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Management Problem-Solving with APL

A GUIDE TO THE SOLUTION OF TYPICAL ACCOUNTING AND FINANCE PROBLEMS THROUGH APL TIME SHARING

Melville

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Preface

Modern managers and students in management are becoming aware of the potential of the computer as a problem-solving tool. Time-sharing is particularly convenient in that it enables many users to operate through terminals on one large system. The system consists not only of physical computing equipment (hardware), but also contains libraries of programs (software) such that the user need not create his own programs. This text is aimed at the time-sharing user who wishes to solve a variety of typical accounting, financial, and managerial problems.

The functions which have been provided are coded in APL ("A PROGRAMMING LANGUAGE" developed by International Business Machines, Inc.) utilizing the APL*PLUS® enhancements (developed by Scientific Time Sharing Corporation, Inc.). Use of these programs in a system without APL and the APL*PLUS® enhancements would require modification or re-coding of the programs to suit the particular installation.

All of the programs detailed in the text are available directly (i.e. without the need for user programming), to users of the APL Public Library, Graduate School of Management, UCLA. Other users will need to key-in the programs prior to use and coding is made available in each instance for this purpose. Alternatively, the programs are stored on tape at the Graduate School of Management, UCLA, and access to these program tapes is possible upon request. Inquiries should be addressed to the Coordinator of Computing Services, Graduate School of Management, University of California, Los Angeles, California, 90024.

It is not the intention of this text to provide instruction in the APL language itself, neither is it assumed that the reader is familiar with APL. This text is designed for those who do not wish to become involved with either the programming or the internal operations of computing systems. For those who want to learn APL programming, several books are available for that purpose.

Some elementary knowledge regarding operation of computer terminals and use of a few APL operators is needed, and Chapter 1 provides that information. The remaining chapters contain programs which are geared to the solution of a wide variety of typical accounting, financial, and managerial problems.

The text does not provide instruction in the subject areas that are covered. For example, it is assumed that the user is familiar with "sum-of-the-years'-digits" depreciation, or the meaning of the term "present-value". For users who are not familiar with topics that are covered, recourse to texts will be necessary. A most comprehensive text for this purpose, and one from which many of the examples are taken, is John W. Buckley and Kevin M. Lightner, Accounting: An Information Systems Approach. To facilitate reference to this text, the chapters in Management Problem-Solving with APL are associated with the appropriate pages in the Buckley and Lightner text as follows:

Subjects in Management Problem-Solving with APL	Pages in Buckley and Lightner
Capital Structure	357 - 359
Cash Management	383 - 417
Credit Management	429 - 465
Inventory Management	474 - 504
Depreciation	517 - 560
Interest, Present and Future Values	1223 -1243
Investment Analysis	696 - 731
Financial Analysis	236 - 287
Price-Level Indices and Adjustments	299 - 335
Capital Budgeting	1041 -1074
Cost Accounting	751 - 891
Forecasting	952 -1027

Problem-solving with APL is not only fun, but problems of considerable complexity can be solved in a very short time period and with minimal effort on the part of the user. Learning to solve problems with APL may develop an interest on the part of the user to learn more about the language itself.

We offer Management Problem-Solving with APL to managers who experience the need to solve practical problems of the types illustrated in this text, and to students who will find that solving problems with APL is an efficient and enjoyable way to learn about accounting, finance, and management.

JWB, MRN
DLS, JWS

UCLA, February 1974

The Authors

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Contents

1
Introduction

A. GENERAL DESCRIPTION

This chapter outlines the basic knowledge of the APL system for the users of this text. This chapter explains:

B. The APL Terminal.

C. Signing-on.

D. Using the APL terminal.

E. Signing-off.

F. Workspace management.

G. Using programs in this text.

H. Coping with interruptions.

I. APL error messages.

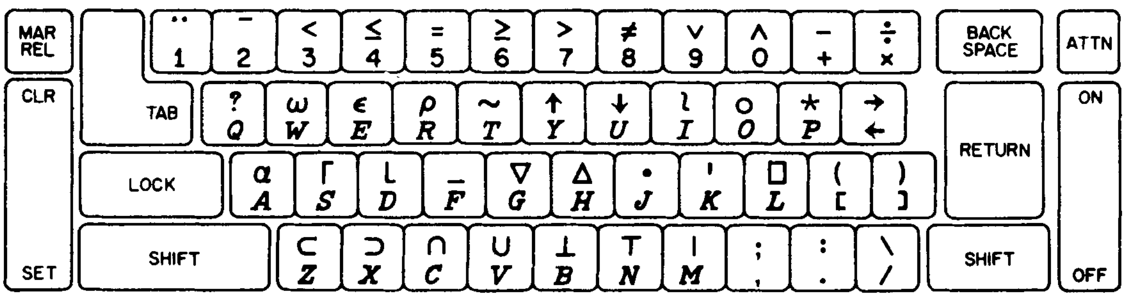
J. Programs common to most workspaces.

Those who are familiar with APL need read only the last four sections.

B. THE APL TERMINAL

A typical APL terminal keyboard is displayed in Exhibit 1-1.

Exhibit 1-1
An APL Terminal Keyboard



The first thing the user probably notices is the variety of strange codes appearing on the keys, such as ρ, ⍳, ⌈, ⌊. These special codes designate APL operators. For instance, the above operators are:

Key Symbol	Operation
ρ	Finds the dimension of a particular variable.
⍳	Scans a particular string of numbers or characters for the first occurrence of a particular number or character.
⌈	Finds the greater of two numbers.
⌊	Finds the lesser of two numbers.

For further information on the use of the special APL codes, consult an APL text. Users of the programs in this text need be aware only that these are programming codes used in writing APL programs. Other features of the keyboard that should be mentioned are:

1. The ATTN key.
2. The ON/OFF key.
3. The TAB system.
4. Use of the SHIFT key.
5. LOC/COM setting.

1. The ATTN Key

The ATTN key is used to interrupt execution. This feature can be used to (a) stop a program, or (b) correct a typing mistake.

(a) Stop a Program

The ability to stop a program should be used sparingly since it can result in the loss of information that has already been entered. For instance, if you were to use the financial ratio programs in FINANAL2 the user would first type in the information contained in a conventional balance sheet. The program then would allow the user to pick from a series of ratios those he wished the program to calculate. If the user struck the ATTN key while one of these ratios was being calculated, he could possibly lose part or all of the data he had entered. He definitely would lose the remainder of the output being entered. However, if he is receiving a long output which is of little or no value, the option is available to terminate printing by striking the ATTN key.

(b) Correcting a Typing Mistake

This is accomplished by striking the backspace key until the type element is positioned just under the error and striking the ATTN key. The terminal will respond by dropping down one line, typing a carat (∧), dropping down a second line and waiting for the rest of the line to be entered. Everything entered to the right of the position corrected is erased.

2. The ON/OFF Key

The on/off switch is explained readily. Obviously it turns the terminal on and off. It is amazing, though, how many times the major problem in starting the terminal is the fact that the user forgot to turn the terminal on. In these days of conservation, users are also encouraged to turn off the terminal when they have finished. This will aid both in conserving electricity and in minimizing the amount of servicing necessary to keep the terminal in good repair.

3. The TAB System

APL allows the user to take advantage of the tabbing capabilities of the terminal. The only constraint is that they must be used in a consistent manner, such as every 5 positions. For example the user would set tabs at positions 5, 10, 15, 20, etc. The tabs must be set physically on the terminal prior to use. If the user instructs the computer that the tabs have been set at every fifth position, the computer will utilize the tabs to speed its output. The tab set and clear keys work identically to those found on standard typewriters. They should be used prior to each session to ensure that the tabs are set in the proper positions if the tabbing capability is desired. To instruct the computer as to what tabs have been set, use the following instruction.

```
)TABS 5
```

In this example, the computer has been informed that the tabs are set physically at every fifth position. If an instruction of this type is not entered, the computer will assume that the tabbing capability should not be used.

4. The SHIFT Key

The shift key has the identical use as its counterpart on a standard typewriter. It causes the code on the upper half of the key to be entered. This key will be used infrequently. Within the standard shift the user has available the entire alphabet and the numbers 0 thru 9. The only keys you may have use for are the ? and the ∧. Their use will be explained later.

5. The LOC/COM Setting

The LOC/COM (Local or Communication) key is used to specify if the terminal is to be used in conjunction with the computer or as an independent unit. When the LOC/COM key is in the LOC position, it allows the user to type on the terminal as if it were a standard typewriter. When the LOC/COM key is in the COM position, the key- board is locked except when the computer is accepting user responses. This key is found at different locations on each make of terminal. For instance on the IBM 2741 terminal this key is on the left side panel and on the Anderson Jacobson 841 terminal the LOC/COM key is in the front. Examine the terminal to find the LOC/COM key and make sure it is in the proper position.

C. SIGNING-ON

The APL terminal can be used in the same manner as a typewriter. To enter information into the computer type in the information and when you have finished a line, strike the carriage return key. This is very necessary since nothing is communicated to the computer until the carriage return key has been struck. To utilize the APL terminal as a link to the computer, the following steps should be followed.

1. Condition the terminal for communication with the computer, i.e., set to COM mode.

2. Make connection with the computer.

3. Sign-on to the APL system.

These items are discussed briefly as follows:

1. Conditioning the Terminal for Communication

The first step is to ensure that the terminal is turned on. Next set the tabs to the desired interval if tabbing capability is to be used. Finally, set the LOC/COM key in the COM position.

2. Making Connection with the Computer

There are two basic modes under which a connection can be made to the computer- "hardwired" or "dial-up". If the terminal is in close proximity to the computer, the cost of connecting to the computer can be reduced by connecting directly to the computer's communication equipment. This is accomplished with a special computer cable. When this mode is used, the computer is connected constantly to the terminal. Thus whenever the terminal is turned on it is automatically connected to the computer.

Under the other mode, "dial-up", the user must make connection with the computer using telephone communication equipment. This is accomplished by dialing a telephone number. The computer communication equipment will respond if the computer is accepting terminal communication by a high-pitched tone. The user's response to this high-pitched tone depends on which type of communication equipment he is using.

There are two basic types of communication equipment that can be used for this purpose. The first type, the dataphone, is normally acquired from the telephone company. To use the dataphone the user pushes down the TALK button, dials the computer, and when the high-pitch tone is present he pushes the DATA button down. If the user is using the newer unit (a Sangamo Coupler) also available from the telephone company, he dials the computer and on hearing the tone pushes down the silver button. This silver button is positioned in the middle of the phone cradle.

The other widely used communication unit, called an acoustic coupler, is available from many producers. To use a unit of this type the user dials the computer, upon hearing the high-pitch dial tone he places the phone in the cradle of the acoustic coupler, making sure the phone is in right side up. This can be checked by looking for a label designating where the phone cord should be placed. These units are designed to be used with a number of computer terminals and may have dials to specify (a) the speed to be used, (b) whether the code is upright or inverted and (c) half or full duplex. If the unit does have these dials they should be set at

a. SPEED - 150 BAUD (15 characters/sec)
b. CODE - UPRIGHT
c. HALF DUPLEX

The speed of some CRT terminals and thermal printer terminals is higher than 150 BAUD. The user in this situation should consult a technician at his installation for details on the use of the acoustic coupler.

3. Signing-on to the APL System

After making connection with the computer, it is necessary to identify yourself to the APL system. Each user of the APL system has an APL number. This number can range from a four digit to an eight digit code. Each number has a password which is the only protection against unauthorized use. To sign-on to the APL system type a right parenthesis (specifying that this is a system command) followed by your APL number, followed by a colon, followed by your current password -)123456:PASSWORD. The computer will respond in one of the following ways:

1. Number Not in System.

2. Number in Use.

3. Incorrect Sign-on.

4. 009) 15.22.32 01/12/74 QA1.

5. No Response.

These responses are discussed below.

1. Number Not in System

This message can mean one of two things. First, that the number does not exist in the list of valid user numbers. Check to see if the correct number was entered and if this is not the problem, check with the supervisor of the APL system to determine why this APL number is invalid. A second cause is that the password just entered does not match the one currently associated with the APL number. Check to make sure the proper password is being used and if this is not the problem, confer with the supervisor of the APL system to determine the correct APL number and password.

2. Number in Use

This message occurs if some other user has signed on to the number. Again, contact the supervisor.

3. Incorrect Sign-on

This message indicates that the sign-on instruction is not structured properly. Retype the instruction making sure that a right parenthesis, the APL number, a colon, and the current password is entered; in that order. Note that in addition to the message INCORRECT SIGN-ON the computer responds with a blacked out area directly below the message. This is provided so the APL number and password can be entered without a readable, permanent copy being created. If you desire to take advantage of this feature whenever signing-on, the first response to begin the sign-on procedure should be a right parenthesis followed by a carriage return.

4. 009) 15.22.32 01/12/74 QA1

This response signifies a proper sign-on to the APL system. The information provided is.

a. The port number you have been assigned 009)

b. The time of the day (15.22.32)

c. The date (01/12/74)

d. An accounting code (QA1)

Upon completion of this message the terminal is conditioned for the user's first response.

5. No Response

If the terminal does not respond to your sign-on request in any of the above ways, assume that the computer is not connnected properly to the terminal. The user should attempt the sign-on procedure again and, if the terminal still has not responded, contact someone who is able to investigate the problem.

D. USING THE APL TERMINAL

The structure of APL is ideal for the solution of business problems that can be formulated mathematically. These problems can be as simple as the accumulation of quarterly sales or can be as complex as simulating the demand for a company's product. To facilitate the range of applications, APL has two basic modes of operation. The first is called the desk calculator mode. While in this mode the APL terminal can be used as a high-level calculator. An example of this would be the first example above, the accumulation of quarterly sales.

13245 + 23432 + 25465 + 35453

If the user entered the above data while in desk calculator mode, he would receive from the computer the sum of these numbers 97595. To determine if the user is in the desk calculator mode at any time, he strikes the carriage return key. If the terminal responds by positioning the type element in position six, he is in the desk calculator mode. Upon completion of the sign-on procedure, the terminal is placed in the desk calculator mode. It can then be used as a calculator taking advantage of the normal operators + - × and ÷ as well as any of the special APL operators.

The second mode, termed "under program control", allows a user to utilize a programmed set of instructions to solve problems. While in this mode the user's responses are evaluated and used by the programs being executed. This book contains the descriptions of programs (also referred to as functions) specifically designed to solve common accounting and financial problems. To start one of these programs the user will need to enter the appropriate instructions to load the workspace containing the desired program. These instructions will be described later. The user then enters the name of the desired program, which causes the program to begin execution. The next response the user receives from the terminal will be initiated by the program. This will normally be either general information concerning the necessary input or a specific request for the first piece of information. The program will continue to solicit information from the user until it has obtained its needed input. The program will then respond with the appropriate answers clearly identified. Upon completion of the program the terminal will be returned to the desk calculator mode. At that time the user can either utilize the terminal as a high-level desk calculator or he can make use of another program. Examples are provided in each chapter of how to utilize the available programs.

E. SIGNING-OFF

When you have finished the tasks for this session and wish to disconnect the terminal from the computer, execute the instruction.

)OFF

This instruction causes the following information to be printed and breaks the connection between the computer and the terminal.

```
009  15.45.22   01/12/74   QA1

CONNECTED   0.22.50   TO DATE   3.24.56

CPU TIME    0.00.01   TO DATE   0.00.05
```

F. WORKSPACE MANAGEMENT

APL has a storage structure unlike that of any other interactive language. The basic unit of storage is the workspace. The workspace can be thought of as a scratch sheet. Assume you wanted to balance your check book. The first step would be to list the outstanding checks on the scratch sheet and accumulate their value. The next step would be to list the outstanding deposits and accumulate their value. The final step would be to add the bank's version of your balance to be the value of the outstanding deposits and subtract the value of the outstanding checks. This corrected value then would be compared to the checkbook balance to determine the accuracy of your bookkeeping.

At the end of this procedure on the scratch sheet, there would be two lists of numbers and their accumulations, the current balance of the checking account per the bank's records, and the adjusted bank balance. In addition, the steps followed to reach the adjusted bank balance represents a procedure which is followed regularly to produce an adjusted balance. Assume that this procedure can be stored in the computer under the name ADJUST.

Within an APL workspace any variety of variables, e.g., list of outstanding checks, and procedures ("programs") can be stored. An internal table of contents keeps track of what is stored, where it is stored, and notes if it is a variable or a function.

These scratch sheets, or workspaces as they will be called from this point on, can be saved for later use. In this example the procedure ADJUST to calculate the discrepency between the bank's record and the user's record can be performed by the computer instead of the user. The user also can dispose of this material if it is of no further use. The disposition of the workspace is handled by two system commands, SAVE and CLEAR.

The SAVE command allows a user to attach a name to his current workspace and store it in his own library of workspaces.

```
    )SAVE BANKBAL

17.29.37        01/25/74
```

This example stores the current active workspace for future use under the name BANKBAL. The APL system responded to the SAVE command by giving the time stamp of the new workspace (seventeenth hour, twenty- ninth minute, thirty-seventh second on January 25, 1974).

The CLEAR command, on the other hand, eliminates all variables and functions within the workspace. This leaves a clean scratch sheet to start a new task.

At any time an APL user can ascertain what workspaces he has currently in his library. This is accomplished by a system instruction LIB. The LIB command when executed returns the names of the APL user's workspaces. In our example the following would occur.

```
    )LIB

BANKBAL
```

Assume now that one month has past and it is again necessary to calculate the adjusted bank balance, and the user wishes to utilize the function ADJUST stored last month. The function called ADJUST can be retrieved in one of two ways: i.e., by using one of the two retrieval system instructions LOAD or COPY.

1. Load

The system instruction LOAD replaces whatever user has in his current active workspace with the contents of the new workspace. For instance, if he was previously calculating his gas mileage and performed a LOAD command, both the variables and the function in the active workspace would be over-ridden by the new variables and functions. LOAD should be used only when there is no need to keep the contents of the current active workspace, or if there is a future need, it has been stored in the user's library using the system instruction SAVE. The format of a load command is)LOAD WORKSPACE NAME. In this example WORKSPACE NAME is replaced with BANKBAL.

2. Copy

The COPY command allows a user to consolidate the contents of other workspaces or parts of other workspaces with his current workspace. By executing the system instruction

```
    )COPY BANKBAL
```

the entire contents of the workspace named BANKBAL is moved into the current active workspace and the directory is updated to indicate the new variables and functions. If the user wishes to copy only the function ADJUST and not the entire contents of workspace BANKBAL, the COPY command can be modified to:

```
    )COPY BANKBAL ADJUST
```

This would retrieve only the function ADJUST. There are two reasons why the COPY command should be used. First a workspace, as with the scratch paper, has a finite amount of storage. This amount of storage ranges from 32,000 positions to approximately 60,000 positions depending upon the particular computer installation. Too many COPY commmands, without regard for its limitations, will fill the workspace. Second, the COPY command is more costly to execute, since more updating is involved.

Beside using your own library of workspaces you can use any other user's workspace or the public library of workspaces. The only change that is necessary to load or copy these workspaces is to specify the workspace name, the other private user's APL number, or the public library number under which the desired workspace is stored. For example, in library 7 a series of business problem workspaces are stored.

)LOAD 7 DEPRECIATION or

)COPY 7 DEPRECIATION

The above commands would bring into your active workspace a copy of the workspace DEPRECIATION from public library 7. Since workspaces in the public library are available readily to any user, the system command)LIB described earlier has the facility to list the contents of the individual public library

)LIB 7

The above command produces a list of the workspaces in the Public Library 7. The public library's range of numbers is from 1 to 999. Numbers above 999 are considered private users' numbers.

Private users' libraries can be loaded or copied in the same way by replacing the library number the private APL user number. For instance if the workspace BANKBAL was stored by APL user 123456, this user would have to give both his APL number and the workspace name BANKBAL to any other user who wished to use ADJUST. This other user would then access the BANKBAL workspace via the following instructions:

)LOAD 123456 BANKBAL or

)COPY 123456 BANKBAL

For security reasons the library command)LIB cannot be used to ascertain the contents of other private users' libraries. In the example above, for any other user to gain the use of workspace BANKBAL he would have to have previously been given both the APL account number 123456 and the workspace name BANKBAL.

Through these system commands a user can take advantage of large quantities of previously developed functions as well as store his own functions for future use.

G. USING THE PROGRAMS IN THIS TEXT

To use the programs in this text the following steps should be followed:

1. Load the appropriate workspace.

2. Enter the name of the desired program.

3. Enter the needed information.

1. Load the Appropriate Workspace

The following instruction is used to load a workspace:

)LOAD (library number, workspace name)

The programs in this book are available currently on the APL system at the University of California, Los Angeles. They are in current use at the Graduate School of Management. Within this text the library number and workspace names referenced are those used by the UCLA system. Users of the UCLA system and users of installations other than UCLA that have loaded these programs into the appropriate libraries, can use the references given in each chapter. If this is not the case, the user will either have to enter in the programs given at the end of each chapter, or check with technicians at their installations to ascertain in which library the workspaces can be found. If you are going to enter in the programs, care should be taken to enter in all the programs elements consisting of major functions, supporting functions and supporting variables. The information for this purpose is given in each chapter.

2. Enter the Name of the Desired Program

The user enters the name of the program desired in full, followed by striking the carriage return. This instruction causes the user's terminal to be placed under the control of the program.

3. Enter the Needed Information

Enter the needed information upon request. The program then evaluates the user's response and determines if it is in the range of valid input. If it is not, the program will give an appropriate error message and repeat the request for the needed information. The user should enter each response followed by striking the carriage return.

H. COPING WITH PROGRAM INTERRUPTIONS

There are occasions when the program will stop execution, i.e., there will be interruptions. The programs in this series have been checked to assure their quality but there may be some unusual situations which we have failed to anticipate. The major cause for an interruption, however, is where the user strikes the ATTN key. When this happens the terminal will respond in one of two ways. First, the user may have interrupted the program just as it was starting to request input. If this is the case the terminal will either be positioned in column 1 awaiting input, or it will have entered a quad, ⎕: , in position 6 and also be waiting for input. If this is the case, the user should enter the necessary input.

The second way in which the terminal may respond to this problem is by stopping execution. This will be seen clearly since the APL system will type an error message which indicates that the user was interrupted and a carat (∧) under the portion of the code currently being executed identifies the specific source of the error. If this situation occurs the user should enter the following instruction:

→RESTART

This instruction should restart the program at the last restart point instructions in the next section.

I. APL ERROR MESSAGES

When an APL program interrupts because of a program error or an incorrect instruction from the user, the APL system responds with one of eight APL errors messages, the line of code that was being executed when the error occurred, and a carat (∧) under the column in the line being executed where the problem terminated. Exhibit 1-2 displays eight error messages and their causes together with possible solutions.

Exhibit 1-2
APL ERROR MESSAGES

APL ERROR	DESCRIPTION
SYNTAX ERROR	This error is caused by the program attempting to execute a sub-program that does not currently exist in the workspace, or by not giving the proper instruction to start the program. This will normally be caused by the user having misentered the program name. This should be checked to make sure the right name was entered with no blanks in the middle.
CHAR ERROR	The character error is caused by a problem in the connection between the user's terminal and the computer. This message indicates that the user will need to enter the remainder of his instruction or input.
RANK ERROR	This error is caused by the program referring to one of the variables as if it had a dimension other than its actual one. If typing the restart instruction does not work, the user should reenter the program's name and start over.
LENGTH ERROR	This error is caused by the program trying to operate on arrays of different dimensions, This is caused by entering too few terms. If typing restart does not solve the problem, the user should reenter the name of the program.

INDEX ERROR	This error is caused by attempting to index a term in a variable that is outside the dimensions of the variable. Again if the restart procedure does not cure the problem the user should reenter the program name.
VALUE ERROR	This error occurs when you enter the name of the program to start its execution. The probable cause is that the user either misentered the name of the program or that the user has the wrong workspace currently loaded in his active workspace. The second problem can be checked by executing the system instruction)WSID. If this error occurs while the program is executing it means that the variable denoted by the carat is not currently in the workspace. You should check to determine what this variable should be.
RESEND	This message, like the CHAR ERROR, is caused by a break in communications. The user should re-enter his last input.
WS FULL	This is caused when the user attempts to use more data than the program was designed to handle. If this occurs the user should reload the workspace and restart his analysis using a smaller quantity of data.

J. PROGRAMS WHICH ARE COMMON TO MOST WORKSPACES.

Since these programs were developed on an APL*PLUS® system certain characters were incorporated that are not available on non-APL*PLUS® system. These include:

1. ∆FMT A high-speed formatting operator
2. ∆FI A high-speed converter from character to numeric data.
3. ∆VI A function to check for non-numeric data in a character string.

Users of non-APL*PLUS® systems should consult the authors for information as to how these functions can be simulated.

Also, there are a few functions consistently used in all workspaces to minimize the errors caused by users entering illegal values These programs were developed mainly by Roy Sykes, Scientific Time Sharing Corporation, Los Angeles Office and Chris Clausen, UCLA. These programs are: AKI, AYN, MI, NIP, AND IPI. These functions are available upon request from the authors.

2
Capital Structure (CAPSTRUCTURE)

A. General Description

The programs in this series facilitate the analysis of various transactions involving the owners' equity accounts. Basic debt-equity leverage can also be accommodated. These functions can be accessed by the instruction:

```
)LOAD 7 CAPSTRUCTURE
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

CAPSTRUCTURE supports two major functions: (1) OEANALYSIS, and (2) LEVERAGE as noted in Exhibit 2-1:

Exhibit 2-1
THE CAPSTRUCTURE WORKSPACE

A. CAPSTRUCTURE → B. OEANALYSIS
A. CAPSTRUCTURE → C. LEVERAGE

The supporting functions and variables for this workspace are noted in Exhibit 2-2:

Exhibit 2-2
CAPSTRUCTURE FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
OEANALYSIS	OUTPUT	-
LEVERAGE	-	-

B. OEANALYSIS

This function accommodates a series of typical transactions involving owners' equity: (1) the issuing of stock; (2) stock dividends; (3) stock splits; and (4) the aquisition, retirement or sale of treasury stock. These transactions can be handled in any order provided that an appropriate state of affairs with respect to the owners' equity accounts exists. For example, it is obvious that the issuance of stock must precede all other transactions in an initiate situation. Similarly, it is impossible to retire treasury stock that does not exist, and so forth.

On the other hand, it is not necessary to retrace to the first issuance of stock. The existing state of the owners' equity accounts can be input at any time, followed by the application of the above transactions in any order, i.e., we can then issue further stock, declare a stock dividend, and so forth.

In the example which follows, the company has an authorized capital of 1,000,000 shares at a par value of $20. It makes an initial public offering of its stock under these conditions: (1) 350,000 shares are issued; (2) the offering is at $22 a share; (3) directors and underwriters receive 50,000 of these shares in lieu of reimbursement of services; and (4) they make no monetary contribution to the purchase as indicated by a zero entry in the example.

Given this input, the function calculates total authorized capital and the status of the owners' equity accounts following this initial transaction.

The example continues by computing the effect on the owners' equity accounts of: (1) a 5% stock dividend which is declared when the market value of the stock is $40; (2) the acquisition of 10,000 shares of treasury stock when the market value is $35; (3) a 2:1 stock split; (4) the exercise of stock options; and (5) the retirement of treasury shares, in this case 20,000 shares at an acquisition value of $17.50 (adjusted for the stock split in #3 above). The program then illustrates the issuance of additional stock.

C. LEVERAGE

This function accommodates basic debt-equity leverage problems. Input consists of:

1. The amount of capital needed and the price of issued stock, if any.

2. The rate of interest on borrowed funds (as a percentage).

3. The percentage of capital raised via borrowing as opposed to the issuance of stock or investment by owners.

4. Different levels of EBIT - "Earnings Before Interest and Taxes".

5. A tax rate.

Based on this input, the program provides a schedule of earnings under the variety of options and computes the break-even point. A plot of the debt-leverage functions is available upon request.

B. OEANALYSIS

```
      OEANALYSIS

ENTER THE AUTHORIZED CAPITAL SHARES AND STOCK AND PAR VALUE
⎕:
      1000000 20
IS THIS A NEW ISSUE?
YES
STOCK ISSUED, PRICE, DIRECTORS' AND UNDERWRITERS' SHARE AND PRICE, IF ANY
⎕:
      350000 22 50000 0
DO YOU WANT TO SEE THE TRANSACTIONS?
YES


AUTHORIZED CAPITAL    1,000,000  SHARES AT $20       20,000,000
                                                     ==========


 350,000  STOCKS ISSUED AND OUTSTANDING AT $20     7,000,000
EXCESS PAID IN CAPITAL OR (DISCOUNT)                (400,000)
                                                 ------------
CONTRIBUTED CAPITAL                                6,600,000



ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'
HELP
ENTER IF YOU HAVE:  AN ISSUE, DIVIDEND, SPLIT OF STOCK
OR DID YOU ACQUIRE, RETIRE, OR SELL ANY TREASURY STOCK?
IF NONE HIT THE TAB AND THE CARRIAGE RETURN
ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'
DIVIDEND
ENTER THE STOCK DIVIDEND  RETAINED EARNINGS AND PRICE
⎕:
      5 1000000 40
DO YOU WANT TO SEE THE TRANSACTIONS?
YES
```

```
 367,500  STOCKS ISSUED AND OUTSTANDING AT $20       7,350,000
EXCESS PAID IN CAPITAL OR (DISCOUNT)                   (50,000)
                                                   ------------
CONTRIBUTED CAPITAL                                  7,300,000
RETAINED EARNINGS                                      300,000
                                                   ------------
OWNERS' EQUITY                                       7,600,000


ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'
ACQUIRE
ENTER THE NUMBER OF SHARES AND MARKET PRICE
⎕:
      10000 35
DO YOU WANT TO SEE THE TRANSACTION?
YES


 367,500  STOCKS ISSUED AND OUTSTANDING AT $20       7,350,000
EXCESS PAID IN CAPITAL OR (DISCOUNT)                   (50,000)
LESS       10,000  SHARES HELD IN TR.                  350,000
                                                   ------------
CONTRIBUTED CAPITAL                                  6,950,000
RETAINED EARNINGS                                      300,000
                                                   ------------
OWNERS' EQUITY                                       7,250,000


ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'
SPLIT
ENTER THE STOCK SPLIT(E.G., 2 1 INSTEAD OF 2 TO 1)
⎕:
      2 1
DO YOU WANT TO SEE THE TRANSACTION?
YES
```

```
 735,000  STOCKS ISSUED AND OUTSTANDING AT $10      7,350,000
EXCESS PAID IN CAPITAL OR (DISCOUNT)                  (50,000)
LESS       20,000  SHARES HELD IN TR.                  350,000
                                                  ------------
CONTRIBUTED CAPITAL                                 6,950,000
RETAINED EARNINGS                                      300,000
                                                  ------------
OWNERS' EQUITY                                      7,250,000



ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'

WERE ANY OF THE STOCK OPTIONS EXERCISED?
YES
ENTER THE NUMBER OF STOCKS
⎕:
      20000
DO YOU WANT TO SEE THE TRANSACTIONS?
YES



 735,000  STOCKS ISSUED AND OUTSTANDING AT $10      7,350,000
EXCESS PAID IN CAPITAL OR (DISCOUNT)                  (50,000)
                                                  ------------
CONTRIBUTED CAPITAL                                 7,300,000
RETAINED EARNINGS                                      300,000
                                                  ------------
OWNERS' EQUITY                                      7,600,000



ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'
RETIRE
ENTER THE NO. OF TR. STOCKS RETIRED AND PRICE OF ACQUISITION
IF THERE HAS BEEN A STOCK SPLIT AFTER ACQUISITION ADJUST THE PRICE
⎕:
      20000 17.50
DO YOU WANT TO SEE THE TRANSACTIONS?
YES
```

```
 715,000  STOCKS ISSUED AND OUTSTANDING AT $10      7,150,000
EXCESS PAID IN CAPITAL OR (DISCOUNT)                 (200,000)
                                                  ------------
CONTRIBUTED CAPITAL                                 6,950,000
RETAINED EARNINGS                                     300,000
                                                  ------------
OWNERS' EQUITY                                      7,250,000


ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'
ISSUE
STOCK ISSUED, PRICE, DIRECTORS' AND UNDERWRITERS' SHARE AND PRICE, IF ANY
⎕:
      200000 27 10000 0
DO YOU WANT TO SEE THE TRANSACTIONS?
YES


AUTHORIZED CAPITAL     1,000,000  SHARES AT $20        20,000,000


 915,000  STOCKS ISSUED AND OUTSTANDING AT $10      9,150,000
EXCESS PAID IN CAPITAL OR (DISCOUNT)                2,930,000
                                                  ------------
CONTRIBUTED CAPITAL                                12,080,000
RETAINED EARNINGS                                     300,000
                                                  ------------
OWNERS' EQUITY                                     12,380,000


ENTER THE TRANSACTION. FOR HELP TYPE 'HELP'

WERE ANY OF THE STOCK OPTIONS EXERCISED?
NO
```

C. LEVERAGE

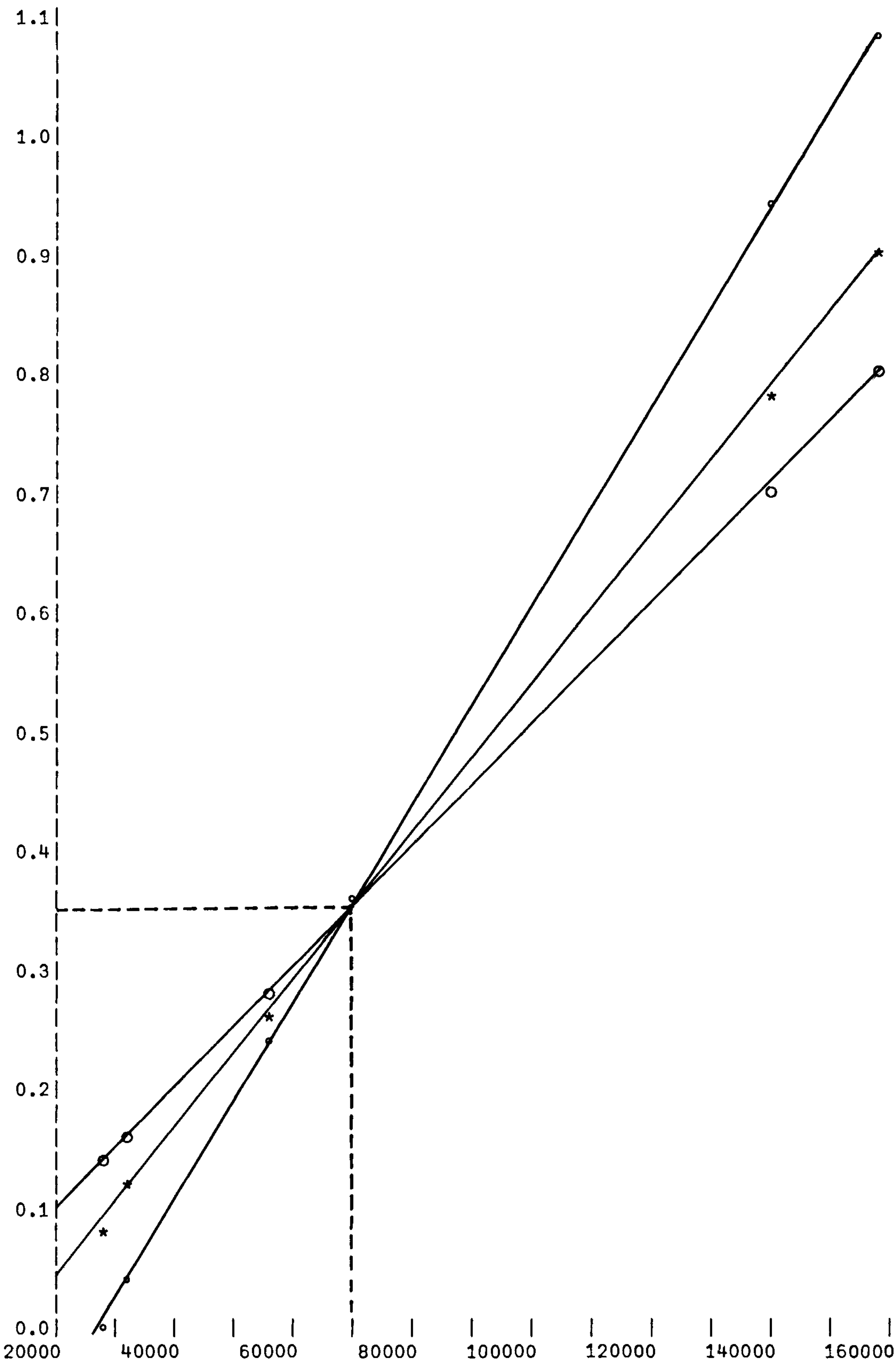
```
      LEVERAGE

ENTER THE AMOUNT NEEDED AND STOCK ISSUE PRICE, IF ANY
⎕:
      1000000 10
INTEREST RATE IF BORROWED
⎕:
      7
TAX RATE
⎕:
      50
PERCENTAGES OF BORROWING
⎕:
      0 20 40
ENTER DIFFERENT AMOUNTS OF EBIT
⎕:
      28000 32000 56000 70000 140000 158000
```

PERCENTAGE BORROWING	AMOUNT OF O.E.	NO. OF SHARES	CREDITORS EQUITY.	INTEREST EXPENSE.
0	1,000,000	100,000	0	0
20	800,000	80,000	200,000	14,000
40	600,000	60,000	400,000	28,000

EBIT	INCOME AFTER INTEREST °/° OF BORROWING			INCOME AFTER TAX °/° OF BORROWING			EPS °/° OF BORROWING		
	0	20	40	0	20	40	0	20	40
28,000	28,000.00	14,000.00	0.00	14,000.00	7,000.00	0.00	0.14	0.09	0.00
32,000	32,000.00	18,000.00	4,000.00	16,000.00	9,000.00	2,000.00	0.16	0.11	0.03
56,000	56,000.00	42,000.00	28,000.00	28,000.00	21,000.00	14,000.00	0.28	0.26	0.23
70,000	70,000.00	56,000.00	42,000.00	35,000.00	28,000.00	21,000.00	0.35	0.35	0.35
140,000	140,000.00	126,000.00	112,000.00	70,000.00	63,000.00	56,000.00	0.70	0.79	0.93
158,000	158,000.00	144,000.00	130,000.00	79,000.00	72,000.00	65,000.00	0.79	0.90	1.08

THE BREAK EVEN POINT IS $ 70,000

DO YOU NEED A PLOT OF THESE?
YES


1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
20000
40000
60000
80000
100000
120000
140000
160000

B. OEANALYSIS

