

The SUMMARY REPORT input is used to specify a summary report title, the individual planning items to be contained in that report, and optionally, the scale of the period values to be printed.

A sample of the summary report input format is shown below:



The format consists of two fields with the following designations:

Field 1 - Columns 1-24, REPORT TITLE. Contains a title, provided by the planner that is to appear on the report. Any characters--alphabetic, numeric, or special--are permitted.

Field 2 - Columns 25-90, FREEFORM REPORT LINES. Contains the scale factors (optional) and the line numbers of the planning items that are to be included in the summary report.

A. Required elements

The FREEFORM REPORT LINES field must contain the line numbers of the planning items, reflected as integers, and separated by a comma.

B. Optional elements

If the FREEFORM REPORT LINES field is not adequate to contain all of the line numbers, the character "C" may be used to continue the report data to column 25 of the next line of the SUMMARY REPORT format.

Two line numbers may be separated by a hyphen "-" to indicate that all lines between and including the lines specified are to be printed in the report.

In generating summary reports the planner also has the option to introduce one or more line spaces between planning items included in the report. To exercise this option a line number is specified in the report which was not previously assigned to any planning item in the model. The "spacing" line number is listed each time the printer is to skip a line in the summary report. There is no limit to the number of times that the same line may be used so that only one line of the model need be reserved as the "spacing" line.

The character "S" is reserved. It indicates that the number immediately following specifies the scaling factor used on the values printed in the report. If this option is desired, the "S" must be the first entry in the FREEFORM REPORT LINES field, with the meaning of the control number as follows:

S0 - Prints real numbers with two decimal places;

S1 - Prints integers rounded;

S10 - Divides each value by 10, rounds the result, and prints integers;

S100 - Divides each value by 100, rounds the results, and prints integers;

S1000 - Divides each value by 1000, rounds the result, and prints integers.

The default option, i.e., no use of the "S" character, generates numbers with two decimal place accuracy if all values of a planning item are less than 1,000,000. If any value exceeds 1,000,000 the planning item values will be integer.

The planning item line numbers may be preceded by the character "L."

Examples:

a. A summary report entitled "Basic Organization" to consist of lines 10, 32, and 89 through 94 with the values in these planning items to be expressed in hundreds.

REPORT TITLE	FREEFORM REPORT LINES
BASIC ORGANIZATION	S100,L10,L32,L89,L90,L91,L92,L93,L99
	S100,10,32,89,90,91,92,93,94
	S100,10,32,89-94

b. The same report as described in Example a, above, but with a blank line appearing between lines 10 and 32 and between 32 and 89 (line 9 having been previously reserved as the "blank" line).

REPORT TITLE	FREEFORM REPORT LINES
BASIC ORGANIZATION	S100,10,9,32,9,89-94

CHAPTER 4

PLANTRAN II EXERCISES

The objective of these planning exercises is to provide the knowledge and skills required to design and manipulate models using the PLANTRAN II modeling language.

Sample exercises are provided to demonstrate the techniques used to identify the model, to provide columnar headings, to specify the model assumptions and relationships, and to generate the summary reports. Attention to the details of each of the input types will enable one to readily understand the planning language concept and will aid in creating more meaningful models.

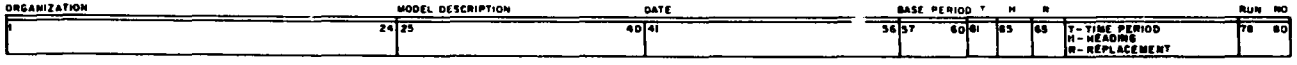
The exercises include examples of each PLANTRAN II input format and all methods of computation or input specification. These exercises are divided into two sections: Section A presents the basic requirements for each input type; and Section B demonstrates the full capability of the various input types.

The types of model specifications for a given planning item are flexible, varying from English-like statements to an abbreviated code. Initially, the English-like statements as shown in these examples should be used to facilitate the learning process. As familarization with the modeling language develops, the model specification statements will naturally be abtreviated.

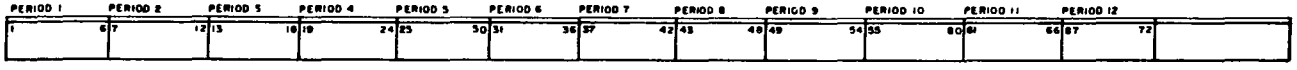
The answers to the exercises are found on the page following the individual exercise. Note that not all the possible answers are provided; only a sample of the various data input that will generate the correct identification, columnar heading, model specification, or summary report is shown. In addition, a sample system output relating to the exercise is provided beneath the sample answer.

THE PLANTRAN II INPUT FORMAT:

IDENTIFICATION

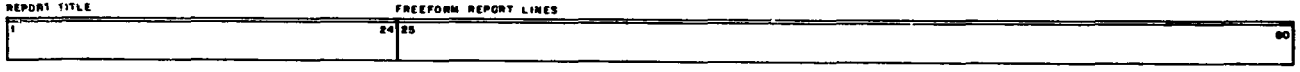


COLUMNAR HEADINGS - OPTIONAL



MODEL SPECIFICATION

SUMMARY REPORTS



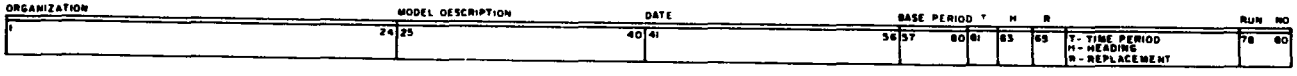
* *

SECTION A, BASIC PLANTRAN II EXERCISES

* *

EXERCISE 1-A

Using the Identification input format (below), provide the input data for: SAMPLE UNIVERSITY as the name of the organization; BUDGET PROJECT as the model description; the current date; 1971 as the base period; a twelve period planning horizon; and a run number of one.



ORGANIZATION	MODEL DESCRIPTION	DATE	BASE PERIOD	T	H	R		RUN NO.
SAMPLE UNIVERSITY	BUDGET PROJECT	CURRENT DATE	1971				T - TIME PERIOD H - HEADING R - REPLACEMENT	001

SAMPLE UNIVERSITY
BUDGET PROJECT

ANSWER TO EXERCISE 1-A

CURRENT DATE
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983

* *

EXERCISE 2-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 20; a planning item name of FEES IN-STATE UNDERGRAD; a base level of 405; and to be increased by 20 each period.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1 4	5 28	29 40	41 44 45 80

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
20	FEES INSTATE UNDERGRAD	405.	INCREASE BY 20 PER PERIOD

ANSWER TO EXERCISE 2-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
20	FEES INSTATE UNDERGRAD	425.00	445.00	465.00	485.00	505.00	525.00	545.00	565.00	585.00	605.00	625.00	645.00

* *

EXERCISE 3-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 30; a planning item name of AVE SALARY UNDERGRAD FAC; a base level of 12389; and to be increased by 6 percent per period.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
30	AVE SALARY UNDERGRAD FAC	12389.	PERCENT INCREASE OF 6 PERCENT PER PERIOD

ANSWER TO EXERCISE 3-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
30	AVE SALARY UNDERGRAD FAC	13132.34	13920.28	14755.50	15640.83	16579.28	17574.03	18628.48	19746.18	20930.95	22186.81	23518.02	24929.10

* *

EXERCISE 4-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 40; a planning item name of SPONSORED RESEARCH; a base level of 800900; and a goal of 5[illegible], to be achieved in the third planning period.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1 4	5 28	29 40	41 44 45 80

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
40	SPONSORED RESEARCH	800900.	GOAL OF 500000 IN 3RD PERIOD

ANSWER TO EXERCISE 4-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
40	SPONSORED RESEARCH	700600.00	600300.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00

* *

EXERCISE 5-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 3; a planning item name of NO BIRTHS 18 YRS AGO; and data to be inserted as follows:

period 1 -- 92309
period 2 -- 94600
period 3 -- 95776
period 4 -- 98142
period 5 -- 98687
period 6 -- 98548
period 7 -- 98748
period 8 -- 98201
period 9 -- 97575
period 10 -- 96865
period 11 -- 94821
period 12 -- 91474

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
3	NO BIRTHS 18 YRS AGO		DATA 92309,94600,95776,98142,98687,C
			98548,98748,98201,97575,96865,C
			94821,92474

ANSWER TO EXERCISE 5-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
3	NO BIRTHS 18 YRS AGO	92309.00	94600.00	95776.00	98142.00	98687.00	98548.00	98748.00	98201.00	97575.00	96865.00	94821.00	92474.00

EXERCISE 6-A

Using the Model Specification input format (below), provide the input data to create a planning item with a line number of 48; a planning item name of INSTRUCTION/DEPT RESEAP; and specify that this line is to be the sum of lines 31, 32, and 33.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
48	INSTRUCTION/DEPT RESEAR		SUM OF LINES 51, 52, 53

ANSWER TO EXERCISE 6-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
48	INSTRUCTION/DEPT RESEAR	25148428	27666239	30527890	34189903	38349212	42812115	47692293	52905026	58537102	64666845	71103567	77871363
51	FAC SALARIES TOTAL	16995136	18836953	20938676	23559027	26497406	29642963	33080375	36741404	40689411	44980890	49464960	54155536
52	SUPPORT STAFF	7253292	7929286	8689214	9676876	10840566	12097238	13475689	14959219	16571024	18332688	20204144	22195296
53	SUPPORT NON-STAFF	900000	900000	900000	954000	1011240	1071914	1136229	1204403	1276667	1353267	1434463	1520531

* *

EXERCISE 7-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 8; a planning item name of SOPHOMORES, a base level value of 3240; and values for each planning period to be determined by taking .80 times line 7, shifted one period to the right.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
8	SOPHOMORES	3240.	SHIFT .80 LINE 7

ANSWER TO EXERCISE 7-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
8	SOPHOMORES	3456.80	3954.51	4255.29	4557.59	4929.86	5222.51	5484.19	5769.05	6013.43	6253.77	6488.98	6630.83
7	FRESHMEN	4943.14	5319.11	5696.99	6162.33	6528.14	6855.23	7211.31	7516.79	7817.21	8111.22	8288.53	8428.07

* *

EXERCISE 8-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 34; a planning item name of INSTATE; and values in each planning period to be determined by adding the product of lines 11 and 20 to the product of lines 14 and 22.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
34	INSTATE		EQTN L11 * L20 + L14 * L22

ANSWER TO EXERCISE 8-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
34	INSTATE	6113696	6856564	7691653	8664638	9554906	10449863	11379651	12300068	13229592	14181157	15076036	15911770
11	TOTAL INSTATE UNDER GRAD	12116.94	13097.30	14191.66	15408.53	16490.41	17496.76	18491.13	19396.50	20253.53	21088.33	21777.02	22329.32
20	FEES INSTATE UNDERGRAD	425.00	445.00	465.00	485.00	505.00	525.00	545.00	565.00	585.00	605.00	625.00	645.00
14	INSTATE GRADUATE	1928.00	1928.00	1928.00	1985.84	2045.42	2106.78	2169.98	2235.08	2302.13	2371.20	2442.33	2515.60
22	FEES INSTATE GRADUATE	500.00	533.33	566.67	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00

* *

EXERCISE 9-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 98; a planning item name of IDEAL AVE UNDERG FEE; and values in each planning period to be determined by taking the maximum of lines 35 and 94.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
96	IDEAL AVE UNDERG FEE		MAXIMUM OF L94, L95

ANSWER TO EXERCISE 9-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
96	IDEAL AVE UNDERG FEE	519.44	545.65	605.84	599.58	627.36	655.72	689.31	743.57	810.27	889.34	987.14	1105.29
95	BALANCED BUDGET UNDG FEE	440.50	532.31	605.84	596.00	616.42	648.12	689.31	743.57	810.27	889.34	987.14	1105.29
94	AVE UNDERGRAD FEE	519.44	545.65	572.36	599.58	627.36	655.72	684.70	714.34	744.68	775.76	807.62	840.31

* *

EXERCISE 10-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 92; a planning item name of SAMPLES SHARE 1960-1971; and the following data to appear in the respective planning periods - 4.5, 4.5, 5.3, 0, 6.7, 6.3, 7.7, 0, 8.6, 9, 9.3, 9.5.

Again using the Model Specification input format, provide the input data to create a planning item with: a line number of 6; a planning item name of SAMPLES SHARE 1960-1971; and values to be identical to those in line 92 except that the missing elements are filled in. Using the Model Specification input format, provide the input data to create a planning item with: a line number of 5; a planning item name of SAMPLES SHARE; and the values in each planning period to be based on a projection of the data trend in line 6.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
92	SAMPLE'S SHARE 1960-1971		DATA 4.5, 4.5, 5.3, 0, 6.7, 6.3, 7.7, 0, 8.6, C
			9, 9.3, 9.5
6	SAMPLES SHARE 1960-1971		FILL LINE 92
5	SAMPLE'S SHARE		PROJECT LINE 6

ANSWER TO EXERCISE 10-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
92	SAMPLE'S SHARE 1960-1971	4.50	4.50	5.30	0.0	6.70	6.30	7.70	0.0	8.60	9.00	9.30	9.5
6	SAMPLES SHARE 1960-1971	4.50	4.50	5.30	5.77	6.70	6.30	7.70	7.87	8.60	9.00	9.30	9.50
5	SAMPLE'S SHARE	10.50	11.02	11.55	12.07	12.60	13.12	13.65	14.17	14.70	15.22	15.75	16.27

* *

EXERCISE 11-A

Using the Model Specification input format (below), provide the input data to create a planning item with a line number of 66; a planning item name of ACCUM SURPLUS/DFFICIT; and the values in each planning period to be the accumulative sum of the data in line 65.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1 4	5 28	29 40	41 44 45 80

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
66	ACCUM SURPLUS/DEFICIT		ACCUMULATE THE SUM OF LINE 65

ANSWER TO EXERCISE 11-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
66	ACCUM SURPLUS/DEFICIT	1061744	1255744	728208	789488	989728	1137392	1042720	413408	-1061200	-3719968	-8059408	-14627168
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760

* *

EXERCISE 12-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 100; a planning item name of COMPOUND CHANGE; and the values in each planning period to be the accumulative product of the data in line 101.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
100	COMPOUND CHANGE		ACCUMULATE THE PRODUCT OF LINE 101

ANSWER TO EXERCISE 12-A

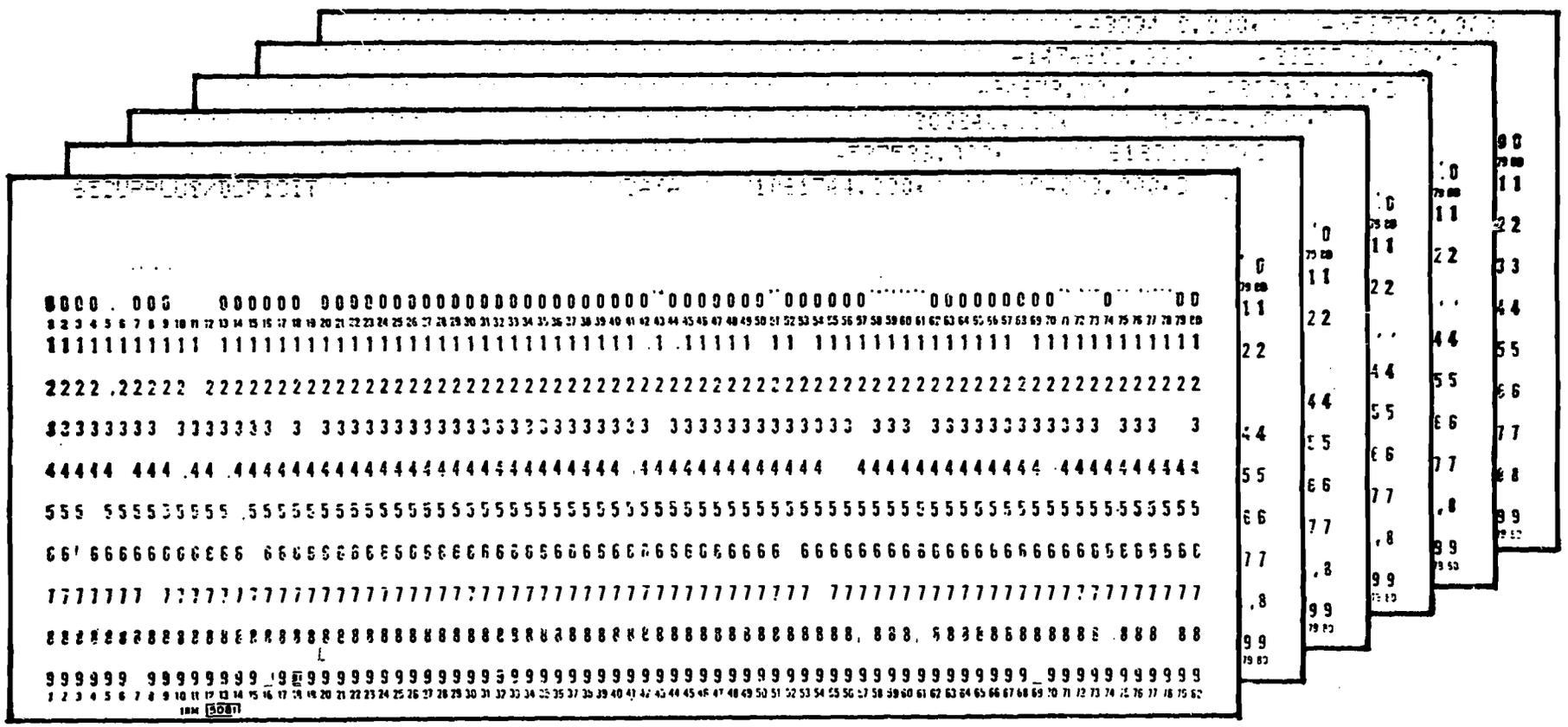
LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
100	COMPOUND CHANGE	1.04	1.10	1.14	1.17	1.25	1.28	1.31	1.37	1.38	1.49	1.66	1.67
101	WORK	1.04	1.06	1.03	1.03	1.07	1.02	1.03	1.04	1.01	1.08	1.11	1.01

* *

EXERCISE 13-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 97; no planning item name; and which generates punched data cards with the same line number, planning item name, and period values as those in line 65.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION



LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
97			PUNCH LINE 65

ANSWER TO EXERCISE 13-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
97		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760

* *

EXERCISE 14-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 99; a planning item name of AVE SURPLUS/DEFICIT; and the values in each planning period to be the running average of line 65.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
99	AVE SURPLUS/DEFICIT		AVERAGE OF LINE 65