```
      ∇OEANALYSIS[⎕]∇

    ∇ OEANALYSIS;A;AS;AX;B;C;D;E;EPC;F;RE;TP;TPS;TRS;TS
[1]  START:'ENTER THE AUTHORIZED CAPITAL SHARES AND STOCK AND PAR VALUE'
[2]   AX←2↑⎕
[3]   TPS←TP←EPC←RE←0
[4]   A←4⍴0
[5]   F←3⍴0
[6]   C←D←E←TS←TRS←2⍴0
[7]   B←2⍴1
[8]   'IS THIS A NEW ISSUE?'
[9]   →('N'=1↑⍞)/Q2
[10] Q1:'STOCK ISSUED, PRICE, DIRECTORS'' AND UNDERWRITERS'' SHARE AND PRICE, IF ANY
      '
[11] INPUT1:A←4↑⎕
[12]  TS[1]←+/TS[1],A[1]
[13]  TS[2]←AX[2]×÷/B[2 1]
[14]  TPS←×/TS
[15]  EPC←EPC+(((A[1]-A[3])×A[2])+(A[3]×A[4]))-A[1]×TS[2]
[16] SEE1:'DO YOU WANT TO SEE THE TRANSACTIONS?'
[17]  →('YN'=1↑⍞)/OUT1,QQ
[18] Q2:'ENTER STOCKS ISSUED AND OUTSTANDING AND PRICE'
[19]  X←2⍴⎕
[20]  TS[1]←TS[1]+X[1]
[21]  TS[2]←AX[2]×÷/B[2 1]
[22]  TPS←×/TS
[23]  'CAPITAL IN EXCESS OF PAR OR STATED VALUE'
[24]  EPC←1⍴⎕
[25]  'TREASURY STOCK HELD AND PRICE'
[26]  TP←×/TRS←2⍴⎕
[27]  'RETAINED EARNINGS'
[28]  RE←⎕
[29]  'DO YOU WANT TO SEE THE DATA?'
[30]  →('Y'=1↑⍞)/OUT1
[31] QQQ:'ENTER IF YOU HAVE:  AN ISSUE, DIVIDEND, SPLIT OF STOCK'
[32]  'OR DID YOU ACQUIRE, RETIRE, OR SELL ANY TREASURY STOCK?'
[33]  'IF NONE HIT THE TAB AND THE CARRIAGE RETURN'
[34] QQ:'ENTER THE TRANSACTION. FOR HELP TYPE ''HELP'''
[35]  →('EDTIRSH'=4↓5⍴⍞)/Q1,Q4,Q3,Q5,Q7,Q6,QQQ
[36]  'WERE ANY OF THE STOCK OPTIONS EXERCISED?'
[37]  →('YN'=1↑⍞)/Q9,0
[38] Q3:'ENTER THE STOCK SPLIT(E.G., 2 1 INSTEAD OF 2 TO 1)'
[39]  B←2↑⎕
[40]  TS[1]←TS[1]×÷/B
[41]  TS[2]←TS[2]×÷/B[2 1]
[42]  TPS←×/TS
[43]  TRS[1]←TRS[1]×÷/B
[44] SEE2:'DO YOU WANT TO SEE THE TRANSACTION?'
[45]  →('YN'=1↑⍞)/OUT,QQ
[46] Q4:'ENTER THE STOCK DIVIDEND  RETAINED EARNINGS AND PRICE'
```

```
[47]  F←3↑⎕
[48]  TS[1]←TS[1]+AS←TS[1]×F[1]÷100
[49]  TPS←×/TS
[50]  EPC←(EPC+AS×F[3])-AS×TS[2]
[51]  RE←RE+F[2]-AS×F[3]
[52] SEE3:'DO YOU WANT TO SEE THE TRANSACTIONS?'
[53]  →('YN'=1↑⍞)/OUT,QQ
[54] Q5:'ENTER THE NUMBER OF SHARES AND MARKET PRICE'
[55]  C←2ρ⎕
[56]  TRS[1]←TRS[1]+C[1]
[57]  TP←TP+×/C
[58]  'DO YOU WANT TO SEE THE TRANSACTION?'
[59]  →('YN'=1↑⍞)/OUT,QQ
[60] Q9:'ENTER THE NUMBER OF STOCKS'
[61]  TRS[1]←TRS[1]-⎕
[62]  TP←×/TRS
[63]  'DO YOU WANT TO SEE THE TRANSACTIONS?'
[64]  →('YN'=1↑⍞)/OUT,QQ
[65] Q6:'ENTER THE NUMBER OF TR. STOCKS SOLD AND THE PRICE'
[66]  D←2ρ⎕
[67]  TRS[1]←TRS[1]-D[1]
[68]  TP←×/TRS
[69]  RE←RE+(×/D)-(D[1]×TRS[2])
[70] PB:'DO YOU WANT TO SEE THE TRANSACTIONS?'
[71]  →('YN'=1↑⍞)/OUT,QQ
[72] Q7:'ENTER THE NO. OF TR. STOCKS RETIRED AND PRICE OF ACQUISITION'
[73]  'IF THERE HAS BEEN A STOCK SPLIT AFTER ACQUISITION ADJUST THE PRICE'
[74]  E←2ρ⎕
[75]  TS[1]←TS[1]-E[1]
[76]  TPS←×/TS
[77]  EPC←EPC-((×/E)-(E[1]×TS[2]))
[78]  'DO YOU WANT TO SEE THE TRANSACTIONS?'
[79]  →('YN'=1↑⍞)/OUT,QQ
[80] OUT:'


      '
[81]  OUTPUT
[82]  →QQ
[83] OUT1:'

      '
[84]  '⍞AUTHORIZED CAPITAL ⍞,CI12,X2,⍞SHARES AT ⍞,I3,X5,CI12' ΔFMT(AX[1];AX[
      2];×/AX)
[85]  '

      '
[86]  OUTPUT
[87]  →QQ
      ∇
```

```
      ∇OUTPUT[⎕]∇

    ∇ OUTPUT;CC;OE
[1]   OE←(CC←TPS+EPC-TP)+RE
[2]   ,('CI8' ΔFMT TS[1]);'  STOCKS ISSUED AND OUTSTANDING AT $';TS[2];,('X2,CI12'
      ΔFMT TPS)
[3]   →(EPC=0)/NQ1
[4]   '⍞EXCESS PAID IN CAPITAL OR (DISCOUNT)⍞,X13,M⍞(⍞N⍞)⍞Q⍞ ⍞CI12' ΔFMT EPC
[5]  NQ1:→(TP=0)/NQ2
[6]   '⍞LESS⍞,X2,CI10,⍞  SHARES HELD IN TR.⍞,X12,CI12' ΔFMT(TRS[1];TP)
[7]  NQ2:48ρ' ';'------------'
[8]   '⍞CONTRIBUTED CAPITAL⍞,X29,CI12' ΔFMT CC
[9]   →(RE=0)/NQ3
[10]  '⍞RETAINED EARNINGS⍞,X31,CI12' ΔFMT RE
[11] NQ3:→(CC=OE)/QN
[12]  48ρ' ';'------------'
[13]  '⍞OWNERS'' EQUITY⍞,X34,CI12' ΔFMT OE
[14] QN:'

      '
    ∇
```

C. LEVERAGE

```
      ∇LEVERAGE[⎕]∇

    ∇ LEVERAGE;A;AOE;C;EBI;EPS;IAI;IAT;IE;IR;K;NOS;PER;TAX
[1]   K←⍳0
[2]  START:'ENTER THE AMOUNT NEEDED AND STOCK ISSUE PRICE, IF ANY'
[3]   A←2↑⎕
[4]   'INTEREST RATE IF BORROWED'
[5]   IR←⎕÷100
[6]   'TAX RATE'
[7]   TAX←⎕÷100
[8]   'PERCENTAGES OF BORROWING'
[9]   PER←,⎕÷100
[10]  IE←C←AOE←NOS←(⍴PER)⍴0
[11]  'ENTER DIFFERENT AMOUNTS OF EBIT'
[12]  EBI←,⎕
[13]  IAI←IAT←EPS←((⍴EBI),(⍴PER))⍴0
[14]  NOS←(AOE←A[1]×(1-PER))÷A[2]
[15]  IE←(A[1]-AOE)×IR
[16]  C←A[1]-AOE
[17] OUT:'

      '
[18]  'PERCENTAGE      AMOUNT OF O.E.   NO. OF SHARES     CREDITORS     INTEREST'
[19]  'BORROWING                                          EQUITY.       EXPENSE.'
[20]  'CI8,X5,CI12,X7,CI10,X5,CI10,X4,CI10' ∆FMT((PER×100);AOE;NOS;C;IE)
[21]  L←1
[22] TRB:EPS[;L]←(IAT[;L]←(IAI[;L]←EBI-IE[L])×(1-TAX))÷NOS[L]
[23]  →((⍴PER)=L)/RESULT
[24]  L←L+1
[25]  →TRB
[26] RESULT:'

      '
[27]  '                    INCOME AFTER INTEREST                          INCOME AFTER TAX
                     EPS'
[28]  'EBIT                    ∘/∘ OF BORROWING                         ∘/∘ OF BORROWING
               ∘/∘ OF BORROWING'
[29]  ' '
[30]  10⍴' ';,('10I12' ∆FMT(Q;Q)),('10I8' ∆FMT Q←((1,(⍴PER))⍴PER×100))
[31]  ' '
[32]  ('CI8,X3,10CF12.2' ∆FMT(EBI;IAI;IAT)),('10F8.2' ∆FMT EPS)
[33]  2⍴CR
[34]  'THE BREAK EVEN POINT IS $';,('CI10' ∆FMT EBI[(∧/(1⌽1 RND EPS)=1 RND EPS)⍳1])
[35]  2⍴CR
[36]  'DO YOU NEED A PLOT OF THESE?'
[37]  →('Y'=1↑⍞)/PLOT1
[38] AGAIN:'DO YOU WANT TO TRY AGAIN?'
[39]  →('YN'=1↑⍞)/START,0
[40]  '

      '
[41] PLOT1:50 PLOT EPS VS EBI
[42]  →AGAIN
    ∇
```

3
Cash Management (CASHMAN)

A. General Description

CASHMAN is the workspace containing the programs comprising the series on cash management. Any program in the series can be used after accessing CASHMAN by means of the instruction:

```
)LOAD 7 CASHMAN
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The CASHMAN workspace is defined in Exhibit 3-1, while the supporting functions and variables are displayed in Exhibit 3-2.

Exhibit 3-1
THE CASHMAN WORKSPACE

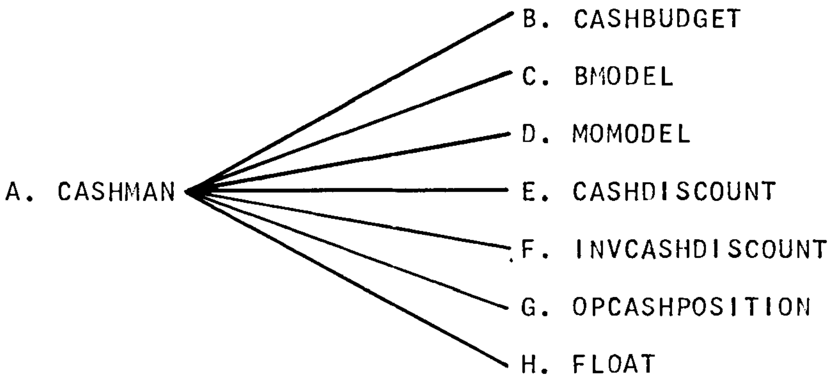


Exhibit 3-2
CASHMAN FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
CASHBUDGET	SBUDGET, SEEDATA1, SEEDATA2, COLSCHED	-
BMODEL	-	-
MOMODEL	-	-
CASHDISCOUNT	-	-
INVCASHDISCOUNT	-	-
OPCASHPOSITION	-	-
FLOAT	CT, STD, Z	-

A description of the major functions follows.

B. CASHBUDGET

This program is designed to generate a cash budget for any number of future periods. The cash budget format is designed to distinguish between operating and non-operating sources and uses of cash. An intermediate output is net operating cash position per period.

Input consists of:

1. The number of future periods.

2. Cash sales for each period.

3. Collections of accounts receivable. Enter if known; if not, the program loops through the supporting function COLSCHED, in which case this additional input is needed:

   (a) Credit sales for each period.

   (b) Collection distribution in percentages which add to 100%, e.g., first period 20%, second period 50%, third period 20%, and fourth period - 10%.

   (c) Credit sales for pertinent periods prior to the current cash budgeting period to provide for carry forward of collections. These sales should be specified in chronological order.

4. Cash purchases of operating goods and services.

5. Payments on accounts payable.

6. Wages and salaries.

7. Other cash operating expense.

8. Taxes paid.

A data summary is optional at this point, with the ability to correct the input. In the example, cash purchases (which is item #4) should be 30 30 and 10, rather than 30, 30, and 30. The instruction 4, 30, 30, 10 accomplishes the change; and zero indicates the end of the series of changes, which in this case is the one entry. A revised data summary is optional at this point.

Intermediate output in the form of an operating cash budget can be specified at this point, or we can proceed with the input of non-operating sources and uses of cash:

9. Interest income per period, (notice that entering one figure without zeroes will make that item repeat in each period).

10. Cash proceeds from sale of investments.

11. Cash proceeds from sale of fixed assets: plant and equipment.

12. Cash proceeds from sale of stock.

13. Cash proceeds from loans, bonds and other long-term creditor's equity.

14. Interest expense.

15. Investment acquired.

16. Purchase of fixed assets, treasury stock, or repayment of debt.

17. Payment of dividends.

18. Cash balance at the beginning of the first period.

A data summary is optional at this point and includes both operating and non-operating items. Changes can be effected at this juncture in the manner described above.

The final output is a comprehensive cash budget which includes: (1) operating sources and uses; (2) net operating cash position; (3) non-operating sources and uses; (4) net non-operating cash position; (5) net cash position; and (6) beginning and ending cash balance.

Example B-1 assumes that collection amounts on accounts receivable are specified, while Example B-2 illustrates the computation of collections on accounts receivable.

C. BMODEL [1]

This function performs cash modeling (optimizing cash position) under the Baumol model. Essentially, BMODEL applies the basic EOQ inventory model to the problem of cash management.

Input to the program is:

1. Total cash available during the period.

2. Investments in short-term investment portfolios.

3. Interest rate (as a percent).

4. Broker's fee per withdrawal.

The program output is:

1. The optimal maximum cash balance.

2. The optimal average cash balance.

3. The optimal number of withdrawals.

D. MOMODEL [2]

This function performs cash modeling under the Miller-Orr model.

Input consists of:

1. The marginal cost per transfer (of cash).

2. The upper bound at which a transfer is undertaken.

3. Minimum cash level restored.

4. Daily rate of interest earned on the portfolio.

5. Expected increase or decrease in the cash balance during the course of an operating period.

6. Specification of the operating period in days.

Output is:

1. The optimal average cash balance.

2. The minimum cash balance that should be maintained.

3. The optimal minimum cash level.

4. The optimal upper bound.

E. CASHDISCOUNT

This function converts a cash discount expression such as 2/10, n/30 into an effective annual rate of interest, e.g., 2(360/20)=36%, and computes the savings (or cost) involved with borrowing in order to take advantage of cash discounts.

Input is:

1. The principal amount, which represents the gross invoice billings subject to cash discounts for a given period.

2. The discount rate in the form 2/10, n/30.

3. Interest rate on borrowed funds (as a percent).

4. Number of days in the period, e.g., 360 days.

The program computes:

1. The amount of the cash discount.

2. The cost of the borrowed funds.

3. Savings (cost) by borrowing to take advantage of the discount.

4. Effective rate of interest in the discount expression.

F. INVCASHDISCOUNT

It is apparent that the inducement to offer cash discounts lies in the opportunity return on the funds obtained. In most instances, such funds would be reinvested in inventory, as this item constitutes the highest rate of return within the portfolio of assets. This program computes the break-even holding period on inventory (in days), given a cash discount expression and the inventory profit margin.

Input is:

1. The cash discount expressions, e.g., 2/10, n/30.

2. The average profit margin on inventory (as a percentage).

3. The number of days in the period, e.g., 360.

Output is:

1. The break-even inventory holding period in days. A longer holding period will result in positive leverage, while the shorter holding period will result in negative leverage.

G. OPCASHPOSITION

This function deals with the desired operating cash position, given.

Input is:

1. The number of days in the period, e.g., 360.

2. The desired number of days to be covered by cash balances based on average daily expenditures for the period.

3. The total expected cash disbursements for the period in #1 above.

The program output consists of:

1. The desired average cash balance.

2. Average daily disbursements.

The program permits a restructuring of the problem in order to solve for the number of days of average cash disbursements or the estimated cash disbursements for the period.

H. FLOAT

This function copes with elementary float analysis in situations dealing with the time lag between issuing checks and the point where they clear the payor's account.

Input is:

1. The number of payees.

2. For each payee, enter the name, amount of payment followed in each instance by the float period in days.

Output consists of:

1. A summary of the payees, their average float and average transactions.

2. Probability analysis applied to the portfolio of accounts.

References:
1. William J. Baumol, "The Transaction Demand for Cash: An Inventory Theoretic Approach," Quarterly Journal of Economics, (November 1952), pp. 545-556.
2. Merton H. Miller and Daniel Orr, "A Model of the Demand for Money by Firms," Quarterly Journal of Economics, (August 1966), pp. 413-435.

B. *CASHBUDGET*
(*EXAMPLE B*-1)

```
    CASHBUDGET

NUMBER OF PERIODS
⎕:
    3
1. CASH SALES FOR 3 PERIODS
⎕:
    200 300 300
3. COLLECTIONS ON ACCOUNTS RECEIVABLE. IF YOU DO NOT HAVE
COLLECTIONS TYPE 'HELP'. OTHERWISE HIT THE CARRIAGE RETURN

⎕:
    477 492 566.5
4. CASH PURCHASES
⎕:
    30
5. PAYMENTS ON ACCOUNTS PAYABLE
⎕:
    500 600 500
6. WAGES AND SALARIES
⎕:
    0
7. OTHER CASH OPERATING EXPENSES
⎕:
    80 140 140
8. TAXES PAID
⎕:
    0
DO YOU WANT TO SEE YOUR DATA?
YES


NO.    ACCOUNT                AMOUNT
1. CASH SALES            200.00      300.00      300.00
2. CREDIT SALES            0.00        0.00        0.00
3. COLLECTIONS ON A/R    477.00      492.00      566.50
4. CASH PURCHASES         30.00       30.00       30.00
5. PAYMENTS ON A/P       500.00      600.00      500.00
6. WAGES AND SALARIES      0.00        0.00        0.00
7. OTHER CASH OP. EXP     80.00      140.00      140.00
8. TAXES PAID              0.00        0.00        0.00


DO YOU WANT TO CHANGE ANY DATA?
YES


PLEASE TYPE THE CHANGED DATA. (A ZERO SIGNALS THE END)
⎕:
    4 30 30 10
⎕:
```

```
      0
DO YOU WANT TO SEE YOUR DATA?
NO
DO YOU WANT TO SEE THE NET OPERATING CASH POSITION?
YES


PERIOD                          1         2         3     TOTAL


OPERATING SOURCES
CASH SALES                 200.00    300.00    300.00    800.00
COLLECTIONS ON A/R         477.00    492.00    566.50   1535.50
                        ----------------------------------------
TOTAL OP. SOURCES          677.00    792.00    866.50   2335.50

USES
CASH PURCHASES              30.00     30.00     10.00     70.00
PAYMENTS ON A/P            500.00    600.00    500.00   1600.00
WAGES AND SALARIES           0.00      0.00      0.00      0.00
OTHER OP. EXPENSES          80.00    140.00    140.00    360.00
TAXES PAID                   0.00      0.00      0.00      0.00
                        ----------------------------------------
TOTAL OP. USES             610.00    770.00    650.00   2030.00
                        ----------------------------------------
NET OPERATING CASH          67.00     22.00    216.50    305.50
                        ----------------------------------------


DO YOU WANT TO INCLUDE NON-OPERATING ITEMS IN THE BUDGET?
YES
9. INTEREST INCOME
⎕:
      5
10. SALE OF INVESTMENTS
⎕:
      50 30 0
11. SALE OF FIXED ASSETS
⎕:
      0
12. SALE OF STOCK
⎕:
      0 0 100
13. LOANS, BONDS OR OTHER LONG-TERM CREDITORS' EQUITY
⎕:
      0
14. INTEREST EXPENSE
⎕:
      10
15. INVESTMENTS
⎕:
      50 90 100
```

16. *PURCHASE OF FIXED ASSETS, TREASURY STOCK, REPAYMENT OF DEBT ETC.,*
⎕:
    0 70 50
17. *PAYMENT OF DIVIDENDS*
⎕:
    20
18. *CASH BALANCE AT THE BEGINNING OF THE FIRST PERIOD*
⎕:
    150

DO YOU WANT TO SEE YOUR DATA?
YES

NO. ACCOUNT	AMOUNT		
1. *CASH SALES*	200.00	300.00	300.00
2. *CREDIT SALES*	0.00	0.00	0.00
3. *COLLECTIONS ON A/R*	477.00	492.00	566.50
4. *CASH PURCHASES*	30.00	30.00	10.00
5. *PAYMENTS ON A/P*	500.00	600.00	500.00
6. *WAGES AND SALARIES*	0.00	0.00	0.00
7. *OTHER CASH OP. EXP*	80.00	140.00	140.00
8. *TAXES PAID*	0.00	0.00	0.00
9. *INTEREST INCOME*	5.00	5.00	5.00
10.*SALE OF INVEST.*	50.00	30.00	0.00
11.*SALE OF F/A*	0.00	0.00	0.00
12.*SALE OF STOCK*	0.00	0.00	100.00
13.*LOANS BONDS ETC.*	0.00	0.00	0.00
14.*INTEREST EXPENSE*	10.00	10.00	10.00
15.*INVESTMENTS*	50.00	90.00	100.00
16.*PURCHASE OF F/A.*	0.00	70.00	50.00
17.*PAYMENT OF DIV.*	20.00	20.00	20.00
18.*BEG. CASH BALANCE*	150.00		

DO YOU WANT TO CHANGE ANY DATA?
NO

CASH BUDGET

PERIOD	1	2	3	*TOTAL*
OPERATING SOURCES				
CASH SALES	200.00	300.00	300.00	800.00
COLLECTIONS ON A/R	477.00	492.00	566.50	1535.50
TOTAL OP. SOURCES	677.00	792.00	866.50	2335.50
USES				
CASH PURCHASES	30.00	30.00	10.00	70.00
PAYMENTS ON A/P	500.00	600.00	500.00	1600.00
WAGES AND SALARIES	0.00	0.00	0.00	0.00
OTHER OP. EXPENSES	80.00	140.00	140.00	360.00
TAXES PAID	0.00	0.00	0.00	0.00
TOTAL OP. USES	610.00	770.00	650.00	2030.00
NET OPERATING CASH	67.00	22.00	216.50	305.50
NON-OPERATING SOURCES				
INTEREST INCOME	5.00	5.00	5.00	15.00
SALE OF INVESTMENTS	50.00	30.00	0.00	80.00
SALE OF F/A	0.00	0.00	0.00	0.00
CONTRIBUTED CAPITAL	0.00	0.00	100.00	100.00
LOANS, BONDS ETC.,	0.00	0.00	0.00	0.00
TOTAL NON-OP. SOURCES	55.00	35.00	105.00	195.00
USES				
INTEREST EXPENSE	10.00	10.00	10.00	30.00
INVESTMENTS	50.00	90.00	100.00	240.00
PURCHASE OF F/A ETC.,	0.00	70.00	50.00	120.00
DIVIDENDS DECLARED	20.00	20.00	20.00	60.00
TOTAL NON-OP. USES	80.00	190.00	180.00	450.00
NET NON-OP. CASH	(25.00)	(155.00)	(75.00)	(255.00)
NET CASH	42.00	(133.00)	141.50	50.50
CASH BALANCE-BEG.	150.00	192.00	59.00	150.00
CASH BALANCE ENDING	192.00	59.00	200.50	200.50

DO YOU WANT TO TRY FOR OTHER PERIODS?
NO

(*EXAMPLE B*-2)

```
      CASHBUDGET

NUMBER OF PERIODS
⎕:
      4
1. CASH SALES FOR 4 PERIODS
⎕:
      0
3. COLLECTIONS ON ACCOUNTS RECEIVABLE. IF YOU DO NOT HAVE
COLLECTIONS TYPE 'HELP'. OTHERWISE HIT THE CARRIAGE RETURN.
HELP
2. CREDIT SALES FOR 4 PERIODS
⎕:
      30000 40000 20000 20000
COLLECTION SCHEDULE. INPUT FORMAT--- ENTER THE PERCENTAGES
OF COLLECTION FOR EACH PERIOD, BEGINNING IN THE PERIOD OF
SALES. THESE PERCENTAGES SHOULD ADD TO 100 IF THE COLLECTION
PERIOD IS LESS THAN THE BUDGETING PERIOD. (E.G., 20 50 20 10)
⎕:
      20 70 10
CREDIT SALES FOR THE PAST 3 PERIOD(S)
⎕:
      10000 10000 20000
THE COLLECTION SCHEDULE IS---
  21000.00  31000.00  35000.00  22000.00
4. CASH PURCHASES
⎕:
      28000 14000 14000 7000
5. PAYMENTS ON ACCOUNTS PAYABLE
⎕:
      21000 28000 14000 14000
6. WAGES AND SALARIES
⎕:
      2000 2500 1500 1500
7. OTHER CASH OPERATING EXPENSES
⎕:
      500
8. TAXES PAID.
⎕:
      8000 0 0 0
DO YOU WANT TO SEE YOUR DATA?
NO
DO YOU WANT TO SEE THE NET OPERATING CASH POSITION?
YES
```

PERIOD	1	2	3	4	TOTAL
OPERATING SOURCES					
CASH SALES	0.00	0.00	0.00	0.00	0.00
COLLECTIONS ON A/R	21000.00	31000.00	35000.00	22000.00	109000.00
TOTAL OP. SOURCES	21000.00	31000.00	35000.00	22000.00	109000.00
USES					
CASH PURCHASES	28000.00	14000.00	14000.00	7000.00	63000.00
PAYMENTS ON A/P	21000.00	28000.00	14000.00	14000.00	77000.00
WAGES AND SALARIES	2000.00	2500.00	1500.00	1500.00	7500.00
OTHER OP. EXPENSES	500.00	500.00	500.00	500.00	2000.00
TAXES PAID	8000.00	0.00	0.00	0.00	8000.00
TOTAL OP. USES	59500.00	45000.00	30000.00	23000.00	157500.00
NET OPERATING CASH	(38500.00)	(14000.00)	5000.00	(1000.00)	(48500.00)

DO YOU WANT TO INCLUDE NON-OPERATING ITEMS IN THE BUDGET?
NO

C. BMODEL

```
      BMODEL

ENTER TOTAL CASH AVAILALE DURING THE PERIOD
⎕:
      10000
INVESTMENTS IN SHORT-TERM INVESTMENT PORTFOLIOS
⎕:
      2000
ENTER THE INTEREST RATE (INTEREST OPPORTUNITY COST)AS A PERCENT
⎕:
      6
ENTER BROKERS' FEE PER WITHDRAWAL
⎕:
      3




THE OPTIMAL MAXIMUM CASH BALANCE IS $1000


THE OPTIMAL AVERAGE CASH BALANCE IS $500


THE NUMBER OF WITHDRAWALS IS 10


DO YOU WANT TO TRY OTHERS?
NO
```

D. MOMODEL

```
      MOMODEL

ENTER THE MARGINAL COST PER TRANSFER
⎕:
      5
ENTER THE UPPER BOUND AT WHICH A TRANSFER IS UNDERTAKEN
⎕:
      300
ENTER THE MINIMUM CASH LEVEL RESTORED
⎕:
      50
ENTER THE DAILY RATE OF INTEREST EARNED ON PORTFOLIO
⎕:
      6
ENTER THE EXPECTED INCREASE OR DECREASE IN CASH BALANCE
DURING THE COURSE OF AN OPERATING PERIOD
⎕:
      50
ENTER THE OPERATING PERIOD IN DAYS
⎕:
      12



THE OPTIMAL AVERAGE CASH BALANCE IS $164.41
THE MINIMUM CASH BALANCE THAT SHOULD BE MAINTAINED IS $827
THE OPTIMAL MINIMUM CASH LEVEL SHOULD BE $123.31
THE OPTIMAL UPPER BOUND SHOULD BE $369.93


DO YOU WANT TO TRY AGAIN?
NO
```

E. CASHDISCOUNT

```
      CASHDISCOUNT

PLEASE ENTER THE PRINCIPAL AMOUNT
⎕:
      825000
ENTER THE DISCOUNT RATE IN THE FORM:
E.G., 5 10 30 INSTEAD OF 5/10,N/30
⎕:
      5 10 30
INTEREST RATE CHARGED BY THE BANK
⎕:
      6
NUMBER OF DAYS IN THE YEAR
⎕:
      360


CASH DISCOUNT IS $41250
COST OF BORROWING FROM THE BANK IS $2612.5
SAVINGS(COST) REALIZED BY BORROWING FROM THE BANK IS $38637.5
EFFECTIVE RATE OF INTEREST IN DISCOUNT EXPRESSION IS 90


DO YOU WANT TO TRY OTHERS?
NO
```

F. INVCASHDISCOUNT

```
      INVCASHDISCOUNT

ENTER THE DISCOUNT RATE IN THE FORM:
E.G., 3 10 30 INSTEAD OF 3/10,N/30.
⎕:
      3 10 30
ENTER THE AVERAGE PROFIT MARGIN ON INVENTORY AS A PERCENTAGE
⎕:
      12
THE NUMBER OF DAYS IN THE PERIOD
⎕:
      360
```

```
FOR POSITIVE LEVERAGE YOUR INVENORY HOLDING PERIOD SHOULD EXCEED 80
DAYS GIVEN THE AVERAGE GROSS PROFIT MARGIN IS 12 PERCENT
DO YOU WANT TO TRY OTHERS?(YES OR NO)
NO
```

G. OPCASHPOSITION

```
      OPCASHPOSITION

ENTER THE NUMBER OF DAYS IN THE PERIOD
⎕:
      360
ENTER THE NUMBER OF DAYS COVERED BY THE CASH RESERVE
⎕:
      15
ENTER THE TOTAL DISBURSEMENT FOR THE PERIOD
⎕:
      720000


THE CASH BALANCE IS $30000
THE AVERAGE DAILY DISBURSEMENT IS $2000


DO YOU WANT TO TRY CHANGING THE CASH BALANCE?
YES
ENTER THE CASH BALANCE
⎕:
      120000
ENTER THE TOTAL CASH EXPENDITURE FOR THE YEAR
⎕:
      1800000


THE NUMBER OF DAYS OF AVERAGE DAILY CASH
EXPENDITURES ARE 24 DAYS


DO YOU WANT TO VARY THE NUMBER OF DAYS OF AVERAGE
DAILY CASH EXPENDITURE?
```

```
YES
ENTER THE CASH BALANCE
⎕:
      240000
ENTER THE NUMBER OF DAYS OF AVGE. CASH EXP.
⎕:
      32


THE ESTIMATED TOTAL CASH EXPENDITURE FOR
THE YEAR IS $2700000


DO YOU WANT TO TRY AGAIN?
NO
```

H. FLOAT

```
      FLOAT
ENTER THE NUMBER OF PAYEES YOU ARE ENTERING?
⎕:
      3
INPUT FORMAT FOR AMOUNT AND FLOAT:350 2 455 3 ETC.,
THE AMOUNT OF EACH TRANSACTION FOLLOWED BY THE FLOAT
ENTER THE NAME OF THE PAYEE NO. 1
NAGARAJ
ENTER THE AMOUNT AND FLOAT FOR NAGARAJ
⎕:
      250 3 400 3 650 5 700
WRONG ENTRY.... REENTER
⎕:
      250 3 400 3 650 5 700 4
ENTER THE NAME OF THE PAYEE NO. 2
DURWIN SHARP
ENTER THE AMOUNT AND FLOAT FOR DURWIN SHARP
⎕:
      350 4 125 4 250 3
ENTER THE NAME OF THE PAYEE NO. 3
JIM SCHENCK
ENTER THE AMOUNT AND FLOAT FOR JIM SCHENCK
⎕:
      400 5 650 3 750 3 450 4
```

PAYEE	AVERAGE FLOAT	AVERAGE TRANSACTION
NAGARAJ	3.75	500.00
DURWIN SHARP	3.67	241.67
JIM SCHENCK	3.75	562.50
AVERAGE	3.72	434.72

```
DO YOU WANT TO TRY, VARY THE CONFIDENCE LEVEL OR RANGE?
IF NONE HIT THE TAB AND CARRIAGE RETURN.
CONF
ENTER THE CONFIDENCE LEVEL AS A PERCENT.
⎕:
      95


THE RANGE FOR THE PORTFOLIOS IS 734.02 AND 170.52


THE RANGE FOR THE FLOAT IS 6.05 AND 1.41


DO YOU WANT TO TRY, VARY THE CONFIDENCE LEVEL OR RANGE?
IF NONE HIT THE TAB AND CARRIAGE RETURN.
RANGE
ENTER THE RANGE FOR THE PORTFOLIO AND FLOAT
⎕:
      120 2


CONFIDENCE LEVEL FOR THE GIVEN RANGE FOR THE PORTFOLIO IS 0.6


CONFIDENCE LEVEL FOR THE GIVE RANGE FOR THE FLOAT IS 0.91
DO YOU WANT TO TRY, VARY THE CONFIDENCE LEVEL OR RANGE?
IF NONE HIT THE TAB AND CARRIAGE RETURN.
```