ANSWER TO EXERCISE 14-A

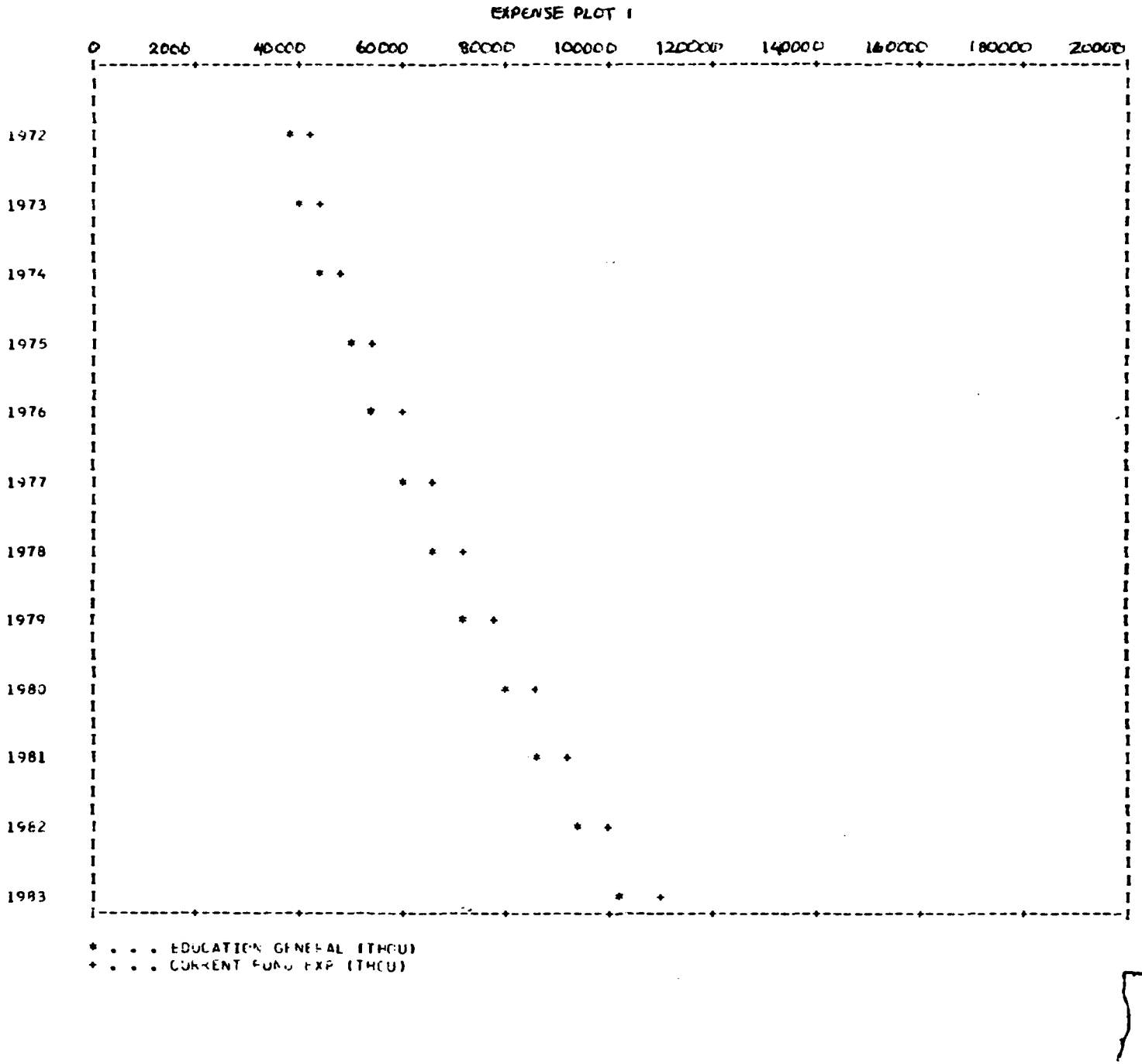
LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
99	AVE SURPLUS/DEFICIT	1061744	627872	242736	197372	197946	189565	148960	51676	-117911	-371997	-732673	-1218930
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760

* *

EXERCISE 15-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 69; a planning item name of EXPENSE PLOT I; and the output to be a printer plot of the planning period values of lines 74 and 77.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION


EXPENSE PLOT 1
0
20000
40000
60000
80000
100000
120000
140000
160000
180000
200000
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
* . . . EDUCATION GENERAL (THOU)
+ . . . CURRENT FUND EXP (THOU)

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
69	EXPENSE PLOT I		PLOT LINE 74, 77

ANSWER TO EXERCISE 15-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
69	EXPENSE PLOT I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
74	EDUCATION GENERAL (THOU)	37584.65	40821.66	44483.63	49192.21	54417.89	59963.01	65974.38	72333.88	79151.19	86522.00	94195.94	102203.75
77	CURRENT FUND EXP (THOU)	41237.82	44748.85	48716.83	53787.04	59335.77	65189.87	71511.88	78163.81	85265.44	92918.88	100841.31	109065.00

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EXERCISE 16-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 181; a planning item name of AFTER TAX DISC YIELD; the planning item value to be the 12 year return on investment calculated from the cash flow represented in line 173.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
181	AFTER TAX DISC YIELD		RETURN OVER 12 PERIODS L173

ANSWER TO EXERCISE 16-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
181	AFTER TAX DISC YIELD	3.36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
173	PROFIT	-1710004	46953	148525	188407	195649	203199	211027	219099	227377	186396	244383	253015

* *

EXERCISE 17-A

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 1; a planning item name of UNDERGRAD FTE ENROLLMENT; and which will provide a heading.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1	UNDERGRAD FTE ENROLLMENT		HEADING

ANSWER TO EXERCISE 17-A

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	UNDERGRAD FTE ENROLLMENT												

* *

EXERCISE 18-A

Using the Summary Report input format (below), provide the input data to create a summary report entitled SURPLUS/DEFICIT, and which consists of planning item lines 85, 86, 87, 88, and 89.

REPORT TITLE	FREEFORM REPORT LINES

REPORT TITLE	FREEFORM REPORT LINES
SURPLUS/DEFICIT	65, 66, 87, 88, 99

RELATED TO EXERCISE 1B-A

SURPLUS/DEFICIT

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-529312	-1474608	-2658768	-4339440	-6567760
66	ACCUM SURPLUS/DEFICIT	1061744	1255744	728208	789488	989728	1137392	1042720	413408	-1061200	-3719968	-8059408	-14627168
87	SUR/DEF PER UNDERGRAD		78.94	13.34	-33.49	3.58	10.94	7.60	-4.61	-29.23	-65.59	-113.58	-179.52	-264.98
88	SUR/DEF PER STUDENT		67.08	11.50	-29.26	3.16	9.70	6.76	-4.12	-26.15	-58.79	-101.95	-161.23	-237.95
99	AVE SURPLUS/DEFICIT	1061744	627872	242736	197372	197946	189565	148960	51676	-117911	-371997	-732673	-1215933

* *

SECTION B, EXPANDED CAPABILITY PLANTRAN II EXERCISES

* *

EXERCISE 1-B

Using the Identification input format and the Columnar Headings input format (below), provide the input data for: SAMPLE UNIVERSITY as the name of the organization; CASH FLOW as the model description; the current date; a value of zero in the base period; a twelve month planning horizon; columnar headings to be provided; a run number of two; and columnar headings of JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, and DEC.

ORGANIZATION	MODEL DESCRIPTION	DATE	BASE PERIOD	T	H	R		RUN NO.
1 24	25 40	41 56	57 60	61	63	65	T = TIME PERIOD H = HEADING R = REPLACEMENT	78 80

PERIOD 1	PERIOD 2	PERIOD 3	PERIOD 4	PERIOD 5	PERIOD 6	PERIOD 7	PERIOD 8	PERIOD 9	PERIOD 10	PERIOD 11	PERIOD 12	
1 6	7 12	13 18	19 24	25 30	31 36	37 42	43 48	49 54	55 60	61 66	67 72	

ORGANIZATION	MODEL DESCRIPTION	DATE	BASE PERIOD			
SAMPLE UNIVERSITY	CASH FLOW	CURRENT DATE	0	H	T - TIME PERIOD H - HEADING R - REPLACEMENT	2

PERIOD 1	PERIOD 2	PERIOD 3	PERIOD 4	PERIOD 5	PERIOD 6	PERIOD 7	PERIOD 8	PERIOD 9	PERIOD 10	PERIOD 11	PERIOD 12
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

ANSWER TO EXERCISE 1-B

SAMPLE UNIVERSITY
CASH FLOW

CURRENT DATE
PAGE 2

LINE NO.	PLANNING ITEM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

* *

EXERCISE 2-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 14; a planning item name of INSTATE GRADUATE; a base level of 1500; and to be increased 2.5 percent each period beginning in the fourth period.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1 4	5 28	29 40	41 44 45 80

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
14	INSTATE GRADUATE	1928.	PERCENT INCREASE OF 3% BEGIN 4TH

ANSWER TO EXERCISE 2-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
14	INSTATE GRADUATE	1928.00	1928.00	1928.00	1985.84	2045.42	2106.78	2169.98	2235.08	2302.13	2371.20	2442.33	2515.60

* *

EXERCISE 3-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 4; a planning item name of COLLEGE ATTENDANCE RATE; a base level of 51; and to be increased by an increment of .5 per period beginning in period 3.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
4	COLLEGE ATTENDANCE RATE	51.	INCREASE .5 PER PERIOD BEGIN IN 3RD

ANSWER TO EXERCISE 3-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
4	COLLEGE ATTENDANCE RATE	51.00	51.00	51.50	52.00	52.50	53.00	53.50	54.00	54.50	55.00	55.50	56.00

* *

EXERCISE 4-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 22; a planning item name of FEES IN-STATE GRADUATE; a base level of 500; and a goal of 600 to be achieved in period 4, beginning in the 2nd period.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
22	FEES IN-STATE GRADUATE	500.	GOAU OF 600 IN PERIOD 4 BEGIN IN 2ND

ANSWER TO EXERCISE 4-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
22	FEES INSTATE GRADUATE	500.00	533.33	566.67	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00

* *

EXERCISE 5-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 92; a planning item name of SAMPLES SHARE 1960-1971; and data to be inserted in each planning period as follows -- 4.5, 4.5, 5.3, 0, 6.7, 6.3, 7.7, 0, 8.6, 9, 3.3, 9.5.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
92	SAMPLE'S SHARE 1960-1971		DATA 4.5, 4.5, 5.3, 0, 6.7, 6.3, 7.7, C
			0, 8.6, 9, 9.3, 9.5

ANSWER TO EXERCISE 5-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
92	SAMPLE'S SHARE 1960-1971	4.50	4.50	5.30	0.0	6.70	6.30	7.70	0.0	8.60	9.00	9.30	9.50

* *

EXERCISE 6-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 61; a planning item name of EDUCATIONAL & GENERAL EXPENSE; and an indication that this line is to be the sum of lines 48, 54, 55, 56, 57, 58, 59, and 60.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
61	EDUCATION & GENERAL EXP		SUM OF LINES 48, 54, 55, 56, 57, 58, C 59, 60

ANSWER TO EXERCISE 6-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
61	EDUCATION & GENERAL EXP	37584666	40821670	44483634	49192209	54417895	59963015	65974412	72333918	79151247	86522008	94195986	102203769
48	INSTRUCTION/DEPT RESEAR	25148428	27666239	30527890	34189903	38349212	42812115	47692293	52905026	58537102	64666845	71103567	77871363
54	SPONSORED RESEARCH	700600.00	600300.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00
55	EXTENSION/PUBLIC SERVICE	350000.00	400000.00	450000.00	500000.00	550000.00	600000.00	650000.00	700000.00	750000.00	800000.00	850000.00	900000.00
56	LIBRARY	2619899	2866650	3147787	3518987	3939918	4391209	4884227	5410500	5978706	6596[illegible]	7245352	7927133
57	STUDENT SERVICES	4272739	4594201	4953620	5359622	5815846	6067097	6404542	6712541	7004637	7289533	7525980	7717221
58	OPERATION & MAINTENANCE	2438000	2584280	2739337	2903697	3077919	3262594	3458350	3665851	3885802	4118950	4366087	4628052
59	GENERAL ADMINISTRATION	1955000	2010000	2065000	2120000	2175000	2230000	2285000	2340000	2395000	2450000	2505000	2560000
60	GENERAL INSTITUTIONAL	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00

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EXERCISE 7-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 105; a planning item name of LIBRARY EXP 12-YEAR BASE; to be determined by taking line 140, shifted back ard 11 periods.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
105	LIBRARY EXP 12-YEAR BASE		SHIFT LINE 149 BACK 11 PERIODS

ANSWER TO EXERCISE 7-8

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
105	LIBRARY EXP 12-YEAR BASE	4662250	0	0	0	0	0	0	0	0	0	0	0
149	LIBRARY EXP 12-YEAR AVE	2619899	1453274	2018112	2393330	2702648	2984074	3255524	3524890	3797541	4077454	4365444	4662725

* *

EXERCISE 8-B

Using the Model Specification input format (below) provide the input data to create a planning item with: a line number of 164; a planning tiem name of NUMBER OF YEARS; a base value of 0; and an instruction to increment the base value by 1 each period.

Using the same input format, provide the input data to create a planning item with: a line number of 165; a planning item name of YEARLY VALUE; and an instruction to calculate the yearly value of $1,000 invested at compounded interest rate of 9 percent using line 164 and the formula

$$\text{YEARLY VALUE} = 1000\ (1 + i)^{n}.$$

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
164	NUMBER OF YEARS	0	INCREASE BY 1 PER PERIOD
166	YEARLY VALUE		EQTN 1000 * (1+.09) ** L164

ANSWER TO EXERCISE 8-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
164	NUMBER OF YEARS	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00
166	YEARLY VALUE	1090.00	1188.10	1295.03	1411.58	1538.62	1677.09	1828.03	1992.55	2171.88	2367.35	2580.41	2812.64

* *

EXERCISE 9-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 100; a planning item name of RESIDENCE HALL FEE; and planning period values to be determined by taking the maximum lf lines 101 and 150 and the constant value 400.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
100	RESIDENCE HALL FEE		MAXIMUM OF L101, L150, AND 400

ANSWER TO EXERCISE 9-B

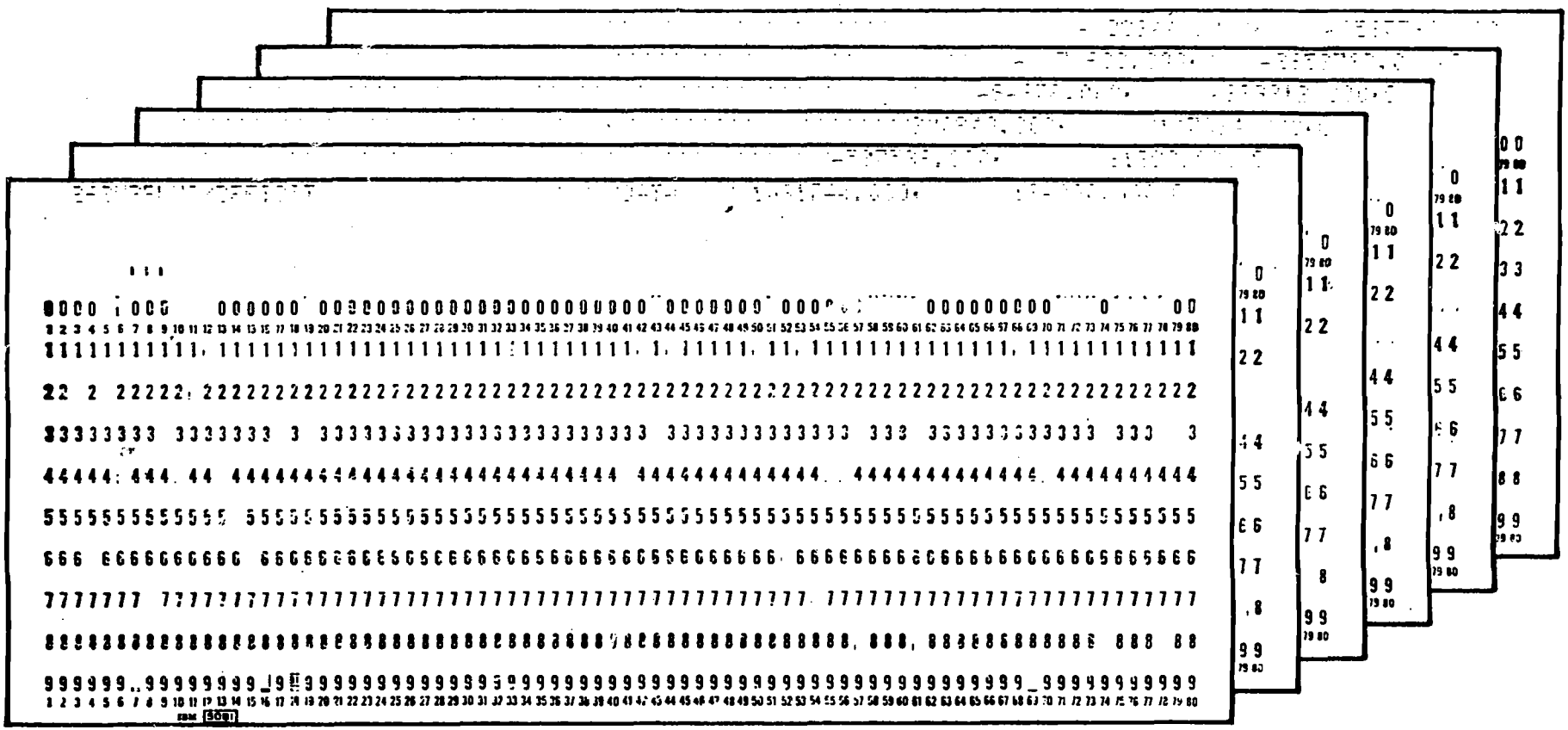
LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	198	19 1	19 2	19 3
100	RESIDENCE HALL FEE	550.00	530.00	450.00	400.00	420.00	460.00	500.00	490.00	500.00	420.00	400.00	405.00
101	RESIDENCE HALL FEE-1	290.00	300.00	350.00	360.00	420.00	460.00	500.00	470.00	430.00	405.00	390.00	3[illegible]
150	RESIDENCE HALL FEE-2	550.00	530.00	450.00	390.00	380.00	400.00	480.00	490.00	500.00	420.00	397.00	405.00

* *

EXERCISE 10-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 98; no planning item name; and instructions to generate a punched data card that contains the same planning item name and period values as line 65 but has a line number of 26.

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION



LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
98			PUNCH LINE 65 AS LINE 26

ANSWER TO EXERCISE 10-8

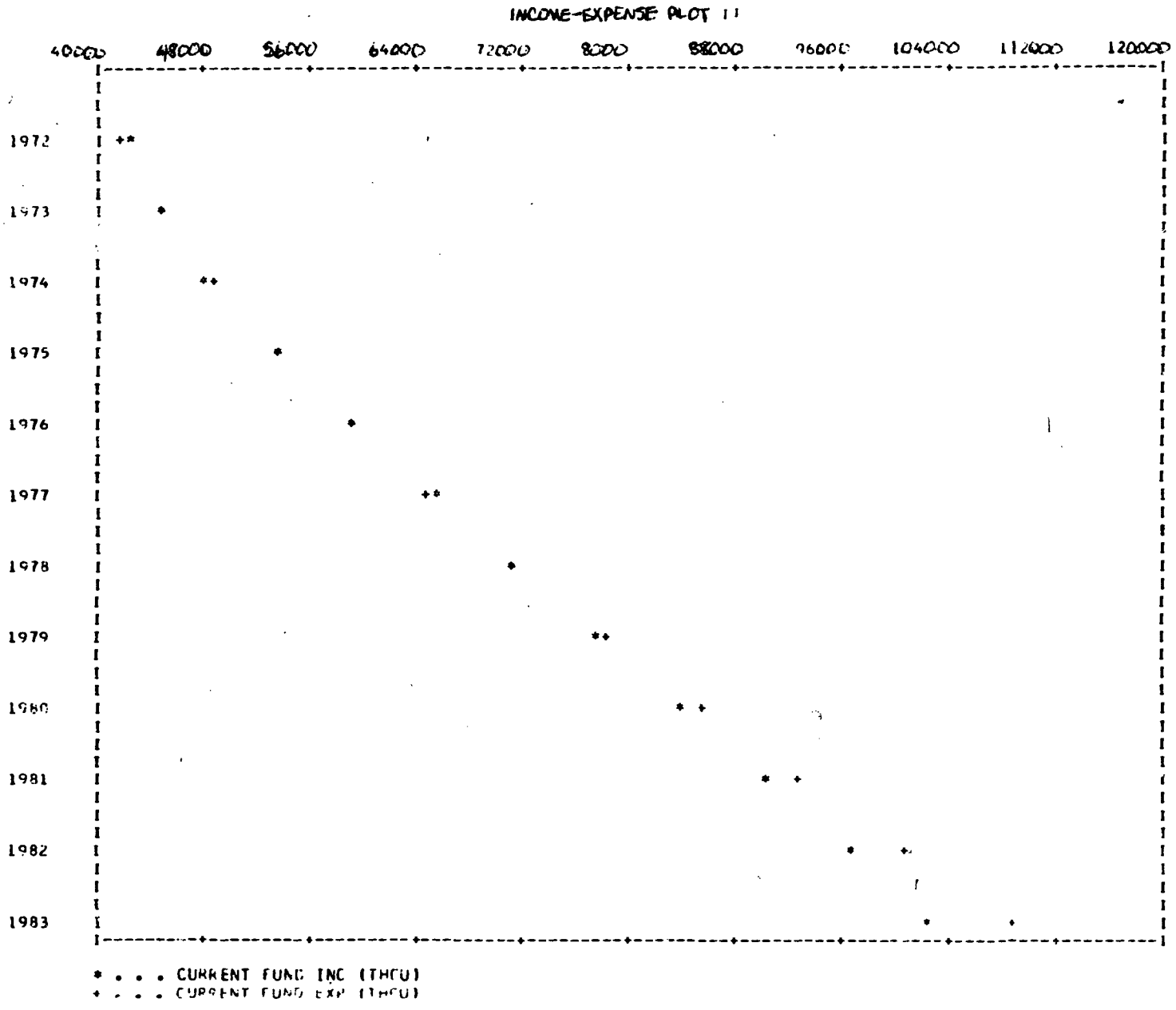
LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
98		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760

* *

EXERCISE 11-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 68; a planning item name of INCOME-EXPENSE PLOT II; and instructions for a printer plot of lines 73 and 77 to be generated using the self scaling feature.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION


INCOME-EXPENSE PLOT 11
40000
48000
56000
64000
72000
80000
88000
96000
104000
112000
120000
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
* . . . CURRENT FUND INC (THOU)
+ . . . CURRENT FUND EXP (THOU)

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
68	INCOME-EXPENSE PLOT II		PLOT LINE 73, LINE 77 SELF SCALING

ANSWER TO EXERCISE 11-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
68	INCOME-EXPENSE PLOT II	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	CURRENT FUND INC (THOU)	42299.57	44942.85	48189.29	53844.32	59536.02	65337.54	71417.19	77534.50	83790.88	90260.13	96501.88	102497.19
77	CURRENT FUND EXP (THOU)	41237.82	44748.85	46716.83	53787.04	59335.77	65189.87	71511.88	78163.81	85265.44	92918.88	100841.31	109065.00

* *

EXERCISE 12-B

Using the Model Specification input format (below), provide the input data to create a planning item with: a line number of 181; a planning item name of AFTER TAX DISC YIELD; and an instruction to calculate the return on investment from the cash flow represented in line 173 over 5 periods beginning in period 2.

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION

LINE NO	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
181	AFTER TAX DISC YIELD		RETURN OVER 5 PERIODS L173 BEGIN 2ND

ANSWER TO EXERCISE 12-B

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
181	AFTER TAX DISC YIELD	57.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
173	PROFIT	0.0	-171004.00	45953.00	148525.00	188407.00	195649.00	203199.00	211027.00	219099.00	227377.00	186396.00	244383.00

* *

EXERCISE 13-B

Using the Summary Report input format (below), provide the input data to create a summary report titled EDUC AND GENERAL INCOME, consisting of the planning item lines 33, and 37 through 43, expressed in thousands.

REPORT TITLE	FREEFORM REPORT LINES

REPORT TITLE	FREEFORM REPORT LINES
EDUC AND GENERAL INCOME	S1000, 33, 37-43

ANSWER TO EXERCISE 13-8

SAMPLE UNIVERSITY
BUDGET PROJECT

EDUC AND GENERAL INCOME

JANUARY 12, 1971
RUN 001

SCALE FACTOR IS 1000.

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
33	STUDENT TUITION & FEES	8693	9681	10739	11986	13251	14539	15896	17261	18663	20122	21528	22877
37	STATE APPROPRIATION	22542	24116	25872	29657	33457	37345	41426	45534	49735	54074	58248	62237
38	ENDOWMENT INCOME	50	51	52	52	53	53	54	54	55	55	56	56
39	GIFTS APPLIED TO CURRENT	6500	6500	6825	7166	7525	7901	8296	8711	9146	9603	10084	10588
40	SPONSORED RESEARCH	701	601	500	500	500	500	500	500	50	500	500	500
41	RECOVERY INDIRECT COSTS	266	228	190	190	190	190	190	190	190	190	190	190
42	OTHER	83	86	89	92	95	98	101	104	107	110	113	116
43	EDUCATION AND GENERAL	38835	41262	44266	49644	55070	60626	66462	72354	78396	84655	90718	96564

CHAPTER 5

SYSTEM OUTPUTS

The PLANTRAN II system outputs are generated on the printer and card punch. The punched cards are generated only when the punch "PUNC" instruction is used. These cards, which contain planning item values in the format of the "DATA" method of model specification, can be used to interrelate or interface, between separate base models.

All other system output is printed. The first system output is an "Analysis of Matrix." The heading for this output is as follows:

Organization	Analysis of Matrix	Date
Model Description	for a	
Run Number	6 (12) period forecast	Base year

The heading information is developed from the data in the identification input format. The next heading contains, LINE, DESCRIPTION, BASE, and METHOD OF COMPUTATION. These terms are above columns which explain the model specification inputs, i.e., the line number, planning item description, base level, and freeform method of computation. These model specification data inputs are reproduced exactly as they are specified by the planner.

The purpose of the "Analysis of Matrix" is to provide the planner with a listing of the model which he has specified. The report has several uses. First, it provides a means to insure that the model was keypunched exactly as specified by the planner. Second, it enables the planner to review the projection methods and interrelationships in the event that the model results are in error. Finally, it provides the planner with the complete documentation of the planning line base level values and assumptions incorporated into the model. This permits the logical explanation of the rationale of a given model, item by item if necessary, which is often important when communicating model results.

The next system output describes the content of the summary report input. First is printed the term: THE FOLLOWING REPORTS ARE REQUESTED. This term is followed by a report title, and the freeform report lines for each summary report specified in the summary report input format.

The next system output consists of diagnostics or error messages if they were generated in the first three system programs. A complete description of these messages and their format is given in Chapter 5.

The next system output will be any computer printed plots developed from use of the "PLOT" instruction. These plots may be of either six or 12 periods, with the time period values or terms printed on the left-hand margin of the page. The zero point for time is located in the upper left side of the page. Up to four planning item line values may be printed, using the characters *, +, X, and O. These characters are associated with the different planning items as specified in the model. A legend is presented in the lower left section of the plot output.

The next system outputs are the summary reports. These reports are the result of the planner's specifications in the identification and report input formats. It is a good practice to initially have one report which contains each planning item line. This report is useful in reviewing the model and making modifications to, or correcting, individual planning item values. Once the model has been reviewed, proofed and debugged, and the planner is assured that it correctly and accurately depicts the desired relationship between planning elements, the report containing all planning item lines can be deleted and the summary reports which directly address the planning issue retained.

The final system output consists of the diagnostics and error messages from the fourth system program.

CHAPTER 6

DIAGNOSTIC MESSAGES

This chapter presents a brief explanation of the diagnostic messages generated by the PLANTRAN II system. Errors are detected and corresponding diagnostic messages printed in each of the four major program modules in the PLANTRAN II system. The four programs and their basic function are as follows:

. PLANTRAN--This COBOL program decodes the model input and converts the input data from a free form to a fixed format.

. TREE--This FORTRAN program develops a "tree" structure of the model and each line item can be computed in one pass. In addition, it checks the logic of the model for errors such as missing lines and loops.

. HELP--This FORTRAN program performs the model computations.

. REPORT--This FORTRAN program prints the reports which are requested.

The error messages and appropriate explanations are presented below.

I. System Program PLANTRAN

A. You Have Exceeded 15 Line Numbers

This message occurs in use of the summation (SUM) or punch method (PUNC). It is generated if there are more than 15 line numbers or more than 14 commas specified. The line numbers beyond the 15th are dropped and the system will continue.

B. You Have Exceeded 12 Items of Data

This message occurs in use of the DATA method. It is generated if there are more than 12 values or more than 11 commas specified. The period values beyond the 12th are dropped, and the system will continue.

C. There Is a Code Error in the Data Card Line Item XXXX*

This message occurs if the first four positions of the FREEFORM METHOD OF COMPUTATION field contain a term other than one of the following:

PERC	SUM	ACCU . . . S	PLOT
PCNT	EQUA	ACCS	RETU
PCT	EQTN	ACCU . . . P	ROI
CONS	SHIF	ACCP	HEAD
INCR	MAXI	FILL	
DECR	MAX	PROJ	
GOAL	MINI	PUNC	
DATA	MIN	AVER	

The planning item is assumed to be a heading (HEAD). The system will continue.

D. When Renumbering Punched Lines, Only 7 Lines May Be Used

This message occurs in use of the punch (PUNC) method with the "AS" option, and indicates that the maximum of seven planning item line numbers, being renumbered has been exceeded. Any line numbers after the seventh before the "AS" are dropped, and the scan continues. If more than the maximum of 15 line numbers are specified, the diagnostic I-A will be shown.

II. System Program TREE II

A. Line Number XXXX Is Too High And Will Be Dropped. The Maximum Value for Line Numbers Is XXXX

This message occurs when a specified line number is larger than the number of lines the system can accommodate. For example, if the system is generated for 3,000 lines, the line number must be an integer between 1 and 3,000 inclusive.

Planning item lines which violate this restriction are dropped, that is, they are not included in solving the planning matrix. This error will not terminate the system, but it may lead to unresolved lines which

* The line number of the planning item with the incorrect term will appear where the XXXX is shown.

is cause for the termination of the system run. This message occupies a single printline and it may be intermixed with error message II-B. Error messages II-A and II-B will appear in sequence immediately following the "Analysis of Matrix" report generated by the PLANTRAN program.

B. Duplicate Line Number XXXX in New Line Information. First Reference Retained, Duplicate Dropped

This message occurs when a duplicate line number is encountered. Every line number used in a given model must be unique.

The planning item lines which violate this, i.e., the duplicates, are dropped, and the first line number with that line number value is retained. This restriction does not apply to replacement cards properly entered to update a preceding model--any line in the preceding model may be replaced. However, within the replacement cards, as within the original model, every line number must be unique.

This error will not terminate the system, but it may lead to unresolved lines which cause termination of the system run. This message occupies a single printline. It may be intermixed with error message II-A.

C. The Following Lines Cannot be Resolved

LINE	REQUIRES THESE UNRESOLVED LINES (A NEGATIVE LINE NUMBER MEANS THAT THE REQUIRED LINE DOES NOT EXIST)
XXXX	XXXX
XXXX	-XXXX
XXXX	XXXX
XXXX	XXXX

This message contains a list of all the lines which could not be resolved in the analysis of line dependencies within the model and indicates any other unresolved lines upon which the given line depends. A line is "unresolved" if (a) it depends on one or more nonexistent lines; (b) it depends on one or more unresolved lines; or (c) it depends on one or more other lines which, through some chain of dependencies, depend on the given line (a logical loop).

The existence of unresolved lines in a model will terminate the system. Programs which follow will not be executed. Instead, the system will re-enter the first program (PLANTRAN) looking for an update to the

current model or for a new model. This message will appear, if required, following any occurrences of error messages I-A and II-B. The message is printed at the top of a new page.

D. * * * * Summary Report * * * * Requires These Unresolved Lines. (A Negative Line Number Means That the Required Line Does Not Exist)

This message occurs if any summary report input specifies invalid, missing or unresolved lines. The message is followed by a list of the summary report titles and the corresponding invalid references. This message will appear, if required, following any occurrences of error message II-C. Specification of missing lines is not a fatal error, although such lines, of course, will not be printed. The message is printed at the top of a new page.

E. Diagnostics From Subroutine TREE

XXXX	TOTAL LINES READ
XXXX	LINES DROPPED FOR INVALID LINE NUMBER
XXXX	LINES DROPPED FOR DUPLICATE LINE NUMBER
XXXX	TOTAL LINES ACCEPTED
XXXX	TOTAL LINES RESOLVED
XXXX	LINES NOT RESOLVABLE AFTER XXXX PASSES.

This message occurs if any errors of types II-A, II-B, II-C are encountered.

The meanings of the message are self-explanatory. The message is printed at the top of the print page.

III. System Program HELP

A. Line XXXX Cannot Be Calculated Because the Power Operation Involves Negative Numbers

This message occurs in the user supplied equation or function (EQTN). It results from an attempt to use a negative exponent. If this condition is encountered the calculation of the line is terminated, the line will have values of zero in the planning periods and the system will continue.

B. Line XXXX Has a Negative Beginning Year. This Is Not Allowed

This message occurs in using the "Beginning In" option for change by a percentage (PERC, PCNT, PCT); change by an increment (DECR, INCR); and change to achieve a goal (GOAL). The "Beginning In" period cannot be in the past, only in the present or the future. The calculation of the line will terminate, the line will have values of zero in the planning periods, and the system will continue.

C. Line XXXX Has No Goal Period. A Goal of 1 Year Is Assumed to Prevent Division by Zero

This message occurs in use of the change to achieve a goal (GOAL) instruction. When no goal period has been specified, the goal period is set to a value of one, the goal value is inserted in all the planning periods, and the system continues.

D. Line XXXX Has a Goal Year Prior to a Beginning Year. This Is Not Possible

This message occurs in use of the change to achieve a goal (GOAL) instruction, when the beginning period is greater than the period in which the goal is to be achieved. The calculation of the line is terminated, the line will have values of zero in the planning periods, and the system will continue.

E. There Is a One Item Comparison Error in Line Item Number XXXX

This message occurs in use of the maximum or minimum of other planning items, (MAXI, MINI, MAX, MIN) instruction, when a single planning item or constant has been specified. There must be at least two values in order to compare, i.e., either two line numbers or a line and a constant value. The calculation of the line is terminated. The line will have values of zero in the planning periods and the system will continue.

IV. System Program REPORT

THE FOLLOWING NONEXISTENT LINES WERE REQUESTED IN THE SUMMARY REPORT

This message occurs when the planner has specified nonexistent line numbers in the summary report data input format. The nonexistent line numbers are deleted, the summary report is generated as specified, and the system continues.

CHAPTER 7

GENERATING ALTERNATIVE PLANS: USE OF THE SYSTEM DRIVER

Simulation provides planners a means of experimenting with various alternatives. PLANTRAN II uses a simple and effective feature to enhance this experimental capability.

The feature--called a "systems driver"--drives or steps the system through successive, planner-specified alternatives. This technique works as follows: the basic, or first, model is entered and executed; the projections are generated for the planning matrix as indicated by the model specification input; the matrix is balanced; and reports are printed as called out by use of the summary report input.

Next, the system reads inputs representing different or alternative projections associated with one or more planning items. These changes cause the entire planning matrix to be recomputed to bring the matrix into a new balance and the reports reflecting the different, or alternative, plan are generated.

The system handles each set of changes sequentially and computes, or balances, the associated plan. Since there is no limit to the number of changes that may be initiated, the planner may design an experiment to sweep through many alternatives. These alternatives permit the examination of a large number of solutions to a given problem. The speed and ease of the technique enable the planner to learn more about the relationships between various planning items, experiment with those items and compare the results with known objectives.

Use of the system driver in the PLANTRAN II system is quite simple. A card with the value 9999 in columns 1-4 is inserted following the last summary report input card of the basic model. This "9999" card may be followed by an optional identification input card, which has an "R" in the R field, columns 65-66. This indicates to the system that the input which follows involves replacement data to the basic, or first model.

If the optional columnar headings are provided, the identification input card must contain an "H" in the H field, columns 63-64. If that "H" is specified, the card following the identification input card must be in the column heading input format.

The next cards are the changes to the basic model expressed in the model specification input format. Note that these cards replace the model specification input in the basic model. If line numbers of the replacement planning items are not the same as those being replaced in the basic model, the replacement items are added to the model.

There is no limit to the number of replacement planning item lines which can be entered at one time.

Another "9999" card (columns 1-4) follows the last replacement card in the model specification input. That "9999" card may be followed by another optional identification input, optional columnar headings and replacement model specification cards. The summary report input for alternative iterations is the same as in the basic model.

In using the systems driver, it is important to note several things. The sequence of replacement data must be explicitly followed:

9999
Identification input (optional)
Columnar heading input (optional)
Model specification input
9999
Identification input (optional)
Columnar heading input (optional)
Model specification input
9999

Second, it must be kept in mind that from iteration to iteration the basic plan reflects the original plan values rather than the latest changes, i.e., the changes from iteration to iteration are not cumulative. Third, note that the summary reports generated by replacement data are the same as those specified for the basic model.

Finally, the sequence of computer printout must be understood. The "Analysis or Matrix" and summary reports will appear for the basic model just as if no replacement data were involved. The last summary report will be followed by a section title "LINE CHANGES TO BE MADE TO ORIGINAL MODEL." Following this will be a heading stating "LINE," "DESCRIPTION," "BASE" and "METHODS OF COMPUTATION." Immediately under, and associated with these headings, will be the line number, planning item description, base value, and method of computation of the input in the replacement data. These data will be printed exactly as specified by the planner.

Next will be any diagnostic or error messages which may have been generated, followed by any specified plot output. The last output consists of the summary reports as specified in the original basic model.

The above sequence will be followed for each set of replacement data. If the optional identification input and columnar heading input cards reflect changes from the original model, they will be incorporated in the summary reports for the iteration.

CHAPTER 8

DATA ORGANIZATION

This section describes the input sequences for setting up the data decks to accomplish common types of planning system runs. A review of these examples will provide the planner with samples which he may use, or modify, to structure a system run for a specific planning need.

Example 1: Base Model Run

A. Identification Input

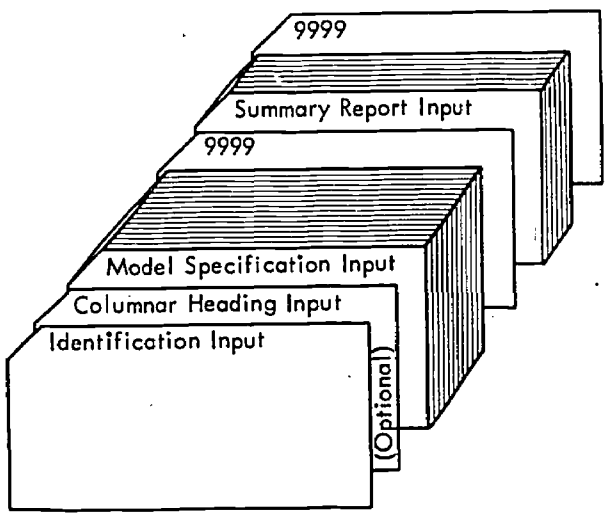
B. Columnar Headings Input-Optional
If this card is used, it must be preceded by an identification card with an "H" in Columns 63 or 64, indicating that headings are to be provided.