B. CASHBUDGET

```
      ∇CASHBUDGET[⎕]∇

    ∇ CASHBUDGET;N;MAT;CBBF;CBB
[1]  START:'NUMBER OF PERIODS'
[2]   N←⎕
[3]   MAT←(17,N)⍴0
[4]   '1. CASH SALES FOR ';N;' PERIODS'
[5]   MAT[1;]←N⍴⎕
[6]   '3. COLLECTIONS ON ACCOUNTS RECEIVABLE. IF YOU DO NOT HAVE'
[7]   'COLLECTIONS TYPE ''HELP''. OTHERWISE HIT THE CARRIAGE RETURN.'
[8]   →('H'=1↑⍞)/HELP
[9]  BACK:MAT[3;]←N⍴⎕
[10]  →NEXT
[11] HELP:COLSCHED
[12] NEXT:'4. CASH PURCHASES'
[13]  MAT[4;]←N⍴⎕
[14]  '5. PAYMENTS ON ACCOUNTS PAYABLE'
[15]  MAT[5;]←N⍴⎕
[16]  '6. WAGES AND SALARIES'
[17]  MAT[6;]←N⍴⎕
[18]  '7. OTHER CASH OPERATING EXPENSES.'
[19]  MAT[7;]←N⍴⎕
[20]  '8. TAXES PAID.'
[21]  MAT[8;]←N⍴⎕
[22] SEE3:'DO YOU WANT TO SEE YOUR DATA?'
[23]  →('YN'=1↑⍞)/SEE1,XXX
[24]  →SEE3
[25] XXX:'DO YOU WANT TO SEE THE NET OPERATING CASH POSITION?'
[26]  →('YN'=1↑⍞)/SEE,PP12
[27]  →XXX
[28] PP12:'9. INTEREST INCOME.'
[29]  MAT[9;]←N⍴⎕
[30]  '10. SALE OF INVESTMENTS.'
[31]  MAT[10;]←N⍴⎕
[32]  '11. SALE OF FIXED ASSETS'
[33]  MAT[11;]←N⍴⎕
[34]  '12. SALE OF STOCK.'
[35]  MAT[12;]←N⍴⎕
[36]  '13. LOANS, BONDS OR OTHER LONG-TERM CREDITOR''S EQUITY'
[37]  MAT[13;]←N⍴⎕
[38]  '14. INTEREST EXPENSE'
[39]  MAT[14;]←N⍴⎕
[40]  '15. INVESTMENTS'
[41]  MAT[15;]←N⍴⎕
[42]  '16. PURCHASE OF FIXED ASSETS, TREASURY STOCK, REPAYMENT OF     DEBT ETC.,'
[43]  MAT[16;]←N⍴⎕
[44]  '17. PAYMENT OF DIVIDENDS.'
[45]  MAT[17;]←N⍴⎕
[46]  '18. CASH BALANCE AT THE BEGINNING OF THE FIRST PERIOD.'
[47]  CBBF←1↑⎕
[48] SEE4:'DO YOU WANT TO SEE YOUR DATA?'
[49]  →('YN'=1↑⍞)/SEE2,OUT
[50]  →SEE4
```

```
[51] SEE:2ρC̲R̲
[52]  SMAT←(7,N)ρ(,MAT[1,(2+ι6);])
[53]  (,'⍞PERIOD⍞,X17,10I10' ΔFMT(1,N)ριN),'    TOTAL'
[54]  ' '
[55]  CBUDGET SMAT
[56]  1ρC̲R̲
[57]  →PP11
[58] SEE1:SEEDATA1
[59]  1ρC̲R̲
[60] PA:'DO YOU WANT TO CHANGE ANY DATA?'
[61]  →('YN'=1↑⍞)/CHANGE,XXX
[62]  →PA
[63] SEE2:SEEDATA2
[64]  1ρC̲R̲
[65] PB:'DO YOU WANT TO CHANGE ANY DATA?'
[66]  →('YN'=1↑⍞)/CHANGE1,OUT
[67]  →PB
[68] PP11:'DO YOU WANT TO INCLUDE NON-OPERATING ITEMS IN THE BUDGET?'
[69]  →('YN'=1↑⍞)/PP12,0
[70]  →PP11
[71] OUT:2ρC̲R̲
[72]  (((12+N×10)÷2)ρ' ');'CASH BUDGET',(11ρBS),'___________'
[73]  1ρC̲R̲
[74]  (,'⍞PERIOD⍞,X17,10I10' ΔFMT(1,N)ριN),'    TOTAL'
[75]  ' '
[76]  CBUDGET SMAT←(7,N)ρ(,MAT[1,(2+ι6);])
[77]  ' '
[78]  SBUDGET XMAT←(9,N)ρ(,MAT[8+ι9;])
[79]  ' '
[80]  '⍞NET CASH⍞,X16,10M⍞(⍞N⍞)⍞Q⍞ ⍞F10.2' ΔFMT(((1,N)ρXYZ);+/XYZ←Z̲+ZZ)
[81]  CBB←Nρ0
[82]  CBB[1]←CBBF
[83]  J←1
[84] TRA:CBB[J+1]←CBB[J]+XYZ[J]
[85]  J←J+1
[86]  →(J<N)/TRA
[87]  '⍞CASH BALANCE-BEG.⍞,X7,10M⍞(⍞N⍞)⍞Q⍞ ⍞F10.2' ΔFMT(((1,N)ρCBB);CBBF)
[88]  (23ρ' '),(10×(N+1))ρ'-'
[89]  '⍞CASH BALANCE ENDING⍞,X5,10M⍞(⍞N⍞)⍞Q⍞ ⍞F10.2' ΔFMT(((1,N)ρXYZ+CBB);((N-1)↓(
      XYZ+CBB)))
[90]  (23ρ' '),(10×(N+1))ρ'-'
[91] PC:'DO YOU WANT TO TRY FOR OTHER PERIODS?'
[92]  →('YN'=1↑⍞)/START,0
[93]  →PC
[94] CHANGE:'

      '
```

```
[95]  'PLEASE TYPE THE CHANGED DATA. (A ZERO SIGNALS THE END)'
[96] NEW:NN←,(⎕)
[97]  →((1↑NN)=0)/SEE3
[98]  →((ρNN)=(1+N))/LX1
[99]  →((ρNN)≠3)/ERROR
[100] →(∧/NN[1]≠ι8)/ERROR
[101] →(∧/NN[2]≠ιN)/ERROR
[102] MAT[NN[1];(ιN)ιNN[2]]←2↓NN
[103] →NEW
[104]LX1:→(∧/NN[1]≠ι8)/ERROR
[105] MAT[NN[1];]←1↓NN
[106] →NEW
[107]ERROR:'WRONG ENTRY....REENTER'
[108] →NEW
[109]CHANGE1:'

      PLEASE TYPE THE CHANGED DATA.(A ZERO SIGNALS THE END)'
[110]NEW1:NN←,(⎕)
[111] →((1↑NN)=0)/SEE4
[112] →((ρNN)=(1+N))/LX2
[113] →((ρNN)≠3)/ERROR1
[114] →(∧/NN[1]≠ι18)/ERROR1
[115] →(∧/NN[2]≠ιN)/ERROR1
[116] MAT[NN[1];(ιN)ιNN[2]]←2↓NN
[117] →NEW1
[118]LX2:→(∧/NN[1]≠ι18)/ERROR1
[119] MAT[NN[1];]←1↓NN
[120] →NEW1
[121]ERROR1:'WRONG ENTRY....REENTER'
[122] →NEW1
      ∇
```

```
      ∇CBUDGET[⎕]∇

    ∇ CBUDGET M
[1]   '
      OPERATING SOURCES',(17ρBS),'_________________'
[2]   '⍞CASH SALES⍞,X13,10F10.2' ΔFMT(((1,N)ρM[1;]);+/M[1;])
[3]   '⍞COLLECTIONS ON A/R⍞,X5,10F10.2' ΔFMT(((1,N)ρM[2;]);+/M[2;])
[4]   (23ρ' '),(10×(N+1))ρ'-'
[5]   '⍞TOTAL OP. SOURCES⍞,X6,10F10.2' ΔFMT(((1,N)ρX);+/X←+⌿M[1 2 ;])
[6]   '
      USES',(4ρBS),'____'
[7]   '⍞CASH PURCHASES⍞,X9,10F10.2' ΔFMT(((1,N)ρM[3;]);+/M[3;])
[8]   '⍞PAYMENTS ON A/P⍞,X8,10F10.2' ΔFMT(((1,N)ρM[4;]);+/M[4;])
[9]   '⍞WAGES AND SALARIES⍞,X5,10F10.2' ΔFMT(((1,N)ρM[5;]);+/M[5;])
[10]  '⍞OTHER OP. EXPENSES⍞,X5,10F10.2' ΔFMT(((1,N)ρM[6;]);+/M[6;])
[11]  '⍞TAXES PAID ⍞,X12,10F10.2' ΔFMT(((1,N)ρM[7;]);+/M[7;])
[12]  (23ρ' '),(10×(N+1))ρ'-'
[13]  '⍞TOTAL OP. USES⍞,X9,10F10.2' ΔFMT(((1,N)ρY);+/Y←+⌿M[2+⍳5;])
[14]  (23ρ' '),(10×(N+1))ρ'-'
[15]  '⍞NET OPERATING CASH⍞,X6,10M⍞(⍞W⍞)⍞Q⍞ ⍞F10.2' ΔFMT(((1,N)ρ⍙);+/⍙←X-Y)
[16]  (23ρ' '),(10×(N+1))ρ'-'
    ∇

      ∇SBUDGET[⎕]∇

    ∇ SBUDGET K
[1]   '
      NON-OPERATING SOURCES',(21ρBS),'___ __________________'
[2]   '⍞INTEREST INCOME⍞,X8,10F10.2' ΔFMT(((1,N)ρK[1;]);+/K[1;])
[3]   '⍞SALE OF INVESTMENTS⍞,X4,10F10.2' ΔFMT(((1,N)ρK[2;]);+/K[2;])
[4]   '⍞SALE OF F/A⍞,X12,10F10.2' ΔFMT(((1,N)ρK[3;]);+/K[3;])
[5]   '⍞CONTRIBUTED CAPITAL⍞,X4,10F10.2' ΔFMT(((1,N)ρK[4;]);+/K[4;])
[6]   '⍞LOANS, BONDS ETC.,⍞,X5,10F10.2' ΔFMT(((1,N)ρK[5;]);+/K[5;])
[7]   (23ρ' '),(10×(N+1))ρ'-'
[8]   '⍞TOTAL NON-OP. SOURCES⍞,X2,10F10.2' ΔFMT(((1,N)ρXX);+/XX←+⌿K[⍳5;])
[9]   (23ρ' '),(10×(N+1))ρ'-'
[10]  '
      USES',(4ρBS),'____'
[11]  '⍞INTEREST EXPENSE⍞,X7,10F10.2' ΔFMT(((1,N)ρK[6;]);+/K[6;])
```

```
[12]  '⍞INVESTMENTS⍞,X12,10F10.2' ΔFMT(((1,N)ρK[7;]);+/K[7;])
[13]  '⍞PURCHASE OF F/A ETC.,⍞,X2,10F10.2' ΔFMT(((1,N)ρK[8;]);+/K[8;])
[14]  '⍞DIVIDENDS DECLARED⍞,X5,10F10.2' ΔFMT(((1,N)ρK[9;]);+/K[9;])
[15]  (23ρ' '),(10×(N+1))ρ'-'
[16]  '⍞TOTAL NON-OP. USES⍞,X5,10F10.2' ΔFMT(((1,N)ρYY);+/YY←+⌿K[5+⍳4;])
[17]  (23ρ' '),(10×(N+1))ρ'-'
[18]  '⍞NET NON-OP. CASH⍞,X8,10M⍞(⍞N⍞)⍞Q⍞ ⍞F10.2' ΔFMT(((1,N)ρZZ);+/ZZ←XX-YY)
[19]  (23ρ' '),(10×(N+1))ρ'-'
      ∇
```

```
      ∇SEEDATA1[⎕]∇

    ∇ SEEDATA1
[1]   M1←'1. CASH SALES         2. CREDIT SALES        3. COLLECTIONS ON A/R'
[2]   M1←M1,'4. CASH PURCHASES     5. PAYMENTS ON A/P   6. WAGES AND SALARIES'
[3]   M2← 8 21 ρM1←M1,'7. OTHER CASH OP. EXP8. TAXES PAID          '
[4]   MATRIX1←(8,N)ρ(,MAT[⍳8;])
[5]   '

      '
[6]   'NO.      ACCOUNT';(((N×10)-6)÷2)ρ' ';'       AMOUNT'
[7]   '21A1,X2,10F11.2' ΔFMT(M2;MATRIX1)
    ∇
```

```
      ∇SEEDATA2[⎕]∇

    ∇ SEEDATA2
[1]   M3←M1,'9. INTEREST INCOME    10.SALE OF INVEST.   '
[2]   M3←M3,'11.SALE OF F/A        12.SALE OF STOCK     '
[3]   M3←M3,'13.LOANS BONDS ETC.   14.INTEREST EXPENSE  '
[4]   M3←M3,'15.INVESTMENTS        16.PURCHASE OF F/A.  '
[5]   M3←M3,'17.PAYMENT OF DIV.    18.BEG. CASH BALANCE '
[6]   M4← 18 21 ρM3
[7]   '

      '
[8]   'NO.      ACCOUNT';(((N×10)-6)÷2)ρ' ';'       AMOUNT'
[9]   '21A1,X2,10F11.2' ΔFMT(M4;MAT)
    ∇
```

```
      ∇COLSCHED[⎕]∇

    ∇ COLSCHED;CSHEDULE;CSHED;CPAST;CSCHED;MATRIX
[1]   '2. CREDIT SALES FOR ';N;' PERIODS'
[2]   MAT[2;]←Nρ⎕
[3]   'COLLECTION SCHEDULE. INPUT FORMAT--- ENTER THE PERCENTAGES'
[4]   'OF COLLECTION FOR EACH PERIOD, BEGINNING IN THE PERIOD OF'
[5]   'SALES. THESE PERCENTAGES SHOULD ADD TO 100 IF THE COLLECTION'
[6]   'PERIOD IS LESS THAN THE BUDGETING PERIOD. (E.G., 20 50 20 10)'
[7]  PP00:CSHEDULE←,(⎕)
[8]   →(((ρCSHEDULE)<N)∧((+/CSHEDULE)≠100))/ERROR
[9]   CSHED←N↑CSHEDULE
[10]  →START
[11] ERROR:'THE TOTAL PERCENT SHOULD BE 100....REENTER'
[12]  →PP00
[13] START:'CREDIT SALES FOR THE PAST ';ρCSHEDULE;' PERIOD(S)'
[14]  CPAST←(ρCSHEDULE)↑⎕
[15]  CSCHED←CPAST,MAT[2;]
[16]  MATRIX←(CSHEDULE÷100)∘.×CSCHED
[17]  I←1
[18] TRA:MATRIX[I;]←(ρCSCHED)↑((I-1)ρ0),MATRIX[I;]
[19]  I←I+1
[20]  →(I≤ρCSHEDULE)/TRA
[21] OUT:'THE COLLECTION SCHEDULE IS---'
[22]  '10F10.2' ΔFMT((1,N)ρMAT[3;]←(ρCPAST)↓+/⍉MATRIX)
    ∇
```

C. BMODEL

```
      ∇BMODEL[⎕]∇

    ∇ BMODEL;T;I;INT;B;C;A;KD
[1]   T←1 INC 'ENTER TOTAL CASH AVAILALE DURING THE PERIOD'
[2]   'INVESTMENTS IN SHORT-TERM INVESTMENT PORTFOLIOS'
[3]   I←⎕
[4]   INT←0.01×1 INC 'ENTER THE INTEREST RATE (INTEREST OPPORTUNITY COST)AS A PERCEN
      T'
[5]   B←1 INC 'ENTER BROKERS'' FEE PER WITHDRAWAL'
[6]   A←(C←((2×B×T)÷INT)*0.5)÷2
[7]   2ρCR
[8]   'THE OPTIMAL MAXIMUM CASH BALANCE IS $';2 RND C
[9]   'THE OPTIMAL AVERAGE CASH BALANCE IS $';2 RND A
[10]  'THE NUMBER OF WITHDRAWALS IS ';2 RND T÷C
[11]  1ρCR
[12] PA:'DO YOU WANT TO TRY OTHERS?'
[13]  →('YN'=1↑⍞)/1,0
[14]  →PA
    ∇
```

D. MOMODEL

```
      ∇MOMODEL[⎕]∇

    ∇ MOMODEL;CAPZ;GAMMA;H;I;M;NU;Z;ZSTAR
[1]  START:GAMMA←1 INC 'ENTER THE MARGINAL COST PER TRANSFER'
[2]   H←1 INC 'ENTER THE UPPER BOUND AT WHICH A TRANSFER IS UNDERTAKEN'
[3]   CAPZ←H-Z←1 INC 'ENTER THE MINIMUM CASH LEVEL RESTORED'
[4]   NU←1 INC 'ENTER THE DAILY RATE OF INTEREST EARNED ON PORTFOLIO'
[5]   'ENTER THE EXPECTED INCREASE OR DECREASE IN CASH BALANCE'
[6]   M←1 INC 'DURING THE COURSE OF AN OPERATING PERIOD'
[7]   T←1 INC 'ENTER THE OPERATING PERIOD IN DAYS'
[8]   CAPZSTAR←2×ZSTAR←((3×GAMMA×(M*2)×T)÷4×NU÷100)*(1÷3)
[9]   HSTAR←3×ZSTAR
[10]  2ρCR
[11]  XX←(4÷3)×((3×GAMMA×(M*2)×T)÷4×NU÷100)*(1÷3)
[12]  'THE OPTIMAL AVERAGE CASH BALANCE IS $';2 RND XX
[13]  YY←((GAMMA×(M*2)×T)÷ZSTAR×CAPZSTAR)+GAMMA×2×CAPZSTAR÷3
[14]  'THE MINIMUM CASH BALANCE THAT SHOULD BE MAINTAINED IS $';2 RND YY
[15]  'THE OPTIMAL MINIMUM CASH LEVEL SHOULD BE $';2 RND ZSTAR
[16]  'THE OPTIMAL UPPER BOUND SHOULD BE $';2 RND 3×ZSTAR
[17]  2ρCR
[18] PA:'DO YOU WANT TO TRY AGAIN?'
[19]  →('YN'=1↑⍞)/START,0
[20]  →PA
    ∇
```

E. CASHDISCOUNT

```
      ∇CASHDISCOUNT[⎕]∇

    ∇ CASHDISCOUNT;CSALES;DRATE;BIRATE;AVDAYS;ACTAMT;ERAT;INTAMT
[1]  START:CSALES←1 INC 'PLEASE ENTER THE PRINCIPAL AMOUNT.'
[2]   'ENTER THE DISCOUNT RATE IN THE FORM:'
[3]  XX:DRATE←3 INC 'E.G., 5 10 30 INSTEAD OF 5/10,N/30'
[4]   BIRATE←0.01×1 INC 'INTEREST RATE CHARGED BY THE BANK.'
[5]   AVDAYS←1 INC 'NUMBER OF DAYS IN THE YEAR'
[6]   ACTAMT←CSALES×DRATE[1]÷100
[7]   ERAT←((ACTAMT)÷(CSALES-ACTAMT)×(DRATE[3]-DRATE[2])÷AVDAYS)×100
[8]   INTAMT←(DRATE[3]-DRATE[2])×BIRATE×(CSALES-ACTAMT)÷AVDAYS
[9]   1ρCR
[10]  'CASH DISCOUNT IS $';2 RND ACTAMT
[11]  'COST OF BORROWING FROM THE BANK IS $';2 RND INTAMT
[12]  '⍞SAVINGS(COST) REALIZED BY BORROWING FROM THE BANK IS⍞,M⍞(⍞M⍞)⍞Q⍞ ⍞F10.2'
      ΔFMT ACTAMT-INTAMT
[13]  'EFFECTIVE RATE OF INTEREST IN DISOCUNT EXPRESSION IS ';2 RND(AVDAYS÷(DRATE[
      3]-DRATE[2]))×DRATE[1]
[14]  2ρCR
[15] PA:'DO YOU WANT TO TRY OTHERS?'
[16]  →('YN'=1↑⍞)/START,0
[17]  →PA
    ∇
```

F. INVCASHDISCOUNT

```
      ∇INVCASHDISCOUNT[⎕]∇

    ∇ INVCASHDISCOUNT;DRATE;APMGN;ADAYS;INT;BTC
[1]   'ENTER THE DISCOUNT RATE IN THE FORM:'
[2]   DRATE←3 INC 'E.G., 3 10 30 INSTEAD OF 3/10,N/30.'
[3]   APMGN←1 INC 'ENTER THE AVERAGE PROFIT MARGIN ON INVENTORY AS A PERCENTAGE'
[4]   ADAYS←1 INC 'THE NUMBER OF DAYS IN THE PERIOD'
[5]   INT←(DRATE[1]÷100)×ADAYS÷(DRATE[3]-DRATE[2])
[6]   BTC←ADAYS÷INT÷APMGN÷100
[7]   1ρCR
[8]   'FOR POSITIVE LEVERAGE YOUR INVENORY HOLDING PERIOD SHOULD EXCEED ';2 RND BTC
[9]   'DAYS GIVEN THE AVERAGE GROSS PROFIT MARGIN IS ';2 RND APMGN;' PERCENT'
[10] PA:'DO YOU WANT TO TRY OTHERS?(YES OR NO)'
[11]  →('YN'=1↑⍞)/1,0
[12]  →PA
    ∇
```

G. OPCASHPOSITION

```
     ∇OPCASHPOSITION[⎕]∇

    ∇ OPCASHPOSITION;NP;NR;DT;DA;CB;CB1;CE;CE1;CB2
[1]   NP←1 INC 'ENTER THE NUMBER OF DAYS IN THE PERIOD'
[2]  START:NR←1 INC 'ENTER THE NUMBER OF DAYS COVERED BY THE CASH RESERVE'
[3]   DT←1 INC 'ENTER THE TOTAL DISBURSEMENT FOR THE PERIOD'
[4]   CB←NR×DA←DT÷NP
[5]   2ρCR
[6]   'THE CASH BALANCE IS $';2 RND CB
[7]   'THE AVERAGE DAILY DISBURSEMENT IS $';2 RND DA
[8]   1ρCR
[9]  PA:'DO YOU WANT TO TRY CHANGING THE CASH BALANCE?'
[10]  →('YN'=1↑⍞)/PB,NEXT
[11]  →PA
[12] PB:CB1←1 INC 'ENTER THE CASH BALANCE'
[13]  CE←1 INC 'ENTER THE TOTAL CASH EXPENDITURE FOR THE YEAR'
[14]  2ρCR
[15]  'THE NUMBER OF DAYS OF AVERAGE DAILY CASH'
[16]  'EXPENDITURES ARE ';2 RND CB1÷CE÷NP;' DAYS'
[17]  1ρCR
[18] NEXT:'DO YOU WANT TO VARY THE NUMBER OF DAYS OF AVERAGE'
[19]  'DAILY CASH EXPENDITURE?'
[20]  →('YN'=1↑⍞)/PC,NEXT1
[21]  →NEXT
[22] PC:CB2←1 INC 'ENTER THE CASH BALANCE'
[23]  CE2←1 INC 'ENTER THE NUMBER OF DAYS OF AVGE. CASH EXP.'
[24]  2ρCR
[25]  'THE ESTIMATED TOTAL CASH EXPENDITURE FOR'
[26]  'THE YEAR IS $';2 RND(CB2÷CE2)×NP
[27]  1ρCR
[28] NEXT1:'DO YOU WANT TO TRY AGAIN?'
[29]  →('YN'=1↑⍞)/START,0
[30]  →NEXT1
    ∇
```

H. FLOAT

```
      ∇FLOAT[⎕]∇

    ∇ FLOAT;N;NAMES;X;Y;X;XX;XM;MM;MN
[1]   MN←X←XX←⍳0
[2]  START:'ENTER THE NUMBER OF PAYEES YOU ARE ENTERING?'
[3]   N←1↑⎕
[4]   NAMES←(N,25)⍴' '
[5]   I←1
[6]   'INPUT FORMAT FOR AMOUNT AND FLOAT:350 2 455 3 ETC.,'
[7]   'THE AMOUNT OF EACH TRANSACTION FOLLOWED BY THE FLOAT'
[8]  ENTER:'ENTER THE NAME OF THE PAYEE NO. ';I
[9]   NAMES[I;]←25↑⍞
[10]  'ENTER THE AMOUNT AND FLOAT FOR ';NAMES[I;]
[11] INPUT:X←⎕
[12]  →((2|⍴X)=1)/ERROR
[13]  XX←XX,X
[14]  M←((X←(⍴X)÷2),2)⍴X
[15]  MN←(+⌿M)÷X
[16]  MN←MN,MN
[17]  →(I=N)/OUT
[18]  I←I+1
[19]  →ENTER
[20] OUT:'

      '
[21]  MM←(((⍴MN)÷2),2)⍴MN
[22]  'PAYEE                 AVERAGE FLOAT     AVERAGE TRANSACTION'
[23]  ' '
[24]  '25A1,F5.2,F15.2' ΔFMT(NAMES;MM[;2];MM[;1])
[25]  ' '
[26]  '⍞AVERAGE⍞,X18,F5.2,F15.2' ΔFMT((+⌿MM[;2])÷N;(+⌿MM[;1])÷N)
[27]  2⍴CR
[28]  XM←((N←(⍴XX)÷2),2)⍴XX
[29]  PM←(+/XM[;1])÷N
[30]  DM←(+/XM[;2])÷N
[31]  SPM←STD XM[;1]
[32]  DPM←STD XM[;2]
[33] PA:'DO YOU WANT TO TRY, VARY THE CONFIDENCE LEVEL OR RANGE?'
[34]  'IF NONE HIT THE TAB AND CARRIAGE RETURN.'
[35]  →('TCR '=1↑⍞)/TRY,CONF,RANGE,0
[36] ERROR:'WRONG ENTRY.... REENTER'
[37]  →INPUT
[38] TRY:→START
[39]  →PA
[40] CONF:ZZ←Z,1,0.01×CO←1 INC 'ENTER THE CONFIDENCE LEVEL AS A PERCENT.'
[41]  1⍴CR
[42]  'THE RANGE FOR THE PORTFOLIOS IS ';2 RND PM+SPM×ZZ;' AND ';2 RND PM-SPM×ZZ
[43]  1⍴CR
[44]  'THE RANGE FOR THE FLOAT IS ';2 RND DM+DPM×ZZ;' AND ';2 RND DM-DPM×ZZ
```

```
[45]  1ρCR
[46]  →PA
[47] RANGE:RN←2 INC 'ENTER THE RANGE FOR THE PORTFOLIO AND FLOAT'
[48]  1ρCR
[49]  'CONFIDENCE LEVEL FOR THE GIVEN RANGE FOR THE PORTFOLIO IS ';2 RND 2×(CT,1,RN[
      1]÷SPM)
[50]  1ρCR
[51]  'CONFIDENCE LEVEL FOR THE GIVE RANGE FOR THE FLOAT IS ';2 RND 2×(CT,1,RN[
      2]÷DPM)
[52]  →PA
[53] ERROR:'WRONG ENTERY....REENTER'
[54]  →INPUT
      ∇
```

```
      ∇RND[⎕]∇

    ∇ R←N RND X
[1]    →4×ι∧/(N≤0),,(2*31)≥X
[2]    R←X-N|X←X+0.5×N←10*-N
[3]    →0
[4]    R←⌊0.5+N×⌊0.5+X÷N←10*-N
    ∇
```

```
      ∇STD[⎕]∇

    ∇ R←STD X;A;B;N
[1]    R←((A←(B+.×B←(+/X)÷N))÷(N←ρX)-1)*0.5
    ∇
```

```
      ∇Z[⎕]∇

    ∇ R←Z N;A;C;T
[1]    →(∨/A←0,(FF 19)∧.=22↑'          1 STATTAB')/L0
[2]    '1 STATTAB' FF 4,(T←((ι11)∊0,FF 18)ι0),32948
[3]    →L1
[4]   L0:T←(1↓A)/FF 18
[5]   L1:→(2=ρN)/L3
[6]    'WRONG SHAPE OF INPUT'
[7]    →0
[8]   L3:→((FF 6,T,2,32948)≥N[1])/L4
[9]    'TABLE NUMBER TWO LARGE'
```

```
[10]  →0
[11] L4:→(1≥N[2]←|N[2])/L5
[12]  'WRONG TABLE ELEMENT REF.'
[13]  →0
[14] L5:R←0.01×((A-C[D])÷(-/C[1 0 +D]))+D←(((A←⌊0.5+(N[2]÷2)×100000)<C←FF 6,T,(
      2+N[1]),32948)⍳1)-1
      ∇
```

```
      ∇CT[⎕]∇

    ∇ R←CT N;A;C;T
[1]   →(∨/A←0,(FF 19)∧.=22↑'          1 STATTAB')/L0
[2]   '1 STATTAB' FF 4,(T←((⍳11)∊0,FF 18)⍳0),32948
[3]   →L1
[4]  L0:T←(1↓A)/FF 18
[5]  L1:→(2=⍴N)/L3
[6]   'WRONG SHAPE OF INPUT'
[7]   →0
[8]  L3:→((FF 6,T,2,32948)≥N[1])/L4
[9]   'TABLE NUMBER TWO LARGE'
[10]  →0
[11] L4:→((A←1+⌈(N[2]←|N[2])×100)≤⍴C←FF 6,T,(2+N[1]),32948)/L5
[12]  'WRONG TABLE ELEMENT REF.'
[13]  →0
[14] L5:R←1E¯5×⌊0.5+C[A-⌈D]+(D←1|100×N[2])×-/C[0 ¯1 +A]
    ∇
```

4
Credit Management (CREDITMAN)

A. General Description

There are three major functions in the CREDITMAN workspace, which can be accessed by the instruction:

```
)LOAD 7 CREDITMAN
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The CREDITMAN workspace is defined in Exhibit 4-1, while the supporting functions and variables are detailed in Exhibit 4-2.

Exhibit 4-1
THE CREDITMAN WORKSPACE

A. CREDITMAN — B. DFAC
A. CREDITMAN — C. CREDITRISK
A. CREDITMAN — D. NOTESDISCOUNT

Exhibit 4-2
CREDITMAN FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
DFAC	OUTPUT, METHOD1, METHOD2, METHOD3	-
CREDITRISK	-	-
NOTESDISCOUNT	-	-

A description of the major functions follows.

B. DFAC

This function creates the allowance for doubtful accounts (DFAC) schedule under three conventional methods: (1) percent of credit sales, (2) average balance in accounts receivable, and (3) aging of accounts receivable.

Initial input consists of:

1. The number of periods, e.g., 70 71 72 73.

2. Actual bad debts for each period.

3. The balance in the allowance for doubtful accounts at the beginning of the first period specified in #1 above.

4. The method used to create the allowance for doubtful accounts.

At this point the program enables the selection of one of three methods.

Additional input under the net credit sales method:

1. Net credit sales (total sales less returns) for each period.

2. The percentage of net credit sales that is assigned to the allowance for doubtful accounts.

Additional input under the average balance in receivables method:

1. The accounts receivable balance for each period, beginning one period before the number of periods specified in #1 above. This feature permits for the averaging of accounts receivable for each period based on (beginning balance + ending balance)/2.

Additional input under the aging of receivables method:

1. Specify the frequency intervals, e.g., 0-30 days, 31-60 days, 61-90 days, and "over 90 days".

2. As each frequency interval is specified, the percentage to be applied to that category of receivables is specified, as is dollar value of receivables in that class for each period.

Output consists of:

1. A detailed schedule of the allowance for doubtful accounts for each period.

2. In the case of the aging of receivables, the program produces an additional schedule relating to the aging of the accounts.

C. CREDITRISK

This function can be used to determine cutoff in accepting credit risks and to generate pro forma marginal income statements on the basis of credit risk analysis.

Input comprises:

1. The identification of the credit risk group, e.g., A, B, C, etc.

2. The identification of each group is followed by specifying the credit risk factor (as a percent), the number of persons in the group, and the potential average sales per person. The credit risk factor is defined as a variable cost of sales within each group, where a zero credit factor implies cash customers.

3. The basic variable cost, i.e., the variable costs of the firm without the imposition of credit costs, is specified as a percent.

4. Fixed costs for the firm as a whole.

5. A cutoff criterion based on minimum contribution to margin (as a percent).

The program outputs:

1. A summary of credit risk groups.

2. Cutoff, i.e., accept groups A, B, C, D and E.

3. Pro forma marginal income statements for each group and the firm as a whole.

D. NOTESDISCOUNT

This function can be used to solve problems which involve the maturity and discounting of notes. The program recognizes five variables as determinants of the maturity value of a note:

1. Face value.

2. Rate of interest (expressed as an annual percentage).

3. Term to maturity (in days).

4. Amount of interest (in dollars).

5. Maturity value.

Any three variables can be specified -- except that either the term or rate of interest (or both) must always be specified -- and the program will solve for the remaining variables.

As noted in the example which follows, it is necessary to specify the number of days in the fiscal period -- in this case 360 days. For note #1, we have input the face value of $2,000, an interest rate of 5%, and a term of 90 days. The remaining two variables are unspecified, as indicated by the two zeroes.

If discounting is involved, the function also calls for the discount period (days to maturity remaining) and the discount rate of interest (as a percentage). These figures are 60 days and 6% respectively in the example. Based on this input, the program computes the unknown variables and prints the schedule which is contained in the example that follows. In this case, note #1 has a maturity value of $2,025, the amount of interest to maturity is $25, the discount amount is $20.25, and net proceeds from discounting is $2,004.75.

The other examples involve the specification of different configuration from among these five variables.

B. DFAC

```
      DFAC

ENTER THE PERIODS (E.G., 67 68 ETC.,)
⎕:
      1970 1971 1972 1973
ENTER THE ACTUAL BAD DEBTS
⎕:
      16000 29000 33000 34000
ENTER THE BEGINNING BALANCE IN ALLOWANCE FOR DOUBTFUL ACCOUNTS.
⎕:
      0
ENTER THE METHOD OF VALUATION
CREDIT SALES, AVERAGE BALANCE IN RECEIVABLES OR AGING RECEIVABLES



CREDIT
ENTER THE NET CREDIT SALES (TOTAL SALES LESS RETURNS)
⎕:
      3000000 3100000 3200000 3500000
ENTER THE PERCENT OF CREDIT SALES THAT IS DOUBTFUL
⎕:
      1
```

PERCENTAGE OF CREDIT SALES METHOD	ALLOWANCE ACCOUNT 1970	1971	1972	1973
BALANCE: BEG.	0	14,000	16,000	15,000
AMOUNT ADDED	30,000	31,000	32,000	35,000
TOTAL AVAILABLE	30,000	45,000	48,000	50,000
LESS: BAD DEBTS	16,000	29,000	33,000	34,000
BALANCE: END	14,000	16,000	15,000	16,000

```
DO YOU WANT TO TRY OTHER METHOD?
YES
CREDIT SALES, AVERAGE BALANCE IN RECEIVABLES OR AGING RECEIVABLES


AVERAGE
ENTER THE ACCOUNTS RECEIVABLE FOR 1969 THRU 1973
⎕:
      600000 600000 700000 900000 800000
ENTER THE PERCENTAGE OF A/R THAT IS DOUBTFUL
⎕:
```

```
⎕:
      4
```

PERCENTAGE OF AVERAGE BALANCE IN ACCOUNTS RECEIVABLE METHOD	ALLOWANCE ACCOUNT 1970	1971	1972	1973
BALANCE: BEG.	0	24,000	26,000	32,000
AMOUNT ADDED	40,000	31,000	39,000	36,000
TOTAL AVAILABLE	40,000	55,000	65,000	68,000
LESS: BAD DEBTS	16,000	29,000	33,000	34,000
BALANCE: END	24,000	26,000	32,000	34,000

```
DO YOU WANT TO TRY OTHER METHOD?
YES
CREDIT SALES, AVERAGE BALANCE IN RECEIVABLES OR AGING RECEIVABLES


AGING
ENTER THE AGE OF A/C. (FORMAT:'OVER 90 DAYS' ETC.,)
WHEN YOU ARE THRU ENTERING  HIT THE CARRIAGE RETURN
FORMAT FOR INPUT OF PERCENT AND AMOUNT: 2 2000 3000 4000
INSTEAD OF '2 °/°, $2,000 3,000 4,000 ETC.,'
ENTER THE AGE
BETWEEN  0 AND 30 DAYS
ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.
⎕:
      1 350000 400000 500000 400000
ENTER THE AGE
BETWEEN 31 AND 60 DAYS
ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.
⎕:
      3 150000 210000 220000 200000
ENTER THE AGE
BETWEEN 61 AND 90 DAYS
ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.
⎕:
      10 40000 70000 140000 150000
ENTER THE AGE
OVER    90 DAYS
ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.
⎕:
      20 60000 20000 40000 50000
ENTER THE AGE
```

AGE IN DAYS	PERCENT	AMOUNT OF BAD DEBT ALLOWANCE			
		1970	1971	1972	1973←-------PERIOD
BETWEEN 0 AND 30 DAYS	1	3,500.00	4,000.00	5,000.00	4,000.00
BETWEEN 31 AND 60 DAYS	3	4,500.00	6,300.00	6,600.00	6,000.00
BETWEEN 61 AND 90 DAYS	10	4,000.00	7,000.00	14,000.00	15,000.00
OVER 90 DAYS	20	12,000.00	4,000.00	8,000.00	10,000.00
TOTAL		24,000.00	21,300.00	33,600.00	35,000.00

AGING OF ACCOUNTS RECEIVABLE METHOD	ALLOWANCE ACCOUNT 1970	1971	1972	1973
BALANCE: BEG.	0	24,000	21,300	33,600
AMOUNT ADDED	40,000	26,300	45,300	35,400
TOTAL AVAILABLE	40,000	50,300	66,600	69,000
LESS: BAD DEBTS	16,000	29,000	33,000	34,000
BALANCE: END	24,000	21,300	33,600	35,000

DO YOU WANT TO TRY OTHER METHOD?
NO
DO YOU HAVE MORE TRANSACTIONS?
NO

C. CREDITRISK

```
      CREDITRISK

INPUT FORMAT FOR THE CREDIT RISK: THE CREDIT-RISK FACTOR
FOLLOWED BY NUMBER OF PERSONS IN THE GROUP AND THE
AVERAGE SALES PER PERSON. E.G., 12 2000 500
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)
A
ENTER THE CREDIT-RISK
⎕:
      0 1000 200
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)
B
ENTER THE CREDIT-RISK
⎕:
      6 1500 600
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)
C
ENTER THE CREDIT-RISK
⎕:
      12 2000 500
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)
D
ENTER THE CREDIT-RISK
⎕:
      17 2500 400
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)
E
ENTER THE CREDIT-RISK
⎕:
      21 2000 300
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)
F
ENTER THE CREDIT-RISK
⎕:
      37 1500 200
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)
G
ENTER THE CREDIT-RISK
⎕:
      75 1000 100
ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)

ENTER THE BASIC VARIABLE COST RATE (AS A PERCENT)
⎕:
      60
ENTER FIXED COSTS
⎕:
      600000
MINIMUM CONTRIBUTION TO MARGIN
⎕:
      10

DO YOU WANT THE SUMMARY OF DATA?
```

YES

PROPERTIES OF OUR ASSUMED CREDIT RISK GROUPS

CREDIT RISK FACTOR	*CREDIT RISK GROUP.*	*POTENTIAL NUMBER OF PERSONS*	*AVERAGE SALES PER PERSON (LIMIT)*	*TOTAL POTENTIAL SALES*
0	*A*	1000	200	200000
6	*B*	1500	600	900000
12	*C*	2000	500	1000000
17	*D*	2500	400	1000000
21	*E*	2000	300	600000
37	*F*	1500	200	300000
75	*G*	1000	100	100000

ACCEPT THE GROUPS A B C D AND E

PRO-FORMA INCOME STATEMENTS ON A MARGINAL BASIS

	GROUP A	B	C	D	E	TOTAL
SALES	200,000.00	900,000.00	1,000,000.00	1,000,000.00	600,000.00	3,700,000.00
VARIABLE COSTS	120,000.00	594,000.00	720,000.00	770,000.00	486,000.00	2,690,000.00
MARG. INCOME	80,000.00	306,000.00	280,000.00	230,000.00	114,000.00	1,010,000.00
FIXED COSTS						600,000.00
PROFIT						410,000.00

PRO-FORMA INCOME STATEMENT ON A CUMULATIVE BASIS

GROUP

	A	B	C	D	E
SALES	200,000.00	1,100,000.00	2,100,000.00	3,100,000.00	3,700,000.00
VARIABLE COSTS	120,000.00	714,000.00	1,434,000.00	2,204,000.00	2,690,000.00
MARG. INCOME	80,000.00	386,000.00	666,000.00	896,000.00	1,010,000.00
FIXED COSTS	600,000.00	600,000.00	600,000.00	600,000.00	600,000.00
PROFIT	(520,000.00)	(214,000.00)	66,000.00	296,000.00	410,000.00

DO YOU HAVE MORE DATA?
NO

D. NOTESDISCOUNT

```
      NOTESDISCOUNT

DO YOU KNOW HOW TO USE THIS PROGRAM?
NO
INPUT ANY THREE OF THE FOLLOWING FIVE VARIABLES.  THE PROGRAM
SOLVES FOR THE REMAINING TWO VARIABLES PROVIDED THAT EITHER THE
TERM OR RATE OF INTEREST (OR BOTH) IS SPECIFIED IN EACH CASE.
THE FIVE VARIABLES ARE: 1. FACE VALUE; 2. RATE (AS ANNUAL PER-
CENT); 3. TERM (IN DAYS); 4. AMOUNT OF INTEREST; AND 5. MATURITY VALUE
INPUT FORMAT: ENTER THE DATA IN THE SAME ORDER AS ABOVE. ENTER
A ZERO (0) FOR VARIABLES TO BE COMPUTED.  TO END TYPE '1E10'
ENTER THE NUMBER OF DAYS IN THE YEAR
⎕:
      360
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 1
⎕:
      2000 5 90 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      60 6
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 2
⎕:
      0 6 75 37.5 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      30 5
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 3
⎕:
      0 7 90 0 4070
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      36 7
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 4
⎕:
      2800 0 60 0 2821
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      22 5
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 5
⎕:
      1500 5 90 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      48 4.5
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 6
⎕:
      0 6 60 10 0
```

```
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      24 6
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 7
⎕:
      3600 0 60 33 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      16 6
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 8
⎕:
      1782 4 84 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      38 5
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 9
⎕:
      3600 6.5 90 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      24 4
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 10
⎕:
      5400 5 48 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
⎕:
      30 6
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 11
⎕:
      1E10
```

NOTE NO.	FACE VALUE	INT. RATE	TERM (DAYS)	INT. AMT.	MAT. VALUE	DISC. PERIOD (DAYS)	DISC. RATE	DISC. AMOUNT	FACTORING PROCEEDS
1	2,000	5	90	25.00	2,025.00	60	6	20.25	2,004.75
2	3,000	6	75	37.50	3,037.50	30	5	12.66	3,024.84
3	4,000	7	90	70.00	4,070.00	36	7	28.49	4,041.51
4	2,800	5	60	21.00	2,821.00	22	5	8.62	2,812.38
5	1,500	5	90	18.75	1,518.75	48	5	9.11	1,509.64
6	1,000	6	60	10.00	1,010.00	24	6	4.04	1,005.96
7	3,600	6	60	33.00	3,633.00	16	6	9.69	3,623.31
8	1,782	4	84	16.63	1,798.63	38	5	9.49	1,789.14
9	3,600	7	90	58.50	3,658.50	24	4	9.76	3,648.74
10	5,400	5	48	36.00	5,436.00	30	6	27.18	5,408.82

B. *DFAC*

```
      ∇DFAC[⎕]∇

    ∇ DFAC;ACR;AVACR;N;NCS;PRD;BD;BB
[1]  START:'ENTER THE PERIODS (E.G., 67 68 ETC.,)'
[2]   N←ρPRD←,⎕
[3]   'ENTER THE ACTUAL BAD DEBTS'
[4]   BD←Nρ⎕
[5]   'ENTER THE BEGINNING BALANCE IN ALLOWANCE FOR DOUBTFUL ACCOUNTS.'
[6]   BB←1ρ⎕
[7]   'ENTER THE METHOD OF VALUATION'
[8]  BACK:'CREDIT SALES, AVERAGE BALANCE IN RECEIVABLES OR AGING RECEIVABLES'
[9]   →('RVG'=1↓2↑⍞)/CREDIT,AVERAGE,AGING
[10] CREDIT:METHOD1
[11]  →OTHERMETHOD
[12] AVERAGE:METHOD2
[13]  →OTHERMETHOD
[14] AGING:METHOD3
[15] OTHERMETHOD:'



      '
[16]  'DO YOU WANT TO TRY OTHER METHOD?'
[17]  →('Y'=1↑⍞)/BACK
[18]  'DO YOU HAVE MORE TRANSACTIONS?'
[19]  →('Y'=1↑⍞)/START
    ∇


      ∇METHOD1[⎕]∇

    ∇ METHOD1;DF;NCS;AA;BBL;EB;TA
[1]   'ENTER THE NET CREDIT SALES (TOTAL SALES LESS RETURNS)'
[2]   NCS←Nρ⎕
[3]   'ENTER THE PERCENT OF CREDIT SALES THAT IS DOUBTFUL'
[4]   DF←⎕
[5]   AA←NCS×DF÷100
[6]   BBL←Nρ0
[7]   BBL[1]←BB
[8]   I←2
[9]  LOOP1:BBL[I]←(BBL[I-1]+AA[I-1])-BD[I-1]
[10]  →(I=N)/OUT
[11]  I←I+1
[12]  →LOOP1
[13] OUT:EB←(TA←BBL+AA)-BD
[14]  '

      '
[15]  (25+N×12)ρ'-'
[16]  'PERCENTAGE OF CREDIT ';(((N×12)-18)÷2)ρ' ';' ALLOWANCE ACCOUNT'
[17]  '⍞     SALES METHOD⍞,X9,10I12' ΔFMT(1,N)ρPRD
[18]  OUTPUT
    ∇
```

```
      ∇METHOD2[⎕]∇

    ∇ METHOD2;ADF;ACR;AVACR;AA;TA;EB;BBL
[1]    'ENTER THE ACCOUNTS RECEIVABLE FOR ';(PRD[1]-1);' THRU ';PRD[ρPRD]
[2]    AVACR←((N↑ACR)+(1↓(ACR←(N+1)ρ⎕)))÷2
[3]    'ENTER THE PERCENTAGE OF A/R THAT IS DOUBTFUL'
[4]   OUT:AA←(TA←EB+BD)-(BBL←BB,(N-1)↑EB←AVACR×(ADF←1ρ⎕÷100))
[5]    '


       '
[6]    (25+N×12)ρ'-'
[7]    'PERCENTAGE OF AVERAGE     ';(((N×12)-18)÷2)ρ' ';'ALLOWANCE ACCOUNT'
[8]    ' BALANCE IN ACCOUNTS      ';(N×12)ρ'-'
[9]    '⍞  RECEIVABLE METHOD      ⍞,10I12' ΔFMT(1,N)ρPRD
[10]   OUTPUT
    ∇


      ∇METHOD3[⎕]∇

    ∇ METHOD3;AGE;ASC;AX;Y;AG;AGSCH;DAYS
[1]    AGE←AGSCH←ι0
[2]    'ENTER THE AGE OF A/C. (FORMAT:''OVER 90 DAYS'' ETC.,)'
[3]    'WHEN YOU ARE THRU ENTERING  HIT THE CARRIAGE RETURN'
[4]    'FORMAT FOR INPUT OF PERCENT AND AMOUNT: 2 2000 3000 4000'
[5]    'INSTEAD OF ''2 °/°, $2,000 3,000 4,000 ETC.,'''
[6]   BEGIN:'ENTER THE AGE'
[7]    AG←⍞
[8]    →OUT×ι0=ρAG
[9]    AGSCH←AGSCH,25ρAG,25ρ' '
[10]  ST:'ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.'
[11]   ASC←,⎕
[12]   →((ρASC)≠N+1)/FORMAT
[13]   AGE←AGE,ASC
[14]   AX←(((ρAGE)÷(1+N)),(1+N))ρAGE
[15]   →BEGIN
[16]  OUT:'

       '
[17]   BBD←(⍉((ρY),((ρAX)[1]))ρ,AX[;1])×(AX[;Y←1↓ι((ρAX)[2])])÷100
[18]   EB←+/⍉BBD
[19]   BAL←Nρ0
[20]   BAL[1]←BB
[21]   DAYS←(((ρAGSCH)÷25),25)ρAGSCH
[22]   →(N=1)/OUT1
[23]   'AGE IN DAYS                 PERCENT';(((N×12)-18)÷2)ρ' ';'AMOUNT OF BAD DEBT A
       LLOWANCE'
[24]   →Q1
[25]  FORMAT:'INPUT FORMAT:2 2000 3000 4000 ETC.,'
```

```
 →ST
OUT1:'AGE IN DAYS                    PERCENT';'   AMOUNT OF BAD DEBT ALLOWANCE'
Q1:('X36,10I12' ΔFMT((1,N)ρPRD));'←-------PERIOD'
 '25A1,X2,I4,X5,10CF12.2' ΔFMT(DAYS;AX[;1];BBD)
 ' '
 '⍞TOTAL⍞,X31,10CF12.2' ΔFMT(1,N)ρEB
 '

 '
 AA←(TA←EB+BD)-BBL←BB,(N-1)↑EB
 (25+N×12)ρ'-'
 'AGING OF ACCOUNTS        ';(((N×12)-18)÷2)ρ' ';'ALLOWANCE ACCOUNT'
 '⍞RECEIVABLE METHOD⍞,X8,10I12' ΔFMT(1,N)ρPRD
 OUTPUT
 ∇




 ∇OUTPUT[⎕]∇
∇ OUTPUT
 (25+N×12)ρ'-'
 '⍞BALANCE: BEG.⍞,X12,10CI12' ΔFMT(1,N)ρBBL
 '⍞AMOUNT ADDED⍞,X13,10CI12' ΔFMT(1,N)ρAA
 '⍞TOTAL AVAILABLE⍞,X10,10CI12' ΔFMT(1,N)ρTA
 '⍞LESS: BAD DEBTS⍞,X10,10CI12' ΔFMT(1,N)ρBD
 '⍞BALANCE: END⍞,X13,10CI12' ΔFMT(1,N)ρEB
 (25+N×12)ρ'-'
∇
```

C. CREDITRISK

```
      ∇CREDITRISK[⎕]∇

    ∇ CREDITRISK;CO;GRP;FACTOR;GP;VCR;FC;MCM;I;TVR;SL;VC;MI;NNGP;NGP;X;FC;PR;I;FMAT
[1]    CO←GRP←FACTOR←⍳0
[2]    'INPUT FORMAT FOR THE CREDIT RISK: THE CREDIT-RISK FACTOR'
[3]    'FOLLOWED BY NUMBER OF PERSONS IN THE GROUP AND THE '
[4]    'AVERAGE SALES PER PERSON. E.G., 12 2000 500'
[5]   BEGIN:'ENTER THE NAME OF THE GROUP(TO END HIT THE TAB AND THE CARRIAGE RETURN)'
[6]    GP←⍞
[7]    →(' '=GP)/OUT
[8]    GRP←GRP,15⍴GP,15⍴' '
[9]   ST:'ENTER THE CREDIT-RISK'
[10]   FACTORS←,⎕
[11]   →((⍴FACTORS)≠3)/FORMAT
[12]   FMAT←(((⍴FACTOR)÷3),3)⍴FACTOR←FACTOR,FACTORS
[13]   →BEGIN
[14]  OUT:'ENTER THE BASIC VARIABLE COST RATE (AS A PERCENT)'
[15]   VCR←1⍴⎕÷100
[16]   'ENTER FIXED COSTS'
[17]   FC←1⍴⎕
[18]   'MINIMUM CONTRIBUTION TO MARGIN'
[19]   MCM←1⍴⎕÷100
[20]   I←1
[21]  STR:→((1-MCM)≥((TVR←(FMAT[;1]÷100)+VCR))[I])/COUNT
[22]  STRT:→(I=⍴FMAT[;1])/OUT1
[23]   I←I+1
[24]   →STR
[25]  COUNT:CO←CO,I
[26]   →STRT
[27]  FORMAT:'INPUT FORMAT: 2 2000 500, WHERE 2 IS THE CREDIT'
[28]   'RISK FACTOR 2000 NO. OF PERSONS IN THE GROUP AND 500'
[29]   'THE AVERAGE SALES PER PERSON'
[30]   →ST
[31]  OUT1:' '
[32]   MI←SL-VC←((SL←((FMAT[;3])[CO])×(FMAT[;2])[CO])×TVR[CO])
[33]   NNGP←(((⍴GRP)÷15),15)⍴GRP
[34]   NGP←,NNGP[CO;]
[35]   X←(5,⍴CO)⍴0
[36]   'DO YOU WANT THE SUMMARY OF DATA?'
[37]   →('Y'=1↑⍞)/SUMMARY
[38]  OUTPUT:'

       '
[39]   'ACCEPT THE GROUPS   ';NOSPACE NGP[⍳((⍴NGP)-15)];' AND ';NGP[(⍴NGP)-14]
[40]   '

       '
[41]   FC←((⍴CO)⍴0),FC
```

```
[42]  PR←((ρCO)ρ0),((+/MI)-FC)
[43]  →((ρCO)≠1)/T1
[44]  'PRO-FORMA INCOME STATEMENTS ON A MARGINAL BASIS'
[45]  →OO
[46] T1:(((28+16×ρCO)-48)÷2)ρ' ';'PRO-FORMA INCOME STATEMENTS ON A MARGINAL BASIS'
[47]  '
      '
[48] OO:((21+(14×ρCO)÷2)-6)ρ' ';'GROUP'
[49]  23ρ' ';NGP;'TOTAL'
[50]  ' '
[51]  '⎕SALES⎕,X10,10CF15.2' ΔFMT(((1,NN←ρCO)ρSL);+/SL)
[52]  '⎕VARIABLE COSTS⎕,X1,10CF15.2' ΔFMT(((1,NN)ρVC);+/VC)
[53]  15ρ' ';(15+ρNGP)ρ'-'
[54]  '⎕MARG. INCOME⎕,X3,10CF15.2' ΔFMT(((1,NN)ρMI);+/MI)
[55]  '⎕FIXED COSTS⎕,X4,10BCF15.2' ΔFMT(1,ρFC)ρFC
[56]  15ρ' ';(15+ρNGP)ρ'-'
[57]  '⎕PROFIT⎕,X9,10BCF15.2' ΔFMT(1,ρPR)ρPR
[58]  '


      '
[59]  I←2
[60] TRB:X[;I]←(+/SL[⍳I]),(+/VC[⍳I]),(+/MI[⍳I]),FC,0
[61]  →(I≥ρCO)/OUTPUT2
[62]  I←I+1
[63]  →TRB
[64]  '

      '
[65] OUTPUT2:X[;1]←SL[1],VC[1],MI[1],FC,0
[66]  X[5;]←X[3;]-X[4;]
[67]  '

      '
[68]  →((ρCO)≠1)/T
[69]  'PRO-FORMA INCOME STATEMENT ON A CUMULATIVE BASIS'
[70]  →OO
[71] T:(((30+16×ρCO)-46)÷2)ρ' ';'PRO-FORMA INCOME STATEMENT ON A CUMULATIVE BASIS'
[72] OO:' '
[73]  ((21+(14×ρCO)÷2)-6)ρ' ';'GROUP'
[74]  ' '
[75]  23ρ' ';NGP
[76]  ' '
[77]  '⎕SALES⎕,X10,10CF15.2' ΔFMT(1,ρCO)ρX[1;]
[78]  '⎕VARIABLE COSTS⎕,X1,10CF15.2' ΔFMT(1,ρCO)ρX[2;]
```

```
[79]  15ρ' ';(ρNGP)ρ'-'
[80]  '⍞MARG. INCOME⍞,X3,10CF15.2' ΔFMT(1,ρCO)ρX̲[3;]
[81]  '⍞FIXED COSTS⍞,X4,10CF15.2' ΔFMT(1,ρCO)ρX̲[4;]
[82]  15ρ' ';(ρNGP)ρ'-'
[83]  '⍞PROFIT⍞,X10,10M⍞(⍞W⍞)⍞Q⍞ ⍞CF15.2' ΔFMT(1,ρCO)ρX̲[5;]
[84]  '

      '
[85]  'DO YOU HAVE MORE DATA?'
[86]  →('YN'=1↑⍞)/BEGIN,0
[87] SUMMARY:'

      '
[88]  '                PROPERTIES OF OUR ASSUMED CREDIT RISK GROUPS'
[89]  ' '
[90]  ' CREDIT    CREDIT                    POTENTIAL        AVERAGE SALES       TOTAL'
[91]  '  RISK      RISK                     NUMBER OF         PER  PERSON     POTENTIAL'
[92]  ' FACTOR   GROUP.                      PERSONS            (LIMIT)          SALES'
[93]  '--------------------------------------------------------------------------------'
[94]  'I5,X5,15A1,X5,I10,X10,I6,X5,I10' ΔFMT(FMAT[;1];NNGP;FMAT[;2];FMAT[;3];FMAT[;
      2]×FMAT[;3])
[95]  '

      '
[96]  →OUTPUT
      ∇
```

D. NOTESDISCOUNT

```
      ∇NOTESDISCOUNT[⎕]∇

     ∇ NOTESDISCOUNT;A;I;K;M;MAT;X;XX;XY;Z
[1]    A← 10 3 ⍴ 1 2 3 1 2 4 1 2 5 1 3 4 1 3 5 2 3 4 2 3 5 3 4 5 1 4 5 2 4 5
[2]    M←⍳0
[3]    X←9⍴0
[4]    'DO YOU KNOW HOW TO USE THIS PROGRAM?'
[5]    →('Y'=1↑⍞)/START
[6]    'INPUT ANY THREE OF THE FOLLOWING FIVE VARIABLES.  THE PROGRAM'
[7]    'SOLVES FOR THE REMAINING TWO VARIABLES PROVIDED THAT EITHER THE'
[8]    'TERM OR RATE OF INTEREST (OR BOTH) IS SPECIFIED IN EACH CASE.'
[9]    'THE FIVE VARIABLES ARE: 1. FACE VALUE; 2. RATE (AS ANNUAL PER-'
[10]   'CENT); 3. TERM (IN DAYS); 4. AMOUNT OF INTEREST; AND 5. MATURITY VALUE'
[11]   'INPUT FORMAT: ENTER THE DATA IN THE SAME ORDER AS ABOVE. ENTER'
[12]   'A ZERO (0) FOR VARIABLES TO BE COMPUTED.  TO END TYPE ''1E10'''
[13]  START:'ENTER THE NUMBER OF DAYS IN THE YEAR'
[14]   Y←1⍴⎕
[15]   I←1
[16]  QQ:'ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. ';I
[17]   Z←X[⍳5]←5⍴⎕
[18]   XY←X[2]÷100
[19]   →(X[1]=10000000000)/END
[20]   K←((Z≠0)/(Z≠0)×⍳⍴Z)
[21]   'ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE'
[22]   X[6 7]←2⍴⎕
[23]   XX←X[7]÷100
[24]   →(A∧.=K)/A1,A2,A3,A4,A5,A6,A7,A8,ERROR,ERROR
[25]  ERROR:'WRONG ENTRY....REENTER'
[26]   →QQ
[27]  A1:X[5]←X[1]+X[4]←(×/X[1 3],XY)÷Y
[28]   →NQ
[29]  A2:X[3]←(Y×X[4])÷(X[1]×XY)
[30]   X[5]←+/X[1 4]
[31]   →NQ
[32]  A3:X[3]←(Y×X[4]←-/X[5 1])÷(X[1]×XY)
[33]   →NQ
[34]  A4:X[5]←+/X[1 4]
[35]   X[2]←((Y×X[4])÷×/X[1 3])×100
[36]   →NQ
[37]  A5:X[2]←((Y×X[4]←-/X[5 1])÷×/X[3 1])×100
[38]   →NQ
[39]  A6:X[5]←(X[1]←(Y×X[4])÷×/X[3],XY)+X[4]
[40]   →NQ
[41]  A7:X[4]←X[5]-X[1]←(Y×X[5])÷(Y+×/X[3],XY)
```

```
[42]  →NQ
[43] A8:X[2]←((Y×X[4])÷(X[3]×X[1]←X[5]-X[4]))
[44] NQ:X[9]←X[5]-X[8]←(×/X[5 6],XX)÷Y
[45]  M←M,X
[46]  I←I+1
[47]  →QQ
[48] END:MAT←(((ρM)÷9),9)ρM
[49]  '

      '
[50]  'NOTE  FACE      INT.      TERM      INT.      MAT.      DISC.     DISC.     D
      ISC.     FACTORING'
[51]  ' NO.  VALUE     RATE     (DAYS)     AMT.      VALUE     PERIOD    RATE      A
      MOUNT     PROCEEDS'
[52]  '                                                        (DAYS)'
[53]  ' '
[54]  'I2,X4,CI6,I6,I12,2CF12.2,I6,I8,2CF14.2' ΔFMT(ι(I-1);MAT[;ι3];MAT[; 4
      5];MAT[; 6 7];MAT[; 8 9])
      ∇
```

5
Inventory Management (INVENTORY)

A. General Description

This series of programs can be used to solve inventory pricing and basic EOQ problems. To access this workspace execute the following instruction:

```
)LOAD 7 INVENTORY
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The configuration of programs available in this workspace is illustrated in Exhibit 5-1.

Exhibit 5-1
THE INVENTORY WORKSPACE

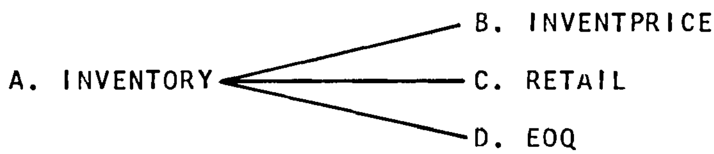


Exhibit 5-2
INVENTORY FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
INVENTPRICE	-	TIL
RETAIL	-	-
EOQ	-	TIE

B. INVENTPRICE

This program facilitates inventory pricing under the periodic or perpetual methods, where LIFO, FIFO, or Weighted Average is used.

Where the perpetual method is used, each sale represents a "period", and these periods can be totaled to form an "accounting period" such as a month or year. Where the periodic method is used, each sales period represents an accounting period.

Input to the program consists of:

1. The number of sales periods.

2. The largest number of separate purchases for any of the sales periods.

3. Unit selling price per sales period.

4. Quantities purchased per sales period.

5. Unit purchase prices.

6. Inventory method: LIFO, FIFO, or Weighted Average.

Output consists of a gross profit statement and statement of ending inventory in units and value. The output can be varied for the different pricing methods without re-entering the data.

C. RETAIL

This program computes inventory pricing data where retail methods are used.

Input consists of:

1. Beginning inventory at retail value.

2. Net purchases for the period.

3. Additional markups for the period.

4. Markup cancellations.

5. Net sales.

6. Markdowns.

7. Markdown cancellations.

8. The inventory pricing method, i.e., one of the following:

(a) lower of cost or market.,

(b) replacement cost.,

(c) LIFO.

(d) FIFO.

9. Cost-price ratio if known, otherwise the program will compute it.

Output consists of:

1. An inventory schedule which shows the retail and cost value of inventory under the selected pricing method.

2. The cost-price ratio.

Output can be varied for other pricing methods without altering or re-entering the input data.

D. EOQ

This program computes basic EOQ quantities using the formula:

$$EOQ = \sqrt{\frac{2 \times C \times D}{i}}$$

Where 'C' = cost of placing an order, 'D' = annual demand, and 'i' = cost of carrying one item in inventory for one year. Given this input, the program computes the economic order quantity.

In addition, sensitivity analysis can be applied selectively to the input data. For example, what effect would a 15% variance in demand cause in EOQ? Sensitivity analysis can be applied to demand, cost of ordering, or the carrying cost.

B. INVENTPRICE

```
      INVENTPRICE
ENTER NUMBER OF SALES PERIODS
⎕:
      4
ENTER MAXIMUM NUMBER OF PURCHASES (NOT UNITS) IN ONE PERIOD
⎕:
      3
ENTER UNIT SALES FOR PERIODS 1 TO 4

⎕:
      20 40 30 50
ENTER CORRESPONDING SALES PRICES
⎕:
      6.00 6.25 6.35 6.05
ENTER QUANTITIES PURCHASED IN PERIOD 1

⎕:
      20 10
ENTER CORRESPONDING UNIT PRICES
⎕:
      4.00 4.10
ENTER QUANTITIES PURCHASED IN PERIOD 2

⎕:
      20 20
ENTER CORRESPONDING UNIT PRICES
⎕:
      4.10 4.05
ENTER QUANTITIES PURCHASED IN PERIOD 3

⎕:
      10 15
ENTER CORRESPONDING UNIT PRICES
⎕:
      4.25 4.35
ENTER QUANTITIES PURCHASED IN PERIOD 4

⎕:
      10 20 30
ENTER CORRESPONDING UNIT PRICES
⎕:
      4.15 4.02 3.95
ENTER INVENTORY METHOD - LIFO, FIFO, OR AVG
LIFO
```

PERIOD	1	2	3	4	TOTAL
SALES	120	250	191	303	863
COST OF SALES	81	163	128	199	571
GROSS PROFIT	39	87	63	104	292
INVENTORY (UNITS)	10	10	5	15	40
INVENTORY (VALUE)	40	40	20	62	162

```
ANOTHER METHOD? (YES OR NO)
YES
```

```
ENTER INVENTORY METHOD - LIFO, FIFO, OR AVG
FIFO


PERIOD                     1         2         3         4     TOTAL
SALES                    120       250       191       303       863
COST OF SALES             80       164       127       203       573
GROSS PROFIT              40        87        64       100       290
INVENTORY (UNITS)         10        10         5        15        40
INVENTORY (VALUE)         41        41        22        59       163

ANOTHER METHOD? (YES OR NO)
YES
ENTER INVENTORY METHOD - LIFO, FIFO, OR AVG
AVG


PERIOD                     1         2         3         4     TOTAL
SALES                    120       250       191       303       863
COST OF SALES             81       163       127       201       572
GROSS PROFIT              39        87        63       101       291
INVENTORY (UNITS)         10        10         5        15        40
INVENTORY (VALUE)         40        41        21        60       163

ANOTHER METHOD? (YES OR NO)
NO
```

C. RETAIL

```
      RETAIL
ENTER THE FOLLOWING INFORMATION AT RETAIL
BEGINNING INVENTORY
⎕:
      47000
PURCHASES (NET)
⎕:
      194500
ADDITIONAL MARKUPS
⎕:
      12000
MARKUP CANCELLATIONS
⎕:
      3000
SALES (NET)
⎕:
      188500
MARKDOWNS
⎕:
      16000
MARKDOWN CANCELLATIONS
⎕:
      7000
ENTER METHOD - LOWER OF COST OR MARKET; REPLACEMENT COST; LIFO; FIFO
C
ENTER COST-PRICE RATIO (AS A PERCENT) OR ZERO TO CALCULATE IT
⎕:
      65

BEGINNING INVENTORY                                    47000
ADD:    PURCHASES (NET)                 194500
        ADDITIONAL MARKUPS              12000
        MARKDOWN CANCELLATIONS          7000
                                                       213500
                                       --------    --------
LESS:   SALES (NET)                     188500
        MARKUP CANCELLATIONS            3000
        MARKDOWNS                       16000
                                                       207500
                                       --------    --------
ENDING INVENTORY                                       53000
ENDING INVENTORY AT COST = 34450
REPEAT WITH A DIFFERENT INVENTORY METHOD? (YES OR NO)
YES
```

```
ENTER METHOD - LOWER OF COST OR MARKET; REPLACEMENT COST; LIFO; FIFO
L
ENTER COST-PRICE RATIO (AS A PERCENT) OR ZERO TO CALCULATE IT
⎕:
      0
ENTER PURCHASES (NET) AT COST
⎕:
      127110
ENTER BEGINNING INVENTORY AT COST
⎕:
      28200
COST-PRICE RATIO IS 64.31 PERCENT


BEGINNING INVENTORY                                    47000
ADD:   PURCHASES (NET)                    194500
       ADDITIONAL MARKUPS                 12000
       MARKDOWN CANCELLATIONS             7000
                                                       213500

                                         --------    --------

LESS:  SALES (NET)                        188500
       MARKUP CANCELLATIONS               3000
       MARKDOWNS                          16000
                                                       207500

                                         --------    --------
ENDING INVENTORY                                       53000
ENDING INVENTORY AT COST = 32058.63
REPEAT WITH A DIFFERENT INVENTORY METHOD? (YES OR NO)
YES
ENTER METHOD - LOWER OF COST OR MARKET; REPLACEMENT COST; LIFO; FIFO
F
ENTER COST-PRICE RATIO (AS A PERCENT) OR ZERO TO CALCULATE IT
⎕:
      0
ENTER PURCHASES (NET) AT COST
⎕:
      127110
COST-PRICE RATIO IS 65.35 PERCENT


BEGINNING INVENTORY                                    47000
ADD:   PURCHASES (NET)                    194500
       ADDITIONAL MARKUPS                 12000
       MARKDOWN CANCELLATIONS             7000
                                                       213500

                                         --------    --------

LESS:  SALES (NET)                        188500
       MARKUP CANCELLATIONS               3000
       MARKDOWNS                          16000
                                                       207500

                                         --------    --------
ENDING INVENTORY                                       53000
ENDING INVENTORY AT COST = 34636.66
REPEAT WITH A DIFFERENT INVENTORY METHOD? (YES OR NO)
NO
```

D. EOQ

```
      EOQ
ENTER ANNUAL DEMAND (UNITS)
⎕:
      1000
ENTER ORDERING COST (IN DOLLARS)
⎕:
      12.50
ENTER CARRYING COST OF ONE UNIT FOR ONE YEAR (IN DOLLARS)
⎕:
      .10
ECONOMIC ORDER QUANTITY IS 500 UNITS
SENSITIVITY ANALYSIS? (ENTER PERCENT VARIATION OR ZERO)
⎕:
      15
SENSITIVITY ANALYSIS ON DEMAND, ORDERING COST, OR CARRYING COST?
D
INCREASE OF ANNUAL DEMAND BY 15 PERCENT CHANGES EOQ TO 536 UNITS
DECREASE OF ANNUAL DEMAND BY 15 PERCENT CHANGES EOQ TO 461 UNITS

MORE
SENSITIVITY ANALYSIS? (ENTER PERCENT VARIATION OR ZERO)
⎕:
      12
SENSITIVITY ANALYSIS ON DEMAND, ORDERING COST, OR CARRYING COST?
O
INCREASE OF ORDERING COST BY 12 PERCENT CHANGES EOQ TO 529 UNITS
DECREASE OF ORDERING COST BY 12 PERCENT CHANGES EOQ TO 469 UNITS

MORE
SENSITIVITY ANALYSIS? (ENTER PERCENT VARIATION OR ZERO)
⎕:
      8
SENSITIVITY ANALYSIS ON DEMAND, ORDERING COST, OR CARRYING COST?
C
INCREASE OF CARRYING COST BY 8 PERCENT CHANGES EOQ TO 481 UNITS
DECREASE OF CARRYING COST BY 8 PERCENT CHANGES EOQ TO 521 UNITS

MORE
SENSITIVITY ANALYSIS? (ENTER PERCENT VARIATION OR ZERO)
⎕:
      0
```

B. INVENTPRICE

```
      ∇INVENTPRICE[⎕]∇
    ∇ INVENTPRICE;P;C;S;SP;X1;X2;A;I;T;R;CG;CI;T1;A1;A2;INV;U;V;IV;VS;REP
[1]    R←1
[2]   RES:→(R=⍳4)/P1,MT,P2,OUT
[3]   P1:X1←1↑IPI 'ENTER NUMBER OF SALES PERIODS',REP←CR,'⎕:',LF,3⍴' '
[4]    X2←1↑IPI 'ENTER MAXIMUM NUMBER OF PURCHASES (NOT UNITS) IN ONE PERIO
       D',REP
[5]    C←P←(X1,X2)⍴I←0
[6]    S←SP←X1⍴0
[7]    'ENTER UNIT SALES FOR PERIODS 1 TO ';X1
[8]    S←X1↑IPI REP
[9]    'ENTER CORRESPONDING SALES PRICES'
[10]   SP←X1↑⎕
[11]  IN:I←I+1
[12]   'ENTER QUANTITIES PURCHASED IN PERIOD ';I
[13]   A←,IPI REP
[14]   P[I;]←A,(X2-⍴A)⍴0
[15]   'ENTER CORRESPONDING UNIT PRICES'
[16]   A←,⎕
[17]   C[I;]←A,(X2-⍴A)⍴0
[18]   →(I<X1)/IN
[19]   VS←S×SP
[20]   R←2
[21]  MT:INV← 2 1 ⍴0
[22]   R←3
[23]  P2:IV←CG←CI←X1⍴I←U←V←0
[24]   'ENTER INVENTORY METHOD - LIFO, FIFO, OR AVG'
[25]   →('LFA'=A←1 ⍞)/NA,NA,AV
[26]   →MT
[27]  NA:I←I+1
[28]   A1←INV[1;],P[I;]
[29]   A2←INV[2;],C[I;]
[30]   INV←(A1>0)/A1,[0.5] A2
[31]   T←S[I]
[32]   CI[I]←(+/INV[1;])-S[I]
[33]   →(CI[I]<0)/SO
[34]  IT:R←1+((⍴INV[1;])-1)×A='L'
[35]   T1←INV[1;R]-T
[36]   CG[I]←CG[I]+INV[2;R]×T+T1×T1<0
[37]   INV[1;R]←T1
[38]   INV←(INV[1;]>0)/INV
[39]   IV[I]←+/×⌿INV
[40]   →(T1≥0)/INCR
[41]   T←-T1
[42]   →IT
[43]  INCR:→(I<X1)/NA
[44]   →OUT
[45]  AVG:I←I+1
[46]   V←V++/P[I;]×C[I;]
[47]   U←U++/P[I;]
[48]   CG[I]←S[I]×V÷U
[49]   CI[I]←U←U-S[I]
[50]   →(U<0)/SO
```

```
[51]   IV[I]←V←V-CG[I]
[52]   →(I<X1)/AVG
[53]   →OUT
[54]  SO:'THERE HAS BEEN A STOCKOUT IN PERIOD ';I
[55]   →0
[56]  OUT:R←4
[57]   T←(⍳X1),[1] VS,[1] CG,[1](VS-CG),[1] CI,[0.5] IV
[58]   2⍴CR
[59]   TTL,('10I8' ∆FMT(T)),'   TOTAL',[1] 'I8' ∆FMT(1↓+/T)
[60]   CR
[61]  Q:'ANOTHER METHOD? (YES OR NO)'
[62]   →('YN'=1↑⍞)/MT,0
[63]   →Q
```

```
      TTL
PERIOD
SALES
COST OF SALES
GROSS PROFIT
INVENTORY (UNITS)
INVENTORY (VALUE)
```

C. RETAIL

```
     ∇RETAIL[⎕]∇
    ∇ RETAIL;B;P;U;UC;S;D;DC;M;R;BC;PC;A;L;EC;E
[1]   R←1
[2]  RES:→(R=⍳3)/P1,Q,OUT
[3]  P1:BC←0
[4]   'ENTER THE FOLLOWING INFORMATION AT RETAIL'
[5]   'BEGINNING INVENTORY'
[6]   B←1↑⎕
[7]   'PURCHASES (NET)'
[8]   P←1↑⎕
[9]   'ADDITIONAL MARKUPS'
[10]  U←1↑⎕
[11]  'MARKUP CANCELLATIONS'
[12]  UC←1↑⎕
[13]  'SALES (NET)'
[14]  S←1↑⎕
[15]  'MARKDOWNS'
[16]  D←1↑⎕
[17]  'MARKDOWN CANCELLATIONS'
[18]  DC←1↑⎕
[19]  R←2
[20] Q:'ENTER METHOD - LOWER OF COST OR MARKET; REPLACEMENT COST; LIFO; FI
      FO'
[21]  →(1≠(+/'CRLF'=M←1↑⍞))/Q
[22]  'ENTER COST-PRICE RATIO (AS A PERCENT) OR ZERO TO CALCULATE IT'
[23]  →(0<R←(1↑⎕)÷100)/OUT
[24]  'ENTER PURCHASES (NET) AT COST'
[25]  PC←1↑⎕
[26]  →(M='F')/LFR
[27]  'ENTER BEGINNING INVENTORY AT COST'
[28]  BC←1↑⎕
[29]  R←(BC+PC)÷B+P+(M='C')×U-UC
[30]  →RO
[31] LFR:R←PC÷P+U+DC-UC+D
[32] RO:'COST-PRICE RATIO IS ';2 RND R×100;' PERCENT'
[33]  R←3
[34] OUT:E←B+(A←P+CDC)-(L←S+UC+D)
[35]  EC←((((E≥B)×BC+R×E-B)+(E<B)×E×BC÷B)×M='L')+R×E×M≠'L'
[36]  ''
[37]  ''
[38]  'BEGINNING INVENTORY                                   ';B
[39]  'ADD:   PURCHASES (NET)                ';P
[40]  '       ADDITIONAL MARKUPS             ';U
[41]  '       MARKDOWN CANCELLATIONS         ';DC
[42]  '                                                      ';A
[43]  '                                       ________    ________'
[44]  ''
[45]  'LESS:  SALES (NET)                    ';S
[46]  '       MARKUP CANCELLATIONS           ';UC
[47]  '       MARKDOWNS                      ';D
[48]  '                                                      ';L
[49]  '                                       ________    ________'
[50]  'ENDIKG INVENTORY                                      ';E
[51]  'ENDING INVENTORY AT COST = ';2 RND EC
[52] EQ:'REPEAT WITH A DIFFERENT INVENTORY METHOD? (YES OR NO)'
[53]  →('YN'=1↑⍞)/Q,0
[54]  →EQ
    ∇
```

D. EOQ

```
      ∇EOQ[⎕]∇
    ∇ EOQ;C;D;I;P;T;F;Q;J
[1]    R←1
[2]   RES:→(R=⍳3)/P1,Q1,P2
[3]   P1:'ENTER ANNUAL DEMAND (UNITS)'
[4]    D←1↑⎕
[5]    'ENTER ORDERING COST (IN DOLLARS)'
[6]    C←1↑⎕
[7]    'ENTER CARRYING COST OF ONE UNIT FOR ONE YEAR (IN DOLLARS)'
[8]    I←1↑⎕
[9]    'ECONOMIC ORDER QUANTITY IS ';0 RND(2×C×D÷I)*
       0.5;' UNITS'
[10]   R←2
[11] Q1'SENSITIVITY ANALYSIS? (ENTER PERCENT VARIATION OR ZERO)'
[12] 5P←(1↑⎕)÷100
[13]   →((P>0.95),P≤0)/Q1,0
[14]   'SENSITIVITY ANALYSIS ON DEMAND, ORDERING COST, OR CARRYING COST?'
[15]   T←,('DOC'=F←1↑⍞)⌿TTE
[16]   R←3
[17] P2:J←1,Q←⍳0
[18] RE:Q←Q,0 RND((2×C×D×1+P×+/F='OD')÷I×1+P×F='C')*
       0.5
[19]   J←J+1
[20]   P←-P
[21]   →(J=2)/RE
[22]   'INCREASE OF ',T,' BY ';P×100;' PERCENT CHANGES EOQ TO ';Q[1];' UNIT
       S'
[23←   'DECREASE OF ',T,' BY ';P×100;' PERCENT CHANGES EOQ TO ';Q[
       2];' UNITS'
[24]   ''
[25]   'MORE'
[26]   →Q1
     ∇
```

```
      TTE
ANNUAL DEMAND
ORDERING COSTS
CARRYING COSTS
```

6
Depreciation

A. General Description

The programs in this series can be used to solve typical problems associated with item, group and composite depreciation.

This workspace can be accessed by the following instruction:

```
)LOAD 7 DEPRECIATION
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

Each program can be used independently, as illustrated by the configuration in Exhibit 6-1.

Exhibit 6-1
THE DEPRECIATION WORKSPACE

A. DEPRECIATION
- B. DEPRECIATE
- C. GROUPLIFE
- D. GROUPDPR
- E. COMPOSITEDPR
- F. DPRSWITCH

Exhibit 6-2
DEPRECIATION FUNCTIONS & VARIABLES

MAJOR FUNCTION	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
DEPRECIATION	DPR, DPROUT	-
GROUPLIFE	-	-
GROUPDPR	GROUPRATE, FLAGRATE ATRANS, DPRC, DPROUT	-
COMPOSITEDPR	COMPRATE, FLAGRATE ATRANS, DPRC, DPROUT	-
DPRSWITCH	DPR, DPROUT	-

A brief description of these programs is provided as follows:

B. DEPRECIATE

This program calculates single item depreciation and produces a complete depreciation schedule or isolated data for specified periods. The program accommodates these depreciation methods: straight-line, declining-balance (at any rate between 100%-200% straight-line), declining-balance internal rate, and sum-of-years' digits. Other input includes cost, salvage value, and expected useful life.

Two observations will facilitate use of this program:

1. A salvage value should be used in conjunction with the declining-balance internal rate method, as the use of zero salvage value will result in depreciation of the asset in the first year.

2. All declining-balance methods will adjust depreciation in the last period to achieve the specified salvage value. The group and composite depreciation programs which follow do not make this last period adjustment in order to reflect the gain or loss on the accounts as a whole.

C. GROUPLIFE

Given a series of years and the percentage (or number) of items retired in those years, the program outputs the weighted average life of the group. The group life is required in order to specify the appropriate depreciation rate in GROUPDPR.

D. GROUPDPR (Group Depreciation)

This program produces a group depreciation schedule, under various methods of depreciation and will accommodate the following factors:

Additions
Retirements
Cash benefits on retirement

The program requires specification of either the depreciation rate (and related method) or the group life (and related method).

E. COMPOSITEDPR (Composite Depreciation)

This program will produce composite depreciation schedules involving different asset classes, which have different expected lives and which utilize different methods of depreciation.

Input consists of the cost, salvage value (if any), life and depreciation method for each asset. Output consists of the composite rate, life and a complete composite schedule.

The program will also accept a given composite rate and proceed to generate the depreciation schedule.

As with GROUPDPR, the program will accommodate additions, retirements, and cash benefits on retirement.

F. DPRSWITCH (Optimum switch-over)

This program applies only to item depreciation, and determines the optimum switch-over point in depreciation methods. The following switch-overs are feasible:

Declining-balance ⟶ Straight-line

Declining-balance ⟶ S. Y. D.

S. Y. D. ⟶ Straight-line

The program responds with the statement "maximum annual depreciation is achieved without a switch" if the combination of factors does not lead to a feasible switch-over.