C. Model Specification Input

D. "9999" in Columns 1-5

E. Summary Reports Input

F. "9999" in Columns 1-4



Example 2: Base Model with One Replacement Iteration

A. Identification Input

B. Columnar Heading Input-Optional (See Note 1)

C. Model Specification Input

D. "9999" in Columns 1-4

E. Summary Report Input

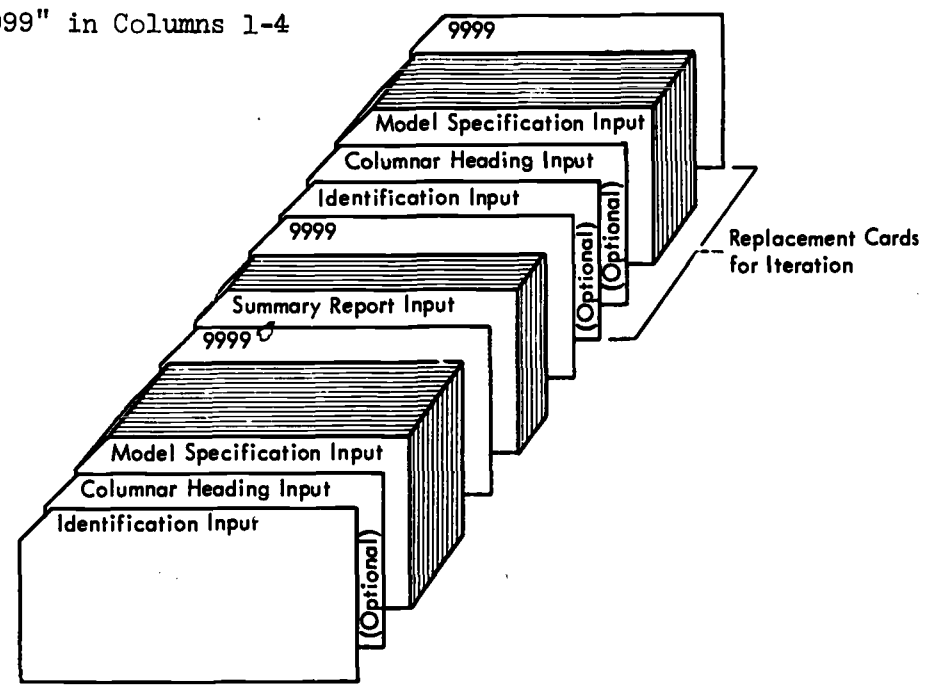
F. "9999" in Columns 1-4

G. Identification Input-Optional (See Note 2)

H. Columnar Heading Input-Optional (See Note 1)

I. Model Specification Input
The replacement planning item data

J. "9999" in Columns 1-4

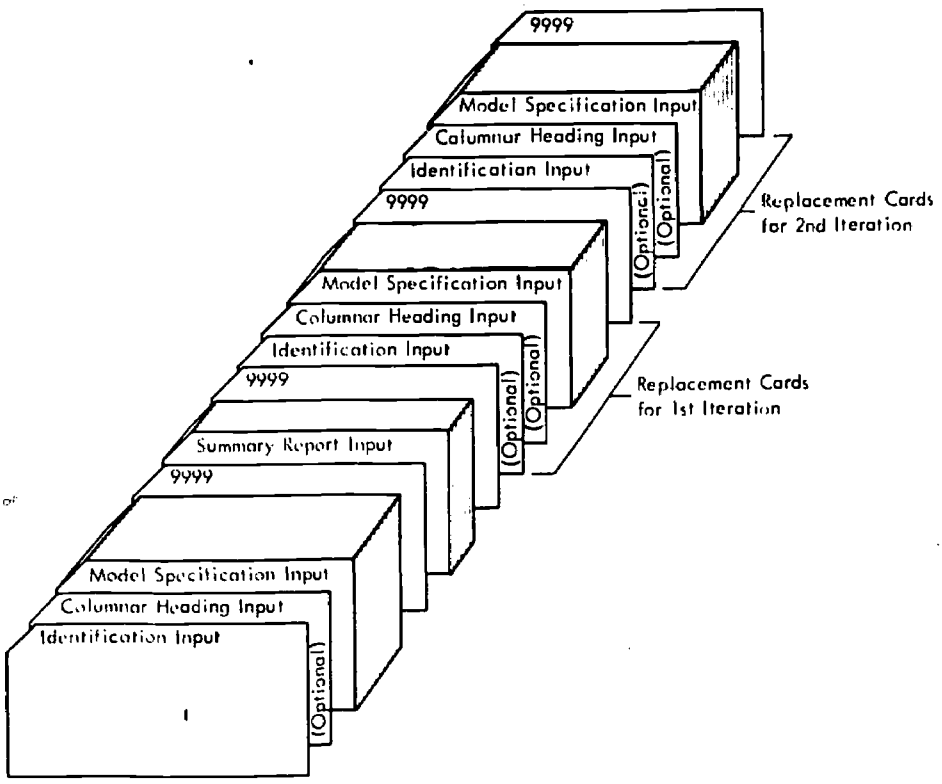


Note 1 - If this card is used, it must be preceded by an identification input card with an "H" in Columns 63 or 64, indicating that headings are to be provided.

Note 2 - If this card is used, it must have an "R" in Columns 65 or 66, indicating that the following data are replacement data.

Example 3: Base Model with Two Replacement Iterations

A. Identification Input
B. Columnar Heading Input-Optional (See Note 1)
C. Model Specification Input
D. "9999" in Columns 1-4
E. Summary Report Input
F. "9999" in Columns 1-4
G. Identification Input-Optional (See Note 2)
H. Columnar Heading Input-Optional (See Note 1)
I. Model Specification Input
J. "9999" in Columns 1-4
K. Identification Input-Optional (See Note 2)
L. Columnar Heading Input-Optional (See Note 1)
M. Model Specification Input
N. "9999" in Columns 1-4.



Note 1 - If this card is used, it must be preceded by an identification input card with an "H" in Columns 63 or 64, indicating that headings are to be provided.

Note 2 - If this card is used, it must have an "R" in Columns 65 or 66, indicating that the following data are replacement data.

Example 4: Two Independent Base Models

A. Identification Input

B. Columnar Heading Input-Optional (See Note 1)

C. Model Specification Input

D. "9999" in Columns 1-4

E. Summary Report Input

F. "9999" in Columns 1-4

G. Identification Input (See Note 2)

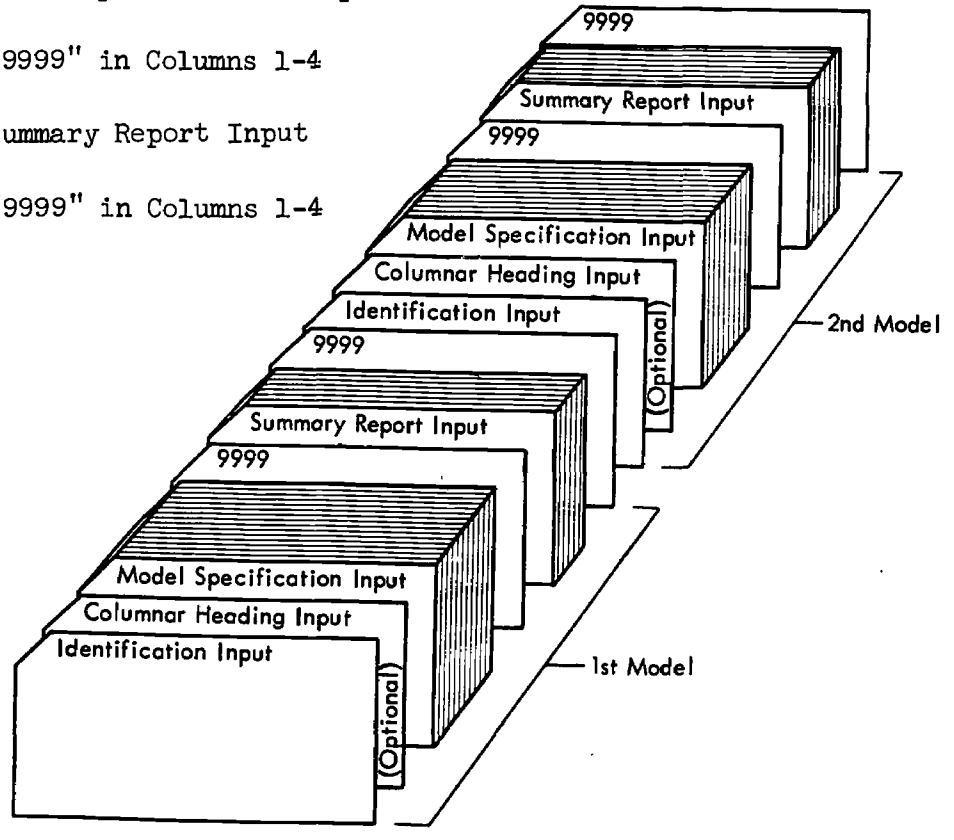
H. Columnar Heading Input-Optional (See Note 1)

I. Model Specification Input

J. "9999" in Columns 1-4

K. Summary Report Input

L. "9999" in Columns 1-4



Note 1 - If this card is used, it must be preceded by an identification input card with an "H" in Columns 63 or 64, indicating that headings are to be provided.

Note 2 - This Card must not have an "R" in Columns 65 or 66.

Example 5: Two Base Models, Each with One Replacement Iteration

A. Identification Input

B. Columnar Heading Input-Optional (See Note 1)

C. Model Specification Input

D. "9999" in Columns 1-4

E. Summary Report Input

F. "9999" in Columns 1-4

G. Identification Input-Optional (See Note 2)

H. Columnar Heading Input-Optional (See Note 2)

I. Model Specification Input

J. "9999" in Columns 1-4

K. Identification Input (See Note 3)

L. Columnar Heading Input-Optional (See Note 2)

M. Model Specification Input

N. "9999" in Columns 1-4

O. Summary Report Input

P. "9999" in Columns 1-4

Q. Identification Input-Optional (See Note 2)

R. Columnar Heading Input-Optional (See Note 1)

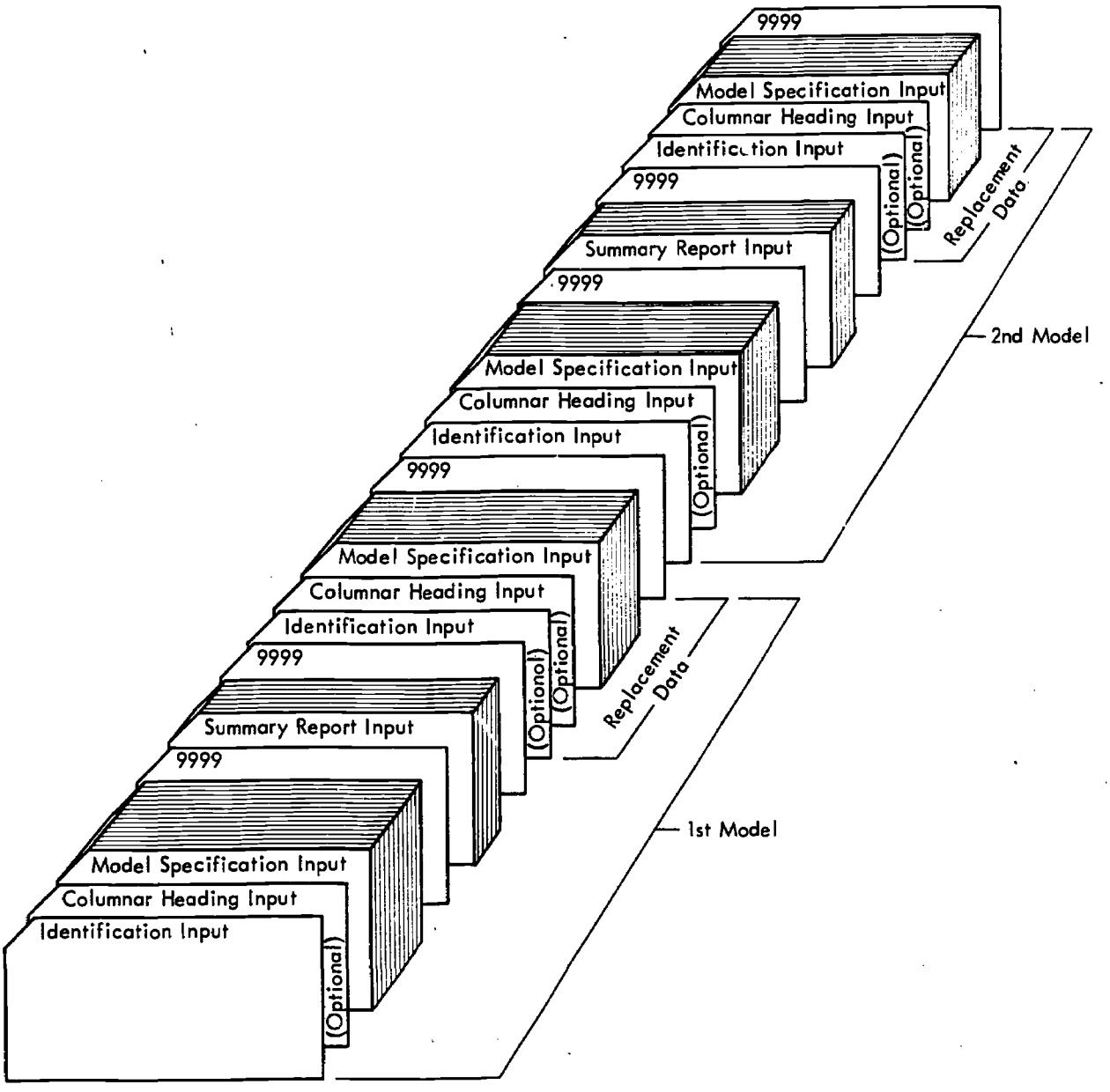
S. Model Specification Input

T. "9999" in Columns 1-4

Note 1 - If this card is used, it must be preceded by an identification input card with an "H" in Columns 63 or 64, indicating that headings are to be provided.

Note 2 - If this card is used, it must have an "R" in Columns 65 or 66, indicating that the following data are replacement data.

Note 3 - This card must not have an "R" in Columns 65 or 66.


9999
Model Specification Input
Columnar Heading Input
Identification Input
(Optional)
9999
Summary Report Input
(Optional)
9999
Model Specification Input
Columnar Heading Input
Identification Input
(Optional)
9999
Model Specification Input
Columnar Heading Input
Identification Input
(Optional)
9999
Summary Report Input
(Optional)
9999
Model Specification Input
Columnar Heading Input
Identification Input
(Optional)
Replacement Data
Replacement Data
2nd Model
1st Model

CHAPTER 9

SAMPLE UNIVERSITY MODEL

This chapter provides an example of the use of PLANTRAN II in meeting the planning needs of an institution. The brief description of "Sample University" is followed by the PLANTRAN Model Specifications. The Summary Reports and the Analysis of Matrix follow.

I. History

Sample University was founded in 1864 as a church-related college. In 1934 it officially disassociated itself from the church and became non-sectarian. It began offering graduate programs after World War II and had developed a few Ph.D. programs when it entered the state university system in 1959. Its enrollment has more than doubled in the last 10 years. In general, the last decade has been one of expansion and optimism for Sample.

II. Enrollment

Sample's current undergraduate enrollment is 12,622 of whom 11,381 are in-state students. Sample's planners know that the 18-year-old in-state cohort will begin to decline in 1978 after having leveled off in 1975. Currently 51 percent of the cohort attend post-secondary institutions. Sample's share of this market is presently 9.5 percent. The university feels that the attendance rate of 51 percent will stay constant for two years and then increase about 0.5 per year. Sample's share of these students can be projected linearly from past data. Out-of-state undergraduate students are limited to 11 percent of the in-state undergraduates.

Total graduate enrollment stands at 2,428 of whom 1,928 are residents of the state. Due to facility constraints and a leveling off of federal funding for graduate programs, the university feels that in-state graduate enrollment will stay constant for the next 3 years after which it will resume its 3 percent annual increase. Out-of-state graduate enrollment will decline to 300 by 1975.

III. Fees

In-state undergraduates are paying fees of $405 per year. Although Sample has delayed increasing its fees to students for the last 5 years, this is no longer possible. In fact, the best estimate is that fees for resident undergraduates will have to increase about $20 per year. Non-resident undergraduates now pay $1,300 a year. This will increase 6 percent annually. Resident graduate students pay more than the undergraduates; this will increase to $600 by the fourth year beginning in 1973; current fees are $500. Out-of-state graduate students pay $1,500 a year. This will increase to $1,800 in 2 years.

IV. Faculty

The student-faculty ratio at Sample has not changed appreciably since the late forties. The undergraduate student-faculty ratio has been 18:1; the graduate ratio hovers around 6:1. Because of the "traditional" character of these ratios, the university's planners must assume that they will not change in the future. Thus they are planning with constant student-faculty ratios at both the undergraduate and graduate level.

Sample's faculty is divided into an undergraduate faculty numbering 700 and a graduate one of 400. The average undergraduate faculty salary is $12,389. This will be increased at 6 percent per year. The average graduate salary is $16,780 which will be increased at 8 percent per year.

V. Revenue

The major income variable is the amount of support received from the state government. This currently stands at $1,605 per resident student (graduate and undergraduate). Since there are signs that the state is reaching a plateau in its level of support, the Sample planners are assuming that state appropriations will remain constant for 4 years and then can be increased $100 per student each year.

The following table summarizes the other income items and their expected changes through time:

Income Item	Current Levels	Changes
Endowment Income	$ 50,000	Increase 1 percent per year
Gifts Applied to Current Operations	6,500,000	Increase 5 percent beginning in third period
Sponsored Research	800,900	Decrease to $500,000 by third period
Recovery of Indirect Costs	309,000	38 percent of the sponsored research

VI. Expense

On the expense side, the major costs are instructional salaries. These projections will be developed on the basis of the staffing and salary factors presented earlier.

Salaries for support staff will be equal to 30 percent of the undergraduate faculty salaries and 60 percent of the graduate faculty salaries. The nonsalary support costs are presently at $900,000. These will stay constant until the fourth year when they will begin to increase 6 percent per year.

Expenditures for extension and public service are now $300,000 and they will increase $50,000 per year. Student services are funded at a level equal to $300 per undergraduate student plus $100 per graduate student.

Student aid expenditures are based on the assumption that the total undergraduate financial aid will be equal to 10 percent of the resident undergraduates receiving full fee scholarships. Graduate financial assistance will be equal to 30 percent of the resident graduate students receiving complete fee remission.

Library expenditures will be equal to 10 percent of the sum of instruction/departmental research expenditures, sponsored research, and extension public service expenditures.

The following table summarizes the other expense items and their expected changes through time:

Expense Item	Current Level	Changes
Operation and Maintenance	$ 2,300,000	Increase 6 percent
General Administration	1,900,000	Increase $55,000 per year
General Institutional	100,000	No change
Auxiliary Enterprises	2,195,000	90 percent of auxiliary enterprise income

VII. Reports

The Sample University planners have taken all of the factors discussed above and put them together in a logical fashion. The PLANTRAN Model Specifications used to do this begin on page 8-6. The Analysis of Matrix on page 8-12 allows the planners to review all the Model Specifications in an orderly manner. The planners developed a number of Summary Reports which begin on page 8-18.

Matrix analysis: This report includes all the planning item lines used in the model. It is useful to the planner in debugging the model and insures that he will have output for every line.

Enrollment: This report presents all the projections for the number of students who will seek educational services from Sample University. A number of different categories are used to display the information in ways meaningful to the planners and decision makers. Notice that the report is scaled in units.

Income-expense variables: This report presents all the "non-financial" items which determine the major portior of income and expense. These include the fee structure, the student-faculty ratios, the number of faculty, and faculty salary levels. Since these are the major assumptions underlying the budget model, it is important for decision makers to be aware of them. These variables are the ones on which administrative options can be exercised.

Current fund account: This is the revenue and income operating statement for Sample University under the assumptions of the model. It is in the standard format recommended in College and University Business Administration.

Key indicators: This report presents elements of the current fund report, enrollment report, and the income-expense variables report. These are the "highlights" of the simulation. Administrators can find the important indicators in one short report.

Analysis: This report analyses selected income and expense items as percentages of other items. For example, line 78 tells the planners what percentage of total income is accounted for by student fee income.

Surplus/deficit: This short report deals with the surplus or deficit of the current fund account. It is a specialized report which presents the level of the surplus/deficit and four statistics developed from it.

Educational and general income: This is another special report dealing only with the educational and general income. Notice that it is scaled in thousands.

Plot: The reports include two plots. One shows the relationship between current expense and current income. The other shows the growth patterns for the major elements of current fund expense.

VIII. Analyses

The most obvious analysis is to compare the total current income with the total current expense. In the first projected period this results in a surplus of $1,061,744. To learn the long-range effects of the projections and assumptions detailed above, the figures for operating surplus/deficit are accumulated throughout the 12-year period for a total of (negative) $14,627,168.

Another type of analysis is to indicate the percent of the total budget represented by the various components. According to the above projections, instruction and departmental research can be expected to climb from 60.98 percent in 1972 to an eventual 74.4 percent of the total budget in 1983.

State appropriations will pay 53.29 percent of total current income in 1972. The percentage will increase to 60.72 in 1983. Income from student fees will increase to 22.32 percent of the total current income.