```
      DEPRECIATE
ENTER ASSET COST
⎕:
      15000
ENTER ASSET SALVAGE VALUE
⎕:
      2500
ENTER ASSET LIFE
⎕:
      8
ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD
DB
PERCENT OF STRAIGHT LINE (100≤M≤200)
⎕:
      150
COMPLETE DEPRECIATION SCHEDULE? (YES OR NO)
NO
ENTER YEAR(S) WANTED
⎕:
      1 3 5 7 8
```

DEPRECIATION SCHEDULE

	ASSET ACCOUNT			ACCUMULATED DEPRECIATION			BOOK VALUE
PERIOD	DEBIT	CREDIT	BALANCE	DEBIT	CREDIT	BALANCE	
1	0.00	0.00	15000.00	0.00	2812.50	2812.50	12187.50
3	0.00	0.00	15000.00	0.00	1856.69	6954.35	8045.65
5	0.00	0.00	15000.00	0.00	1225.70	9688.61	5311.39
7	0.00	0.00	15000.00	0.00	809.15	11493.65	3506.35
8	0.00	0.00	15000.00	0.00	1006.35	12500.00	2500.00

```
      DEPRECIATE
ENTER ASSET COST
⎕:
      10000
ENTER ASSET SALVAGE VALUE
⎕:
      1000
ENTER ASSET LIFE
⎕:
      10
ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD
SYD
COMPLETE DEPRECIATION SCHEDULE? (YES OR NO)
YES
```

DEPRECIATION SCHEDULE

	ASSET_ACCOUNT			*ACCUMULATED_DEPRECIATION*			*BOOK_VALUE*
PERIOD	*DEBIT*	*CREDIT*	*BALANCE*	*DEBIT*	*CREDIT*	*BALANCE*	
0	10000.00	0.00	10000.00	0.00	0.00	0.00	10000.00
1	0.00	0.00	10000.00	0.00	1636.36	1636.36	8363.64
2	0.00	0.00	10000.00	0.00	1472.73	3109.09	6890.91
3	0.00	0.00	10000.00	0.00	1309.09	4418.18	5581.82
4	0.00	0.00	10000.00	0.00	1145.45	5563.63	4436.37
5	0.00	0.00	10000.00	0.00	981.82	6545.45	3454.55
6	0.00	0.00	10000.00	0.00	818.18	7363.63	2636.37
7	0.00	0.00	10000.00	0.00	654.55	8018.18	1981.82
8	0.00	0.00	10000.00	0.00	490.91	8509.09	1490.91
9	0.00	0.00	10000.00	0.00	327.27	8836.36	1163.64
10	0.00	0.00	10000.00	0.00	163.64	9000.00	1000.00

C. GROUPLIFE

```
      GROUPLIFE
ENTER NUMBER (OR PERCENT) OF UNITS FOLLOWED BY EXPECTED LIFE
ONE QUANTITY AND LIFE PER ENTRY - ZERO WILL SIGNAL END OF ENTRIES
⎕:
      30 4
⎕:
      30 5
⎕:
      10 6
⎕:
      10 7
⎕:
      10 8
⎕:
      10 9
⎕:
      0
GROUPLIFE IS  5.7 YEARS
```

```
      GROUPDPR
ASSET PURCHASE IN YEAR ZERO (TOTAL COST)
⎕:
      100000
ENTER ASSET TRANSACTIONS ONE AT A TIME USING THE FOLLOWING FORMAT:
YEAR, ADDITION, RETIREMENT, CASH_BENEFIT_ON_RETIREMENT
ADDITIONS AND RETIREMENTS AT COST
ZERO WILL TERMINATE ENTRIES
⎕:
      3 0 10000
⎕:
      4 0 20000
⎕:
      5 0 40000 10000
⎕:
      6 0 20000
⎕:
      7 0 10000
⎕:
      0
ENTER DEPRECIATION RATE  (AS A PERCENT)
ENTER ZERO IF YOU WANT TO COMPUTE IT
⎕:
      20
SL OR ACCELERATED DEPRECIATION
SL
```

DEPRECIATION SCHEDULE

	ASSET_ACCOUNT			ACCUMULATED_DEPRECIATION			BOOK_VALUE
PERIOD	DEBIT	CREDIT	BALANCE	DEBIT	CREDIT	BALANCE	
0	100000.00	0.00	100000.00	0.00	0.00	0.00	100000.00
1	0.00	0.00	100000.00	0.00	20000.00	20000.00	80000.00
2	0.00	0.00	100000.00	0.00	20000.00	40000.00	60000.00
3	0.00	10000.00	90000.00	10000.00	20000.00	50000.00	40000.00
4	0.00	20000.00	70000.00	20000.00	18000.00	48000.00	22000.00
5	0.00	40000.00	30000.00	30000.00	14000.00	32000.00	(2000.00)
6	0.00	20000.00	10000.00	20000.00	6000.00	18000.00	(8000.00)
7	0.00	10000.00	0.00	10000.00	2000.00	10000.00	(10000.00)

```
MORE GROUP DEPRECIATION? - (YES OR NO)
NO
```

```
      GROUPDPR
ASSET PURCHASE IN YEAR ZERO (TOTAL COST)
⎕:
      100000
ENTER ASSET TRANSACTIONS ONE AT A TIME USING THE FOLLOWING FORMAT:
YEAR, ADDITION, RETIREMENT, CASH_BENEFIT_ON_RETIREMENT
ADDITIONS AND RETIREMENTS AT COST
ZERO WILL TERMINATE ENTRIES
⎕:
      3 0 10000
⎕:
      4 0 20000
⎕:
      5 20000 40000 10000
⎕:
      6 0 20000
⎕:
      7 0 10000
⎕:
      8 0 2000
⎕:
      9 0 4000
⎕:
      10 0 8000
⎕:
      11 0 4000
⎕:
      12 0 2000
⎕:
      0
ENTER DEPRECIATION RATE  (AS A PERCENT)
ENTER ZERO IF YOU WANT TO COMPUTE IT
⎕:
      0
ENTER GROUP LIFE
⎕:
      5.7
ENTER DEPRECIATION METHOD - SL, DB, SYD
DB
PERCENT OF STRAIGHT LINE (100≤M≤200)
⎕:
      150
```

DEPRECIATION SCHEDULE

	ASSET_ACCOUNT			*ACCUMULATED_DEPRECIATION*			*BOOK_VALUE*
PERIOD	*DEBIT*	*CREDIT*	*BALANCE*	*DEBIT*	*CREDIT*	*BALANCE*	
0	100000.00	0.00	100000.00	0.00	0.00	0.00	100000.00
1	0.00	0.00	100000.00	0.00	26315.79	26315.79	73684.21
2	0.00	0.00	100000.00	0.00	19390.58	45706.37	54293.63
3	0.00	10000.00	90000.00	10000.00	14287.80	49994.17	40005.83
4	0.00	20000.00	70000.00	20000.00	10527.85	40522.02	29477.98
5	20000.00	40000.00	50000.00	30000.00	7757.36	18279.38	31720.62
6	0.00	20000.00	30000.00	20000.00	8347.53	6626.91	23373.09
7	0.00	10000.00	20000.00	10000.00	6150.81	2777.73	17222.27
8	0.00	2000.00	18000.00	2000.00	4532.18	5309.90	12690.10
9	0.00	4000.00	14000.00	4000.00	3339.50	4649.40	9350.60
10	0.00	8000.00	6000.00	8000.00	2460.68	(889.91)	6889.91
11	0.00	4000.00	2000.00	4000.00	1813.14	(3076.78)	5076.78
12	0.00	2000.00	0.00	2000.00	1335.99	(3740.78)	3740.78

MORE GROUP DEPRECIATION? - (YES OR NO)

NO

E. COMPOSITEDRP

```
      COMPOSITEDPR
ENTER DEPRECIATION RATE  (AS A PERCENT)
ENTER ZERO IF YOU WANT TO COMPUTE IT
⎕:
      0
ENTER COST, SALVAGE_VALUE, AND LIFE FOR EACH ASSET
ZERO WILL SIGNAL END OF ENTRIES
ASSET TYPE 1
⎕:
      10000 1000 3
DEPRECIATION METHOD FOR ASSET 1 - SL, DB, IR, SYD
SL
ASSET TYPE 2
⎕:
      15000 3000 4
DEPRECIATION METHOD FOR ASSET 2 - SL, DB, IR, SYD
DB
PERCENT OF STRAIGHT LINE (100≤M≤200)
⎕:
      200
ASSET TYPE 3
⎕:
      25000 5000 10
DEPRECIATION METHOD FOR ASSET 3 - SL, DB, IR, SYD
SYD
ASSET TYPE 4
⎕:
      0
COMPOSITE RATE IS 28.27 PERCENT
COMPOSITE LIFE IS 6.25 YEARS
ASSET PURCHASE IN YEAR ZERO (TOTAL COST)
⎕:
      50000
ENTER ASSET TRANSACTIONS ONE AT A TIME USING THE FOLLOWING FORMAT:
YEAR, ADDITION, RETIREMENT, CASH_BENEFIT_ON_RETIREMENT
ADDITIONS AND RETIREMENTS AT COST
ZERO WILL TERMINATE ENTRIES
⎕:
      3 0 10000
⎕:
      4 0 15000
⎕:
      10 0 25000
⎕:
      0
```

DEPRECIATION SCHEDULE

	ASSET ACCOUNT			ACCUMULATED DEPRECIATION			BOOK VALUE
PERIOD	DEBIT	CREDIT	BALANCE	DEBIT	CREDIT	BALANCE	
0	50000.00	0.00	50000.00	0.00	0.00	0.00	50000.00
1	0.00	0.00	50000.00	0.00	14136.36	14136.36	35863.64
2	0.00	0.00	50000.00	0.00	10139.63	24275.99	25724.01
3	0.00	10000.00	40000.00	10000.00	7272.88	21548.87	18451.13
4	0.00	15000.00	25000.00	15000.00	5216.64	11765.51	13234.49
5	0.00	0.00	25000.00	0.00	3741.75	15507.26	9492.74
6	0.00	0.00	25000.00	0.00	2683.86	18191.12	6808.88
7	0.00	0.00	25000.00	0.00	1925.06	20116.17	4883.83
8	0.00	0.00	25000.00	0.00	1380.79	21496.96	3503.04
9	0.00	0.00	25000.00	0.00	990.40	22487.37	2512.63
10	0.00	25000.00	0.00	25000.00	710.39	(1802.24)	1802.24

MORE COMPOSITE DEPRECIATION? - (YES OR NO)
NO

```
      DPRSWITCH
ENTER ASSET COST
⎕:
      25000
ENTER ASSET SALVAGE VALUE
⎕:
      1200
ENTER ASSET LIFE
⎕:
      10
FOR INITIAL PERIOD - -
ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD
DB
PERCENT OF STRAIGHT LINE (100≤M≤200)
⎕:
      200
SWITCH TO SL OR SYD?
SL
SWITCH TO S-L DEPRECIATION IS AFTER YEAR 6
COMPLETE SCHEDULE FOR MAXIMUM ANNUAL DEPRECIATION? (YES OR NO)
YES
```

DEPRECIATION SCHEDULE

	ASSET ACCOUNT			ACCUMULATED DEPRECIATION			BOOK VALUE
PERIOD	DEBIT	CREDIT	BALANCE	DEBIT	CREDIT	BALANCE	
0	25000.00	0.00	25000.00	0.00	0.00	0.00	25000.00
1	0.00	0.00	25000.00	0.00	5000.00	5000.00	20000.00
2	0.00	0.00	25000.00	0.00	4000.00	9000.00	16000.00
3	0.00	0.00	25000.00	0.00	3200.00	12200.00	12800.00
4	0.00	0.00	25000.00	0.00	2560.00	14760.00	10240.00
5	0.00	0.00	25000.00	0.00	2048.00	16808.00	8192.00
6	0.00	0.00	25000.00	0.00	1638.40	18446.40	6553.60
7	0.00	0.00	25000.00	0.00	1338.40	19784.80	5215.20
8	0.00	0.00	25000.00	0.00	1338.40	21123.20	3876.80
9	0.00	0.00	25000.00	0.00	1338.40	22461.60	2538.40
10	0.00	0.00	25000.00	0.00	1338.40	23800.00	1200.00

```
      DPRSWITCH
ENTER ASSET COST
⎕:
      10000
ENTER ASSET SALVAGE VALUE
⎕:
      100
ENTER ASSET LIFE
⎕:
      8
FOR INITIAL PERIOD - -
ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD
DB
PERCENT OF STRAIGHT LINE (100≤M≤200)
⎕:
      190
SWITCH TO SL OR SYD?
SYD
SWITCH TO S-Y-D DEPRECIATION IS AFTER YEAR 1
COMPLETE SCHEDULE FOR MAXIMUM ANNUAL DEPRECIATION? (YES OR NO)
YES
```

DEPRECIATION SCHEDULE

	ASSET ACCOUNT			ACCUMULATED DEPRECIATION			BOOK VALUE
PERIOD	DEBIT	CREDIT	BALANCE	DEBIT	CREDIT	BALANCE	
0	10000.00	0.00	10000.00	0.00	0.00	0.00	10000.00
1	0.00	0.00	10000.00	0.00	2375.00	2375.00	7625.00
2	0.00	0.00	10000.00	0.00	1881.25	4256.25	5743.75
3	0.00	0.00	10000.00	0.00	1612.50	5868.75	4131.25
4	0.00	0.00	10000.00	0.00	1343.75	7212.50	2787.50
5	0.00	0.00	10000.00	0.00	1075.00	8287.50	1712.50
6	0.00	0.00	10000.00	0.00	806.25	9093.75	906.25
7	0.00	0.00	10000.00	0.00	537.50	9631.25	368.75
8	0.00	0.00	10000.00	0.00	268.75	9900.00	100.00

```
      DPRSWITCH
ENTER ASSET COST
⎕:
      10000
ENTER ASSET SALVAGE VALUE
⎕:
      1500
ENTER ASSET LIFE
⎕:
      10
FOR INITIAL PERIOD - -
ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD
DB
PERCENT OF STRAIGHT LINE (100≤M≤200)
⎕:
      200
SWITCH TO SL OR SYD?
SYD
MAXIMUM ANNUAL DEPRECIATION IS ACHIEVED WITHOUT A SWITCH
COMPLETE SCHEDULE FOR MAXIMUM ANNUAL DEPRECIATION? (YES OR NO)
NO
```

B. DEPRECIATE

```
      ∇DEPRECIATE[⎕]∇
    ∇ DEPRECIATE;C;D;L;S;DS;I
[1]     R←1
[2]   RES:→(R=⍳4)/P1,Q1,Q2,SCH
[3]   P1:C←1 INC 'ENTER ASSET COST'
[4]     S←1 INC 'ENTER ASSET SALVAGE VALUE'
[5]     L←1⍴IPI 'ENTER ASSET LIFE',CR,'⎕:',LF,3⍴' '
[6]     I←⍳L+1
[7]     D←DPR C,S,L
[8]     R←2
[9]   Q1:'COMPLETE DEPRECIATION SCHEDULE? (YES OR NO)'
[10]    →('YN'=1↑⍞)/SCH,Q2
[11]    →Q1
[12]    R←3
[13]  Q2:I←1+IPI 'ENTER YEAR(S) WANTED',CR,'⎕:',LF,3⍴' '
[14]    →(I>L+1)/(⍴I)⍴Q2
[15]    D←((+/I≥0),7)⍴D[I;]
[16]    R←4
[17]  SCH:DPROUT(I-1),D
    ∇
```

```
      ∇DPROUT[⎕]∇
    ∇ DPROUT D;H;I
[1]     H←'DEBIT          CREDIT       BALANCE'
[2]     I←'ACCUMULATED_DEPRECIATION'
[3]     '
                                                DEPRECIATION  SCHEDULE
        '
[4]     (21⍴' '),'ASSET_ACCOUNT',(16⍴' '),I,'         BOOK_VALUE'
[5]     ''
[6]     '  PERIOD     ',H,'          ',H
[7]     'I6,7M⍞(⍞N⍞)⍞Q⍞ ⍞ F12.2' ΔFMT(D)
    ∇
```

```
      ∇DPR[⎕]∇
    ∇ DP←DPR X;C;D;L;R;S;AD;BV;J;K;M
[1]    C←X[1]
[2]    S←X[2]
[3]    L←X[3]
[4]   Q1:'ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD'
[5]    →('LRBY'=1↓2↑⍞)/SL,DBI,DD,SYD
[6]    →Q1
[7]   SL:BV←2 RND C-(⍳L)×(C-S)÷L
[8]    →C1
[9]   DBI:BV←2 RND C×(S÷C)*(⍳L)÷L
[10]   →C1
[11]  DD:'PERCENT OF STRAIGHT LINE (100≤M≤200)'
[12]   M←(1↑⎕)÷100
[13]   →((M<1),M>2)/DD,DD
[14]   BV←2 RND S⌈C×(1-M÷L)*(⍳L)
[15]   BV[L]←S
[16]   →C1
[17]  SYD:AD←D←2 RND(C-S)×(1+L-⍳L)÷(L×L+1)÷2
[18]   K←1
[19]  RE1:AD[K+1]←AD[K]+D[K+1]
[20]   K←K+1
[21]   →(K<L)/RE1
[22]   BV←C-AD
[23]   →OUT
[24]  C1:D←AD←C-BV
[25]   K←1
[26]  RE:K←K+1
[27]   D[K]←AD[K]-AD[K-1]
[28]   →(K<L)/RE
[29]  OUT:DP←(C,0,C,0,0,0,C),[1] 0,0,C,0,D,AD,[1.5] BV
    ∇



      ∇DPRC[⎕]∇
    ∇ DS←DPRC AM;D;C;I;AB;BV;DB;DD;J;DC
[1]    R←2ρ 1 2 ↑AM
[2]    AM←(0,((1↑ρAM)-1)ρ1)/[1] AM
[3]    AB←DD←DB←DC←BV←AM[;2]
[4]    DD←DD-AM[;3]
[5]    J←1
[6]    AB[1]←BV[1]←AM[1;1]-AM[1;2]
[7]   RE:J←J+1
[8]    AB[J]←AB[J-1]+AM[J;1]-AM[J;2]
[9]    DC[J]←R[2]×(AB[J-1]×R[1])+BV[J-1]×~R[1]
[10]   DB[J]←DB[J-1]+DC[J]-DD[J]
[11]   BV[J]←AB[J]-DB[J]
[12]   →(J<ρAM[;1])/RE
[13]   DS←2 RND AM,AB,DD,DC,DB,[1.5] BV
    ∇
```

C. GROUPLIFE

```
      ∇GROUPLIFE[⎕]∇
    ∇ GROUPLIFE;A;E;F;L
[1]  Q1:'ENTER NUMBER (OR PERCENT) OF UNITS FOLLOWED BY EXPECTED LIFE'
[2]   'ONE QUANTITY AND LIFE PER ENTRY - ZERO WILL SIGNAL END OF ENTRIES'
[3]   A← 1 2 ⍴F←0
[4]  IN:E←2↑⎕
[5]   →(E[1]=0)/EX
[6]   A←A,[1] E
[7]   →IN
[8]  EX:L←(+/×/A)÷+/A[;1]
[9]   'GROUPLIFE IS  ';2 RND L;' YEARS'
    ∇
```

D. GROUPDPR

```
      ∇GROUPDPR[⎕]∇
    ∇ GROUPDPR;A;B;R
[1]   R←1
[2]  RES:→(R=⍳5)/P1,P2,P3,NC,P4
[3]  P1:A←ATRANS
[4]   R←2
[5]  P2:R←FLAGRATE
[6]   R←3
[7]   →(0≤1↑R)/NC
[8]  P3:R←GROUPRATE
[9]   R←4
[10] NC:B←DPRC(R,0),[1] A
[11]  R←5
[12] P4:DPROUT((⍳1↑⍴B)-1),B[; 1 2 4 5 6 7 8]
[13]  'MORE GROUP DEPRECIATION? - (YES OR NO)'
[14]  →('Y'=1↑⍞)/1
    ∇
```

E. COMPOSITEDPR

```
      ∇COMPOSITEDPR[⎕]∇
    ∇ COMPOSITEDPR;A;B;R
[1]   R←1
[2]  RES:→(R=⍳5)/P1,P2,NC,P3,P4
[3]  P1:R←FLAGRATE
[4]   R←2
[5]   →(0 ≤1↑R)/NC
[6]  P2:R←COMPRATE
[7]   R←3
[8]  NC:A←ATRANS
[9]   R←4
[10] P3:B←DPRC(R,0),[1] A
[11]  R←5
[12] P4:DPROUT((⍳1↑⍴B)-1),B[; 1 2 4 5 6 7 8]
[13]  'MORE COMPOSITE DEPRECIATION? - (YES OR NO)'
[14]  →('Y'=1↑⍞)/1
    ∇
```

F. DPRSWITCH

```
      ∇DPRSWITCH[⎕]∇
    ∇ DPRSWITCH;C;S;L;D;SY;SL;K;N;SD
[1]     R←1
[2]    RES:→(R=⍳4)/P1,Q1,HR,OUT
[3]    P1:C←1 INC 'ENTER ASSET COST'
[4]     S←1 INC 'ENTER ASSET SALVAGE VALUE'
[5]     L←1↑IPI 'ENTER ASSET LIFE',CR,'⎕:',LF,3⍴' '
[6]     'FOR INITIAL PERIOD - -'
[7]     D←(DPR C,S,L)[; 5 6 7]
[8]     R←2
[9]    Q1:'SWITCH TO SL OR SYD?'
[10]    →(0=+/('LY'=SL←1↓2↑⍞))/Q1
[11]    SY←~SL←SL='L'
[12]    K←1
[13]   RE:SD←(D[K;3]-S)×(SL÷L+1-K)+2×SY÷L+2-K
[14]    →(SD≥D[(K+1);1])/HR
[15]    →(K≥L)/NS
[16]    K←K+1
[17]    →RE
[18]   HR:'SWITCH TO ',(SL/'S-L'),(SY/'S-Y-D'),' DEPRECIATION IS AFTER YEAR
        ';K←K-1
[19]    R←3
[20]   Q2:'COMPLETE SCHEDULE FOR MAXIMUM ANNUAL DEPRECIATION? (YES OR NO)'
[21]    →('YN'=1↑⍞)/SC,0
[22]    →Q2
[23]   NS:'MAXIMUM ANNUAL DEPRECIATION IS ACHIEVED WITHOUT A SWITCH'
[24]    →Q2
[25]   SC:K←K+1
[26]    N←(((L+1-K)×(L+2-K)×SY÷2)+(SL×L+1-K))÷D[K;3]-S
[27]   RE1:→(K>L)/OUT
[28]    D[(K+1);3]←D[1;3]-D[(K+1);2]←D[K;2]+D[(K+1);1]←(SL+(SY×L+1-K))÷N
[29]    K←K+1
[30]    →RE1
[31]    R←4
[32]   OUT:DPROUT(0,⍳L),(C,L⍴0),0,((L+1)⍴C),0,D
    ∇
```

FLAGRATE

```
      ∇FLAGRATE[⎕]∇
    ∇ FR←FLAGRATE;E;F
[1]    Q1:'ENTER DEPRECIATION RATE  (AS A PERCENT)'
[2]     'ENTER ZERO IF YOU WANT TO COMPUTE IT'
[3]     E←(1↑⎕)÷100
[4]     →((E=0),(E<0.01),E>0.9)/CA,Q1,Q1
[5]    Q2:'SL OR ACCELERATED DEPRECIATION'
[6]     →(0=+/('SA'=F←1↑⍞))/Q2
[7]     FR←(F='S'),E
[8]     →0
[9]    CA:FR←¯1
    ∇
```

```
      ∇GROUPRATE[⎕]∇
    ∇ GR←GROUPRATE;L;R;M;F
[1]   F←0
[2]   'ENTER GROUP LIFE'
[3]   L←1↑⎕
[4]  Q3:'ENTER DEPRECIATION METHOD - SL, DB, SYD'
[5]   →('LBY'=1↓2↑⍞)/SL,MSL,SYD
[6]   →Q3
[7]  SL:R←1÷L
[8]   F←1
[9]   →OUT
[10] MSL:'PERCENT OF STRAIGHT LINE (100≤M≤200)'
[11]  M←(1↑⎕)÷100
[12]  →((M<1),M>2)/MSL,MSL
[13]  R←M÷L
[14]  →OUT
[15] SYD:R←2÷L+1
[16]  'DEPRECIATION RATE IS ';100×4 RND R
[17] OUT:GR←F,R
    ∇
```

```
      ∇ATRANS[⎕]∇
    ∇ TM←ATRANS;E;A;S;K;A;AM;PO
[1]  R:'ASSET PURCHASE IN YEAR ZERO (TOTAL COST)'
[2]   PO←1↑⎕
[3]   A← 1 4 ρ0
[4]   K←1
[5]   'ENTER ASSET TRANSACTIONS ONE AT A TIME USING THE FOLLOWING FORMAT:
      '
[6]   'YEAR, ADDITION, RETIREMENT, CASH_BENEFIT_ON_RETIREMENT'
[7]   'ADDITIONS AND RETIREMENTS AT COST'
[8]   'ZERO WILL TERMINATE ENTRIES'
[9]  IN:E←4↑⎕
[10]  →(E[1]=0)/CK
[11]  A←A,[1] E
[12]  →IN
[13] CK:→((PO++/A[;2])≠+/A[;3])/ER
[14]  A← 1 0 ↓A
[15]  AM←((⌈/A[;1]),3)ρ0
[16]  S←1↑ρA
[17] RE:AM[A[K;1];]←A[K; 2 3 4]
[18]  K←K+1
[19]  →(K≤S)/RE
[20]  TM←(PO,0,0),[1] AM
[21]  →0
[22] ER:'ADDITIONS MUST EQUAL RETIREMENTS - RE ENTER DATA'
[23]  →R
    ∇
```

```
      ∇COMPRATE[⎕]∇
    ∇ CR←COMPRATE;K;E;C;D;F;M
[1]   F←K←1+D←0
[2]   C← 1 3 ⍴0
[3]   'ENTER COST, SALVAGE_VALUE, AND LIFE FOR EACH ASSET'
[4]   'ZERO WILL SIGNAL END OF ENTRIES'
[5]  IN:'ASSET TYPE ';K
[6]   E←3↑⎕
[7]   →(E[1]=0)/EI
[8]   C←C,[1] E
[9]  Q1:'DEPRECIATION METHOD FOR ASSET ';K;' - SL, DB, IR, SYD'
[10]  K←K+1
[11]  →('LBRY'=1↓2↑⍞)/SL,MSL,IR,SYD
[12]  →Q1
[13] SL:D←D+(-/E[1 2])÷E[3]
[14]  →IN
[15] MSL:'PERCENT OF STRAIGHT LINE (100≤M≤200)'
[16]  M←(1↑⎕)÷100
[17]  F←0
[18]  →((M<1),M>2)/MSL,MSL
[19]  D←D+E[1]×M÷E[3]
[20]  →IN
[21] IR:D←D+(-/E[1 2])×1-(÷/E[1 2])*1÷E[3]
[22]  F←0
[23]  →IN
[24] SYD:D←D+(-/E[1 2])×2÷E[3]+1
[25]  F←0
[26]  →IN
[27] EI:C← 1 0 ↓C
[28]  'COMPOSITE RATE IS ';100×4 RND D÷+/C[;1];' PERCENT'
[29]  'COMPOSITE LIFE IS ';2 RND(+/C[;1])÷+/(-/C[; 1 2])÷C[;3];' YEARS'
[30]  CR←F,D÷+/C[;1]
    ∇
```

7
Interest, Present and Future Values (TIMEVALUE)

A. General Description

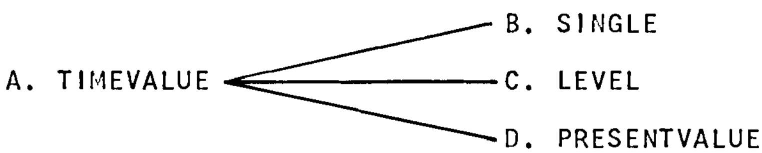
This series is devoted to the solution of problems involving interest, present and future values. Access to the workspace can be achieved through the instruction:

)LOAD 7 TIMEVALUE

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The TIMEVALUE workspace is defined in Exhibit 7-1.

Exhibit 7-1
THE TIMEVALUE WORKSPACE



These major functions, together with their supporting functions and variables are classified in Exhibit 7-2.

Exhibit 7-2
TIMEVALUE FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
SINGLE	-	-
LEVEL	-	TTT
PRESENTVALUE	-	-

For further applications on investment analysis, see Chapter 8 on Investment Analysis and Chapter 11 on Capital Budgeting.

B. SINGLE

This function deals with problems in which there is a single payment. The inputs are:

1. Present value.

2. Number of years.

3. The interest rate as an annual percent.

4. Future value.

Any three variables must be specified in the above order, with a question mark "?" substituted for the missing value.

Four examples are shown in the text. Example 1 solves for future value where the present value is $10,000, the number of years is five, the annual interest rate is 8%, and interest is compounded monthly. Under these conditions, $10,000 invested now will grow to $14,898.46 in five years.

Example 2 solves for the interest rate, where the present value is $10,000, the period is five years, and the future value is $25,000. There are 360 compounding periods in the year, i.e., interest is compounded daily. An interest rate of 18.33% is necessary for $10,000 to grow to $25,000 under the specified conditions.

Example 3 solves for the number of periods where the present value is $10,000, the annual interest rate is 8.75% and the future value is $20,000. Interest is compound annually. The number of years required for $10,000 to grow to $20,000 under these conditions is 8.263 years.

Example 4 solves for present value, where the term is 12 years, the annual interest rate is 9.5% and future value is $450,000. Interest is compounded daily. Under these conditions the present value is $143,940.21.

C. LEVEL

This function solves problems involving present or future values where the payment stream is in the form of equal periodic amounts (annuities). For uneven series refer to the RINV function in Chapter 8. Also, see the capital budgeting examples in Chapter 11 in this regard.

The inputs are:

1. Present value.

2. Number of periods.

3. Interest rate as an annual percent.

4. The annuity.

5. Future value.

Any three of the five inputs must be specified in the order above. The two values to be solved for are replaced with a question mark "?".

Again, provision is made to indicate the number of interest compounding periods within the year. Provision is also made to indicate whether the annuity is in advance or arrears.

There are three examples in the text. Example 1 calls for the solution of the annuity and future value given the other three items. The input is the present value amount of $10,000, the term of three years, the interest rate of 8.75% and the number of compounding periods (12 in this case). Output consists of the annuity, which is a payment of $316.84 per month and the future value of $12,989.39

Example 2 solves for both present and future value given a monthly annuity of $1,000 for a period of 12 years at an annual interest rate of 9.5%. Output is the present value amount of $86,414.59 and the future value amount of $268,988.26.

Example 3 solves for term and an annual interest rate given a present value figure of $10,000, an annual payment of $1,000, and the future value sum of $100,000.

D. PRESENTVALUE

This function computes the present value of an uneven series given a cost of capital. In the example which follows a series consisting of eight unequal payments is discounted by an annual interest rate of 8.75% to achieve a present value of $2,316.89.

B. SINGLE

```
      SINGLE
ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE,
AND FUTURE VALUE --  SUBSTITUTE '?' FOR THE ONE UNKNOWN VALUE
10000 5 8 ?
NUMBER OF COMPOUNDING PERIODS PER YEAR
⎕:
      12
FUTURE VALUE IS 14898.46
```

```
      SINGLE
ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE,
AND FUTURE VALUE --  SUBSTITUTE '?' FOR THE ONE UNKNOWN VALUE
10000 5 ? 25000
NUMBER OF COMPOUNDING PERIODS PER YEAR
⎕:
      360
ANNUAL RATE IS 18.33 PERCENT
```

```
      SINGLE
ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE,
AND FUTURE VALUE --  SUBSTITUTE '?' FOR THE ONE UNKNOWN VALUE
10000 ? 8.75 20000
NUMBER OF COMPOUNDING PERIODS PER YEAR
⎕:
      1
NUMBER OF YEARS IS 8.263
```

```
      SINGLE
ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE,
AND FUTURE VALUE --  SUBSTITUTE '?' FOR THE ONE UNKNOWN VALUE
? 12 9.5 450000
NUMBER OF COMPOUNDING PERIODS PER YEAR
⎕:
      360
PRESENT VALUE IS 143940.21
```

C. LEVEL

```
      LEVEL
ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE, ANNUITY,
AND FUTURE VALUE -- SUBSTITUTE '?' FOR THE TWO UNKNOWN VALUES
10000 3 8.75 ? ?
NUMBER OF INSTALLMENTS PER YEAR
 12
ANNUITY IN ARREARS? YES OR NO: Y
PRESENT VALUE              10,000.00
NUMBER OF YEARS                 3.00
ANNUAL PERCENT                  8.75
ANNUITY                       316.84
FUTURE VALUE               12,989.39
```

```
      LEVEL
ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE, ANNUITY,
AND FUTURE VALUE -- SUBSTITUTE '?' FOR THE TWO UNKNOWN VALUES
? 12 9.5 1000 ?
NUMBER OF INSTALLMENTS PER YEAR
 12
ANNUITY IN ARREARS? YES OR NO: NO
PRESENT VALUE              86,414.59
NUMBER OF YEARS                12.00
ANNUAL PERCENT                  9.50
ANNUITY                     1,000.00
FUTURE VALUE              268,988.26
```

```
      LEVEL
ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE, ANNUITY,
AND FUTURE VALUE -- SUBSTITUTE '?' FOR THE TWO UNKNOWN VALUES
10000 ? ? 1000 100000
NUMBER OF INSTALLMENTS PER YEAR
 1
ANNUITY IN ARREARS? YES OR NO: Y
PRESENT VALUE              10,000.00
NUMBER OF YEARS                26.72
ANNUAL PERCENT                  9.00
ANNUITY                     1,000.00
FUTURE VALUE              100,000.00
```

D. PRESENTVALUE

```
      PRESENTVALUE
NUMBER OF PERIODS:8
AMOUNTS TO BE PRESENT VALUED (ONE AMOUNT FOR EACH PERIOD)
⎕:
      102.75  284.36  400  310  600  210.75  200.15  1250
INTEREST RATE - AS A PERCENT
⎕:
      8.75
PRESENT VALUE IS: 2326.89
```

B. SINGLE

```
      ∇SINGLE[⎕]∇
    ∇ SINGLE;A;IN;B;C
[1]     R←1
[2]   RES:'ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE,'
[3]     'AND FUTURE VALUE --  SUBSTITUTE ''?'' FOR THE ONE UNKNOWN VALUE'
[4]     →FE×ι2≠+/ 4 3 =(ρB),+/B←ΔVI A←AKI ''
[5]     →2×ι~'?'=(ΔMI A)[(Bι0);1]
[6]     →FE×ι1>C←1 INC 'NUMBER OF COMPOUNDING PERIODS PER YEAR'
[7]     IN←B/(ΔFI A)×1,C,(0.01÷C),1
[8]     →(~B)/P,N,R,F
[9]   P:'PRESENT VALUE IS ';2 RND IN[3]×(1+IN[2])*-IN[1]
[10]   →0
[11]  N:→IE×ι(0≥÷/IN[3 1])∨IN[2]≤¯1
[12]   'NUMBER OF YEARS IS ';3 RND((⍟÷/IN[3 1])÷⍟1+IN[2])÷C
[13]   →0
[14]  R:'ANNUAL RATE IS ';3 RND C×100×((÷/IN[3 1])*1÷IN[2])-1;' PERCENT'
[15]   →0
[16]  F:'FUTURE VALUE IS ';2 RND IN[1]×(1+IN[3])*IN[2]
[17]   →0
[18]  FE:'INPUT FORMAT ERROR....'
[19]   →1
[20]  IE:'INPUT VALIDITY ERROR....'
[21]   →1
    ∇
```

C. LEVEL

```
      ∇LEVEL[⎕]∇
    ∇ LEVEL;A;B;C;IN;T;Z
[1]    R←1
[2]   RES:'ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE, ANNU
       ITY,'
[3]    'AND FUTURE VALUE -- SUBSTITUTE ''?'' FOR THE TWO UNKNOWN VALUES'
[4]    →FE×⍳2≠+/ 5 3 =(⍴B),+/B←ΔVI A←AKI ''
[5]    →2×⍳~'?'=(ΔMI A)[(B⍳0);1]
[6]    →FE×⍳1>C←1⌈IPI 'NUMBER OF INSTALLMENTS PER YEAR',CR
[7]    T←~AYN 'ANNUITY IN ARREARS? YES OR NO:'
[8]    IN←(ΔFI A)×1,C,(0.01÷C),1,1
[9]    →((2⊥B)= 28 22 19 21 26 25 14 11 13 7)/D,E,F,G,H,I,J,K,L,M
[10]  D:IN[4]←IN[1]÷((1-(1+IN[3])*-IN[2]-T)÷IN[3])+T
[11]   →FV
[12]  E:IN[2]←T-(⍟(1-IN[3]×(÷/IN[1 4])-T))÷⍟1+IN[3]
[13]   →FV
[14]  F:IN[2]←(⍟÷/Z)÷⍟1+IN[3]←((~T),T)/(((÷/Z)-1)÷(÷/IN[5 4])),(IN[
       4]×-/Z)÷(×/Z)-IN[4]×-/Z←IN[5 1]
[15]   →OUT
[16]  G:IN[2]←(⍟÷/IN[5 1])÷⍟1+IN[3]
[17]   →AC
[18]  H:IN[3]←¯1+IN[2] YLD(T⌽0,(⌈IN[2])⍴IN[4]),[0.5] IN[1],(⌈IN[2])⍴0
[19]   →FV
[20]  I:IN[3]←((÷/IN[5 1])*1÷IN[2])-1
[21]   →AC
[22]  J:IN[5]←IN[4]×(-T)+(((1+IN[3])*IN[2]+T)-1)÷IN[3]
[23]   →PV
[24]  K:IN[3]←¯1+(⌈IN[2]) YLD(((⌈IN[2])⍴0),IN[5]),[0.5] T⌽0,(⌈IN[2])⍴IN[4]
[25]   →PV
[26]  L:IN[4]←IN[5]÷(-T)+(((1+IN[3])*IN[2]+T)-1)÷IN[3]
[27]   →PV
[28]  M:IN[2]←(-T)+(⍟1+IN[3]×T+÷/IN[5 4])÷⍟1+IN[3]
[29]  PV:IN[1]←IN[5]×(1+IN[3])*-IN[2]
[30]   →OUT
[31]  FV:IN[5]←IN[1]×(1+IN[3])*IN[2]
[32]   →OUT
[33]  AC:IN[4]←IN[5]÷(-T)+(((1+IN[3])*IN[2]+T)-1)÷IN[3]
[34]  OUT:CR
[35]   TTT,'CF20.2' ΔFMT(IN[1],(IN[2]÷C),(100×IN[3]×C),IN[4 5])
[36]   →0
[37]  FE:'INPUT FORMAT ERROR....'
[38]   →1
    ∇
```

D. PRESENTVALUE

```
      ∇PRESENTVALUE[⎕]∇
    ∇ PRESENTVALUE;N;B;R
[1]     R←1
[2]    RES:→1×ι1≠ρ,N←IPI 'NUMBER OF PERIODS:_',2ρBS
[3]     B←N INC 'AMOUNTS TO BE PRESENT VALUED (ONE AMOUNT FOR EACH PERIOD)'
[4]     R←0.01×1 INC 'INTEREST RATE - AS A PERCENT'
[5]     'PRESENT VALUE IS: ';2 RND+/B÷(1+R)*(ιN)-1
    ∇
```

8
Investment Analysis (INVESTMENT)

A. General Description

The programs in this series are designed to facilitate investment analysis relating to bonds, stocks, sinking funds, and real estate.

Each program can be used individually after loading the workspace INVESTMENT using the instruction:

```
)LOAD 7 INVESTMENT
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The series configuration is illustrated in Exhibit 8-1.

Exhibit 8-1
THE INVESTMENT WORKSPACE

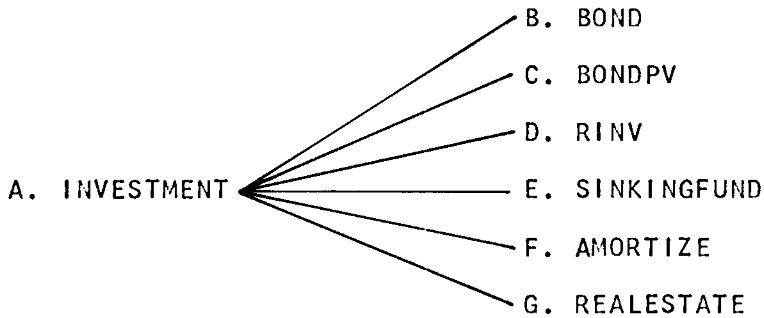


Exhibit 8-2
INVESTMENT FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
BOND	BONDIN, YLD	-
BONDPV	BONDIN	-
RINV	-	-
SINKINGFUND	SFD	-
AMORTIZE	ARTZ	-
REALESTATE	ARTZ, DPR, YLD	-

B. BOND

This program computes the yield of a bond where the bond price is expressed as a percentage of the face value. Also, BOND will construct a discount accumulation or premium amortization schedule.

Input consists of:

1. The face value of the bond.

2. The nominal rate of interest expressed as an annual percent.

3. The number of interest payments per year.

4. The bond life or years to maturity from the date of purchase.

5. The bond purchase price other than 100.

Output consists of:

1. The yield of the investment, expressed as an annual percentage.

2. A discount accumulation or premium amortization schedule, (on the basis of anual totals or a complete schedule), using either the straight-line (SL) or compound-interest (CI) methods.

C. BONDPV (Present Value)

This program will compute the present value of a bond. The input consists of:

1. The face value of the bond.

2. Nominal interest expressed as an annual percentage

3. Number of interest payments per year.

4. Years to maturity from the date of purchase.

5. The market or desired interest rate as a percentage.

The program outputs the present value of the bond. This value sets a theoretical purchase or selling price on the bond.

D. RINV (Return on Investment)

The yield of an investment, such as with an investment in stocks, is accommodated by this program. Input consists of specifying the amount returned per period for any number of periods.

If, for example, $1,000 is invested in stock in year zero, and the amounts returned in each year, including dividends per year and proceeds on sale in the final year, are:

YEAR	1	2	3	4	5
RETURN	$50	$60	$70	$80	$1245

The yield on the investment is 9.39% in this example.

E. SINKINGFUND

This program produces an accumulation table for a sinking fund.

Input consists of:

1. Future amount required.

2. Interest rate as a percentage.

3. Number of years required to complete the fund.

4. Number of deposits into the fund per year. The accumulation table can be specified on a per period or per annum basis. An example of each format is given.

F. AMORTIZE

The input to this program is:

1. The amount to be amortized.

2. The interest rate as a percentage.

3. The loan period in years.

4. The number of payments per year.

The program yields:

1. The annual payment, which is the sum of periodic payments within a year.

2. An amortization schedule based on annual totals.

3. A complete, periodic schedule of the balances outstanding. As the periodic payment is constant, the ratio of interest to principal can be computed readily for any period by the following means:

Periodic Payment - Balance = Periodic Interest

The difference between periodic balances is equal to the pricipal payment for the period. Subtracting principal from the total payment will furnish the amount of interest for the period.

NOTE: If requested, the program will print out the complete schedule of balances. The year followed by the balances during the year (after each payment) will be printed on more than one line if necessary (as in the example).

G. REALESTATE

This program performs a comprehensive analysis of a real estate investment.

The input consists of:

1. Purchase price of the property.

2. Land as a percentage of the purchase price.

3. The life of the investment and depreciation and amortization periods.

4. Capital gains tax rate.

5. Recapture percentage.

6. EBDFT ("Earnings Before Depreciation, Financing, & Taxes"). This figure represents gross income less regular operating expenses. The program will accommodate either one EBDFT figure for all periods, or a different EBDFT for each period under analysis.

7. The tax rate of the investor.

8. The rate of appreciation in the value of the property.

9. The down payment against the purchase price of the property.

10. The interest rate on the amount of the mortgage, which is the difference between the purchase price and down payment.

11. The number of loan payments per year.

12. The method of depreciation used, i.e., straight-line (SL), declining-balance (between 100 & 200 percent of straight-line), internal-rate (IR), or sum-of-years' digits (SYD).

The program outputs:

1. The annual payment required to amortize the loan, which is the sum of the periodic payments within each year.

2. The periodic payment.

3. An amortization schedule, if requested.

4. A depreciation schedule, if requested.

5. An integrated schedule of earnings and cash flow, including the rate of return on the down payment in relation to CAT (Cash flow After Tax), based on annual totals.

6. An "investment data" schedule, if requested, which computes time-adjusted yield assuming a sale at the end of each year. The program computes the capital gain on sale, appreciation in the value of the property, and depreciation recapture for depreciation taken to the point of sale in excess of straight-line.

```
      BOND
BOND FACE VALUE
⎕:
      100000
BOND ANNUAL INTEREST RATE - (AS A PERCENT)
⎕:
      6.5
NUMBER OF INTEREST PAYMENTS PER YEAR
⎕:
      2
BOND LIFE - (YEARS)
⎕:
      5
BOND PRICE (E.G. 104.375)
⎕:
      105.6

BOND YIELD IS  5.21  PERCENT
DO YOU WANT SCHEDULE OF PREM AMORT
YES
PREM AMORT METHOD - SL OR CI
CI
ANNUAL TOTALS OR COMPLETE
A

   YEAR       INT REC'D        PREM AMORT        INT INCOME   BOND CARRYING VALUE
     0             0.00              0.00              0.00        105600.00
     1          6500.00           1007.80           5492.20        104592.20
     2          6500.00           1061.03           5438.97        103531.17
     3          6500.00           1117.06           5382.94        102414.11
     4          6500.00           1176.06           5323.94        101238.05
     5          6500.00           1238.05           5277.76        100000.00
```

B-1. BOND

```
      BOND
BOND FACE VALUE
⎕:
      100000
BOND ANNUAL INTEREST RATE - (AS A PERCENT)
⎕:
      4
NUMBER OF INTEREST PAYMENTS PER YEAR
⎕:
      2
BOND LIFE - (YEARS)
⎕:
      5
BOND PRICE (E.G. 104.375)
⎕:
      93.6

BOND YIELD IS  5.48  PERCENT
DO YOU WANT SCHEDULE OF DISC ACCUM
YES
DISC ACCUM METHOD - SL OR CI
SL
ANNUAL TOTALS OR COMPLETE
C

PAYMENT      INT REC'D      DISC ACCUM      INT INCOME   BOND CARRYING VALUE
     0            0.00            0.00            0.00          93600.00
     1         2000.00          640.00         2640.00          94240.00
     2         2000.00          640.00         2640.00          94880.00
     3         2000.00          640.00         2640.00          95520.00
     4         2000.00          640.00         2640.00          96160.00
     5         2000.00          640.00         2640.00          96800.00
     6         2000.00          640.00         2640.00          97440.00
     7         2000.00          640.00         2640.00          98080.00
     8         2000.00          640.00         2640.00          98720.00
     9         2000.00          640.00         2640.00          99360.00
    10         2000.00          640.00         2640.00         100000.00
```

C. BONDPV

```
      BONDPV
BOND FACE VALUE
⎕:
      100000
BOND ANNUAL INTEREST RATE - (AS A PERCENT)
⎕:
      4
NUMBER OF INTEREST PAYMENTS PER YEAR
⎕:
      2
BOND LIFE - (YEARS)
⎕:
      5
MARKET INTEREST RATE - (AS A PERCENT)
⎕:
      6.5
BOND PRESENT VALUE IS  89472.01
```

D. RINV

```
      RINV
ENTER INVESTMENT AMOUNTS
⎕:
      1000
ENTER PERIOD WHEN EACH INVESTMENT IS MADE
⎕:
      0
ENTER RETURN AMOUNTS
⎕:
      50 60 70 80 1245
ENTER PERIOD WHEN EACH RETURN IS RECEIVED
⎕:
      1 2 3 4 5
YIELD IS 9.39 PERCENT
```

E-1. SINKINGFUND

```
      SINKINGFUND
FUTURE AMOUNT
⎕:
      150000
INTEREST RATE (AS A PERCENT)
⎕:
      8.75
NUMBER OF YEARS
⎕:
      10
NUMBER OF PERIODS PER YEAR
⎕:
      4
PERIOD OR ANNUAL TOTALS?
A
```

YEAR	CONTRIBUTION	INTEREST	BALANCE
1	9536.07	317.49	9853.56
2	9536.07	1208.38	20598.01
3	9536.07	2179.82	32313.91
4	9536.07	3239.09	45089.07
5	9536.07	4394.14	59019.28
6	9536.07	5653.61	74208.96
7	9536.07	7026.96	90771.99
8	9536.07	8524.48	108832.54
9	9536.07	10157.39	128525.99
10	9536.07	11937.94	150000.00

E-2. SINKINGFUND

```
      SINKINGFUND
FUTURE AMOUNT
⎕:
      45000
INTEREST RATE (AS A PERCENT)
⎕:
      6
NUMBER OF YEARS
⎕:
      4
NUMBER OF PERIODS PER YEAR
⎕:
      2
PERIOD OR ANNUAL TOTALS?
P
```

PERIOD	CONTRIBUTION	INTEREST	BALANCE
1	5060.54	0.00	5060.54
2	5060.54	151.82	10272.89
3	5060.54	308.19	15641.62
4	5060.54	469.25	21171.40
5	5060.54	635.14	26867.08
6	5060.54	806.01	32733.63
7	5060.54	982.01	38776.18
8	5060.54	1163.29	45000.00

F. AMORTIZE

```
        AMORTIZE
AMOUNT TO BE AMORTIZED
⎕:
      100000
INTEREST RATE (AS A PERCENT)
⎕:
      8.5
LENGTH OF LOAN (YEARS)
⎕:
      15
NUMBER OF LOAN PAYMENTS PER YEAR
⎕:
      12
ANNUAL PAYMENT IS  11816.87
PERIODIC PAYMENT IS  984.74
ANNUAL AMORTIZATION SCHEDULE? - (YES OR NO)
YES


         AMORTIZATION SCHEDULE

YEAR     INTEREST       PRINCIPAL       BALANCE
  1          8368            3449         96551
  2          8063            3754         92797
  3          7731            4086         88711
  4          7370            4447         84264
  5          6977            4840         79424
  6          6549            5268         74156
  7          6083            5734         68422
  8          5576            6240         62182
  9          5025            6792         55390
 10          4425            7392         47997
 11          3771            8046         39952
 12          3060            8757         31195
 13          2286            9531         21664
 14          1443           10373         11290
 15           527           11290             0
COMPLETE SCHEDULE OF AMORTIZATION BALANCES? - (YES OR NO)
YES
```

COMPLETE SCHEDULE OF BALANCES

1	99723.59	99445.23	99164.89	98882.57	98598.25	98311.92
98023.55	97733.15	97440.68	97146.15	96849.53	96550.81	
2	96249.97	95947	95641.88	95334.61	95025.15	94713.51
94399.66	94083.58	93765.27	93444.7	93121.86	92796.73	
3	92469.3	92139.55	91807.47	91473.03	91136.23	90797.04
90455.44	90111.43	89764.98	89416.08	89064.7	88710.83	
4	88354.46	87995.57	87634.13	87270.13	86903.56	86534.38
86162.6	85788.18	85411.1	85031.36	84648.92	84263.78	
5	83875.91	83485.29	83091.91	82695.73	82296.76	81894.95
81490.3	81082.78	80672.38	80259.07	79842.83	79423.65	
6	79001.49	78576.35	78148.19	77717	77282.75	76845.43
76405.02	75961.48	75514.8	75064.96	74611.93	74155.69	
7	73696.22	73233.49	72767.49	72298.19	71825.56	71349.59
70870.24	70387.5	69901.34	69411.73	68918.66	68422.09	
8	67922.01	67418.38	66911.19	66400.41	65886	65367.96
64846.24	64320.83	63791.69	63258.81	62722.16	62181.7	
9	61637.41	61089.27	60537.25	59981.31	59421.44	58857.6
58289.77	57717.92	57142.01	56562.03	55977.94	55389.71	
10	54797.31	54200.72	53599.9	52994.83	52385.47	51771.8
51153.77	50531.37	49904.56	49273.31	48637.59	47997.37	
11	47352.61	46703.29	46049.36	45390.81	44727.58	44059.67
43387.02	42709.6	42027.39	41340.34	40648.43	39951.62	
12	39249.87	38543.15	37831.42	37114.66	36392.81	35665.85
34933.75	34196.46	33453.94	32706.17	31953.1	31194.69	
13	30430.91	29661.73	28887.09	28106.97	27321.32	26530.11
25733.29	24930.83	24122.68	23308.81	22489.17	21663.73	
14	20832.44	19995.27	19152.16	18303.08	17447.99	16586.84
15719.59	14846.2	13966.62	13080.81	12188.73	11290.32	
15	10385.56	9474.38	8556.75	7632.62	6701.95	5764.68
4820.77	3870.18	2912.86	1948.75	977.81	0	

G. REALESTATE

```
      REALESTATE
PURCHASE PRICE
⎕:
      120000
VALUE OF LAND (AS A PERCENTAGE OF PURCHASE PRICE)
⎕:
      12.5
DEPRECIATION PERIOD (YEARS)
⎕:
      21
AMORTIZATION PERIOD (YEARS)
⎕:
      21
INVESTMENT PERIOD (YEARS)
⎕:
      21
CAPITAL GAINS TAX RATE (AS A PERCENT)
⎕:
      25
PERCENT RECAPTURE
⎕:
      0
EBDFT - (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      11000
TAX RATE - (AS A PERCENT)
⎕:
      50
ANNUAL PROPERTY APPRECIATION RATE - (AS A PERCENT)
⎕:
      5
DOWN PAYMENT
⎕:
      20000
INTEREST RATE - (AS A PERCENT)
⎕:
      6.5
NUMBER OF LOAN PAYMENTS PER YEAR
⎕:
      12
ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD
SL
ANNUAL PAYMENT IS  8740.36
PERIODIC PAYMENT IS  728.36
ANNUAL AMORTIZATION SCHEDULE? - (YES OR NO)
YES
```

AMORTIZATION SCHEDULE

YEAR	*INTEREST*	*PRINCIPAL*	*BALANCE*
1	6432	2308	97692
2	6277	2463	95229
3	6112	2628	92601
4	5937	2804	89797
5	5749	2992	86805
6	5548	3192	83613
7	5335	3406	80208
8	5107	3634	76574
9	4863	3877	72697
10	4603	4137	68560
11	4326	4414	64146
12	4031	4710	59436
13	3715	5025	54411
14	3379	5361	49050
15	3020	5721	43329
16	2637	6104	37226
17	2228	6512	30713
18	1792	6949	23765
19	1326	7414	16351
20	830	7910	8440
21	300	8440	0

COMPLETE SCHEDULE OF AMORTIZATION BALANCES? - (YES OR NO)
NO
DEPRECIATION SCHEDULE? (YES OR NO)
YES

DEPRECIATION SCHEDULE

YEAR	*DEPRECIATION*	*ACCUM DEPR*	*BOOK VALUE*
1	5000	5000	115000
2	5000	10000	110000
3	5000	15000	105000
4	5000	20000	100000
5	5000	25000	95000
6	5000	30000	90000
7	5000	35000	85000
8	5000	40000	80000
9	5000	45000	75000
10	5000	50000	70000
11	5000	55000	65000
12	5000	60000	60000
13	5000	65000	55000
14	5000	70000	50000
15	5000	75000	45000
16	5000	80000	40000
17	5000	85000	35000
18	5000	90000	30000
19	5000	95000	25000
20	5000	100000	20000
21	5000	105000	15000

INTEGRATED STATEMENT OF EARNINGS AND CASH FLOW

YEAR	*EBDFT*	*(INTEREST)*	*(DEPREC)*	*EBT*	*(TAX)*	*EAT*	*DEPREC*	*(PRIN)*	*CAT*	*RETURN*
1	11000	6432	5000	(432)	(216)	(216)	5000	2308	2476	12.38
2	11000	6277	5000	(277)	(139)	(139)	5000	2463	2398	11.99
3	11000	6112	5000	(112)	(56)	(56)	5000	2628	2316	11.58
4	11000	5937	5000	63	32	32	5000	2804	2228	11.14
5	11000	5749	5000	251	126	126	5000	2992	2134	10.67
6	11000	5548	5000	452	226	226	5000	3192	2034	10.17
7	11000	5335	5000	665	333	333	5000	3406	1927	9.63
8	11000	5107	5000	893	447	447	5000	3634	1813	9.06
9	11000	4863	5000	1137	568	568	5000	3877	1691	8.46
10	11000	4603	5000	1397	698	698	5000	4137	1561	7.81
11	11000	4326	5000	1674	837	837	5000	4414	1423	7.11
12	11000	4031	5000	1969	985	985	5000	4710	1275	6.38
13	11000	3715	5000	2285	1142	1142	5000	5025	1117	5.59
14	11000	3379	5000	2621	1311	1311	5000	5361	949	4.75
15	11000	3020	5000	2980	1490	1490	5000	5721	770	3.85
16	11000	2637	5000	3363	1682	1682	5000	6104	578	2.89
17	11000	2228	5000	3772	1886	1886	5000	6512	374	1.87
18	11000	1792	5000	4208	2104	2104	5000	6949	156	0.78
19	11000	1326	5000	4674	2337	2337	5000	7414	(77)	(0.39)
20	11000	830	5000	5170	2585	2585	5000	7910	(325)	(1.63)
21	11000	300	5000	5700	2850	2850	5000	8440	(590)	(2.95)
TOTALS	231000	83547	105000	42453	21226	21226	105000	100000	26226	

DO YOU WANT A STATEMENT OF PRO FORMA YIELD ASSUMING SALE EACH YEAR? (YES OR NO)
YES

PRO FORMA YIELD ON SALE OF INVESTMENT

YEAR	CUMULATIVE DEPREC	CUMULATIVE APPREC	CAPITAL GAIN	CAP. GAIN AFTER TAX	TAX BASIS LESS LOAN	CASH FLOW ON SALE	CUMULATIVE SPEND.(N)	TOTAL CASH FLOW A.T.	YIELD
1	5000	6000	11000	8250	17308	25558	2476	28034	40.17
2	10000	12300	22300	16725	14771	31496	4874	36370	36.52
3	15000	18915	33915	25436	12399	37835	7190	45025	33.68
4	20000	25861	45861	34396	10203	44599	9418	54016	31.40
5	25000	33154	58154	43615	8195	51810	11552	63362	29.52
6	30000	40811	70811	53109	6387	59495	13586	73081	27.93
7	35000	48852	83852	62889	4792	67681	15513	83194	26.56
8	40000	57295	97295	72971	3426	76397	17325	93723	25.37
9	45000	66159	111159	83370	2303	85673	19017	104690	24.32
10	50000	75467	125467	94101	1440	95541	20578	116119	23.39
11	55000	85241	140241	105181	854	106035	22001	128036	22.56
12	60000	95503	155503	116627	564	117191	23276	140467	21.80
13	65000	106278	171278	128458	589	129047	24393	153440	21.11
14	70000	117592	187592	140694	950	141644	25342	166986	20.48
15	75000	129471	204471	153354	1671	155024	26112	181136	19.90
16	80000	141945	221945	166459	2774	169233	26690	195923	19.37
17	85000	155042	240042	180032	4287	184318	27064	211382	18.87
18	90000	168794	258794	194096	6235	200331	27219	227550	18.41
19	95000	183234	278234	208676	8649	217325	27142	244467	17.98
20	100000	198396	298396	223797	11560	235357	26817	262173	17.57
21	105000	214316	319316	239487	15000	254487	26226	280713	17.19

B. BOND

```
      ∇BOND[⎕]∇
    ∇ BOND;A;B;C;D;AA;P;Q;R;K;I;S
[1]    R←1
[2]   RES:→(R=⍳4)/P1,P2,Q2,OUT
[3]   P1:A←BONDIN
[4]    A←A,0.01×A[1]×1 INC 'BOND PRICE (E.G. 104.375)'
[5]    ((=/A[1 5])/'FACE VALUE EQUALS PRICE - RE ENTER DATA')
[6]    →(=/A[1 5])/1
[7]    Q←((>/A[1 5])/'DISC ACCUM'),((</A[1 5])/'PREM AMORT')
[8]    S←'PAYMENT'
[9]    AA←(×/A[1 2])÷A[3]
[10]   P←×/A[3 4]
[11]   R←2
[12]  P2:R←(P YLD(0,(1↓PρAA),A[1]+AA),[0.5] A[5],Pρ0)-1
[13]   'BOND YIELD IS  ';2 RND R×A[3]×100;'  PERCENT'
[14]   R←3
[15]  Q2:'DO YOU WANT SCHEDULE OF ',Q
[16]   →('YN'=1↑⍞)/Q1,0
[17]   →Q2
[18]  Q1:Q,' METHOD - SL OR CI'
[19]   →('SC'=1↑⍞)/SL,CI
[20]   →Q1
[21]  SL:B←2 RND(-/A[5 1])÷P
[22]   K←×/A[3 4]
[23]   C←0,Pρ|AA-B
[24]   D←A[5],A[5]-(⍳P)×B
[25]   B←0,Pρ|B
[26]   AA←0,PρAA
[27]   →OUT
[28]  CI:K←1
[29]  SCH:B←C←Pρ0
[30]   D←PρA[5]
[31]  RE1:K←K+1
[32]   D[K]←D[K-1]-B[K]←AA-C[K]←R×D[K-1]
[33]   →(K<P)/RE1
[34]   B←|B,D[P]-A[1]
[35]   D←D,A[1]
[36]   C←C,R×D[P-1]
[37]   AA←0,PρAA
[38]  OUT:R←4
[39]   →(A[3]=1)/OUT1
[40]   'ANNUAL TOTALS OR COMPLETE'
[41]   →('AC'=1↑⍞)/AN,OUT1
[42]   →OUT
[43]  AN:AA←A[3]×(A[4]+1)↑AA
[44]   D←D[1+A[3]×(0,⍳A[4])]
[45]   K←0
[46]   S←'   YEAR'
[47]  RE:K←K+1
[48]   I←((⍳A[3])-1)+2×K
[49]   B[K+1]←+/B[I]
[50]   C[K+1]←+/C[I]
```

```
[51]  →(K<A[4])/RE
[52]  B←(K+1)↑B
[53]  C←(K+1)↑C
[54] OUT1:''
[55]  S,'      INT REC''D      ',Q,'      INT INCOME   BOND CARRYING VALU
      E'
[56]  'I6,4F16.2' ΔFMT((0,⍳K),AA,B,C,[1.5] D)
    ∇
```

BONDIN

```
      ∇BONDIN[⎕]∇
    ∇ BINV←BONDIN;A1;A2;A3;A4;REP
[1]   REP←CR,'⎕:',LF,3⍴' '
[2]   A1←1 INC 'BOND FACE VALUE'
[3]   A2←0.01×1 INC 'BOND ANNUAL INTEREST RATE - (AS A PERCENT)'
[4]   A3←1↑IPI 'NUMBER OF INTEREST PAYMENTS PER YEAR',REP
[5]   A4←1↑IPI 'BOND LIFE - (YEARS)',REP
[6]   BINV←A1,A2,A3,A4
    ∇
```

C. BONDPV

```
      ∇BONDPV[⎕]∇
    ∇ BONDPV;A;PV
[1]   A←BONDIN
[2]   A←A,0.01×1 INC 'MARKET INTEREST RATE - (AS A PERCENT)'
[3]   PV←((×/A[1 2])÷A[3])×(1-(1+A[5]÷A[3])*-×/A[3 4])÷A[5]÷A[3]
[4]   PV←2 RND PV+A[1]÷(1+A[5]÷A[3])*×/A[3 4]
[5]   'BOND PRESENT VALUE IS  ';PV
    ∇
```

```
      ∇YLD[⎕]∇
    ∇ Y←A YLD X;R;D
[1]   R←(÷/+/X)*1÷A
[2]  RE:D←÷/+/X÷R*(2,A+1)⍴(⍳A+1)-1
[3]   R←R×D*1÷A
[4]   →RE×⍳(|D-1)>5E¯5
[5]   Y←R
    ∇
```

D. RINV

```
      ∇RINV[⎕]∇
    ∇ RINV;IV;IP;RT;RP;D;N;R;REP
[1]    REP←CR,'⎕:',LF,3ρ' '
[2]   Q1:'ENTER INVESTMENT AMOUNTS'
[3]    IV←,⎕
[4]    IP←,IPI 'ENTER PERIOD WHEN EACH INVESTMENT IS MADE',REP
[5]    →ER1×ι(ρIV)≠ρIP
[6]   Q2:'ENTER RETURN AMOUNTS'
[7]    RT←,⎕
[8]    N←⌈/IP,RP←,IPI 'ENTER PERIOD WHEN EACH RETURN IS RECEIVED',REP
[9]    →ER2×ι(ρRT)≠ρRP
[10]   R←((+/RT)÷+/IV)*1÷N
[11]  RE:D←(+/RT×R*-RP)÷+/IV×R*-IP
[12]   R←R×D*1÷N
[13]   →((|D-1)<5E¯5)/OUT
[14]   →RE
[15]  OUT:'YIELD IS ';2 RND 100×R-1;' PERCENT'
[16]   →0
[17]  ER1:'NUMBER OF PERIODS NOT EQUAL TO NUMBER OF INVESTMENTS'
[18]   →Q1
[19]  ER2:'NUMBER OF PERIODS NOT EQUAL TO NUMBER OF RETURNS'
[20]   →Q2
    ∇
```

E. SINKINGFUND

```
      ∇SINKINGFUND[⎕]∇
    ∇ SINKINGFUND;A;F;R;N;Y;T;I;K;REP
[1]    REP←CR,'⎕:',LF,3ρ' '
[2]    R←1
[3]   RES:→(R=ι3)/P1,P2,PER1
[4]   P1:F←1 INC 'FUTURE AMOUNT'
[5]    R←0.01×1 INC 'INTEREST RATE (AS A PERCENT)'
[6]    Y←1↑IPI 'NUMBER OF YEARS',REP
[7]    N←1↑IPI 'NUMBER OF PERIODS PER YEAR',REP
[8]    R←2
[9]   P2:A←SFD F,(R÷N),Y×N
[10]   T←'    YEAR'
[11]   →(N=1)/PER1
[12]  Q:'PERIOD OR ANNUAL TOTALS?'
[13]   →('PA'=1↑⍞)/PER,ANN
[14]   →Q
[15]  ANN:I←1
[16]  RE:K←(ιN)+N×I-1
[17]   A[I; 1 2]←+⌿A[K; 1 2]
[18]   I←I+1
[19]   →(I≤Y)/RE
[20]   A[ιY;3]←A[(N×ιY);3]
[21]   A←(Y,3)↑A
[22]   →PER1
[23]  PER:T←'  PERIOD'
[24]  PER1:R←3
[25]   T,'  CONTRIBUTION      INTEREST       BALANCE'
[26]   'I6,3F14.2' ΔFMT((ι1↑ρA),A)
    ∇
```

```
      ∇SFD[⎕]∇
    ∇ VSF←SFD X;AD;D;I;J
[1]    D←X[1]×X[2]÷((1+X[2])*(X[3]))-1
[2]    J←1
[3]    AD←D+I←,0
[4]   RE:I←I,AD[J]×X[2]
[5]    AD←AD,AD[J]+D+I[J+1]
[6]    J←J+1
[7]    →(J<X[3])/RE
[8]    VSF←D,I,[1.5] AD
    ∇
```

F. AMORTIZE

```
      ∇AMORTIZE[⎕]∇
    ∇ AMORTIZE;P;R;Y;NP;A;REP
[1]   REP←CR,'⎕:',LF,3⍴' '
[2]  RES:P←1 INC 'AMOUNT TO BE AMORTIZED'
[3]   R←0.01×1 INC 'INTEREST RATE (AS A PERCENT)'
[4]   Y←1↑IPI 'LENGTH OF LOAN (YEARS)',REP
[5]   NP←1↑IPI 'NUMBER OF LOAN PAYMENTS PER YEAR',REP
[6]   A←ARTZ P,R,Y,NP
    ∇
```

```
      ∇ARTZ[⎕]∇
    ∇ AM←ARTZ X;MP;BAL;Y;M;I;P;PB;MR
[1]   MR←X[2]÷X[4]
[2]   MP←(×/X[1 4])÷(1-(1+MR)*-×/X[3 4])÷MR
[3]   'ANNUAL PAYMENT IS  ';2 RND MP
[4]   'PERIODIC PAYMENT IS  ';2 RND MP÷X[4]
[5]   BAL←X[3 4]⍴0
[6]   P←I←X[3]⍴0
[7]   PB←X[1]
[8]   Y←1
[9]  IY:M←1
[10] IM:I[Y]←I[Y]+PB×MR
[11]  BAL[Y;M]←PB←PB-((MP÷X[4])-(PB×MR))
[12]  M←M+1
[13]  →(M<X[4]+1)/IM
[14]  Y←Y+1
[15]  →(Y<X[3]+1)/IY
[16]  I[X[3]]←I[X[3]]+BAL[X[3];X[4]]
[17]  BAL[X[3];X[4]]←0
[18] Q1:'ANNUAL AMORTIZATION SCHEDULE? - (YES OR NO)'
[19]  →('YN'=1↑⍞)/B,Q2
[20]  →Q1
[21] Q2:'COMPLETE SCHEDULE OF AMORTIZATION BALANCES? - (YES OR NO)'
[22]  →('YN'=1↑⍞)/A,EX
[23]  →Q2
[24] A:'
      '
[25]  'COMPLETE SCHEDULE OF BALANCES'
[26]  (⍳X[3]),2 RND BAL
[27]  →EX
[28] B:P←MP-I
[29]  '
      '
[30]  '           AMORTIZATION SCHEDULE'
[31]  ''
[32]  'YEAR    INTEREST       PRINCIPAL      BALANCE'
[33]  'I3,3M⍞(⍞N⍞)⍞Q⍞ ⍞ I14' ΔFMT((⍳X[3]),I,P,[1.5] BAL[;X[4]])
[34]  →Q2
[35] EX:AM←2 RND(⍳X[3]),I,(MP-I),[1.5] BAL[;X[4]]
    ∇
```

G. REALESTATE

```
      ∇REALESTATE[⎕]∇
    ∇ REALESTATE;P;L;ET;TR;AP;D;IR;DP;A;S;C;CG;TX;EA;EB;RTN;CAT;CNS;CFAT;
        TB;T;R;K;NP;CA;CAP;CGD;CGAT;MR;NP;Y;CT;IY;RC;YA;YD;YI;REP
[1]     REP←C̲R̲,'⎕:',L̲F̲,3ρ' '
[2]     R̲←1
[3]   R̲E̲S̲:→(R̲=⍳8)/P1,P2,P3,P4,PQ,RE1,P3,P4
[4]   P1:P←1 INC 'PURCHASE PRICE'
[5]   LQ:L←1 INC 'VALUE OF LAND (AS A PERCENTAGE OF PURCHASE PRICE)'
[6]     →((L<1),L>100)/LQ,LQ
[7]     L←L×P÷100
[8]     YD←1↑IPI 'DEPRECIATION PERIOD (YEARS)',REP
[9]     YA←1↑IPI 'AMORTIZATION PERIOD (YEARS)',REP
[10]    YI←1↑IPI 'INVESTMENT PERIOD (YEARS)',REP
[11]    CT←0.01×1 INC 'CAPITAL GAINS TAX RATE (AS A PERCENT)'
[12]    RC←0.01×1 INC 'PERCENT RECAPTURE'
[13]    ET←YIρ(1,YI) INC 'EBDFT - (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)'
[14]    TR←0.01×1 INC 'TAX RATE - (AS A PERCENT)'
[15]    AP←0.01×1 INC 'ANNUAL PROPERTY APPRECIATION RATE - (AS A PERCENT)'
[16]    D←1 INC 'DOWN PAYMENT'
[17]    IR←0.01×1 INC 'INTEREST RATE - (AS A PERCENT)'
[18]    R̲←2
[19]    NP←1↑IPI 'NUMBER OF LOAN PAYMENTS PER YEAR',REP
[20]  P2:DP← 1 0 ↓(DPR P,L,YD)[; 5 6 7]
[21]    R̲←3
[22]  P3:A←ARTZ(P-D),IR,YA,NP
[23]    R̲←4
[24]  DQ:'DEPRECIATION SCHEDULE? (YES OR NO)'
[25]    →('YN'=1↑⍞)/DSC,BY
[26]    →DQ
[27]  DSC:(3ρC̲R̲),(10ρ' '),'DEPRECIATION SCHEDULE',C̲R̲
[28]    'YEAR    DEPRECIATION   ACCUM DEPR   BOOK VALUE'
[29]    'I4,3I13' ΔFMT((⍳1↑ρDP);DP)
[30]  BY:→(YD≥YI)/PF1
[31]    DP←DP,[1]((YI-YD),3)ρ0,DP[YD; 2 3]
[32]  PF1:DP←(YI,3)↑DP
[33]    →(YA≥YI)/PFO
[34]    A←A,[1]((YI-YA),4)ρ0,0,A[YA; 3 4]
[35]  PFO:A←(YI,4)↑A
[36]    S←P×(1+AP)*IY←⍳YI
[37]    TX←TR×EB←ET-A[;2]+DP[;1]
[38]    CA←(DP[;1]-A[;3])+EA←EB-TX
[39]    RTN←CA×100÷D
[40]    R̲←5
[41]  P4:(3ρC̲R̲),(23ρ' '),'INTEGRATED  STATEMENT  OF  EARNINGS  AND  CASH
        FLOW',C̲R̲
[42]    '  YEAR   EBDFT  (INTEREST)  (DEPREC)     EBT        (TAX)       EAT
          DEPREC     (PRIN)      CAT      RETURN'
[43]    'I5,9M⍞(⎕N⍞)⎕Q⍞ ⍞ I10,M⍞(⎕N⍞)⎕Q⍞ ⍞ F10.2' ΔFMT(IY;ET;A[;2];DP[;1];
        EB;TX;EA;DP[;1];A[;3];CA;RTN)
[44]    (4ρ' '),90ρ(3ρ' '),7ρ'_'
[45]    'TOTALS'
[46]    'X4,9I10' ΔFMT((+/ET);(+/A[;2]);(+/DP[;1]);(+/EB);(+/TX);(+/EA);(+/
        DP[;1]);(+/A[;3]);+/CA)
```

```
[47]  R̲←6
[48] PQ:'DO YOU WANT A STATEMENT OF PRO FORMA YIELD ASSUMING SALE EACH YE
      AR? (YES OR NO)'
[49]  →('YN'=1↑⍞)/PF,0
[50]  →PQ
[51] PF:CG←S+DP[;2]-P
[52]  CGD←RC×CG-S+(((P-L)÷YI)×⍳YI)-P
[53]  CGAT←(CG×1-CT)+(CGD×CT)-CGD×TR
[54]  C←S+CGAT-A[;4]+CG
[55]  TB←P-DP[;2]+A[;4]
[56]  CNS←,CA[1]
[57]  K←1
[58] BK:CNS←CNS,CNS[K]+CA[K+1]
[59]  K←K+1
[60]  →(K<YI)/BK
[61]  CFAT←C+CNS
[62]  Y←⍳0
[63]  K←1
[64]  R̲←7
[65] RE1:R←K YLD(0,CA[⍳K-1],CA[K]+C[K]),[0.5] D,Kρ0
[66]  Y←Y,(R-1)×100
[67]  K←K+1
[68]  →(K≤YI)/RE1
[69]  R̲←8
[70] P5:(3ρC̲R̲),(26ρ' '),'PRO FORMA YIELD ON SALE OF INVESTMENT',C̲R̲
[71]  'YEAR   CUMULATIVE   CUMULATIVE   CAPITAL    CAP. GAIN  TAX BASIS
       CASH FLOW   CUMULATIVE    TOTAL CASH      YIELD'
[72]  '          DEPREC          APPREC          GAIN      AFTER TAX  LESS LOAN
        ON SALE      SPEND.(N)      FLOW A.T.'
[73]  'I3,8M⍞(⎕N⍞)⎕Q⍞ ⍞ I12,M⍞(⎕N⍞)⎕Q⍞ ⍞ F15.2' ΔFMT(IY;DP[;2];(S-P);CG;
      CGAT;TB;C;CNS;CFAT;Y)
     ∇
```

9
Financial Analysis (FINANAL)

A. General Description

Problems in financial analysis can be solved by using the functions in this workspace. Rudimentary analysis of beta and alpha factors is also possible. The functions in this series can be accessed by the instruction:

```
)LOAD 7 FINANAL
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The financial analysis section consists of two parts - FINANAL1 and FINANAL2. FINANAL1 allows the user to solve for individual financial ratios. For example, if the user wishes to compute liquidity ratios only, FINANAL1 provides access to that discrete area of analysis. FINANAL2, on the other hand, should be used for the comprehensive analysis of financial statements. All relevant data is input at the beginning of the program and the output is a conventional set of ratios.

The major functions in FINANAL1 are presented in Exhibit 9-1.

Exhibit 9-1
THE FINANAL1 WORKSPACE

A. FINANAL1

- B. LIQ (liquidity ratios)
- C. PROF (profitability ratios)
- D. EARN (earning power ratios)
- E. CRED (credit ratios)
- F. INV (inventory ratios)
- G. DEBT (debt ratios)
- H. STAN (standard ratios)
- I. NORM (normalized statements)
- J. BETA (beta analysis)

The supporting functions and variables for these major functions are shown in Exhibit 9-2.

Exhibit 9-2
FINANAL1 FUNCTIONS AND VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
LIQ	PLOT, VS	-
PROF	PLOT, VS	-
EARN	PLOT, VS	-
CRED	PLOT, VS	-
INV	PLOT, VS	-
DEBT	PLOT, VS	-
STAN	PLOT, VS	-
NORM	NOSTMT, NOBSHEET PLOT, VS	-
BETA	BETAFACTOR, BETAFORMULA	-

A brief introduction to these functions follows. Having chosen the appropriate mode, the user can select any of the above major functions by typing the name of the desired program.

B. LIQ

This function computes these liquidity ratios:

1. Quick ratio.

2. Current ratio.

3. Cash to total assets.

4. Cash to sales.

Input consists of:

1. The periods to be analyzed, i.e., 1959, 1960, 1961, etc.

2. The cash balance for each of those periods in the same order as #1.

3. Marketable securities and receivables for each period.

4. Inventory for each period.

5. Fixed assets for each period.

6. Total sales for each period.

7. Current liabilities for each period.

The program now produces an array of the input data to facilitate review and correction of errors. An error is corrected by typing the correct line number, year and the correct amount (see the example which corrects the amount of $127 to $227 for current liabilities in 1961). A revised summary can be requested following corrections. After the user is satisfied that the entry data is accurate, the program computes the respective ratios. A final option permits the user to plot any of these functions. A line connecting the points on the graph must be applied manually.

C. PROF

This function computes profitability ratios:

1. Earnings per share.

2. Pro forma earnings per share (i.e., earnings per share which is fully diluted with respect to convertible debt and other "common stock equivalents").

3. Price-earnings ratio.

4. Yield per share.

5. Book value per share.

Input for a designated number of periods is:

1. Net income after tax.

2. Number of common shares outstanding.

3. Common stock equivalents, i.e., number of shares that would be created through convertibility or the exercise of rights and options.

4. Dividend per share.

5. Market price per share.

6. Total owners' equity.

The summary, output and graphic potential is as described in B above.

D. EARN

This function computes the following earning power ratios:

1. Earning power (sales/total assets).

2. Gross earning power (gross profit/total assets).

3. Net earning power (net income/total assets).

Input consists of specifying for each period:

1. Net sales.

2. Gross Profit.

3. Net income.

4. Total assets.

The summary, output and graphic capabilities are as described in B above.

E. CRED

Three credit ratios are computed by this function:

1. Collection period (in days).

2. Receivables to sales.

3. Average daily sales.

Input consists of specifying for each period (after indicating the number of days in the period):

1. Total sales.

2. Accounts receivable at the beginning of the period.

3. Accounts receivable at the end of the period.

Again, a summary, provision for changing the input data, and a graphic potential is available. The function also computes the savings (or cost) of changes in the collection period, using the future value of an annuity formula for that purpose , i.e.,

$$F = \left[A \frac{(1 + r)^n - 1}{r} \right]$$

F. INV

This function can be used to compute the following inventory ratios:

1. Inventory turnover.

2. Inventory holding period.

3. Inventory to total assets.

4. Average inventory.

Again, it is necessary to specify the number of days in the periods under analysis, and this input for each period:

1. Inventory value at the beginning of the period.

2. Inventory value at the end of the period.

3. Cost of goods sold.

4. Total assets.

The data summary, error provision and graphic ability are identical to those described earlier. As with credit ratios, the savings (or cost) associated with changes in the inventory holding period can be calculated by this function. The formula used for this purpose is the future value of a single deposit , i.e., $F = A(1 + r)^n$.

G. DEBT

Two debt ratios are computed by this function:

1. Debt to equity.

2. Long-term debt to equity.

Input for each period consists of:

1. Total current liabilities.

2. Long-term debt.

3. Total owners' equity (paid-in capital plus retained earnings).

This program has the standard summary, correction ability, output and graphical potential of the other programs in this series.

H. STAN

This function creates standard ratios, i.e., it compresses a series of ratios into one figure using these standard statistical measures: (1) mean; (2) median; (3) interquartile average; and (4) moving average -- where the number of units in the moving average is specified, i.e., a two-place, three-place moving average, etc.

Input consists simply of entering a series of ratios. The example in the text shows the compression of five current ratios into a standard ratio.

I. NORM

This function converts dollar income statements and balance sheets into normalized statements. Following the selection of the statement to be normalized, the items are input in dollar form. A summary is provided, and provision for the correction of input. The output, as noted in the examples which follow, is in the form of normalized or percentage statements, where: (1) all of the items in the income statement are expressed as percentages of sales; and (2) the items in the balance sheet are expressed as percentages of assets and equities respectively.

J. BETA

This function performs basic alpha and beta analysis according to current convention. Input consists of:

1. A number of specified periods (at least five periods are necessary).

2. The return on a market index, (such as Standard & Poors Index of 500), for each of the above periods.

3. The high point of the stock in each of the periods.

4. The low point of the stock in each of the periods.

5. Dividends per share.

The program's output is:

1. The alpha factor.

2. The beta factor.

3. The error term.

4. Intercept for dividend line.

5. Slope of the dividend line.

6. The anticipated price of the stock or portfolio under examination.

If the user chooses to use the FINANAL routines as a group, he will be placed under the control of the program FINANAL2. FINANAL2 accepts comprehensive input from financial statements and furnishes a full set of ratios. As the input, format, and nature of the ratios available is identified above, no detailed specification is needed at this point. In addition to computing ratios, the function also produces normalized financial statements. The supporting functions and variables for FINANAL2 are displayed in Exhibit 9-3.

Exhibit 9-3
FINANAL2 FUNCTIONS & VARIABLES

MAJOR FUNCTION	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
FINANAL2	LIQ, PROF, CRED, EARN,	MAT, AVDAYS, YRS

*FINANAL*1