NAME _____

PLANTRAN II DATA SHEET
IDENTIFICATION

MRI

ORGANIZATION	MODEL DESCRIPTION	DATE	BASE PERIOD	H	R		RUN NO
SAMPLE UNIVERSITY	BUDGET PROJECT	JANUARY 12, 1972	1977			T- TIME PERIOD H- HEADING R- REPLACEMENT	

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1	PERIOD 2	PERIOD 3	PERIOD 4	PERIOD 5	PERIOD 6	PERIOD 7	PERIOD 8	PERIOD 9	PERIOD 10	PERIOD 11	PERIOD 12

MODEL SPECIFICATION

LINE NO.	PLANNING ITEM	BASE LEVEL	FREEFORM METHOD OF COMPUTATION
1	UNDERGRAD FTE ENROLLMENT		
2	INSTATE		
3	NO BIRTHS 18 YRS AGO		DATA 92309, 94600, 95776, 98142, 98687, 98548, 98748, 98201, 97575, 96865, 94821, 92474
4	COLLEGE ATTENDANCE RATE	51	INCREASE .5 PER YEAR BEGINNING IN YEAR 3
5	SAMPLE'S SHARE	9	PROJECT LINE 6
6	SAMPLE'S SHARE 1960-1971		FILL LINE 92
7	FRESHMEN	4321	EQUATION: L3 *.0114*.0115
8	SOPHOMORES	3240	SHIFT .80 LINE 7
9	JUNIORS	1970	SHIFT .60 LINE 8
10	SENIORS	1850	SHIFT .90 LINE 9
11	TOTAL INSTATE UNDER GRAD	11381	SUM OF LINES 7, 8, 9, 10
12	OUT-OF-STATE UNDER GRAD	1231	EQUATION : .1121
13	TOTAL UNDERGRADUATES	12622	SUM OF LINES 11, 12
14	INSTATE GRADUATE	1928	PERCENTAGE INCR 3 PER YEAR BEGIN YEAR 4
15	OUT-OF-STATE GRADUATE	500	GOAL OF 300 IN PERIOD 4
16	TOTAL GRADUATE	2428	SUM OF LINES 14, 15
17	GRAND TOTAL FTE STUDENTS	15050	SUM OF LINES 13, 16

SUMMARY REPORTS

REPORT TITLE	FREEFORM REPORT LINES
MATRIX ANALYSIS	1-101
ENROLLMENT	S1, 7-19
INCOME-EXP VARIABLES	20-23, 36, 67, 24, 25, 29, 67, 26-28, 67, 30, 31

Figure 9-1

NAME _____

PLANTRAN II DATA SHEET

PAGE 2 OF 6 MRI

IDENTIFICATION

ORGANIZATION (1–24)	MODEL DESCRIPTION (25–40)	DATE (41–56)	BASE PERIOD (57–60)	T (61)	H (63)	R (65)	RUN NO (78–80)

T - TIME PERIOD
H - HEADING
R - REPLACEMENT

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1 (1–6)	PERIOD 2 (7–12)	PERIOD 3 (13–18)	PERIOD 4 (19–24)	PERIOD 5 (25–30)	PERIOD 6 (31–36)	PERIOD 7 (37–42)	PERIOD 8 (43–48)	PERIOD 9 (49–54)	PERIOD 10 (55–60)	PERIOD 11 (61–66)	PERIOD 12 (67–72)

MODEL SPECIFICATION

LINE NO. (1–4)	PLANNING ITEM (5–28)	BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–80)
18	INSTATE ENROLLMENT	13319	SUM OF LINES 11, 14
19	OUT-OF-STATE ENROLLMENT	1731	SUM OF LINES 12, 15
20	FEES INSTATE UNDERGRAD	405	INCREASE 20 PER PERIOD
21	FEES OUT-OF-STATE UNDER	1300	PERCENT INCREASE 6 PCT PER YEAR
22	FEES INSTATE GRADUATE	500	GOAL OF 600 IN PERIOD 4 BEGIN IN PER 2
23	FEES OUT-OF-STATE GRAD	1500	GOAL OF 1800 IN PERIOD 2
24	STUDENT/FAC RATIO UNDERG	18	INCREASE 0 PER YEAR
25	STUDENT/FAC RATIO GRAD	6	INCREASE 0 PER YEAR
26	UNDERGRADUATE FACULTY		EQUATION: L13/L24
27	GRADUATE FACULTY		EQUATION: L16/L25
28	TOTAL FACULTY		SUM OF LINES 26,27
29	OVERALL STUD/FAC RATIO		EQUATION: L17/L28
30	AVERAGE SALARY UNDER FAC	12389	PERCENTAGE INCREASE 6 PER YEAR
31	AVE SALARY GRADUATE FAC	16780	PERCENTAGE INCREASE 8 PER YEAR
32	CURRENT FUND INCOME		
33	STUDENT TUITION & FEES		SUM OF LINES 34, 35
34	INSTATE		EQUATION: (L11 * L20) + (L14 * L22)
35	OUT-OF-STATE		EQUATION: (L12 * L21) + (L15 * L23)

SUMMARY REPORTS

REPORT TITLE (1–24)	FREEFORM REPORT LINES (25–80)
CURRENT FUND ACCOUNT	51, 32-35 37-43, 67, 44, 67, 45, 67, 46, 67, 67, 47-61, 67, 62, 67, 63, 67, 64, 67, 67, 65, 66
KEY INDICATORS	13, 16, 20-23, 36, 24, 25, 28, 30, 31, 46, 64-66

Figure 9-1 (Continued)

NAME _____

PLANTRAN II DATA SHEET
IDENTIFICATION

PAGE 3 OF 6 MRI

ORGANIZATION (1–24)	MODEL DESCRIPTION (25–40)	DATE (41–56)	BASE PERIOD T (57–60)	H (61)	R (63)	RUN NO (65–80)
						T - TIME PERIOD H - HEADING R - REPLACEMENT

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1 (1–6)	PERIOD 2 (7–12)	PERIOD 3 (13–18)	PERIOD 4 (19–24)	PERIOD 5 (25–30)	PERIOD 6 (31–36)	PERIOD 7 (37–42)	PERIOD 8 (43–48)	PERIOD 9 (49–54)	PERIOD 10 (55–60)	PERIOD 11 (61–66)	PERIOD 12 (67–72)

MODEL SPECIFICATION

LINE NO. (1–4)	PLANNING ITEM (5–28)	BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–80)
36	STATE APPROP/FTE INSTATE	1605	INCREASE 100 PER YEAR BEGINNING YEAR 4
37	STATE APPROPRIATION		EQUATION: L18*L36
38	ENDOWMENT INCOME	50000	PERCENTAGE INCREASE 1 PER YEAR
39	GIFTS APPLIED TO CURRENT	6500000	PERCEIVT INCREASE OF 5 BEGINNING IN PER3
40	SPONSORED RESEARCH	800900	GOAL OF 500000 IN PERIOD 3
41	RECOVERY INDIRECT COSTS	30900	EQUATION: .38 L40
42	OTHER	80000	INCREASE 3000 PER YEAR
43	EDUCATION AND GENERAL		SUM OF LINES 33, 37 38, 39, 40, 41, 42
44	STUDENT AID INCOME	290000	PERCENTAGE INCREASE 3 PER YEAR
45	AUXILIARY ENTERPRISES	2750000	EQUATION: 200 * L17
46	CURRENT FOND INCOME		SUM OF LINES 43, 44, 45
47	CURRENT FOND EXPENSE		
48	INSTRUCTION/DEPT RESEAR		SUM OF LINES 51, 52, 53
49	FAC SALARIES UNDERGRAD		EQUATION: L30*L26
50	FAC SALARIES GRADUATE		EQUATION: L31*L27
51	FAC SALARIES TOTAL		SUM OF LINES 49, 50
52	SOPPORT STAFF		EQUATION: .30L49 + .60L50
53	SUPPORT NON-STAFF	900000	PERCENT INCR 6/YEAR BEGINNING IN YEAR 4

SUMMARY REPORTS

REPORT TITLE (1–24)	FREEFORM REPORT LINES (25–80)
ANALYSIS	65, 66, 78-91
SURPLUS/DEFICIT	65, 66, 87, 88, 99
EDUC AND GENERAL INCOME	S1000, 33, 37-43

Figure 9-1 (Continued)

NAME _____

PLANTRAN II DATA SHEET
IDENTIFICATION

MRI

ORGANIZATION (1–24)	MODEL DESCRIPTION (25–40)	DATE (41–56)	BASE PERIOD (57–60)	H (61)	R (63)	(65) T-TIME PERIOD H-HEADING R-REPLACEMENT	RUN NO (78–80)

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1 (1–6)	PERIOD 2 (7–12)	PERIOD 3 (13–18)	PERIOD 4 (19–24)	PERIOD 5 (25–30)	PERIOD 6 (31–36)	PERIOD 7 (37–42)	PERIOD 8 (43–48)	PERIOD 9 (49–54)	PERIOD 10 (55–60)	PERIOD 11 (61–66)	PERIOD 12 (67–72)

MODEL SPECIFICATION

LINE NO. (1–4)	PLANNING ITEM (5–28)	BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–80)
54	SPONSORED RESEARCH	800900	EQUATION: L40
55	EXTENSION/PUBLIC SERVICE	300000	INCREASE 50000 PER YEAR
56	LIBRARY		EQUATION : .10*(L48+L54+L55)
57	STUDENT SERVICES		EQUATION : (300* L13)+ (100*L16)
58	OPERATION & MAINTENANCE	2300000	PERCENTAGE INCREASE OF 6 PER YEAR
59	GENERAL ADMINISTRATION	1900000	INCREASE 55000 PER YEAR
60	GENERAL INSTITUTIONAL	100000	INCREASE 0 PER YEAR
61	EDUCATIONAL & GENERAL EX		SUM OF LINES 48, 54, 55, 56, 57, 58, 59, 60
62	STUDENT AID		EQUATION: CL20 *.10L11)+(L22*.30L14)
63	AUXILIARY ENTERPRISES		EQUATION: .90L45
64	CURRENT FUND EXPENSE		SUM OF LINES 61,62,63
65	SURPLUS/DEFICIT		EQUATION: L46-L64
66	ACCUM SURPLUS/DEFICIT		ACCUMULATED SUM OF LINE 65
67			
68	INCOME-EXPENSE PLOT II		PLOT L73, L77 SELF SCALING
69	EXPENSE PLOT I		PLOT L74, L77
73	CURRENT FUND INC (thou)		EQUATION: L46/1000
74	EDUCATION GENERAL (thou)		EQUATION: L61/1000

SUMMARY REPORTS

REPORT TITLE (1–24)	FREEFORM REPORT LINES (25–80)

Figure 9-1 (Continued)

NAME _____

PLANTRAN II DATA SHEET
IDENTIFICATION

MRI

ORGANIZATION (1–24)	MODEL DESCRIPTION (25–40)	DATE (41–56)	BASE PERIOD T (57–60)	H (61–63)	R (65)	T- TIME PERIOD H- HEADING R- REPLACEMENT	RUN NO. (78–80)

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1 (1–6)	PERIOD 2 (7–12)	PERIOD 3 (13–18)	PERIOD 4 (19–24)	PERIOD 5 (25–30)	PERIOD 6 (31–36)	PERIOD 7 (37–42)	PERIOD 8 (43–48)	PERIOD 9 (49–54)	PERIOD 10 (55–60)	PERIOD 11 (61–66)	PERIOD 12 (67–72)	

MODEL SPECIFICATION

LINE NO. (1–4)	PLANNING ITEM (5–28)	BASE LEVE. (29–40)	FREEFORM METHOD OF COMPUTATION (41–44, 45–80)
77	CURRENT FUND EXP (thou)		EQUATION: L64/1000
78	FEE INC PCT TOTAL INC		EQUATION: L33/L46 * 100
79	STATE APP PCT TOT INC		EQUATION: L37/L46 * 100
80	E + G INC PCT TOTAL INC		EQUATION: L43/L46 * 100
81	STU AID INC PCT TOT INC		EQUATION: L44/L46 * 100
82	INST/DPT RES PCT TOT EXP		EQUATION: L48/L64 * 100
83	LIBRARY PCT TOT EXP		EQUATION: L56/L64 * 100
84	STUD SERV PCT TOT EXP		EQUATION: L57/L64 * 100
85	E + G EXP PCT TOT EXP		EQUATION: L61/L64 * 100
86	STU AID EXP PCT TOT EXP		EQUATION: L62/L64 * 100
87	SUR/DEF PER UNDERGRAD		EQUATION: L65/L13
88	SUR/DEF PER STUDENT		EQUATION: L65/L17
89	E + G INC PCT E + G EXP		EQUATION: L43/L61 * 100
90	STU AID INC PCT S A EXP		EQUATION: L44/L62 * 100
91	TOT INC PCT TOT EXP		EQUATION: L46/L64 * 100
92	SAMPLE'S SHARE 1960-1971		DATA 4.5, 4.5, 5.3, , 6.7, 6.3, 7.7, 8.6, 9, 9.3, 9.5 C
93	UNDERGRAD FEE INCOME		EQUATION: (L11 * L20 + L12 * L21)

SUMMARY REPORTS

REPORT TITLE (1–24)	FREEFORM REPORT LINES (25–80)

Figure 9-1 (Continued)

NAME _____

PLANTRAN II DATA SHEET
IDENTIFICATION

MRI

ORGANIZATION (1–24)	MODEL DESCRIPTION (25–40)	DATE (41–56)	BASE PERIOD (57–60)	T (61)	H (63)	R (65)	T - TIME PERIOD H - HEADING R - REPLACEMENT	RUN NO (78–80)

COLUMNAR HEADINGS - OPTIONAL

PERIOD 1 (1–6)	PERIOD 2 (7–12)	PERIOD 3 (13–18)	PERIOD 4 (19–24)	PERIOD 5 (25–30)	PERIOD 6 (31–36)	PERIOD 7 (37–42)	PERIOD 8 (43–48)	PERIOD 9 (49–54)	PERIOD 10 (55–60)	PERIOD 11 (61–66)	PERIOD 12 (67–72)	

MODEL SPECIFICATION

LINE NO. (1–4)	PLANNING ITEM (5–28)	BASE LEVEL (29–40)	FREEFORM METHOD OF COMPUTATION (41–80)
94	AVE UNDERGRAD FEE		EQUATION: L93/L13
95	BALANCED BUDGET UNDG FEE		EQUATION: L94-L87
96	IDEAL AVE UNDG FEE		MAXIMUM OF L95, L94
97			PUNCH LINE 65
98			PUNCH LINE 65 AS LINE 26
99	AVE SURPLUS/DEFICIT		AVERAGE OF LINE 65

SUMMARY REPORTS

REPORT TITLE (1–24)	FREEFORM REPORT LINES (25–80)

Figure 9-1 (Concluded)

SAMPLE UNIVERSITY
BUDGET PROJECT
RUN 001

ANALYSIS OF MATRIX
FOR A
12 PERIOD FORECAST

JANUARY 12, 1971
BASE YR. 1971

LINE	DESCRIPTION	BASE	METHOD OF COMPUTATION
1	UNDERGRAD FTE ENROLLMENT		
2	INSTATE		
3	NO BIRTHS 18 YRS AGO		DATA92309,94600,95776,98142,98687.98548C 98748,98201,97575,96865,94821,92474
4	COLLEGE ATTENDANCE RATE	51.	INCREASE .5 PER YEAR BEGINNING IN YEAR 3
5	SAMPLE'S SHARE	9.	PROJECT LINE 6
6	SAMPLES SHARE 1960-1971		FILL LINE 92
7	FRESHMEN	4321.	EQUATION: L3*.01L4*.01L5
8	SOPHOMORES	3240.	SHIFT .80 LINE 7
9	JUNIORS	1970.	SHIFT .60 LINE 8
10	SENIORS	1850.	SHIFT .90 LINE 9
11	TOTAL INSTATE UNDER GRAD	I1381.	SUM OF LINES 7,8,9,10
12	OUT-OF-STATE UNDER GRAD	1231.	EQUATION:.11L11
13	TOTAL UNDERGRADUATES	12622.	SUM OF LINES 11,12
14	INSTATE GRADUATE	1928.	PERCENTAGE INCR 3 PER YEAR BEGIN YEAR 4
15	OUT-OF-STATE GRADUATE	500.	GOAL OF 300 IN PERIOD 4
16	TOTAL GRADUATE	2428.	SUM OF LINES 14,15
17	GRAND TOTAL FTE STUDENTS	15050.	SUM OF LINES 13,16
18	INSTATE ENROLLMENT	13319.	SUM OF LINES 11,14
19	OUT-OF-STATE ENROLLMENT	1731.	SUM OF LINES 12,15

Figure 9-2

SAMPLE UNIVERSITY
BUDGET PROJECT
RUN 001

ANALYSIS OF MATRIX
FOR A
12 PERIOD FORECAST

JANUARY 12, 1971
BASE YR. 1971

LINE	DESCRIPTION	BASE	METHOD OF COMPUTATION
20	FEES INSTATE UNDERGRAD	405.	INCREASE 20 PER PERIOD
21	FEES OUT-OF-STATE UNDER	1300.	PERCENT INCREASE 6 PCT PER YEAR
22	FEES INSTATE GRADUATE	500.	GDAL OF 600 IN PERIOD 4 BEGIN IN PER 2
23	FEES OUT-OF-STATE GRAD	1500.	GOAL OF 1800 IN PERIOD 2
24	STUDENT/FAC RATIO UNDERG	18.	INCREASE 0 PER YEAR
25	STUDENT/FAC RATIO GRAD	6.	INCREASE 0 PER YEAR
26	UNDERGRADUATE FACULTY		EQUATION:L13 / L24
27	GRADUATE FACULTY		EQUATION: L16 / L25
28	TOTAL FACULTY		SUM OF LINES 26,27
29	OVERALL STUD/FAC RATIO		EQUATION: L17 / L28
30	AVE SALARY UNDERGRAD FAC	12389.	PERCENTAGE INCREASE 6 PER YEAR
31	AVE SALARY GRADUATE FAC	16780.	PERCENTAGE INCREASE 8 PER YEAR
32	CURRENT FUND INCOME		
33	STUDENT TUITION & FEES		SUM OF LINES 34,35
34	INSTATE		EQUATION:(L11 * L20)+(L14*L22)
35	OUT-OF-STATE		EQUATION:(L12*L21)+(L15*L23)
36	STATE APPRDD/FTE INSTATE	1605.	INCREASE 100 PER YEAR BEGINNING YEAR 4
37	STATE APPROPRIATION		EQUATION: L18 * L36
38	ENDOWMENT INCOME	50000.	PERCENTAGE INCREASE 1 PER YEAR

Figure 9-2 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT
RUN 001

ANALYSIS OF MATRIX
FOR A
12 PERIOD FORECAST

JANUARY 12, 1971
BASE YR. 1971

LINE	DESCRIPTION	BASE	METHOD OF COMPUTATION
39	GIFTS APPLIED TO CURRENT	6500000	PERCENT INCREASE OF 5 BEGINNING IN PER 3
40	SPONSORED RESEARCH	800900.	GOAL OF 500000 IN PERIOD 3
41	RECOVERY INDIRECT COSTS	309000.	EQUATION: .38L40
42	OTHER	80000.	INCREASE 3000 PER YEAR
43	EDUCATION AND GENERAL		SUM OF LINES 33,37,38,39,40,41,42
44	STUDENT AID INCOME	290000.	PERCENTAGE INCREASE 3 PER YEAR
45	AUXILIARY ENTERPRISES	2750000.	EQUATION: 200 * L17
46	CURRENT FUND INCOME		SUM OF LINES 43,44,45
47	CURRENT FUND EXPENSE		
48	INSTRUCTION/DEPT RESEAR		SUM OF LINES 51,52,53
49	FAC SALARIES UNDERGRAD		EQUATION: L30 * L26
50	FAC SALARIES GRADUATE		EQUATION: L31 * L27
51	FAC SALARIES TOTAL		SUM OF LINES 49,50
52	SUPPORT STAFF		EQUATION: .30 L49 + .60 L50
53	SUPPORT NON-STAFF	900000.	PERCENT INCR 6/YEAR BEGINNING IN YEAR 4
54	SPONSORED RESEARCH	800900.	EQUATION:L40
55	EXTENSION/PUBLIC SERVICE	300000.	INCREASE 50000 PER YEAR
56	LIBRARY		EQUATION .10 * (L48 + L54 + L55)
57	STUDENT SERVICES		EQUATION:(300*L13)+(100*L16)