```
DO YOU KNOW THE VARIOUS RATIOS YOU CAN ANALYZE? NO
THERE ARE VARIOUS RATIOS YOU CAN ANALYZE. THESE ARE:-
LIQUIDITY,PROFITABILITY,EARNING POWER
CREDIT MGMT,INVENTORY MGMT. AND DEBT MGMT.
STANDARD RATIOS, NORMALIZED STATEMENTS AND BETA ANALYSIS.
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM
```

B. LIQ

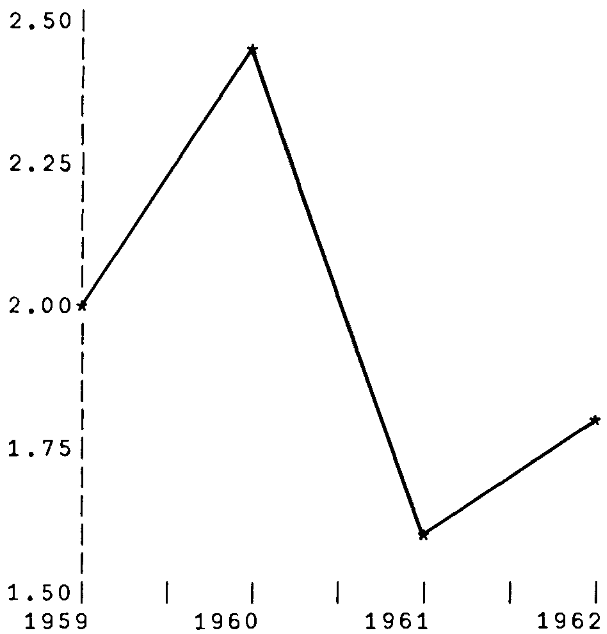
```
LIQ

PERIODS(E.G., 69 70 ETC.,)?
⎕:
      1959 1960 1961 1962
1. CASH?
⎕:
      37 40 39 43
2. M/S AND RECEIVABLES?
⎕:
      123 140 159 148
3. INVENTORY?
⎕:
      156 172 162 165
4. PREPAID EXPENSES?
⎕:
      0
5. FIXED ASSETS (LAND, BLDG, PLANT, INVEST. DEF. CHARGES ETC.,)?
⎕:
      17 57 66 76+5 8 11 10+560 620 615 578+4 3 3 2
6. TOTAL SALES?
⎕:
      781.4 817.5 890.6
LENGTH ERROR...REENTER 1 OR 4 VALUES.
⎕:
      781.4 817.5 890.6 926.2
7. CURRENT LIABILITIES (N/P,A/P,DIV/P, ACCRUED INT. ETC.,)?
⎕:
      160 143 127 196
DO YOU WANT TO SEE YOUR DATA? YES
```

```
NO.     ACCOUNT                          AMOUNT
1. CASH                    37.00      40.00      39.00      43.00
2. M/S AND RECEIB.        123.00     140.00     159.00     148.00
3. INVENTORY              156.00     172.00     162.00     165.00
4. PREPAID EXPENSES         0.00       0.00       0.00       0.00
5. FIXED ASSETS           586.00     688.00     695.00     666.00
6. TOTAL SALES            781.40     817.50     890.60     926.20
7. CURRENT LIAB.          160.00     143.00     127.00     196.00


DO YOU WANT TO CHANGE ANY DATA? YES
PLEASE TYPE THE CHANGED DATA.(A ZERO SIGNALS THE END)
⎕:
      7 1969 227
WRONG ENTRY....REENTER
⎕:
      7 1961 227
⎕:
      0
DO YOU WANT TO SEE YOUR DATA? YES


NO.     ACCOUNT                          AMOUNT
1. CASH                    37.00      40.00      39.00      43.00
2. M/S AND RECEIB.        123.00     140.00     159.00     148.00
3. INVENTORY              156.00     172.00     162.00     165.00
4. PREPAID EXPENSES         0.00       0.00       0.00       0.00
5. FIXED ASSETS           586.00     688.00     695.00     666.00
6. TOTAL SALES            781.40     817.50     890.60     926.20
7. CURRENT LIAB.          160.00     143.00     227.00     196.00


DO YOU WANT TO CHANGE ANY DATA? NO
```

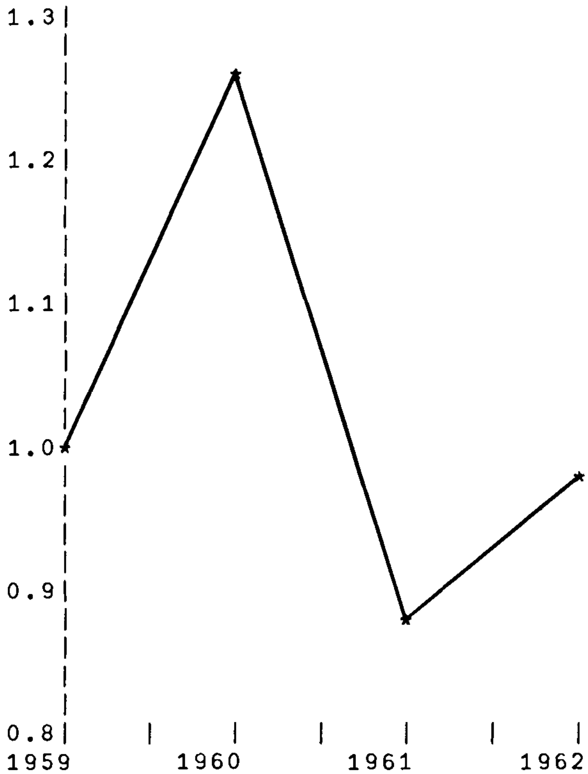
LIQUIDITY RATIOS.

YEAR	1959	1960	1961	1962
QUICK RATIO(S)	1.000	1.259	0.872	0.974
CURRENT RATIO(S)	1.975	2.462	1.586	1.816
CASH TO TOTAL ASSETS	0.035	0.033	0.032	0.036
CASH TO SALES	0.047	0.049	0.044	0.046

DO YOU WANT A PLOT OF ANY OF THESE? YES
TYPE THE UNDERLINED LETTERS FOR WHICH YOU WANT THE PLOT.
CURRENT RATIO,QUICK RATIO,CASH TO TOTAL ASSETS, CASH TO SALES.
CU



DO YOU WANT ANY OTHER PLOT? YES
TYPE THE UNDERLINED LETTERS FOR WHICH YOU WANT THE PLOT.
CURRENT RATIO,QUICK RATIO,CASH TO TOTAL ASSETS, CASH TO SALES.
QU



DO YOU WANT ANY OTHER PLOT? NO
DO YOU WISH TO CHANGE ANY DATA? NO
DO YOU WANT THE OTHER RATIOS? YES
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM

C. PROF

PROF

PERIODS(E.G., 69 70 *ETC.,)?*
⎕:
      1970 1971
1. *NET INCOME?*
⎕:
      20800 195000
2. *NO. OF COMMON SHARES OUTSTANDING?*
⎕:
      0
YOU CANNOT HAVE ZERO STOCKS...REENTER.
2. *NO. OF COMMON SHARES OUTSTANDING?*
⎕:
      100000 120000

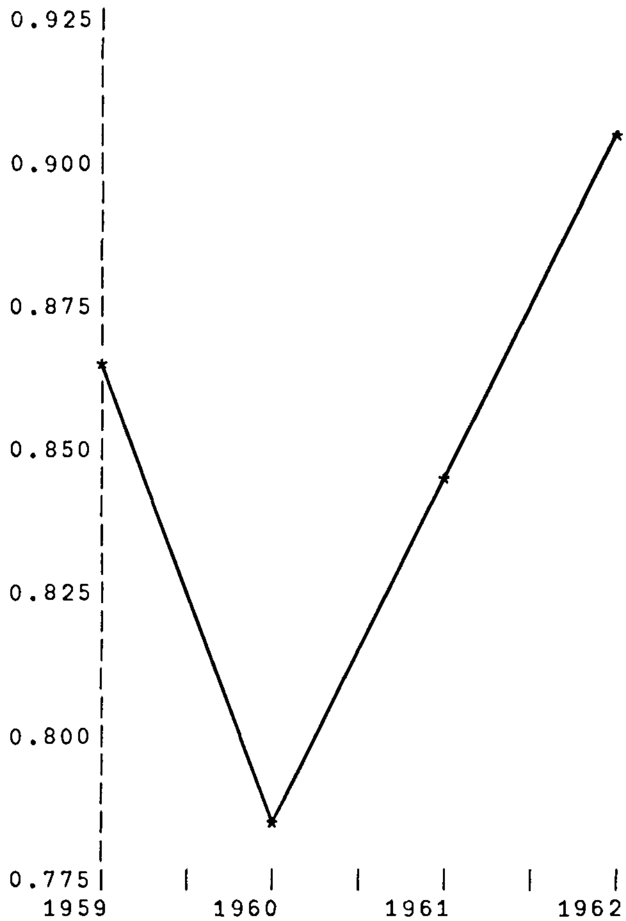
```
3. COMMON STOCK EQUIVALENTS?
⎕:
      0
4. DIVIDEND PER SHARE DECLARED?
⎕:
      .80 .75
5. MARKET PRICE PER SHARE?
⎕:
      25 32
6. TOTAL OWNERS' EQUITY?
⎕:
      2500000 3200000
DO YOU WANT TO SEE YOUR DATA? YES



NO.   ACCOUNT          AMOUNT
1. NET INCOME       20800.00  195000.00
2. COM. SH. OUT    100000.00  120000.00
3. COM. ST. EQ.         0.00       0.00
4. DIV. DECL.           0.80       0.75
5. MKT. PR./SH.        25.00      32.00
6. TOTAL O.E.     2500000.00 3200000.00



DO YOU WANT TO CHANGE ANY DATA? YES
PLEASE TYPE THE CHANGED DATA.(A ZERO SIGNALS THE END)
⎕:
      1 208000 295000
⎕:
      0
DO YOU WANT TO SEE YOUR DATA? YES



NO.   ACCOUNT          AMOUNT
1. NET INCOME      208000.00  295000.00
2. COM. SH. OUT    100000.00  120000.00
3. COM. ST. EQ.         0.00       0.00
4. DIV. DECL.           0.80       0.75
5. MKT. PR./SH.        25.00      32.00
6. TOTAL O.E.     2500000.00 3200000.00



DO YOU WANT TO CHANGE ANY DATA? NO
```

```
            PROFITABILITY RATIOS.

YEAR                                1970      1971

EARNING PER SHARE                  2.080     2.458
PRO-FORMA E.P.S.                   2.080     2.458
PRICE-EARNING RATIO               12.019    13.017
YIELD                              0.032     0.023
BOOK VALUE PER SHARE              25.000    26.667


DO YOU NEED A PLOT OF ANY OF THESE? NO_
DO YOU WISH TO CHANGE ANY DATA? N__
DO YOU WANT THE OTHER RATIOS? Y__
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM
```

D. EARN

```
EARN

PERIODS(E.G., 69 70 ETC.,)?
⎕:
      1959 1960 1961 1962
1. NET SALES?
⎕:
      781.4 817.5 890.6 926.2
2. GROSS PROFIT?
⎕:
      318.2 304.9 318.1 342.3
3. NET INCOME AFTER TAX?
⎕:
      82.4 64.1 69.2 72.9
4. TOTAL ASSETS?
⎕:
      902 1040 1055 1022
DO YOU WANT TO SEE YOUR DATA? YES
```

```
NO.     ACCOUNT          AMOUNT
1. NET SALES             781.40     817.50     890.60     926.20
2. GROSS PROFIT          318.20     304.90     318.10     342.30
3. NET INCOME             82.40      64.10      69.20      72.90
4. TOTAL ASSETS          902.00    1040.00    1055.00    1022.00


DO YOU WANT TO CHANGE ANY DATA? YES
PLEASE TYPE THE CHANGED DATA.(A ZERO SIGNALS THE END)
⎕:
      3 1961 59.2
⎕:
      0
DO YOU WANT TO SEE YOUR DATA? NO


                           EARNING POWER RATIOS.

YEAR                                  1959       1960       1961       1962

EARNING POWER                        0.866      0.786      0.844      0.906
GROSS EARNING POWER                  0.353      0.293      0.302      0.335
NET EARNING POWER                    0.091      0.062      0.056      0.071


DO YOU WANT A PLOT OF ANY OF THESE? YES
PLEASE TYPE THE UNDERLINED LETTERS FOR THE PLOT.
EARNING POWER,GROSS EARNING POWER OR NET EARNING POWER.

EAR
```



DO YOU WANT ANY OTHER PLOT? NO
DO YOU WISH TO CHANGE ANY DATA? NO
DO YOU WANT THE OTHER RATIOS? YES
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM

E. CRED

```
CRED

 PERIODS(E.G., 69 70 ETC.,)?
⎕:
      1961 1962
AVERAGE NO. OF DAYS IN THE PERIOD?
⎕:
      360
1. TOTAL SALES?
⎕:
      2700000 3000000
2. A/R AT THE BEGINNING OF EACH PERIOD?
⎕:
      140000 150000
```

```
3. A/R AT THE END OF EACH PERIOD?
⎕:
      150000 180000
DO YOU WANT TO SEE YOUR DATA? YES


NO.   ACCOUNT          AMOUNT
1. TOTAL SALES      2700000.00 3000000.00
2. BEGINNING A/R     140000.00  150000.00
3. ENDING A/R        150000.00  180000.00


DO YOU WISH TO CHANGE ANY DATA? NO


             CREDIT MGMT. RATIOS

YEAR                              1961      1962

COLLECTION PERIOD               19.333    19.800
RECEIVABLES TO SALES             0.054     0.055
AVERAGE SALES/DAY             7500.000  8333.333



DO YOU WANT A PLOT OF ANY OF THESE? NO
DO YOU WISH TO CHANGE ANY DATA? NO
DO YOU WANT TO SEE THE SAVINGS BY CHANGING
COLLECTION PERIOD FOR TWO PERIODS? YES
PLEASE TYPE THE AVERAGE COLLECTION PERIOD FOR TWO PERIODS.
⎕:
      19.3 19.8
WHAT IS THE AVERAGE SALES PER DAY FOR THE SECOND YEAR?.
⎕:
      8333.33
WHAT IS THE INTEREST RATE?.
⎕:
      10
THE COST(SAVINGS) OF EXTENDING(REDUCING) THE CREDIT BY 0.5 DAYS
IS.....    $87.52
DO YOU WANT TO TRY AGAIN?. NO
DO YOU WANT THE OTHER RATIOS? YES
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM
```

F. INV

```
   INV


 PERIODS(E.G., 69 70 ETC.,)?
⎕:
      1971 1972
1. INVENTORY AT THE BEGINNING OF EACH PERIOD?
⎕:
      400000
2. INVENTORY AT THE END OF EACH PERIOD?
⎕:
      400000 300000
3. COST OF GOODS SOLD?
⎕:
      1590000 1880000
NO. OF DAYS IN THE PERIOD?
⎕:
      360
4. TOTAL ASSETS?
⎕:
      2800000
DO YOU WANT TO SEE YOUR DATA? NO


                 INVENTORY MGMT. RATIOS

YEAR                                       1971         1972

INVENTORY TURNOVER                        3.975        5.371
INVENTORY HOLDING PERIOD                 90.566       67.021
INVENTORY TO TOTAL ASSETS                 0.143        0.125
AVERAGE INVENTORY                    400000.000   350000.000


DO YOU WANT A PLOT OF ANY OF THESE? NO
DO YOU WISH TO CHANGE ANY DATA? NO
DO YOU WANT TO SEE THE SAVINGS BY CHANGING
THE HOLDING PERIOD FOR TWO PERIODS?. YES
PLEASE TYPE THE INVENTORY HOLDING PERIOD FOR TWO PERIODS.
⎕:
      67 90.7
PLEASE TYPE THE INTEREST RATE(I.E., CARRYING
COSTS EXPRESSED AS A PERCENTAGE OF C.G.S.).
⎕:
      10
AVERAGE INVENTORY FOR THE SECOND PERIOD?.
⎕:
      350000
```

```
THE SAVINGS IN (COST OF) REDUCING (EXTENDING) THE INVENTORY
HOLDING PERIOD BY 23.7 DAYS IS... $10678.17
DO YOU WANT TO TRY AGAIN?. NO
DO YOU WANT THE OTHER RATIOS? YES
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM
```

G. DEBT

```
DEBT

PERIODS (E.G., 69 70 ETC.,)?
⎕:
      1971 1972
1. TOTAL CURRENT LIABILITIES?
⎕:
      430000 300000
2. LONG TERM DEBT?
⎕:
      820000 900000
3. TOTAL OWNERS' EQUITY (PAID-IN CAPITAL PLUS R.E.)?
⎕:
      310000 350000
DO YOU WANT TO SEE YOUR DATA? YES
```

NO.	ACCOUNT	AMOUNT	
1.	TOTAL C.L.	430000.00	300000.00
2.	LONG TERM DEBT	820000.00	900000.00
3.	TOTAL O.E.	310000.00	350000.00

```
DO YOU WISH TO CHANGE ANY DATA? NO
```

DEBT MGMT. RATIOS

YEAR	1971	1972
DEBT TO EQUITY	4.032	3.429
LONG TERM DEBT TO EQUITY	2.645	2.571

```
DO YOU NEED A PLOT OF ANY OF THESE? NO
```

```
DO YOU WISH TO CHANGE ANY DATA? NO
DO YOU WANT THE OTHER RATIOS? YES
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM
```

H. STAN

```
STAN
PLEASE TYPE THE RATIO YOU WISH TO EXAMINE.(CURRENT ETC.,)
CURRENT
PLEASE ENTER  CURRENT RATIOS AS A VECTOR.
⎕:
      2.2 2.1 2.5 2 1.9
PLEASE TYPE THE NUMBER OF UNITS FOR THE MOVING AVERAGE.
⎕:
      3



MEAN IS                                  2.140
MEDIAN IS                                2.100
INTERQUARTILE AVERAGE IS                 2.100
MOVING AVERAGE IS                        2.267     2.200     2.133
```

I. NORM

```
DO YOU WANT TO TRY OTHER RATIOS?. NO
DO YOU WANT THE OTHER RATIOS? YES
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM
NORM
DO YOU WANT THE INCOME STATEMENT OR BALANCE SHEET?
TYPE THE UNDERLINED WORD.



INCOME

PERIODS(E.G., 69 70 ETC.,)?
⎕:
      1959 1960 1961 1962
1. SALES?
⎕:
      781.4 817.5 890.6 926.2
2. COST OF SALES?
⎕:
      463.2 512.6 572.5 583.9
3. G AND A AND SELLING EXPENSES?
⎕:
      91.7 114.1 115.8 117.6
4. DEPRECIATION?
⎕:
      78.4 89.8 103.2 99.6
```

```
5. OTHER ITEMS?
⎕:
      ¯2.6 ¯6.8 ¯3.5 ¯5.6
6. INCOME TAX?
⎕:
      68 43.7 43.1 58.5
DO YOU WANT TO SEE YOUR DATA? YES



YEARS                      1959      1960      1961      1962

1. SALES                 781.40    817.50    890.60    926.20
2. COST OF SALES         463.20    512.60    572.50    583.90
3. EXPENSES               91.70    114.10    115.80    117.60
4. DEPRECIATION           78.40     89.80    103.20     99.60
5. OTHER ITEMS           ¯2.60     ¯6.80     ¯3.50     ¯5.60
6. INCOME TAX             68.00     43.70     43.10     58.50



DO YOU WANT TO CHANGE ANY DATA? YES
PLEASE TYPE THE CHANGED DATA.(A ZERO SIGNALS THE END)
⎕:
      6 1959 68.3
⎕:
      6 1961 43.3
⎕:
      0
DO YOU WANT TO SEE YOUR DATA? YES



YEARS                      1959      1960      1961      1962

1. SALES                 781.40    817.50    890.60    926.20
2. COST OF SALES         463.20    512.60    572.50    583.90
3. EXPENSES               91.70    114.10    115.80    117.60
4. DEPRECIATION           78.40     89.80    103.20     99.60
5. OTHER ITEMS           ¯2.60     ¯6.80     ¯3.50     ¯5.60
6. INCOME TAX             68.30     43.70     43.30     58.50



DO YOU WANT TO CHANGE ANY DATA? NO_
```

INCOME STATEMENT

YEAR	1959	1960	1961	1962
SALES	100.0	100.0	100.0	100.0
COST OF SALES	59.3	62.7	64.3	63.0
GROSS PROFIT	40.7	37.3	35.7	37.0
SELLING AND ADMN.	11.7	14.0	13.0	12.7
DEPRECIATION	10.0	11.0	11.6	10.8
OPERATING EXP.	21.8	24.9	24.6	23.5
NET OPER. INCOME	19.0	12.4	11.1	13.5
OTHER ITEMS	¯0.3	¯0.8	¯0.4	¯0.6
INCOME TAX	8.7	5.3	4.9	6.3
NET INCOME	10.5	7.8	6.7	7.8

```
DO YOU WISH TO CHANGE ANY DATA? NO
DO YOU WANT TO TRY OTHER PERIODS? NO
DO YOU WANT THE OTHER STATEMENT? YES
TYPE THE UNDERLINED WORD.


BALANCE

PERIODS(E.G., 69 70 ETC.,)?
⎕:
      1959 1960 1961 1962
1. CASH AND EQUIVALENTS?
⎕:
      37 40 39 43
2. RECEIVABLES?
⎕:
      123 140 159 148
3. INVENTORIES?
⎕:
      156 172 162 165
4. INVESTMENTS?
⎕:
      17 57 66 76
5. DEFERRED CHARGES?
⎕:
      5 8 11 10
```

```
6. PLANT AND EQUIPMENT(NET)?
⎕:
      560 620 615 578
7. INTANGIBLES?
⎕:
      4 3 3 2
8. CURRENT LIABILITIES?
⎕:
      160 243 227 196
9. LONG TERM DEBT?
⎕:
      156 146 147 127
DO YOU WANT TO SEE YOUR DATA? NP
PLEASE ANSWER YES OR NO: NO
```

BALANCE SHEET

YEAR	1959	1960	1961	1962
ASSETS				
CASH AND EQUIVALENTS	4.1	3.8	3.7	4.2
RECEIVABLES	13.6	13.5	15.1	14.5
INVENTORIES	17.3	16.5	15.4	16.1
CURRENT ASSETS	35.0	33.8	34.1	34.8
INVESTMENTS	1.9	5.5	6.3	7.4
DEFERRED CHARGES	0.6	0.8	1.0	1.0
PLANT AND EQUIP. (NET)	62.1	59.6	58.3	56.6
INTANGIBLES	0.4	0.3	0.3	0.2
TOTAL	100.0	100.0	100.0	100.0
EQUITIES				
CURRENT LIABILITIES	17.7	23.4	21.5	19.2
LONG-TERM DEBT	17.3	14.0	13.9	12.4
TOTAL DEBT	35.0	37.4	35.5	31.6
OWNERS' EQUITY	65.0	62.6	64.5	68.4

```
DO YOU WISH TO CHANGE ANY DATA? NO
DO YOU WANT TO TRY FOR OTHER PERIODS? NO
DO YOU WANT THE OTHER STATEMENT? NO
```

```
DO YOU WANT THE OTHER RATIOS? YES
TYPE ANY OF THE RATIOS AND RUN THE PROGRAM
```

J. BETA

```
BETA
DO YOU KNOW HOW TO USE THIS PROGRAM? NO_
1.  THE NUMBER OF PERIODS SHOULD ALWAYS BE MORE THAN 5.
2.  THE RETURN ON MARKET, STOCK-PRICE HIGH, STOCK-PRICE
    LOW AND THE DIVIDENDS PER SHARE CAN BE FOUND IN THE
    STANDARD AND POOR'S ANALYSTS HANDBOOK.
    TO AVOID ERRORS IT IS ADVISABLE THAT THE DIVIDEND PER
    SHARE BE ENTERED AS A DECIMAL. E.G., 2.000001 INSTEAD OF 2.
PERIODS(E.G., 69 70 ETC.,OR 1 2 3 ETC.,)?
⎕:
      49 50 51 52
YOU CANNOT HAVE LESS THAN FIVE PERIODS....REENTER
⎕:
      49 50 51 52 53 54
PLEASE TYPE 1. THE RETURN ON MARKET FOR THE YEARS
50 THRU 54
⎕:
      18.41 15.37 14.36 15.48 13.61
2. STOCK PRICE HIGH?
⎕:
      18.89 30.99 37.99 40.04 42.77 69.09
3. STOCK PRICE LOW?
⎕:
      15.87 18.79 28.72 33.11 33.66 42.06
4. DIVIDENDS PER SHARE?
⎕:
      .84 .98 1.16 1.28 1.33 1.38
DO YOU WANT TO SEE YOUR DATA? NO_


ALPHA FACTOR IS                    ¯0.117
BETA FACTOR IS                      0.028
ERROR TERM IS                       0.218
INTERCEPT FOR DIV. LINE IS          0.775
SLOPE OF THE DIV. LINE IS           0.111
BEGINNING STOCK PRICE IS            55.58


DO YOU WISH TO CHANGE ANY DATA? ___


PLEASE ANSWER YES OR NO: NO_
DO YOU WANT TO TRY FOR OTHER PERIODS? NO_
DO YOU WANT THE FORMULA METHOD? YES
```

```
DO YOU KNOW THE VARIOUS FACTORS TO BE ENTERED? NO_

1.  THE RISK-FREE RATE.
2.  THE EXPECTED RETURN ON THE MARKET AS A PERCENTAGE,
3.  THE ACTUAL RETURN ON THE STOCK AS A PERCENTAGE AND
4.  THE BETAFACTOR(FROM THE PREVIOUS PROGRAM)
THESE ARE IN ORDER RF,E(RM),A(RJ) AND BETA
(REF:'ACCOUNTING' BY DR. BUCKLEY)
PLEASE ENTER THE FACTORS IN THE SAME ORDER. IF YOU NEED
HELP TYPE HELP. OTHERWISE HIT THE CARRIAGE RETURN.

⎕:
      5 10 6 1


ALPHA FACTOR IS                          ¯4.00
EXPECTED RTN. ON STK. IS                 10.00



DO YOU WANT TO TRY OTHERS? NO_
DO YOU WANT THE OTHER RATIOS? NO_
```

FINANAL2

```
      FINANAL2
ENTER THE PERIODS (E.G., 69 70 ETC.,)
⎕:
      69 70 71 72
AVERAGE NUMBER OF DAYS IN THE PERIOD.
⎕:
      360
1. CASH.
⎕:
      36 45 36 26
2. MARKETABLE SECURITIES.
⎕:
      64 67 65 65
3. ACCOUNTS RECEIVABLE BEGINNING.
⎕:
      142 162 152 142
4. ACCOUNTS RECEIVABLE ENDING.
⎕:
      162 152 142 135
5. INVENTORY BEGINNING.
⎕:
      156 172 162 172
6. INVENTORY ENDING.
⎕:
      172 162 172 165
7. PREPAID EXPENSES.
⎕:
      0
8. LAND, BLDGS, PLANT AND EQUIPMENT(LESS ACC. DEPRN.).
⎕:
      17 57 66 76+560 620 615 578
9. INTANGIBLE ASSETS (LESS AMORTIZATION, IF ANY).
⎕:
      4 3 3 2
10. INVESTMENTS.
⎕:
      5 8 11 10
11. CURRENT LIABILITIES (N/P, A/P, DIV./P ACCRUED INT. ETC.,).
⎕:
      160 143 127 196
12. DEFERRED CHARGES.
⎕:
      0
13. LONG-TERM DEBT.
⎕:
      120 200 125 100
```

```
14. TOTAL OWNERS' EQUITY.
⎕:
      320 310 335 357
15. TOTAL SALES.
⎕:
      1200 1350 1465 1753
16. COST OF SALES.
⎕:
      375 389 465 486
17. G AND A AND SELLING EXPENSES.
⎕:
      120
18. DEPRECIATION EXPENSES.
⎕:
      120
19. OTHER ITEMS, IF ANY.
⎕:
      53
20. INCOME TAX.
⎕:
      475
21. NUMBER OF COMMON SHARES OUTSTANDING.
⎕:
      10
22. COMMON STOCK EQUIVALENTS.
⎕:
      0
23. DIVIDEND PER SHARE DECLARED.
⎕:
      .65 .75 .8 .93
24. MARKET PRICE PER SHARE.
⎕:
      0
YOU CANNOT HAVE ZERO MARKET PRICE PER SHARE....REENTER.
24. MARKET PRICE PER SHARE.
⎕:
      25 32 28 42


DO YOU WANT TO SEE YOUR DATA? YES
```

NO.	ACCOUNT	AMOUNT			
1.	CASH	36.00	45.00	36.00	26.00
2.	MARKETABLE SECURITIES	64.00	67.00	65.00	65.00
3.	ACCOUNTS RECEIVABLE BEGINNING	142.00	162.00	152.00	142.00
4.	ACCOUNTS RECEIVABLE ENDING	162.00	152.00	142.00	135.00
5.	INVENTORY BEGINNING	156.00	172.00	162.00	172.00
6.	INVENTORY ENDING	172.00	162.00	172.00	165.00
7.	PREPAID EXPENSES	0.00	0.00	0.00	0.00
8.	LAND, BLDGS, PLANT ETC.,	577.00	677.00	681.00	654.00
9.	INTANGIBLE ASSETS(LESS AMORTN.)	4.00	3.00	3.00	2.00
10.	INVESTMENTS	5.00	8.00	11.00	10.00
11.	CURRENT LIABILITIES	160.00	143.00	127.00	196.00
12.	DEFERRED CHARGES	0.00	0.00	0.00	0.00
13.	LONG-TERM DEBT	120.00	200.00	125.00	100.00
14.	TOTAL OWNERS'EQUITY	320.00	310.00	335.00	357.00
15.	TOTAL SALES	1200.00	1350.00	1465.00	1753.00
16.	COST OF SALES	375.00	389.00	465.00	486.00
17.	G AND A AND SELLING EXPENSES	120.00	120.00	120.00	120.00
18.	DEPRECIATION	120.00	120.00	120.00	120.00
19.	OTHER ITEMS	53.00	53.00	53.00	53.00
20.	INCOME TAX	475.00	475.00	475.00	475.00
21.	NUMBER OF COMMON SHARES O/S.	10.00	10.00	10.00	10.00
22.	COMMON STOCK EQUIVALENTS	0.00	0.00	0.00	0.00
23.	DIVIDEND PER SHARE DECLARED	0.65	0.75	0.80	0.93
24.	MARKET PRICE PER SHARE	25.00	32.00	28.00	42.00

DO YOU WANT TO CHANGE ANY DATA? NO_

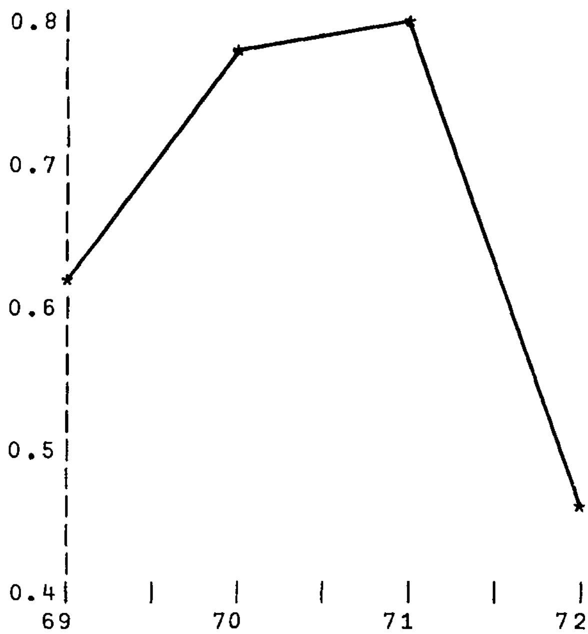
LIQUIDITY,PROFITABLILITY,EARNING POWER
CREDIT MGMT., INVENTORY MGMT. AND DEBT MGMT.
STANDARD RATIOS, NORMALIZED STATEMENTS AND BETA ANALYSIS.
TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.

LIQ

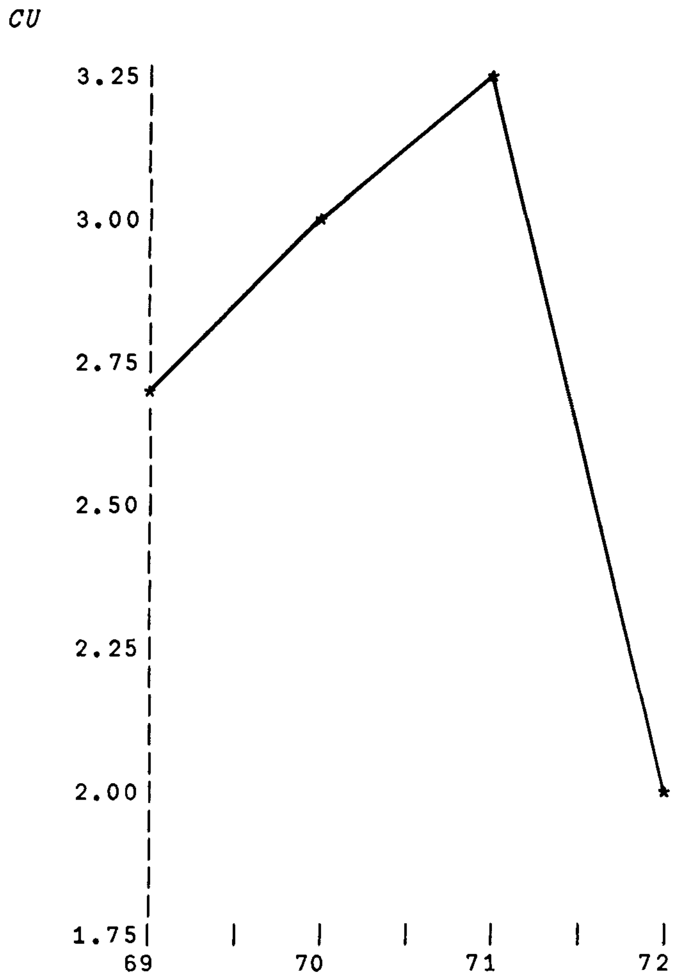
LIQUIDITY RATIOS

YEAR	69	70	71	72
QUICK RATIO(S)	0.63	0.78	0.80	0.46
CURRENT RATIO(S)	2.71	2.98	3.27	1.99
CASH TO TOTAL ASSETS	0.04	0.04	0.03	0.02
CASH TO SALES	0.03	0.03	0.02	0.01

DO YOU WANT A PLOT OF ANY OF THESE? YES
CURRENT RATIO, QUICK RATIO, CASH TO TOTAL ASSETS, CASH TO SALES
TYPE THE UNDERLINED LETTERS FOR THE PLOT
QU



DO YOU WANT ANY OTHER PLOT? YES
TYPE THE UNDERLINED LETTERS FOR THE PLOT



DO YOU WANT ANY OTHER PLOT? NO

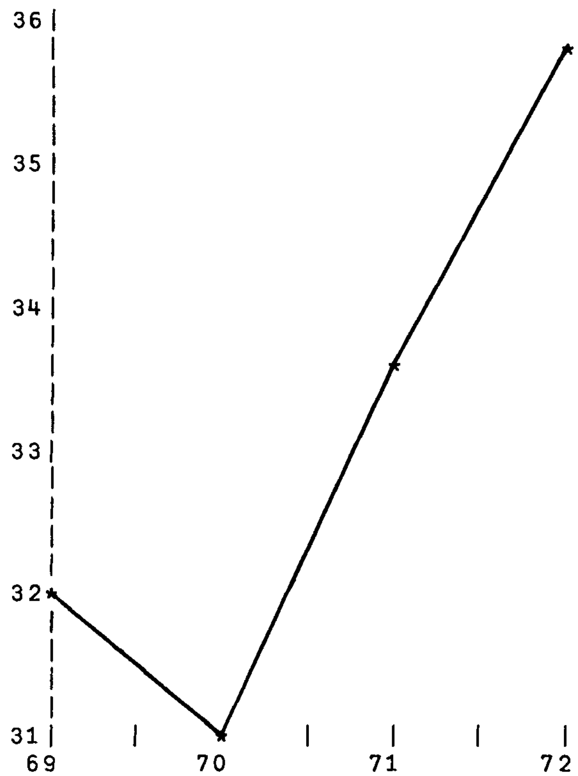
DO YOU WANT TO TRY OTHER RATIOS? YES
TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.

PROF

PROFITABILITY RATIOS

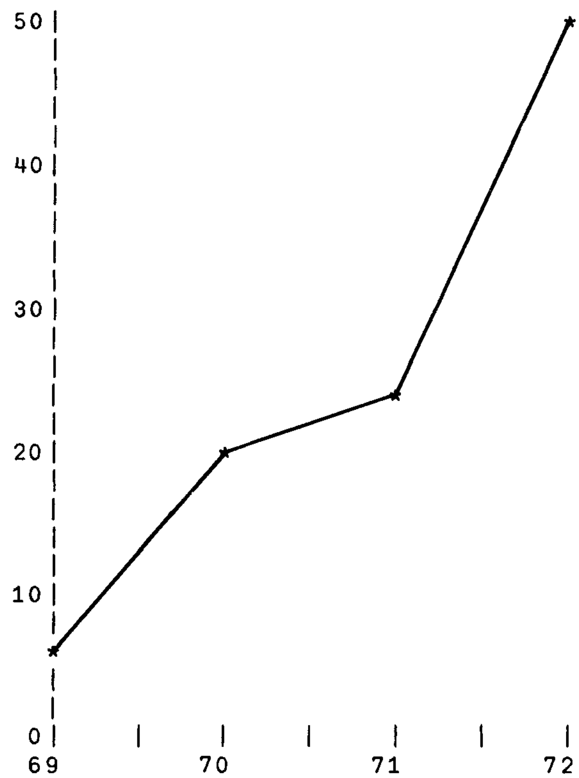
YEAR	69	70	71	72
EARNING PER SHARE	5.70	19.30	23.20	49.90
PRO-FORMA E.P.S.	5.70	19.30	23.20	49.90
PRICE-EARNING RATIO	4.39	1.66	1.21	0.84
YIELD	0.03	0.02	0.03	0.02
BOOK VALUE PER SHARE	32.00	31.00	33.50	35.70

DO YOU WANT A PLOT OF ANY OF THESE? YES
EPS, PE RATIO, YIELD, PRO-FORMA E.P.S. OR BOOK VALUE/SH.
TYPE THE UNDERLINED LETTERS FOR THE PLOT
BOO



DO YOU WANT ANY OTHER PLOT? YES
TYPE THE UNDERLINED LETTERS FOR THE PLOT

EPS, PE RATIO, YIELD, PRO-FORMA E.P.S. OR BOOK VALUE/SH.
TYPE THE UNDERLINED LETTERS FOR THE PLOT
EPS



DO YOU WANT ANY OTHER PLOT? NO

DO YOU WANT TO TRY OTHER RATIOS? YES
TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.

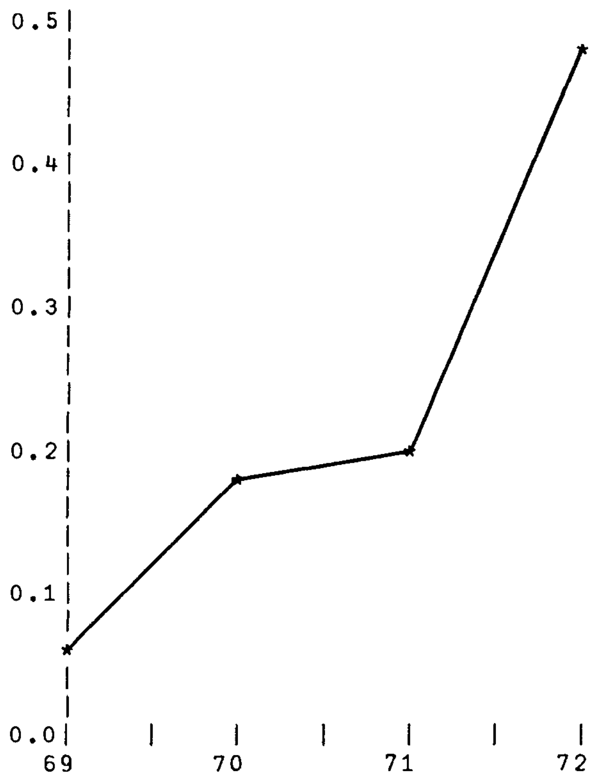
EARN

EARNING POWER RATIOS

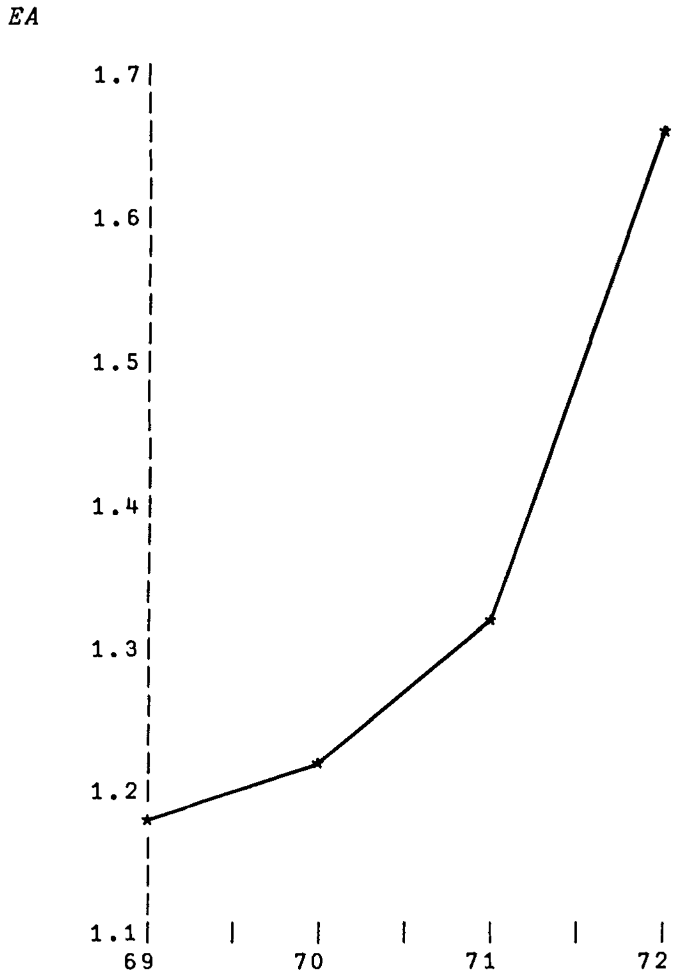
YEAR	69	70	71	72
EARNING POWER	1.18	1.21	1.32	1.66
GROSS EARNING POWER	0.81	0.86	0.90	1.20
NET EARNING POWER	0.06	0.17	0.21	0.47

DO YOU WANT A PLOT OF ANY OF THESE? YES
EARNING POWER, GROSS EARNING POWER OR NET EARNING POWER.
TYPE THE UNDERLINED LETTERS FOR THE PLOT

NET



DO YOU WANT ANY OTHER PLOT? YES
TYPE THE UNDERLINED LETTERS FOR THE PLOT



DO YOU WANT ANY OTHER PLOT? NO

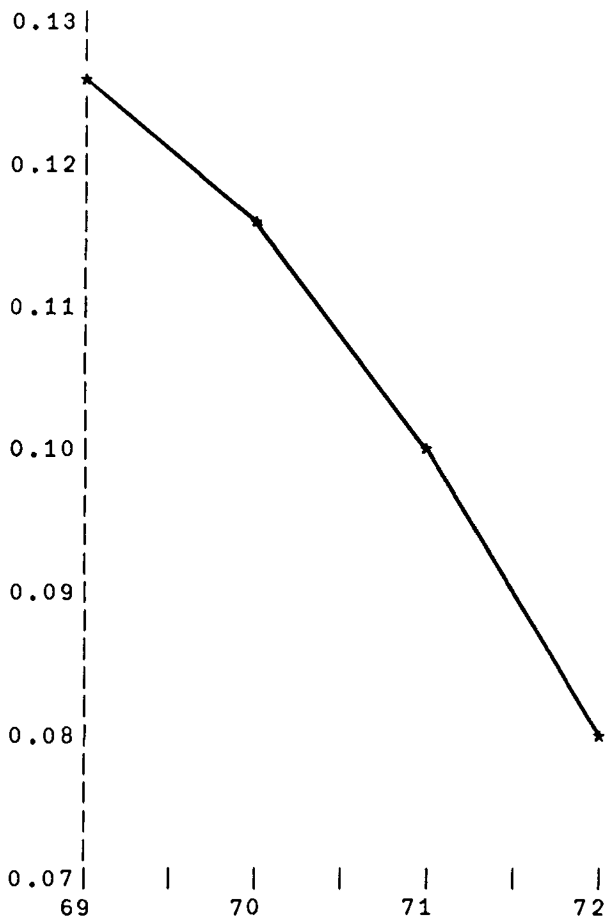
DO YOU WANT TO TRY OTHER RATIOS? YES
TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.

CRED

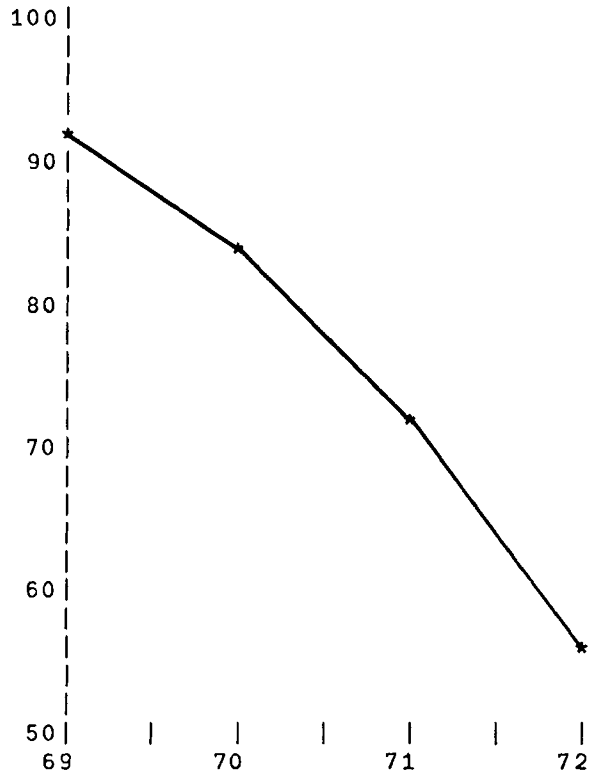
CREDIT MGMT. RATIOS

YEAR	69	70	71	72
COLLECTION PERIOD	91.20	83.73	72.25	56.89
RECEIVABLES TO SALES	0.13	0.12	0.10	0.08
AVERAGE SALES PER DAY	3.33	3.75	4.07	4.87

DO YOU WANT A PLOT OF ANY OF THESE? YES
COLLECTION PERIOD OR RECEIVABLES TO SALES
TYPE THE UNDERLINED LETTERS FOR THE PLOT
RE



DO YOU WANT ANY OTHER PLOT? YES
TYPE THE UNDERLINED LETTERS FOR THE PLOT
CO



DO YOU WANT ANY OTHER PLOT? NO
DO YOU WANT TO SEE THE SAVINGS BY CHANGING
THE COLLECTION PERIOD FOR TWO PERIODS? YES
PLEASE TYPE THE AVERAGE COLLECTION PERIOD FOR TWO PERIODS
⎕:
      19.3 19.8
WHAT IS THE AVERAGE SALES PER DAY FOR THE SECOND YEAR?
⎕:
      8333.33
WHAT IS THE INTEREST RATE?
⎕:
      10

THE COST(SAVINGS) OF EXTENDING(REDUCING) THE CREDIT BY 0.5 DAYS
IS $87.52

DO YOU WANT TRY AGAIN? NO

DO YOU WANT TO TRY OTHER RATIOS? YES

TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.

INV

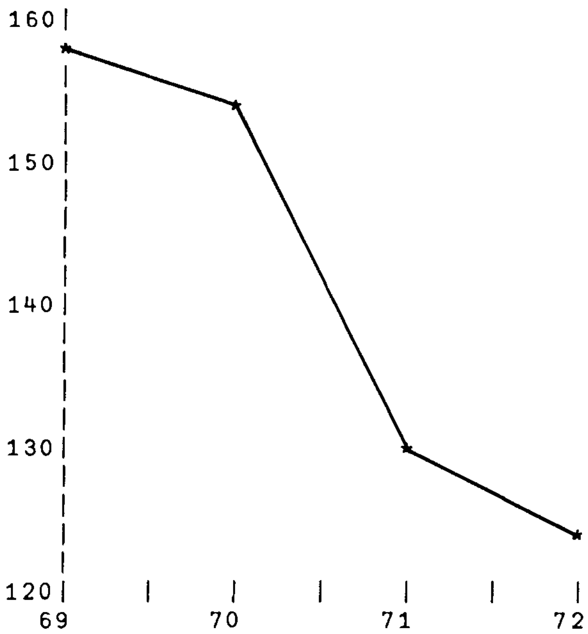
INVENTORY MGMT. RATIOS

YEAR	69	70	71	72
INVENTORY TURNOVER	2.29	2.33	2.78	2.88
INVENTORY HOLDING PERIOD	157.44	154.55	129.29	124.81
INVENTORY TO TOTAL ASSETS	0.16	0.15	0.15	0.16
AVERAGE INVENTORY	164.00	167.00	167.00	168.50

DO YOU WANT A PLOT OF ANY OF THESE? YES

INVENTORY TURNOVER, HOLDING PERIOD, TO TOTAL ASSETS
TYPE THE UNDERLINED LETTERS FOR THE PLOT

HO

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DO YOU WANT ANY OTHER PLOT? NO
DO YOU WANT TO SEE THE SAVINGS BY CHANGING
THE HOLDING PERIOD FOR TWO PERIODS? YES
PLEASE TYPE THE INVENTORY HOLDING PERIOD FOR TWO PERIODS
⎕:
      67 90.7
PLEASE TYPE THE INTEREST RATE (I.E., CARRYING COSTS
EXPRESSED AS A PERCENTAGE OF C.G.S.)
⎕:
      10
AVERAGE INVENTORY FOR THE SECOND PERIOD
⎕:
      350000


THE SAVINGS(COST OF) IN REDUCING(EXTENDING) THE
HOLDING PERIOD BY 23.7 DAYS IS $10678.17



DO YOU WANT TO TRY AGAIN? NO



DO YOU WANT TO TRY OTHER RATIOS? YES
TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.
```