Figure 9-2 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT
RUN 001

ANALYSIS OF MATRIX
FOR A
12 PERIOD FORECAST

JANUARY 12, 1971
BASE YR. 1971

LINE	DESCRIPTION	BASE	METHOD OF COMPUTATION
58	OPERATION & MAINTENANCE	2300000.	PERCENTAGE INCREASE OF 6 PER YEAR
59	GENERAL ADMINISTRATION	1900000.	INCREASE 55000 PER YEAR
60	GENERAL INSTITUTIONAL	100000.	INCREASE 0 PER YEAR
61	EDUCATION & GENERAL EXP		SUM OF LINES 48,54,55,56,57,58,59,60
62	STUDENT AID		EQUATION: (L20*.10L11)+(L22*.30L14)
63	AUXILIARY ENTERPRISES		EQUATION: .90 L45
64	CURRENT FUND EXPENSE		SUM OF LINES 61,62,63
65	SURPLUS/DEFICIT		EQUATION: L46-L64
66	ACCUM SURPLUS/DEFICIT		ACCUMULATED SUM OF LINE 65
67			
68	INCOME-EXPENSE PLOT II		PLOTL73,L77 SELF SCALING
69	EXPENSE PLOT I		PLOT L74,L77
73	CURRENT FUND INC (THOU)		EQUATION L46 / 1000
74	EDUCATION GENERAL (THOU)		EQUATION L61 / 1000
77	CURRENT FUND EXP (THOU)		EQUATION L64 / 1000
78	FEE INC PCT TOTAL INC		EQUATION L33 / L46 * 100
79	STATE APP PCT TOT INC		EQUATION L37 / L46 * 100
80	E + G INC PCT TOTAL INC		EQUATION L43 / L46 * 100
81	STU AID INC PCT TOT INC		EQUATION L44 / L46 * 100

Figure 9-2 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT
RUN 001

ANALYSIS OF MATRIX
FOR A
12 PERIOD FORECAST

JANUARY 12, 1971
BASE YR. 1971

LINE	DESCRIPTION	BASE	METHOD OF COMPUTATION
82	INST/DPT RES PCT TOT EXP		EQUATION L48 / L64 * 100
83	LIBRARY PCT TOT EXP		EQUATION L56 / L64 * 100
84	STUD SERV PCT TOT EXP		EQUATION L57 / L64 * 100
85	E + G EXP PCT TOT EXP		EQUATION L61 / L64 * 100
86	STU AID PCT TOT EXP		EQUATION L62 / L64 * 100
87	SUR/DEF PER UNDERGRAD		EQUATION L65 / L13
88	SUR/DEF PER STUDENT		EQUATION L65 / L17
89	E + G INC PCT E + G EXP		EQUATION L43 / L61 * 100
90	STU AID INC PCT S A EXP		EQUATION L44 / L62 * 100
91	TOT INC PCT TDT EXP		EQUATION L46 / L64 * 100
92	SAMPLE'S SHARE 1960-1971		DATA4.5,4.5,5.3,,6.7,6.3,7.7,,8.6,9,C 9.3,9.5
93	UNDERGRAD FEE INCOME		EQUATION (L11 * L20 + L12 * L21)
94	AVE UNDERGRAD FEE		EQUATION L93 / L13
95	BALANCED BUDGET UNDG FEE		EQUATION L94 - L87
96	IDEAL AVE UNDERG FEE		MAXIMUM OF L95,L94
97			PUNCH LINE 65
98			PUNCH LINE 65 AS LINE 26
99	AVE SURPLUS/DEFICIT		AVERAGE OF LINE 65

Figure 9-2 (Concluded)

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THE FOLLOWING REPORTS ARE REQUESTED
MATRIX ANALYSIS                 1-101
ANALYSIS                        65,66,78-91
ENROLLMENT                      51,7-19
INCOME-EXP VARIABLES            20-23,36,67,24,25,29,67,26-28,67,30,31
CURRENT FUND ACCOUNT            S1,32-35,37-43,67,44,67,45,67,46,67,67,47-61,67,62,67, C
                                63,67,64,67,67,65,66
KEY INDICATORS                  13,16,20-23,36,24,25,28,30,31,46,64-66
SURPLUS/DEFICIT                 65,66,87,88,99
EDUC AND GENERAL INCOME         S1000,33,37-43
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Figure 9-3

SAMPLE UNIVERSITY
BUDGET PROJECT

MATRIX ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1						UNDERGRAD FTE ENROLLMENT							
2						INSTATE							
3	NO BIRTHS 18 YRS AGO	92309.00	94600.00	95776.00	98142.00	98687.00	98548.00	98748.00	98201.00	97575.00	96865.00	94821.00	92474.0
4	COLLEGE ATTENDANCE RATE	51.00	51.00	51.50	52.00	52.50	53.00	53.50	54.00	54.50	55.00	55.50	56.00
5	SAMPLE'S SHARE	10.50	11.02	11.55	12.07	12.60	13.12	13.65	14.17	14.70	15.22	15.75	16.27
6	SAMPLES SHARE 1960-1971	4.50	4.50	5.30	5.77	6.70	6.30	7.70	7.87	8.60	9.00	9.30	9.50
7	FRESHMEN	4943.14	5319.11	5696.99	6162.33	6528.14	6855.23	7211.31	7516.79	7817.21	8111.22	8288.53	8428.07
8	SOPHOMORES	3456.80	3954.51	4255.29	4557.59	4929.86	5222.51	5484.19	5769.05	6013.43	6253.77	6488.98	6630.83
9	JUNIORS	1944.00	2074.08	2372.71	2553.17	2734.55	2957.92	3133.51	3290.51	3461.43	3608.06	3752.26	3893.39
10	SENIORS	1773.00	1749.60	1866.67	2135.44	2297.86	2461.10	2662.13	2820.16	2961.46	3115.29	3247.25	3377.04
11	TOTAL INSTATE UNDER GRAD	12116.94	13097.30	14191.66	15408.53	16490.41	17496.76	18491.13	19396.50	20253.53	21088.33	21777.02	22329.32
12	OUT-OF-STATE UNDER GRAD	1332.86	1440.70	1561.08	1694.94	1813.94	1924.64	2034.02	2133.61	2227.89	2319.72	2395.47	2456.22
13	TOTAL UNDERGRADUATES	13449.80	14538.01	15752.74	17103.47	18304.35	19421.40	20525.15	21530.11	22481.42	23408.05	24172.49	24785.54
14	INSTATE GRADUATE	1928.00	1928.00	1928.00	1985.84	2045.42	2106.78	2169.98	2235.08	2302.13	2371.20	2442.33	2515.60
15	OUT-OF-STATE GRADUATE	450.00	400.00	350.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00

Figure 9-3 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT

MATRIX ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
16	TOTAL GRADUATE	2378.00	2328.00	2278.00	2285.84	2345.42	2406.78	2469.98	2535.08	2602.13	2671.20	2742.33	2815.60
17	GRAND TOTAL FTE STUDENTS	15827.80	16866.01	18030.74	19389.31	20649.77	21828.18	22995.13	24065.19	25083.55	26079.25	26914.83	27601.14
18	INSTATE ENROLLMENT	14044.94	15025.30	16119.66	17394.37	18535.83	19603.54	20661.11	21631.58	22555.66	23459.53	24219.35	24844.92
19	OUT-OF-STATE ENROLLMENT	1782.86	1840.70	1911.08	1994.94	2113.94	2224.64	2334.02	2433.61	2527.89	2619.72	2695.47	2756.22
20	FEES INSTATE UNDERGRAD	425.00	445.00	465.00	485.00	505.00	525.00	545.00	565.00	585.00	605.00	625.00	645.00
21	FEES OUT-OF-STATE UNDER	1378.00	1460.68	1548.32	1641.22	1739.69	1844.07	1954.72	2072.00	2196.32	2328.10	2467.79	2615.86
22	FEES INSTATE GRADUATE	500.00	533.33	566.67	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
23	FEES OUT-OF-STATE GRAD	1650.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
24	STUDENT/FAC RATIO UNDERG	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
25	STUDENT/FAC RATIO GRAD	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
26	UNDERGRADUATE FACULTY	747.21	807.67	875.15	950.19	1016.91	1078.97	1140.29	1196.12	1248.97	1300.45	1342.92	1376.97
27	GRADUATE FACULTY	396.33	388.00	379.67	380.97	390.90	401.13	411.66	422.51	433.69	445.20	457.06	469.27
28	TOTAL FACULTY	1143.54	1195.67	1254.82	1331.17	1407.81	1480.10	1551.95	1618.63	1682.66	1745.65	1799.97	1846.24
29	OVERALL STUD/FAC RATIO	13.84	14.11	14.37	14.57	14.67	14.75	14.82	14.87	14.91	14.94	14.95	14.95
30	AVE SALARY UNDERGRAD FAC	13132.34	13920.28	14755.50	15640.83	16579.28	17574.03	18628.48	19746.18	20930.95	22186.81	23518.02	24929.10

Figure 9-3 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT

MATRIX ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
31	AVE SALARY GRADUATE FAC	18122.40	19572.19	21137.97	22829.00	24655.32	26627.75	28757.97	31058.61	33543.29	36226.76	39124.90	42254.89
32	CURRENT FUND INCOME												
33	STUDENT TUITION & FEES	8692879	9680969	10738707	11986402	13250612	14539048	15895594	17260921	18662750	20121691	21527551	22876896
34	INSTATE	6113696	6856564	7691653	8664638	9554906	10449863	11379651	12300068	13229592	14181157	15076636	15911770
35	OUT-OF-STATE	2579183	2824405	3047054	3321764	3695706	4089185	4515943	4960853	5433158	5940534	6451515	6965126
36	STATE APPROD/FTE INSTATE	1605.00	1605.00	1605.00	1705.00	1805.00	1905.00	2005.00	2105.00	2205.00	2305.00	2405.00	2505.00
37	STATE APPROPRIATION	22542112	24115600	25872048	29657392	33457152	37344720	41425504	45534464	49735216	54074208	58247536	62236512
38	ENDOWMENT INCOME	50500.00	51005.00	51515.05	52030.20	52550.50	53076.01	53606.77	54142.83	54684.26	55231.11	55783.42	56341.25
39	GIFTS APPLIED TO CURRENT	6500000	6500000	6825000	7166250	7524562	7900791	8295830	8710622	9146153	9603460	10083633	10587815
40	SPONSORED RESEARCH	700600.00	600300.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00
41	RECOVERY INDIRECT COSTS	266227.94	228113.94	189999.94	189999.94	189999.94	189999.94	189999.94	189999.94	189999.94	189999.94	189999.94	189999.94
42	OTHER	83000.00	86000.00	89000.00	92000.00	95000.00	98000.00	101000.00	104000.00	107000.00	110000.00	113000.00	116000.00
43	EDUCATION AND GENERAL	38835319	41261988	44266270	49644074	55069877	60625634	66461535	72354149	78395803	84654590	90717503	96563564
44	STUDENT AID INCOME	298700.00	307661.00	316890.83	326397.55	336189.48	346275.16	356663.41	367363.32	378384.21	389735.74	401427.81	413470.64
45	AUXILIARY ENTERPRISES	3165559	3373200	3606146	3877860	4129953	4365635	4599025	4813038	5016709	5215848	5382964	5520228

Figure 9-3 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT

MATRIX ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
46	CURRENT FUND INCOME	42299578	44942849	48189307	53848332	59536019	65337545	71417223	77534551	83790896	90260174	96501895	102497263
47						CURRENT FUND EXPENSE							
48	INSTRUCTION/DEPT RESEAR	25148428	27666239	30527890	34189903	38349212	42812115	47692293	52905026	58537102	64666845	71103567	77871363
49	FAC SALARIES UNDERGRAD	9812627	11242945	12913299	14861792	16859584	18961792	21241776	23618736	26142064	28852768	31582720	34326720
50	FAC SALARIES GRADUATE	7182509	7594008	8025377	8697235	9637822	10681171	11838599	13122668	14547347	16128122	17882240	19828816
51	FAC SALARIES TOTAL	16995136	18836953	20938676	23559027	26497406	29642963	33080375	36741404	40689411	44980890	49464960	54155536
52	SUPPORT STAFF	7252292	7929286	8689214	9676876	10840566	12097238	13475689	14959219	16571024	18332688	20204144	22195296
53	SUPPORT NON-STAFF	900000	900000	900000	954000	1011240	1071914	1136229	1204403	1276667	1353267	1434463	1520531
54	SPONSORED RESEARCH	700600.00	600300.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00	500000.00
55	EXTENSION/PUBLIC SERVICE	350000.00	400000.00	450000.00	500000.00	550000.00	600000.00	650000.00	700000.00	750000.00	800000.00	850000.00	900000.00
56	LIBRARY	2619899	2866650	3147787	3518987	3939918	4391209	4884227	5410500	5978706	6596680	7245352	7927133
57	STUDENT SERVICES	4272739	4594201	4953620	5359622	5725846	6067097	6404542	6712541	7004637	7289533	7525980	7717221
58	OPERATION & MAINTENANCE	2438000	2584280	2739337	2903697	3077919	3262594	3458350	3665851	3885802	4118950	4366087	4628052
59	GENERAL ADMINISTRATION	1955000	2010000	2065000	2120000	2175000	2230000	2285000	2340000	2395000	2450000	2505000	2560000
60	GENERAL INSTITUTIONAL	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00

Figure 9-3 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT

MATRIX ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
61	EDUCATION & GENERAL EXP	37584666	40821670	44483634	49192209	54417895	59963015	65974412	72333918	79151247	86522008	94195986	102203769
62	STUDENT AID	804170	891310	987672	1104764	1200939	1297799	1398362	1498215	1599213	1702658	1800682	1893048
63	AUXILIARY ENTERPRISES	2849003	3035879	3245531	3490073	3716957	3929071	4139122	4331734	4515037	4694263	4844667	4968205
64	CURRENT FUND EXPENSE	41237838	44748859	48716836	53787046	59335791	65189885	71511896	78163867	85265497	92918929	100841335	109065022
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760
66	ACCUM SURPLUS/DEFICIT	1061744	1255744	728208	789488	989728	1137392	1042720	413408	-1061200	-3719968	-8059408	-14627168
67													
68	INCOME-EXPENSE PLOT II	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
69	EXPENSE PLOT I	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73	CURRENT FUND INC (THOU)	42299.57	44942.85	48189.29	53848.32	59536.02	65337.54	71417.19	77534.50	83790.88	90260.13	96501.88	102497.19
74	EDUCATION GENERAL (THOU)	37584.65	40821.66	44483.63	49192.21	54417.89	59963.01	65974.38	72333.88	79151.19	86522.00	94195.94	102203.75
77	CURRENT FUND EXP (THOU)	41237.82	44748.85	48716.83	53787.04	59335.77	65189.87	71511.88	78163.81	85265.44	92918.88	100841.31	109065.00
78	FEE INC PCT TOTAL INC	20.55	21.54	22.28	22.26	22.26	22.25	22.26	22.26	22.27	22.29	22.31	22.32
79	STATE APP PCT TOT INC	53.29	53.66	53.69	55.08	56.20	57.16	58.00	58.73	59.36	59.91	60.36	60.72
80	E + G INC PCT TOTAL INC	91.81	91.81	91.86	92.19	92.50	92.79	93.06	93.32	93.56	93.79	94.01	94.21

Figure 9-3 (Continued)

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
81	STU AID INC PCT TOT INC	0.71	0.68	0.66	0.61	0.56	0.53	0.50	0.47	0.45	0.43	0.42	0.40
82	INST/DPT RES PCT TOT EXP	60.98	61.83	62.66	63.57	64.63	65.67	66.69	67.68	68.65	69.59	70.51	71.40
83	LIBRARY PCT TOT EXP	6.35	6.41	6.46	6.54	6.64	6.74	6.83	6.92	7.01	7.10	7.18	7.27
84	STUD SERV PCT TOT EXP	10.36	10.27	10.17	9.96	9.65	9.31	8.96	8.59	8.22	7.85	7.46	7.06
85	E + G EXP PCT TOT EXP	91.14	91.22	91.31	91.46	91.71	91.98	92.26	92.54	92.83	93.12	93.41	93.71
86	STU AID PCT TOT EXP	1.95	1.99	2.03	2.05	2.02	1.99	1.96	1.92	1.88	1.83	1.79	1.74
87	SUR/DEF PER UNDERGRAD	78.94	13.34	-33.49	3.58	10.94	7.60	-4.61	-29.23	-65.59	-113.58	-179.52	-264.98
88	SUR/DEF PER STUDENT	67.08	11.50	-29.26	3.16	9.70	6.76	-4.12	-26.15	-58.79	-101.95	-161.23	-237.95
89	E + G INC PCT E + G EXP	103.33	101.08	99.51	100.92	101.20	101.11	100.74	100.03	99.05	97.84	96.31	94.48
90	STU AID INC PCT S A EXP	37.14	34.52	32.08	29.54	27.99	26.68	25.51	24.52	23.66	22.89	22.29	21.84
91	TOT INC PCT TOT EXP	102.57	100.43	98.92	100.11	100.34	100.23	99.87	99.19	98.27	97.14	95.70	93.98
92	SAMPLE'S SHARE 1960-1971	4.50	4.50	5.30	0.0	6.70	6.30	7.70	0.0	8.60	9.00	9.30	9.50
93	UNDERGRAD FEE INCOME	6986379	7932703	9016174	10254899	11483363	12734982	14053606	15379873	16741471	18158960	19522144	20827520
94	AVE UNDERGRAD FEE	519.44	545.65	572.36	599.58	627.36	655.72	684.70	714.34	744.68	775.76	807.62	840.31
95	BALANCED BUDGET UNDG FEE	440.50	532.31	605.84	596.00	616.42	648.12	689.31	743.57	810.27	889.34	987.14	1105.29

Figure 9-3 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT

MATRIX ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
96	IDEAL AVE UNDERG FEE	519.44	545.65	605.84	599.58	627.36	655.72	689.31	743.57	810.27	889.34	987.14	1105.29
97		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
98		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
99	AVE SURPLUS/DEFICIT	1061744	627872	242736	197372	197946	189565	148960	51676	-117911	-371997	-732673	-1218930

Figure 9-3 (Concluded)

SAMPLE UNIVERSITY
BUDGET PROJECT

ENROLLMENT

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
7	FRESHMEN	4943	5319	5697	6162	6528	6855	7211	7517	7817	8111	8289	8428
8	SOPHOMORES	3457	3955	4255	4558	4930	5223	5484	5769	6013	6254	6489	6631
9	JUNIORS	1944	2074	2373	2553	2735	2958	3134	3291	3461	3608	3752	3893
10	SENIORS	1773	1750	1867	2135	2298	2461	2662	2820	2961	3115	3247	3377
11	TOTAL INSTATE UNDER GRAD	12117	13097	14192	15409	16490	17497	18491	19396	20254	21088	21777	22329
12	OUT-OF-STATE UNDER GRAD	1333	1441	1561	1695	1814	1925	2034	2134	2228	2320	2395	2456
13	TOTAL UNDERGRADUATES	13450	14538	15753	17103	18304	19421	20525	21530	22481	23408	24172	24786
14	INSTATE GRADUATE	1928	1928	1928	1986	2045	2107	2170	2235	2302	2371	2442	2516
15	OUT-OF-STATE GRADUATE	450	400	350	300	300	300	300	300	300	300	300	300
16	TOTAL GRADUATE	2378	2328	2278	2286	2345	2407	2470	2535	2602	2671	2742	2816
17	GRAND TOTAL FTE STUDENTS	15828	16866	18031	19389	20650	21828	22995	24065	25084	26079	26915	27601
18	INSTATE ENROLLMENT	14045	15025	16120	17394	18536	19604	20661	21632	22556	23460	24219	24845
19	OUT-OF-STATE ENROLLMENT	1783	1841	1911	1995	2114	2225	2334	2434	2528	2620	2695	2756

Figure 9-4

SAMPLE UNIVERSITY
BUDGET PROJECT

INCOME-EXP VARIABLES

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
20	FEES INSTATE UNDERGRAD	425.00	445.00	465.00	485.00	505.00	525.00	545.00	565.00	585.00	605.00	625.00	645.00
21	FEES OUT-OF-STATE UNDER	1378.00	1460.68	1548.32	1641.22	1739.69	1844.07	1954.72	2072.00	2196.32	2328.10	2467.79	2615.86
22	FEES INSTATE GRADUATE	500.00	533.33	566.67	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
23	FEES OUT-OF-STATE GRAD	1650.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
36	STATE APPROD/FTE INSTATE	1605.00	1605.00	1605.00	1705.00	1805.00	1905.00	2005.00	2105.00	2205.00	2305.00	2405.00	2505.00
67													
24	STUDENT/FAC RATIO UNDERG	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
25	STUDENT/FAC RATIO GRAD	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
29	OVERALL STUD/FAC RATIO	13.84	14.11	14.37	14.57	14.67	14.75	14.82	14.87	14.91	14.94	14.95	14.95
67													
26	UNDERGRADUATE FACULTY	747.21	807.67	875.15	950.19	1016.91	1078.97	1140.29	1196.12	1248.97	1300.45	1342.92	1376.97
27	GRADUATE FACULTY	396.33	388.00	379.67	380.97	390.90	401.13	411.66	422.51	433.69	445.20	457.06	469.27
28	TOTAL FACULTY	1143.54	1195.67	1254.82	1331.17	1407.81	1480.10	1551.95	1618.63	1682.66	1745.65	1799.97	1846.24
67													
30	AVE SALARY UNDERGRAD FAC	13132.34	13920.28	14755.50	15640.83	16579.28	17574.03	18628.48	19746.18	20930.95	22186.81	23518.02	24929.10

Figure 9-5

SAMPLE UNIVERSITY
BUDGET PROJECT

INCOME-EXP VARIABLES

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
31	AVE SALARY GRADUATE FAC	18122.40	19572.19	21137.97	22829.00	24655.32	26627.75	28757.97	31058.61	33543.29	36226.76	39124.90	42254.89

Figure 9-5 (Concluded)

SAMPLE UNIVERSITY
BUDGET PROJECT

CURRENT FUND ACCOUNT

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
32	CURRENT FUND INCOME												
33	STUDENT TUITION & FEES	8692879	9680969	10738707	11986402	13250612	14539048	15895594	17260921	18662750	20121691	21527551	22876896
34	INSTATE	6113696	6856564	7691653	8664638	9554906	10449863	11379651	12300068	13229592	14181157	15076036	15911770
35	OUT-OF-STATE	2579183	2824405	3047054	3321764	3695706	4089185	4515943	4960853	5433158	5940534	6451515	6965126
37	STATE APPRDPRIATION	22542112	24115600	25872048	29657392	33457152	37344720	41425504	45534464	49735216	54074208	58247536	62236512
38	ENDOWMENT INCOME	50500	51005	51515	52030	52551	53076	53607	54143	54684	55231	55783	56341
39	GIFTS APPLIED TO CURRENT	6500000	6500000	6825000	7166250	7524562	7900791	8295830	8710622	9146153	9603460	10083633	10587815
40	SPONSORED RESEARCH	700600	600300	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000
41	RECOVERY INDIRECT CDSTS	266228	228114	190000	190000	190000	190000	190000	190000	190000	190000	190000	190000
42	OTHER	83000	86000	89000	92000	95000	98000	101000	104000	107000	110000	113000	116000
43	EDUCATION AND GENERAL	38835319	41261988	44266270	49644074	55069877	60625634	66461535	72354149	78395803	84654590	90717503	96563564
67													
44	STUDENT AID INCOME	298700	307661	316891	326398	336189	346275	356663	367363	378384	389736	401428	413471
67													
45	AUXILIARY ENTERPRISES	3165559	3373200	3606146	3877860	4129953	4365635	4599025	4813038	5016709	5215848	5382964	5520228

Figure 9-6

SAMPLE UNIVERSITY
BUDGET PROJECT

CURRENT FUND ACCOUNT

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
67													
46	CURRENT FUND INCOME	42299578	44942849	48189307	53848332	59536019	65337545	71417223	77534551	83790896	90260174	96501895	102497263
67													
67													
47	CURRENT FUND EXPENSE												
48	INSTRUCTION/DEPT RESEAR	25148428	27666239	30527890	34189903	38349212	42812115	47692293	52905026	58537102	64666845	71103567	77871363
49	FAC SALARIES UNDERGRAD	9812627	11242945	12913299	14861792	16859584	18961792	21241776	23618736	26142064	28852768	31582720	34326720
50	FAC SALARIES GRADUATE	7182509	7594008	8025377	8697235	9637822	10681171	11838599	13122668	14547347	16120 22	17882240	19828816
51	FAC SALARIES TOTAL	16995136	18836953	20938676	23559027	26497406	29642963	33080375	36741404	40689411	44980890	49464960	54155536
52	SUPPORT STAFF	7253292	7929286	8689214	9676876	10840566	12097238	13475689	14959219	16571024	18332688	20204144	22195296
53	SUPPORT NON-STAFF	900000	900000	900000	954000	1011240	1071914	1136229	1204403	1276667	1353267	1434463	1520531
54	SPONSORED RESEARCH	700600	600300	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000
55	EXTENSION/PUBLIC SERVICE	350000	400000	450000	500000	550000	600000	650000	700000	750000	800000	850000	900000
56	LIBRARY	2619899	2866650	3147787	3518987	3939918	4391209	4884227	5410500	5978706	6596680	7245352	7927133
57	STUDENT SERVICES	4272739	4594201	4953620	5359622	5725846	6067097	6404542	6712541	7004637	7289513	7525980	7717221

Figure 9-6 (Continued)

SAMPLE UNIVERSITY
BUDGET PROJECT

CURRENT FUND ACCOUNT

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
58	OPERATION & MAINTENANCE	2438000	2584280	2739337	2903697	3077919	3262594	3458350	3665851	3885802	4118950	4366087	4628052
59	GENERAL ADMINISTRATION	1955000	2010000	2065000	2120000	2175000	2230000	2285000	2340000	2395000	2450000	2505000	2560000
60	GENERAL INSTITUTIONAL	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000
61	EDUCATION & GENERAL EXP	37584666	40821670	44483634	49192209	54417895	59963015	65974412	72333918	79151247	86522008	94195986	102203769
67													
62	STUDENT AID	804170	891310	987672	1104764	1200939	1297799	1398362	1498215	1599213	1702658	1800682	1893048
67													
63	AUXILIARY ENTERPRISES	2849003	3035879	3245531	3490073	3716957	3929071	4139122	4331734	4515037	4694263	4844667	4968205
67													
64	CURRENT FUND EXPENSE	41237838	44748859	48716836	53787046	59335791	65189885	71511896	78163867	85265497	92918929	100841335	109065022
67													
67													
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760
66	ACCUM SURPLUS/DEFICIT	1061744	1255744	728208	789488	989728	1137392	1042720	413408	-1061200	-3719968	-8059408	-14627168

Figure 9-6 (Concluded)

SAMPLE UNIVERSITY
BUDGET PROJECT

KEY INDICATORS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
13	TOTAL UNDERGRADUATES	13449.80	14538.01	15752.74	17103.47	18304.35	19421.40	20525.15	21530.11	22481.42	23408.05	24172.49	24785.54
16	TOTAL GRADUATE	2378.00	2328.00	2278.00	2285.84	2345.42	2406.78	2469.98	2535.08	2602.13	2671.20	2742.33	2815.60
20	FEES INSTATE UNDERGRAD	425.00	445.00	465.00	485.00	505.00	525.00	545.00	565.00	585.00	605.00	625.00	645.00
21	FEES OUT-OF-STATE UNDER	1378.00	1460.68	1548.32	1641.22	1739.69	1844.07	1954.72	2072.00	2196.32	2328.10	2467.79	2615.86
22	FEES INSTATE GRADUATE	500.00	533.33	566.67	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00	600.00
23	FEES OUT-OF-STATE GRAD	1650.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
36	STATE APPROD/FTE INSTATE	1605.00	1605.00	1605.00	1705.00	1805.00	1905.00	2005.00	2105.00	2205.00	2305.00	2405.00	2505.00
24	STUDENT/FAC RATIO UNDERG	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
25	STUDENT/FAC RATIO GRAD	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
28	TOTAL FACULTY	1143.54	1195.67	1254.82	1331.17	1407.81	1480.10	1551.95	1618.63	1682.66	1745.65	1799.97	1846.24
30	AVE SALARY UNDERGRAD FAC	13132.34	13920.28	14755.50	15640.83	16579.28	17574.03	18628.48	19746.18	20930.95	22186.81	23518.02	24929.10
31	AVE SALARY GRADUATE FAC	18122.40	19572.19	21137.97	22829.00	24655.32	26627.75	28757.97	31058.61	33543.29	36226.76	39124.90	42254.89
46	CURRENT FUND INCOME	42299578	44942849	48189307	53848332	59536019	65337545	71417223	77534551	83790896	90260174	96501895	102497263
64	CURRENT FUND EXPENSE	41237838	44748859	48716836	53787046	59335791	65189885	71511896	78163867	85265497	92918929	100841335	109065022
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760

Figure 9-7

SAMPLE UNIVERSITY
BUDGET PROJECT

KEY INDICATORS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
66	ACCUM SURPLUS/DEFICIT	1061744	1255744	728208	789488	989728	1137392	1042720	413408	-1061200	-3719968	-8059408	-14627168

Figure 9-7 (Concluded)

SAMPLE UNIVERSITY
BUDGET PROJECT

SURPLUS/DEFICIT

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
65	SURPLUS/DEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760
66	ACCUM SURPLUS/DEFICIT	1061744	1255744	728208	789488	989728	1137392	1042720	413408	-1061200	-3719968	-8059408	-14627168
87	SUR/DEF PER UNDERGRAD	78.94	13.34	-33.49	3.58	10.94	7.60	-4.61	-29.23	-65.59	-113.58	-179.52	-264.98
88	SUR/DEF PER STUDENT	67.08	11.50	-29.26	3.16	9.70	6.76	-4.12	-26.15	-58.79	-101.95	-161.23	-237.95
99	AVE SURPLUS/DEFICIT	1061744	627872	242736	197372	197946	189565	148960	51676	-117911	-371997	-732673	-1218930

Figure 9-8

SAMPLE UNIVERSITY
BUDGET PROJECT

ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
91	TOT INC PCT TOT EXP	102.57	100.43	98.92	100.11	100.34	100.23	99.87	99.19	98.27	97.14	95.70	93.98

Figure 9-9

SAMPLE UNIVERSITY
BUDGET PROJECT

ANALYSIS

JANUARY 12, 1971
RUN 001

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
65	SURPLUS/OEFICIT	1061744	194000	-527536	61280	200240	147664	-94672	-629312	-1474608	-2658768	-4339440	-6567760
66	ACCUM SURPLUS/DEFICIT	1061744	1255744	728208	789488	989728	1137392	1042720	413408	-1061200	-3719968	-8059408	-14627168
78	FEE INC PCT TOTAL INC	20.55	21.54	22.28	22.26	22.26	22.25	22.26	22.26	22.27	22.29	22.31	22.32
79	STATE APP PCT TOT INC	53.29	53.66	53.69	55.08	56.20	57.16	58.00	58.73	59.36	59.91	60.36	60.72
80	E + G INC PCT TOTAL INC	91.81	91.81	91.86	92.19	92.50	92.79	93.06	93.32	93.56	93.79	94.01	94.21
81	STU AID INC PCT TOT INC	0.71	0.68	0.66	0.61	0.56	0.53	0.50	0.47	0.45	0.43	0.42	0.40
82	INST/DPT RES PCT TOT EXP	60.98	61.83	62.66	63.57	64.63	65.67	66.69	67.68	68.65	69.59	70.51	71.40
83	LIBRARY PCT TOT EXP	6.35	6.41	6.46	6.54	6.64	6.74	6.83	6.92	7.01	7.10	7.18	7.27
84	STUD SERV PCT TOT EXP	10.36	10.27	10.17	9.96	9.65	9.31	8.96	8.59	8.22	7.85	7.46	7.08
85	E + G EXP PCT TOT EXP	91.14	91.22	91.31	91.46	91.71	91.98	92.26	92.54	92.83	93.12	93.41	93.71
86	STU AID PCT TOT EXP	1.95	1.99	2.03	2.05	2.02	1.99	1.96	1.92	1.88	1.83	1.79	1.74
87	SUR/DEF PER UNDERGRAD	78.94	13.34	-33.49	3.58	10.94	7.60	-4.61	-29.23	-65.59	-113.58	-179.52	-264.98
88	SUR/DEF PER STUDENT	67.08	11.50	-29.26	3.16	9.70	6.76	-4.12	-26.15	-58.79	-101.95	-161.23	-237.95
89	E + G INC PCT E + G EXP	103.33	101.08	99.51	100.92	101.20	101.11	100.74	100.03	99.05	97.84	96.31	94.48
90	STU AID INC PCT S A EXP	37.14	34.52	32.08	29.54	27.99	26.68	25.51	24.52	23.66	22.89	22.29	21.84

Figure 9-9 (Concluded)

SAMPLE UNIVERSITY
BUDGET PROJECT

EDUC AND GENERAL INCOME

JANUARY 12, 1971
RUN 001

SCALE FACTOR IS 1000.

LINE NO.	PLANNING ITEM	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
33	STUDENT TUITION & FEES	8693	9681	10739	11986	13251	14539	15896	17261	18663	20122	21528	22877
37	STATE APPROPRIATION	22542	24116	25872	29657	33457	37345	41426	45534	49735	54074	58248	62237
38	ENDOWMENT INCOME	50	51	52	52	53	53	54	54	55	55	56	56
39	GIFTS APPLIED TO CURRENT	6500	6500	6825	7166	7525	7901	8296	8711	9146	9603	10084	10588
40	SPONSORED RESEARCH	701	600	500	500	500	500	500	500	500	500	500	500
41	RECOVERY INDIRECT COSTS	266	228	190	190	190	190	190	190	190	190	190	190
42	OTHER	83	86	89	92	95	98	101	104	107	110	113	116
43	EDUCATION AND GENERAL	38835	41262	44266	49644	55070	60626	66462	72354	78396	84655	90718	96564

Figure 9-10

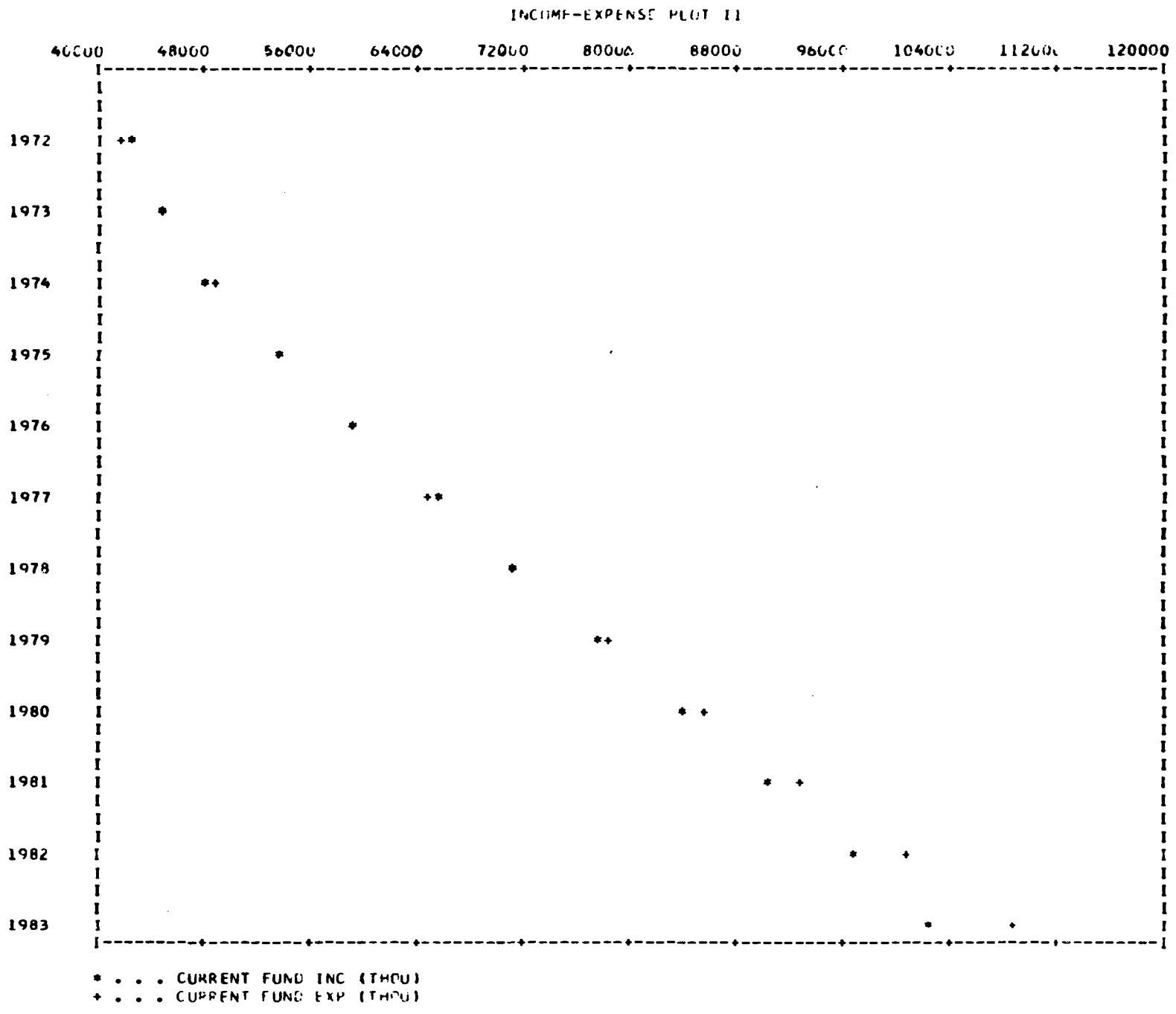


Figure 9-11

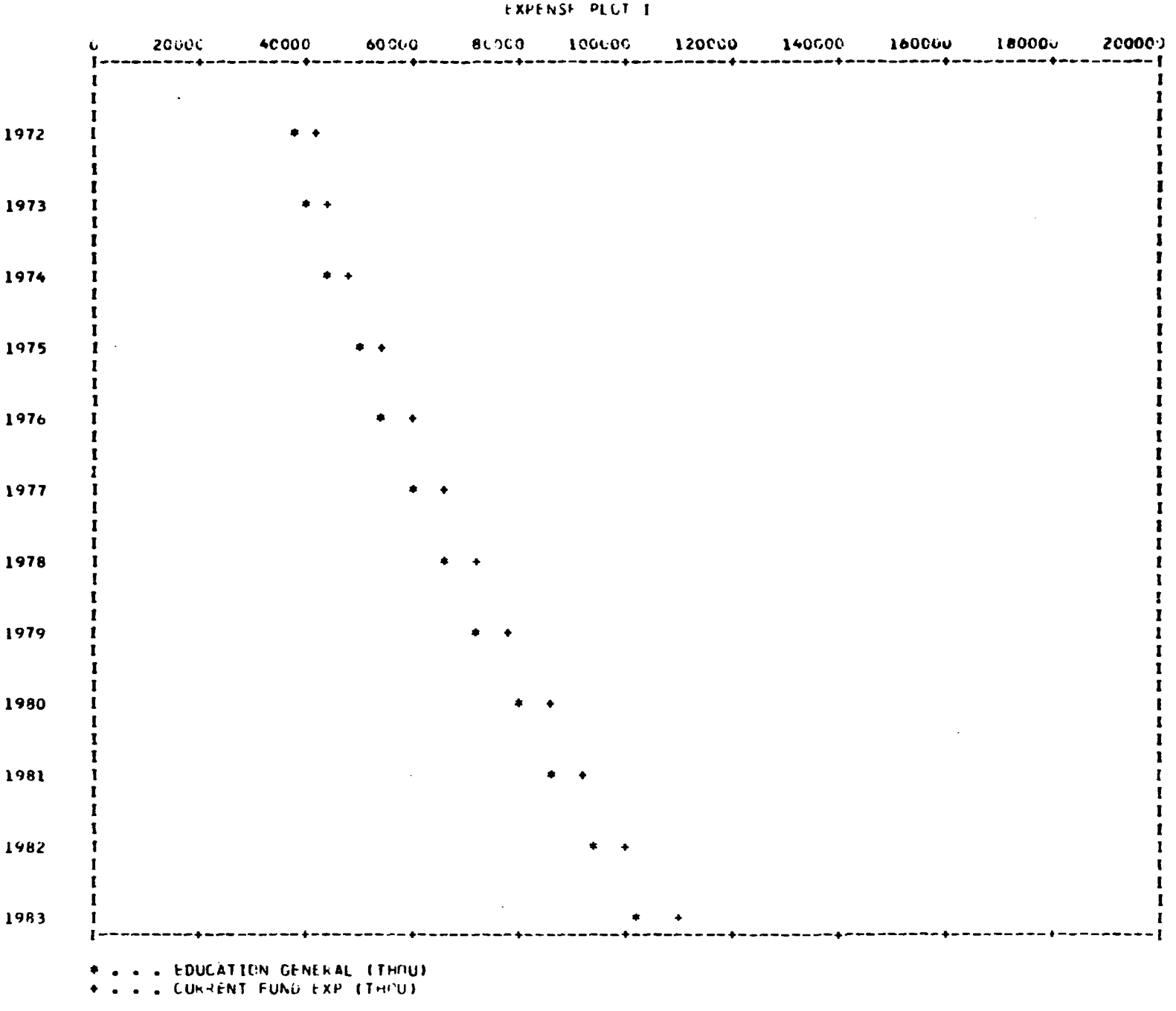


Figure 9-12

APPENDIX A: MATHEMATICAL DESCRIPTIONS OF LANGUAGE ELEMENTS

I. INSTRUCTION NOTATION

The following notation has been adopted to provide a succinct and compact definition of PLANTRAN II instruction SYNTAX:

. Key characters are capitalized and underlined; these characters are mandatory.

. Literal characters shown in lower case and not underlined may be added for clarity--they are not mandatory.

. Brackets [ ] are used to indicate required elements of the instruction.

Example: [GOAL] of [v] in [n] years

The operation code, GOAL; the goal value, v ; and goal period, n--are required elements of the instruction.

. Braces { } signify that one of two or more alternatives is a required element.

Example: {PCT / PCNT / PERC} ent increase of [p] per year

To indicate a compound growth or decay, the operation code PCT, PCNT, or PERC(ent) may be used.

. Parenthesis ( ) indicate an optional element.

Example: [INCR] ease 100/year (B eginning in 3rd year)

"Beginning in 3rd year" is optional. Default is to begin in 1st year.

. Mathematical notation.

$A_{i,k}$ = k-th period value of a given (i-th) variable (planning item)

$A_{i,o}$ = base or current value of a given (i-th) variable

II. INSTRUCTION SET

A. Percent

[PCT / PCNT / PERC] ent [I / D / ∓ / ∅] ncrease / ecrease of [p / ∅] per [month / year / period / etc.] ([B]eginning in [n] th [month / period / year])

p = numeric specification of compound percentage change

∅ = blank assumed to be zero percent

n = integer where $1 \leq n \leq 12$

if the "Beginning in..." option is not used, period 1 is assumed

Example:

Percentage increase of 7.5 percent per year beginning in third year.

BASE LEVEL	FREEFORM METHOD OF COMPUTATION (40 / 41 / 44 / 45 ... 80)
00.	PERCENT INCREASE 7.5 PCT BEGIN 3RD PERIOD
1000	PCNT INCR 7.5 % BEGIN 3RD PERIOD
1000.	PCT 7.5 % B3
1000	PCT 7.5 B3

Mathematical Definition

$$A_{i,k} = A_{i,o}\,(1 + p/100)^{k+1-n} \quad \text{for } k \geq n$$

$$= A_{i,o} \quad \text{for } k < n$$

B. Increase/Decrease

[INCR / DECR] ement / ease [Δ / ∅] per [month / period / year / etc.] ([B] eginning in [month / period / year / etc.] [n])

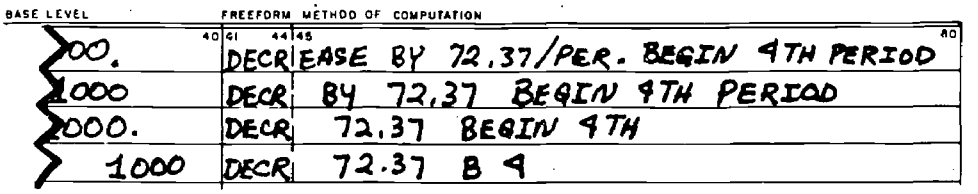
Δ = periodic incremental change

∅ = blank, assumed to be zero increase/decrease

n = integer, $1 \leq n \leq 12$

Example:

Incremental decrease of 72.37 per year beginning in fourth year.



Mathematical Definition

$$A_{i,k} = A_{i,o} \qquad \text{if } k < n$$

$$= A_{i,o} + (k+1-n)\,\Delta \qquad \text{if } k \geq n$$

C. Goal

[Goal] of [v] in [m] months / periods / years / etc. ([B]eginning in [n] month / period / year / etc.)

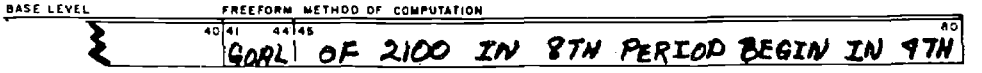
v = goal value

m = integer $1 \leq m \leq 12$ specifying the period in which goal is to be achieved

n = integer $1 \leq n \leq m-1$ specifying period in which change is to begin

Example:

Change to a goal of 2100 in 8 years beginning in fourth year.



Mathematical Definition

$$A_{i,k} = A_{i,o} \qquad \text{for } k < n$$

$$= v \qquad \text{for } k \geq m$$

$$= \frac{(v - A_{i,o})}{(m+1-n)}\,(k+1-n) + A_{i,o} \qquad \text{for } n \leq k < m$$

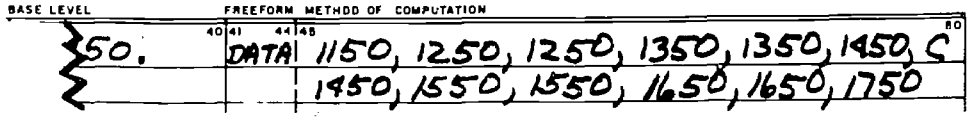
D. Data

[DATA] $(v_1, v_2, \ldots, v_{12})$

v_i - numeric between $\pm$ 999 999 999 999. 9999

blanks assumed to be zero

Example:



Mathematical Definition

$A_{i,k} = v_{i,k}$ or

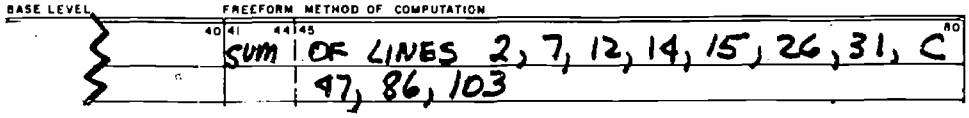
$A_{i,k}$ = zero if kth position blank

E. Sum

[SUM] of lines $[\ell_1]$ $(,\ell_2,---,\ell_{15})$

ℓ_i - line number

Example:



Mathematical Definition

$$A_{i,k} = A_{\ell_1,k} + A_{\ell_2,k} + \ldots + A_{\ell_{15},k}$$

where

ℓ_i is i-th designated line number

F. Shift

[SHIF]t (c) [L]ine [ℓ] ([F]orward / [B]ackward [p] months / periods / years / etc.)

c = constant multiplier, if blank, 1 is assumed

ℓ = line number to be shifted

p = number of periods--extent of shift, 13 > p > o

default option is to shift forward (right) one period

Example:

FREEFORM METHOD OF COMPUTATION

	40 41 44 48 80
0.	SHIFT .75 LINE 31 BACKWARD 6 PERIODS
00.	SHIFT .75 L31 BACK 6 PERIODS

Mathematical Definition

$A_{i,k} = c\ A_{j,k-p}$ if shift forward

$= c\ A_{j,k+p}$ if shift backward

$= c\ A_{j,k-1}$ if default option

G. Equation

[EQTN]tion / [EQUA]ls (C1) [L1] ([+ / * / / / **] ... (C4) (L4))

C_i = numeric constant

L_i = line number

Example:

FREEFORM METHOD OF COMPUTATION

	40 41 44 48 80
	EQTN 94.32 * LINE 63 - LINE 109
	EQTN 94.32 LINE 63 - LINE 109

Mathematical Definition

$$A_{i,k} = f\left(C_1 A_{\ell_1,k} \quad \cdots \quad C_4 A_{\ell_4,k}\right)$$

where the function, f, is an analytical function of up to 4 variables (lines) and up to 4 constants.

H. Maximum/Minimum

$$\begin{bmatrix} \text{MAXI} \\ \text{MAX} \\ \text{MINI} \\ \text{MIN} \end{bmatrix} \text{mum of} \quad \begin{bmatrix} L_j, L_\ell \\ \\ L_j, c \end{bmatrix} \left(, L_m \, L_n\right)$$

L_j = line number

c = numeric, representing a constant value

Example:

FREEFORM METHOD OF COMPUTATION

40	41	44	45	80
	MINI	mum OF L206, L239, -19.63		
	MINI	OF L206, L239, - 19.63		

Mathematical Definition

$$A_{i,k} = \begin{pmatrix} \text{MAXIMUM} \\ \text{MINIMUM} \end{pmatrix} \left(A_{j,k}, A_{\ell,k} \quad \ldots, c\right)$$

I. Fill

[FILL] line [ℓ]

ℓ = line number

Example:

FREEFORM METHOD OF COMPUTATION

40	41	44	45	80
	FILL	LINE 73		
	FILL	L73		
	FILL	73		

Mathematical Definition

$A_{i,k} = A_{j,k}$ if $A_{j,k} \neq o$; when $A_{j,k} = o$,

$A_{i,k} = (m)(k) + b$ where

$$m = \frac{2}{n}\left(\sum_{j=1}^{n/2} A_j - \sum_{j=n/2}^{n} A_j\right) \frac{2}{j}\left(\sum_{n/2}^{n} j - \sum_{1}^{n/2} j\right)$$

$$b = \frac{2}{n}\left(\sum_{j=1}^{n/2} A_j\right) - m$$

This instruction utilizes a technique of "semi-averaging."

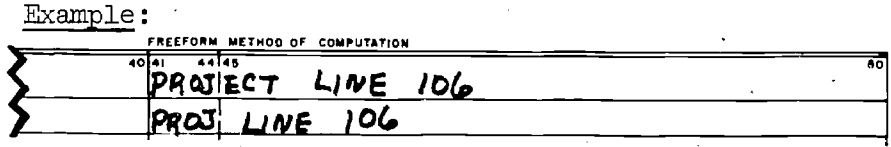
"Semi-averaging" consists of a linear fit to existing data points by averaging the first half of the data points for y_1 , the first half of the indices for x_1--proceeding similarly for the latter half of the points for y_2 and x_2--the equation of a line is determined. This equation is used to "FILL" gaps or missing data points. Only missing data points are "filled."

J. Project

[PROJ]ect line [ℓ]

ℓ = line number

Example:



Mathematical Definition

See mathematical definition of FILL. Using the same "semi-averaging" method, the equation for a linear function is computed and PROJECTED, extended or extrapolated through the next time periods 13 through 24. Thus,

$$A_{i,k} = (m)(k+12) + b$$

K. Accumulated Sum or Product

[ACCU / ACCS / ACCP] mulated [S / P] um / roduct of line [ℓ]

ℓ = line number

Example:

FREEFORM METHOD OF COMPUTATION

ACCUMULATE THE PRODUCT OF LINE 47

Mathematical Definition

$$A_{i,k} = \sum_{\ell=1}^{k} A_{\ell,k} \quad \text{if SUM;}$$

$$A_{i,k} = \prod_{\ell=1}^{k} A_{\ell,k} \quad \text{if PRODUCT}$$

L. Punch

[PUNC]h lines [ℓ_1] (, ℓ_2, ℓ_3, ---, ℓ_n) ([A]S [ℓ_{16}, ℓ_{17}, --- ℓ_m])

ℓ_i = line number

n = m if AS option used

Example:

FREEFORM METHOD OF COMPUTATION

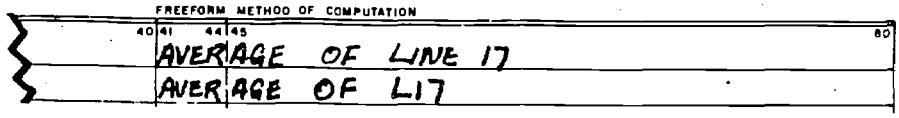
PUNCH LINES 109, 131, 146, 152, 180 AS C
LINES 31, 46, 16, 9, 71
PUNCH L109, L131, L146, L152, L180 AS C
L31, L46, L16, L9, L7

M. Average

[AVER]age of line [j]

j = line number

Example:



Mathematical Definition

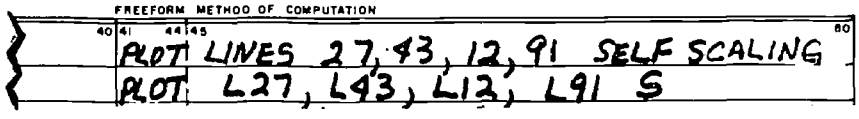
$$A_{i,k} = \frac{1}{k} \sum_{n=1}^{k} A_{j,n}$$

N. Plot

[PLOT] lines [ℓ_i] ($, \ell_2, \text{---} \ell_4$)

ℓ_i = line number

Example:



O. Return on Investment

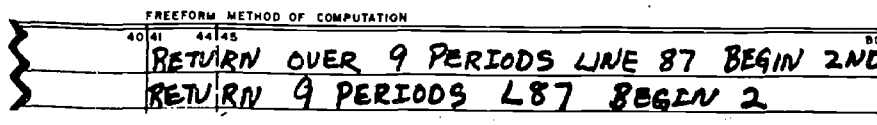
{ROI / RETU} rn on investment over [n] month / year / period, etc. line [ℓ] beginning in month / year / period, etc. [m]

ℓ = line number

n = number of years in the time span of consideration

m = beginning period

Example:



Mathematical Definition

$A_{i,k} = \emptyset$ for $i \neq 1$ and valid cash flow series

$A_{i,k}$ = 9999.99 if invalid cash flow series, i.e., there must be at least one negative and one positive value of C_j.

$A_{i,k}$ = I, compound interest rate which discounts cited net cash flow series to zero according to the expression:

$$\sum_{j=o}^{n-1} \frac{C_{j+m}}{(1+I)^j} = 0 \quad \text{where}$$

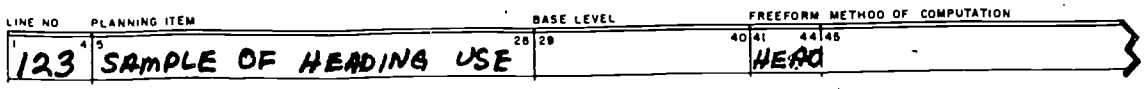
C_j = net cash flow, period j

m, n, I = as defined above

P. Heading

[HEAD]ing

Example:



Q. Summary Reports

$$\left[\text{report title}\right] \quad \text{(S-code)} \quad \left[, \ell_1\right]\left(, \ell_2, \ell_3 - \ell_n, \text{---}\right)$$

S-Code = scaling instruction for numeric values--

S00 = 2 decimal places

S1 = integers, rounded

S10 = values x 10

S100 = values x 100

S1000 = values x 1,000

S10000 = values x 10,000

ℓ_1 = line number

APPENDIX B: GLOSSARY OF WORDS AND TERMINOLOGY

Accumulative product	Planning item values are multiplied horizontally across the planning horizon. Thus, if annual values are: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, the accumulative product is: 1, 3, 9, 36, 180, 1260, 10080, 90720, 907200, 9979200, 119750400. This capability is useful in evaluating growth rates expressed as compound percentage increases.
Accumulative sum	The horizontal summation of the planning item values are taken one by one in each period of the planning horizon. Thus, if annual values for a given planning item are: 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1; then the accumulative sum is: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
Base level	The beginning or current level of a given planning item. The numeric value that is assigned to that item now.
COBOL	A high level programming language particularly suited for writing programs to process large files of data, using a vocabulary of common English words, phrases and sentences. COmmon Business Oriented Language.
Constant value	A value that remains fixed throughout the time span of the planning horizon. Constant values are often used as multiplying factors in equations. Constant values may also be projected across the planning horizon as bounding values, for example.
Data point	Individual values in a string of data.
Default option	The operation performed by the system in lieu of planner specifications. For example, if the T field of the Identification Input format is blank, the system generates a 12-column planning horizon.

Delimiter	To compensate for that lack of structure in the "Freeform" instructions, some character must be used to separate the several parts of the instruction. For example, the Data instruction requires that the individual data points be separated by commas. These commas serve to delimit the fields--thus they are called delimiters.
Exercising the model	The processing of the model in computer runs. The examination of model results under various and varied alternative assumptions.
Field	A data processing term. A field is a collection of one or more contiguous characters usually in a machine sensible form and considered as one data item. Example--the Planning Item field is the collection of alphabetic, numeric, and special characters (including blanks) between card columns 5 and 28 of an instruction.
FORTRAN	A coding system using mathematical notation for programming scientific problems to be solved by a computer. FORmula TRANslation.
Freeform method of computation	This portion of the model specification is called freeform because it accommodates a variety of ways to describe how the item is to be projected.
Input	Data, information, and instructions put into a format assembled in an appropriate fashion to be applied to the computer for processing.
Line number	A nonsymbolic number assigned to a planning item for ease in identification and internal manipulation. The line number concept is analogous to the budget line numbers.
Linear regression	A statistical routine to determine the relationship between two variables. "Linear" means that the relationship does not change through time or across groups of variables.
Logical loop	A closed series of dependent relationships. There must also be at least one independent planning item in a series of relationships.

Model	In the PLANTRAN II system, a collection of planning items, identified with a verbal description as well as a unique line number and each with an associated instruction for projection of values through time. The model is a vehicle or analytic tool that aids in the prediction of how an institution or organization would react or perform under a given, hypothesized set of conditions.
Output	The product or result of a computer run usually in the form of a pre-designated report or machine-readable data.
Planning horizon	That period of time of interest to the planner.
PLANTRAN	An acronym for PLANning TRANslator. An English-like language in which a planner may instruct the computer to perform calculations in order to project values of a given planning item through time.
Printer plot	This is a system output which plots the period values of up to four planning items. This requires no special plotting equipment but uses the computer's printer.
Printout	The physical product of a computer run. A tabulation. See Output above.
Reserved character	Within the rules of the PLANTRAN language, certain characters in the "freeform method of computation" have special meaning and cause the computer to perform special calculations. Since the computer cannot perceive the context in which these characters are used, they are reserved and are not to be used except as defined in the rules of the language. See Chapter 3 for a discussion of these rules.
Right adjusted	To place the rightmost character of a data item in the rightmost position in the field designated for that item. No space is left in that field following the information entered.

Self-scaling	A feature of the PLOT instruction in which the vertical axis is to have a value other than zero.
System driver	The facility within the PLANTRAN II system to automatically step through a series of pre-designated iterations or runs examining several sets of hypotheses at one time. This capability permits the design of experiments to examine multiple alternatives simultaneously.
Variable	One planning item. Mathematically the planning items or variables are considered to be a matrix of row vectors that are either auto-generated or are functions of other row vectors. The description of a planning item along with its 12 (or 6) projected values is considered to be one variable.