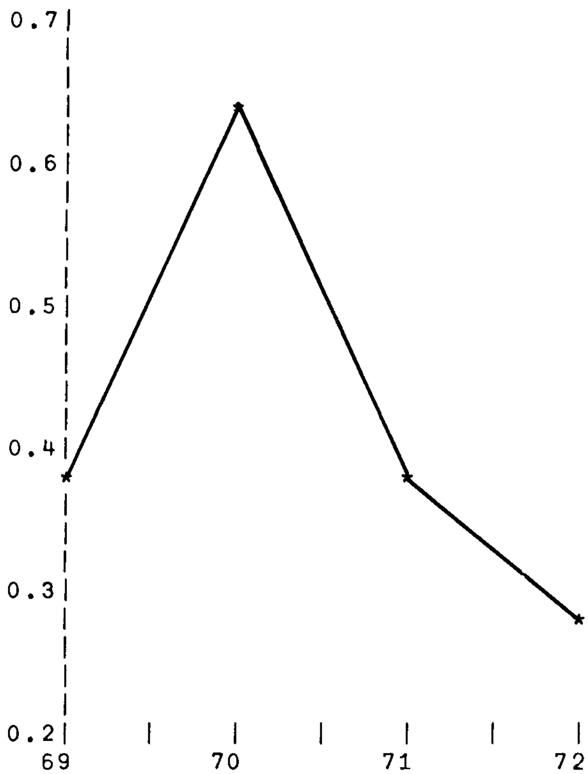
DEBT

DEBT MGMT. RATIOS

YEAR	69	70	71	72
DEBT TO EQUITY	0.88	1.11	0.75	0.83
LONG TERM DEBT TO EQUITY	0.38	0.65	0.37	0.28

DO YOU WANT A PLOT OF ANY OF THESE? YES
DEBT TO EQUITY OR LTD TO EQUITY
TYPE THE UNDERLINED LETTERS FOR THE PLOT

LTD



DO YOU WANT ANY OTHER PLOT? NO

DO YOU WANT TO TRY OTHER RATIOS? YES

```
TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.
NORM
DO YOU WANT THE INCOME STATEMENT OR BALANCE SHEET?
TYPE THE UNDERLINED WORD.



BALANCE
```

BALANCE SHEET

YEAR	69	70	71	72
ASSETS				
CASH AND EQUIVALENTS	9.8	10.1	9.1	8.6
RECEIVABLES	15.9	13.6	12.8	12.8
INVENTORIES	16.9	14.5	15.5	15.6
CURRENT ASSETS	42.5	38.2	37.4	37.0
INVESTMENTS	0.5	0.7	1.0	0.9
DEFERRED CHARGES	0.0	0.0	0.0	0.0
LAND, BUILDINGS, ETC.,(NET)	56.6	60.8	61.4	61.9
INTANGIBLES	0.4	0.3	0.3	0.2
TOTAL	100.0	100.0	100.0	100.0
EQUITIES				
CURRENT LIABILITIES	15.7	12.8	11.4	18.5
LONG-TERM DEBT	11.8	18.0	11.3	9.5
TOTAL DEBT	27.5	30.8	22.7	28.0
OWNERS' EQUITY	72.5	69.2	77.3	72.0

DO YOU WANT THE OTHER STATEMENT? YES

INCOME STATEMENT

YEAR	69	70	71	72
SALES	100.0	100.0	100.0	100.0
COST OF SALES	31.3	28.8	31.7	27.7
GROSS PROFIT	68.8	71.2	68.3	72.3
SELLING AND ADMN.	10.0	8.9	8.2	6.8
DEPRECIATION	10.0	8.9	8.2	6.8
OPERATING EXP.	20.0	17.8	16.4	13.7
NET OPER. INCOME	48.8	53.4	51.9	58.6
OTHER ITEMS	4.4	3.9	3.6	3.0
INCOME TAX	39.6	35.2	32.4	27.1
NET INCOME	44.0	39.1	36.0	30.1

DO YOU WANT THE OTHER STATEMENT? <u>NO</u>

DO YOU WANT TO TRY OTHER RATIOS? <u>NO</u>

FINANAL1

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      ∇FINANAL1[⎕]∇

    ∇ FINANAL1
[1]    '

       '
[2]    →(AYN 'DO YOU KNOW THE VARIOUS RATIOS YOU CAN ANALYZE?')/STP99
[3]   STP97:'THERE ARE VARIOUS RATIOS YOU CAN ANALYZE. THESE ARE:-'
[4]    'LIQUIDITY,PROFITABILITY,EARNING POWER'
[5]    'CREDIT MGMT,INVENTORY MGMT. AND DEBT MGMT.'
[6]    'STANDARD RATIOS, NORMALIZED STATEMENTS AND BETA ANALYSIS.'
[7]   STP99:'TYPE ANY OF THE RATIOS AND RUN THE PROGRAM'
[8]    →('LPECIDSNB'=(1↑⍞))/LR,PRO,INTE,CRE,INVE,DEB,STR,NORM,BET
[9]    →STP97
[10] LR:LIQ
[11]   →STP100
[12] PRO:PROF
[13]   →STP100
[14] CRE:CRED
[15]   →STP100
[16] DEB:DEBT
[17]   →STP100
[18] INVE:INV
[19]   →STP100
[20] INTE:EARN
[21]   →STP100
[22] STR:STAN
[23]   →STP100
[24] NORM:NORM
[25]   →STP100
[26] BET:BETA
[27] STP100:→(AYN 'DO YOU WANT THE OTHER RATIOS?')/STP99
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B. LIQ

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      ∇LIQ[⎕]∇

    ∇ LIQ;A1;A2;A3;A4;M;N1;MAT;YRS
[1]   M←'1. CASH              2. M/S AND RECEIB. 3. INVENTORY         '
[2]   M←M,'4. PREPAID EXPENSES5. FIXED ASSETS    6. TOTAL SALES       '
[3]   M1← 7 19 ρM←M,'7. CURRENT LIAB.    '
[4]  START:'PERIODS(E.G., 69 70 ETC.,)?'
[5]   MAT←(7,N1←ρYRS←,⎕)ρ0
[6]   MAT[1;]←(1,N1) INC '1. CASH?'
[7]   MAT[2;]←(1,N1) INC '2. M/S AND RECEIVABLES?'
[8]   MAT[3;]←(1,N1) INC '3. INVENTORY?'
[9]   MAT[4;]←(1,N1) INC '4. PREPAID EXPENSES?'
[10]  MAT[5;]←(1,N1) INC '5. FIXED ASSETS (LAND, BLDG, PLANT, INVEST.
       DEF. CHARGES ETC.,)?'
[11]  MAT[6;]←(1,N1) INC '6. TOTAL SALES?'
[12]  MAT[7;]←(1,N1) INC '7. CURRENT LIABILITIES (N/P,A/P,DIV/P, ACCR
      UED INT. ETC.,)?'
[13] SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[14] COMPUTE:1ρCR
[15]  (((8+10×N1)÷2)ρ' ');'LIQUIDITY RATIOS.'
[16]  ' '
[17]  '⍞YEAR      ⍞,X16,10I10' ΔFMT(1,N1)ρYRS
[18]  ' '
[19]  '⍞QUICK RATIO(S)⍞,X11,10F10.3' ΔFMT(1,N1)ρA1←(+⌿MAT[⍳2;])÷MAT[
      7;]
[20]  '⍞CURRENT RATIO(S)⍞,X9,10F10.3' ΔFMT(1,N1)ρA2←(+⌿MAT[⍳
      4;])÷MAT[7;]
[21]  '⍞CASH TO TOTAL ASSETS⍞,X5,10F10.3' ΔFMT(1,N1)ρA3←MAT[1;]÷+⌿MAT
      [⍳5;]
[22]  '⍞CASH TO SALES⍞,X12,10F10.3' ΔFMT(1,N1)ρ÷⌿MAT[1 6 ;]
[23]  1ρCR
[24]  →(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[25] CH1:→(~(AYN 'DO YOU WISH TO CHANGE ANY DATA?'))/0
[26] CHA:CHANGE YRS
[27]  →SEE
[28] STP1:'TYPE THE UNDERLINED LETTERS FOR WHICH YOU WANT THE PLOT.'
[29] STP200:'CURRENT RATIO,QUICK RATIO,CASH TO TOTAL ASSETS, CASH TO
      SALES.'
[30]  →('CQAS'=1↑⍞)/S2,S3,S4,S5
[31]  →STP1
[32] S1:1ρCR
[33]  'NO.      ACCOUNT';((6+10×N1)÷2)ρ' ';'AMOUNT'
[34]  '19A1,X2,10F11.2' ΔFMT(M1;MAT)
[35]  1ρCR
[36] CH:→(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHA
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[37]  →COMPUTE
[38] S2: 30 40 PLOT A2 VS YRS
[39]  →STP2
[40] S3: 30 40 PLOT A1 VS YRS
[41]  →STP2
[42] S4: 30 40 PLOT A3 VS YRS
[43]  →STP2
[44] S5: 30 40 PLOT A4 VS YRS
[45] STP2:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1
[46]  →CH1
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C. PROF

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      ∇PROF[⎕]∇

     ∇ PROF;M;M1;MAT;N4;A1;A2;A3;A4;YRS
[1]   M←'1. NET INCOME  2. COM. SH. OUT3. COM. ST. EQ.'
[2]   M←M,'4. DIV. DECL.  5. MKT. PR./SH.6. TOTAL O.E.  '
[3]   M1← 6 15 ρM
[4]  START:'PERIODS(E.G., 69 70 ETC.,)?'
[5]   MAT←(6,N4←ρYRS←,⎕)ρ0
[6]   MAT[1;]←(1,N4) INC '1. NET INCOME?'
[7]  CSHE:MAT[2;]←(1,N4) INC '2. NO. OF COMMON SHARES OUTSTANDING?'
[8]   →((×/MAT[2;])≠0)/CSTE
[9]   'YOU CANNOT HAVE ZERO STOCKS...REENTER.'
[10]  →CSHE
[11] CSTE:MAT[3;]←(1,N4) INC '3. COMMON STOCK EQUIVALENTS?'
[12]  MAT[4;]←(1,N4) INC '4. DIVIDEND PER SHARE DECLARED?'
[13] MPPS:MAT[5;]←(1,N4) INC '5. MARKET PRICE PER SHARE?'
[14]  →((×/MAT[5;])≠0)/TOTO
[15]  'YOU CANNOT HAVE ZERO MARKET PRICE PER SHARE...REENTER'
[16]  →MPPS
[17] TOTO:MAT[6;]←(1,N4) INC '6. TOTAL OWNERS'' EQUITY?'
[18] SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[19] COMPUTE:1ρCR
[20]  (((4+10×N4)÷2)ρ' ');'PROFITABILITY RATIOS.'
[21]  ' '
[22]  '⍞YEAR    ⍞,X17,10I10' ΔFMT(1,N4)ρYRS
[23]  ' '
[24]  '⍞EARNING PER SHARE⍞,X8,10F10.3' ΔFMT(1,N4)ρA1←÷⌿MAT[ι
      2;]
[25]  '⍞PRO-FORMA E.P.S.⍞,X9,10F10.3' ΔFMT(1,N4)ρA0←MAT[1;]÷+⌿MAT[
      2 3 ;]
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[26]  '⍞PRICE-EARNING RATIO⍞,X6,10F10.3' ΔFMT(1,N4)ρA2←(×/MAT[
      5 2 ;])÷MAT[1;]
[27]  '⍞YIELD⍞,X20,10F10.3' ΔFMT(1,N4)ρA3←÷/MAT[4 5 ;]
[28]  '⍞BOOK VALUE PER SHARE⍞,X5,10F10.3' ΔFMT(1,N4)ρA4←÷/MAT[
      6 2 ;]
[29]  1ρCR
[30]  →(AYN 'DO YOU NEED A PLOT OF ANY OF THESE?')/STP1
[31] CH1:→(~(AYN 'DO YOU WISH TO CHANGE ANY DATA?'))/0
[32] CHA:CHANGE YRS
[33]  →SEE
[34] STP1:'TYPE THE UNDERLINED LETTER FOR WHICH YOU WANT THE PLOT'
[35] STP200:'EPS, PE RATIO, YIELD, PRO-FORMA E.P.S. OR BOOK VALUE/SH.
      '
[36]  →('EPYFB'=1↑⍞)/S2,S3,S4,S5,S6
[37]  →STP200
[38] S1:1ρCR
[39]  'NO.   ACCOUNT          AMOUNT'
[40]  '15A1,X2,10F11.2' ΔFMT(M1;MAT)
[41]  1ρCR
[42]  →(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHA
[43]  →COMPUTE
[44] S2: 30 40 PLOT A1 VS YRS
[45]  →MOREPLOT
[46] S3: 30 40 PLOT A2 VS YRS
[47]  →MOREPLOT
[48] S4: 30 40 PLOT A3 VS YRS
[49]  →MOREPLOT
[50] S5: 30 40 PLOT A0 VS YRS
[51]  →MOREPLOT
[52] S6: 30 40 PLOT A4 VS YRS
[53] MOREPLOT:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1
[54]  →CH1
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D. EARN

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      ∇EARN[⎕]∇

    ∇ EARN;A1;A2;A3;N1;YRS
[1]   M←'1. NET SALES    2. GROSS PROFIT3. NET INCOME   '
[2]   M1← 4 15 ρM←M,'4. TOTAL ASSETS'
[3]  START:'PERIODS(E.G., 69 70 ETC.,)?'
[4]   MAT←(4,N1←ρYRS←,⎕)ρ0
[5]   MAT[1;]←(1,N1) INC '1. NET SALES?'
[6]   MAT[2;]←(1,N1) INC '2. GROSS PROFIT?'
[7]   MAT[3;]←(1,N1) INC '3. NET INCOME AFTER TAX?'
[8]   MAT[4;]←(1,N1) INC '4. TOTAL ASSETS?'
[9]  SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[10] COMPUTE:1ρCR
[11]  (((4+10×N1)÷2)ρ' ');'EARNING POWER RATIOS.'
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[12]  ' '
[13]  '⍞YEAR    ⍞,X18,10I10' ΔFMT(1,N1)⍴YRS
[14]  ' '
[15]  '⍞EARNING POWER⍞,X12,10F10.3' ΔFMT(1,N1)⍴A1←÷⌿MAT[1 4 ;]
[16]  '⍞GROSS EARNING POWER⍞,X6,10F10.3' ΔFMT(1,N1)⍴A2←÷⌿MAT[
      2 4 ;]
[17]  '⍞NET EARNING POWER⍞,X8,10F10.3' ΔFMT(1,N1)⍴A3←÷⌿MAT[3
      4 ;]
[18]  1⍴CR
[19]  →(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[20] CH1:→(~(AYN 'DO YOU WISH TO CHANGE ANY DATA?'))/0
[21] CHA:CHANGE YRS
[22]  →SEE
[23] STP1:'PLEASE TYPE THE UNDERLINED LETTERS FOR THE PLOT.'
[24]  'EARNING POWER,GROSS EARNING POWER OR NET EARNING POWER.'
[25]  →('EGN'=(1↑⍞))/S2,S3,S4
[26]  →STP1
[27] S1:'


      '
[28]  'NO.      ACCOUNT        AMOUNT'
[29]  '15A1,X2,10F11.2' ΔFMT(M1;MAT)
[30]  1⍴CR
[31] CH:→(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHA
[32]  →COMPUTE
[33] S2: 30 40 PLOT A1 VS YRS
[34]  →MOREPLOT
[35] S3: 30 40 PLOT A2 VS YRS
[36]  →MOREPLOT
[37] S4: 30 40 PLOT A3 VS YRS
[38] MOREPLOT:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1
[39]  →CH1
     ∇
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E. CRED

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     ∇CRED[⎕]∇

    ∇ CRED;YRS;N1;MAT;M1;ASD;AVDAYS;A1;A2;X1;X2;X3;ACR;INTEREST
[1]   M←'1. TOTAL SALES   2. BEGINNING A/R3. ENDING A/R    '
[2]   M1← 3 16 ⍴M
[3]  START:' PERIODS(E.G., 69 70 ETC.,)?'
[4]   MAT←(3,N1←⍴YRS←,⎕)⍴0
[5]   AVDAYS←1 INC 'AVERAGE NO. OF DAYS IN THE PERIOD?'
[6]   MAT[1;]←(1,N1) INC '1. TOTAL SALES?'
[7]   MAT[2;]←(1,N1) INC '2. A/R AT THE BEGINNING OF EACH PERIOD?'
[8]   MAT[3;]←(1,N1) INC '3. A/R AT THE END OF EACH PERIOD?'
[9]  SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[10] COMPUTE:1⍴CR
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[11]  (((6+10×N1)÷2)⍴' ');'CREDIT MGMT. RATIOS'
[12]  ' '
[13]  '⎕YEAR            ⎕,X11,10I10' ΔFMT(1,N1)⍴YRS
[14]  ' '
[15]  '⎕COLLECTION PERIOD⎕,X8,10F10.3' ΔFMT(1,N1)⍴A1←(AVDAYS×+⌿MAT[
      2 3 ;])÷2×MAT[1;]
[16]  '⎕RECEIVABLES TO SALES⎕,X5,10F10.3' ΔFMT(1,N1)⍴A2←(+⌿MAT[
      2 3 ;])÷2×MAT[1;]
[17]  '⎕AVERAGE SALES/DAY⎕,X8,10F10.3' ΔFMT(1,N1)⍴MAT[1;]÷AVDAYS
[18]  '


      '
[19]  →(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[20] CHANGE:→(~(AYN 'DO YOU WISH TO CHANGE ANY DATA?'))/CHI
[21] CHA:CHANGE YRS
[22]  →SEE
[23] STP1:'TYPE THE UNDERLINED LETTERS FOR THE PLOT.'
[24] STP2:'COLLECTION PERIOD, RECEIVABLES TO SALES.'
[25]  →('CR'=(1↑⍞))/S2,S3
[26]  →STP2
[27] S1:1⍴CR
[28]  'NO.   ACCOUNT          AMOUNT'
[29]  '16A1,X2,10F11.2' ΔFMT(M1;MAT)
[30]  1⍴CR
[31] CH:→(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHA
[32]  →COMPUTE
[33] S2: 30 40 PLOT A1 VS YRS
[34]  →MOREPLOT
[35] S3: 30 40 PLOT A2 VS YRS
[36] MOREPLOT:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1
[37] CHI:'DO YOU WANT TO SEE THE SAVINGS BY CHANGING'
[38]  →(~(AYN 'COLLECTION PERIOD FOR TWO PERIODS?'))/0
[39] CHA:ACR←2 INC 'PLEASE TYPE THE AVERAGE COLLECTION PERIOD FOR TWO
       PERIODS.'
[40]  X3←(X1←|(-/ACR))×(X2←AVDAYS÷(+/ACR)÷2)
[41]  ASD←1 INC 'WHAT IS THE AVERAGE SALES PER DAY FOR THE SECOND YEA
      R?.'
[42]  INTEREST←0.01×1 INC 'WHAT IS THE INTEREST RATE?.'
[43]  'THE COST(SAVINGS) OF EXTENDING(REDUCING) THE CREDIT BY ';X1;'
      DAYS'
[44]  '⎕IS.....⎕,P⎕$⎕CF10.2' ΔFMT(FN←(ASD×(((1+IR1)*X3)-1))÷IR1←
      INTEREST÷AVDAYS)-FN1←ASD×X3
[45]  →(AYN 'DO YOU WANT TO TRY AGAIN?.')/CHA
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F. INV

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      ∇INV[⎕]∇

    ∇ INV;A1;A2;A3;AVIN;MAT;M;M1;AHP;INT;IR1;TDAYS;AIN;FN;FN1;DX
[1]    M←'1. BEGINNING INV.2. ENDING INV.   3. C.G.S.         '
[2]    M1← 4 17 ρM←M,'4. TOTAL ASSETS  '
[3]   START:' PERIODS(E.G., 69 70 ETC.,)?'
[4]    MAT←(4,N1←ρYRS←,⎕)ρ0
[5]    MAT[1;]←(1,N1) INC '1. INVENTORY AT THE BEGINNING OF EACH PERIO
       D?'
[6]    MAT[2;]←(1,N1) INC '2. INVENTORY AT THE END OF EACH PERIOD?'
[7]    AVIN←(+⌿MAT[⍳2;])÷2
[8]    MAT[3;]←(1,N1) INC '3. COST OF GOODS SOLD?'
[9]    TDAYS←1 INC 'NO. OF DAYS IN THE PERIOD?'
[10]   MAT[4;]←(1,N1) INC '4. TOTAL ASSETS?'
[11]  SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[12]  COMPUTE:1ρCR
[13]   (((8+12×N1)÷2)ρ' ');'INVENTORY MGMT. RATIOS'
[14]   ' '
[15]   '⍞YEAR            ⍞,X16,10I12' ΔFMT(1,N1)ρYRS
[16]   ' '
[17]   '⍞INVENTORY TURNOVER⍞,X12,10F12.3' ΔFMT(1,N1)ρA1←MAT[3;]÷AVIN
[18]   '⍞INVENTORY HOLDING PERIOD⍞,X6,10F12.3' ΔFMT(1,N1)ρA2←(TDAYS×
       AVIN)÷MAT[3;]
[19]   '⍞INVENTORY TO TOTAL ASSETS⍞,X5,10F12.3' ΔFMT(1,N1)ρA3←AVIN÷MAT
       [4;]
[20]   '⍞AVERAGE INVENTORY⍞,X13,10F12.3' ΔFMT(1,N1)ρAVIN
[21]   1ρCR
[22]   →(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[23]  CHA:→(~(AYN 'DO YOU WISH TO CHANGE ANY DATA?'))/CHI
[24]  CHG:CHANGE YRS
[25]   →SEE
[26]  STP1:'TYPE THE UNDERLINED LETTERS FOR THE PLOT.'
[27]  STP2:'INVENTORY TURNOVER,HOLDING PERIOD, TO TOTAL ASSETS.'
[28]   →('THA'=(1↑⍞))/S2,S3,S4
[29]   →STP1
[30]  S1:1ρCR
[31]   'NO.    ACCOUNT       AMOUNT'
[32]   '17A1,X2,10F11.2' ΔFMT(M1;MAT)
[33]   1ρCR
[34]  CH:→(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHG
[35]   →COMPUTE
[36]  S2: 30 40 PLOT A1 VS YRS
[37]   →MOREPLOT
[38]  S3: 30 40 PLOT A2 VS YRS
[39]   →MOREPLOT
[40]  S4: 30 40 PLOT A3 VS YRS
[41]  MOREPLOT:→(AYN 'DO YOU WANT OTHER PLOTS?')/STP1
[42]   →CHA
[43]  CHI:'DO YOU WANT TO SEE THE SAVINGS BY CHANGING'
[44]   →(~(AYN 'THE HOLDING PERIOD FOR TWO PERIODS?.'))/0
[45]  CHN:AHP←2 INC 'PLEASE TYPE THE INVENTORY HOLDING PERIOD FOR TWO
       PERIODS.'
[46]   'PLEASE TYPE THE INTEREST RATE(I.E., CARRYING'
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[47]  INT←0.01×1 INC 'COSTS EXPRESSED AS A PERCENTAGE OF C.G.S.).'
[48]  IR1←INT÷TDAYS
[49]  FN1←(FN←(AIN×((1+IR1)*N1←((|(-/AHP))×(360÷((+/AHP)÷2))))))-AIN←
      1 INC 'AVERAGE INVENTORY FOR THE SECOND PERIOD.'
[50]  DX←|(AHP[1]-AHP[2])
[51]  'THE SAVINGS IN (COST OF) REDUCING (EXTENDING) THE INVENTORY'
[52]  '⎕HOLDING PERIOD BY ⎕,F4.1,⎕ DAYS IS...⎕,P⎕$⎕F10.2' ΔFMT(DX;FN1
      )
[53]  →(AYN 'DO YOU WANT TO TRY AGAIN?.')/CHN
      ∇
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G. DEBT

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      ∇DEBT[⎕]∇

    ∇ DEBT;A1;A2;M;M1;N1;MAT;YRS
[1]   M←'1. TOTAL C.L.     2. LONG TERM DEBT3. TOTAL O.E.      '
[2]   M1← 3 17 ρM
[3]  START:'PERIODS (E.G., 69 70 ETC.,)?'
[4]   MAT←(3,N1←ρYRS←,⎕)ρ0
[5]   MAT[1;]←(1,N1) INC '1. TOTAL CURRENT LIABILITIES?'
[6]   MAT[2;]←(1,N1) INC '2. LONG TERM DEBT?'
[7]   MAT[3;]←(1,N1) INC '3. TOTAL OWNERS'' EQUITY (PAID-IN CAPITAL P
      LUS R.E.)?'
[8]  SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[9]  COMPUTE:1ρCR
[10]  (((12+10×N1)÷2)ρ' ');'DEBT MGMT. RATIOS'
[11]  ' '
[12]  '⎕YEAR    ⎕,X22,10I10' ΔFMT(1,N1)ρYRS
[13]  ' '
[14]  '⎕DEBT TO EQUITY⎕,X15,10F10.3' ΔFMT(1,N1)ρA1←(+/MAT[⍳2;])÷MAT[
      3;]
[15]  '⎕LONG TERM DEBT TO EQUITY⎕,X5,10F10.3' ΔFMT(1,N1)ρA2←÷/MAT[
      2 3 ;]
[16]  '


      '
[17]  →(AYN 'DO YOU NEED A PLOT OF ANY OF THESE?')/STP1
[18] CH1:→(~(AYN 'DO YOU WISH TO CHANGE ANY DATA?'))/0
[19] CHA:CHANGE YRS
[20]  →SEE
[21] STP1:'TYPE THE UNDERLINED LETTERS FOR THE PLOT.'
[22] STP2:'DEBT TO EQUITY, LTD TO EQUITY.'
[23]  →('DL'=(1↑⎕))/S2,S3
[24]  →STP1
[25] S1:1ρCR
[26]  'NO.   ACCOUNT          AMOUNT'
[27]  '17A1,X2,10F11.2' ΔFMT(M1;MAT)
[28]  1ρCR
[29] CHNG:→(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHA
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[30]  →COMPUTE
[31] S2: 30 40 PLOT A1 VS YRS
[32]  →MOREPLOT
[33] S3: 30 40 PLOT A2 VS YRS
[34] MOREPLOT:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1
[35]  →CH1
      ∇
```

H. STAN

```
      ∇STAN[⎕]∇

    ∇ STAN
[1]  RATIO:'PLEASE TYPE THE RATIO YOU WISH TO EXAMINE.(CURRENT ETC.,)
      '
[2]   RX←⍞
[3]   R←'PLEASE ENTER  ';RX;' RATIOS AS A VECTOR.'
[4]   R←⎕
[5]   N←1 INC 'PLEASE TYPE THE NUMBER OF UNITS FOR THE MOVING AVERAGE
      .'
[6]   MVAV1←R EMA(N,ρR)
[7]   MVAV←(1,ρMVAV1)ρMVAV1
[8]   RS←R[⍋R]
[9]   RMEAN←(+/R)÷(R1←ρR)
[10]  →((2|R1)=1)/ODD1
[11] EVEN1:RMEDIAN←0.5×+/RS[⌈0.5× 0 1 +R1]
[12]  R2←RS[⍳(R1÷2)],RMEDIAN,RMEDIAN,RS[(R1÷2)+⍳(R1÷2)]
[13]  R3←(ρR2)÷2
[14]  →((2|R3)=1)/ODD2
[15] EVEN2:IUP←(R2[R3÷2]+R2[(R3÷2)+1])÷2
[16]  IDN←(R2[R3+(R3÷2)]+R2[R3+1+(R3÷2)])÷2
[17]  IQA←(IUP+IDN)÷2
[18]  →OUT
[19] ODD1:RMEDIAN←0.5×+/RS[⌈0.5× 0 1 +R1]
[20]  R2←RS[⍳((R1-1)÷2)],RMEDIAN,RMEDIAN,RS[((R1+1)÷2)+⍳((R1-1)÷
      2)]
[21]  R3←(ρR2)÷2
[22]  →((2|R3)=1)/ODD2
[23]  →EVEN2
[24] ODD2:IUP←R2[((R3-1)÷2)+1]
[25]  IDN←R2[R3+1+((R3-1)÷2)]
[26]  IQA←(IUP+IDN)÷2
[27] OUT:'

      '
[28]  '⍞MEAN IS⍞,X23,F10.3' ΔFMT(RMEAN)
[29]  '⍞MEDIAN IS⍞,X21,F10.3' ΔFMT(RMEDIAN)
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[30]  '⍞INTERQUARTILE AVERAGE IS⍞,X6,F10.3' ΔFMT(IQA)
[31]  '⍞MOVING AVERAGE IS⍞,X13,20F10.3' ΔFMT(MVAV)
[32]  '


      '
[33]  →(AYN 'DO YOU WANT TO TRY OTHER RATIOS?.')/RATIO
      ∇
```

I. NORM

```
      ∇NORM[⎕]∇

    ∇ NORM
[1]   'DO YOU WANT THE INCOME STATEMENT OR BALANCE SHEET?'
[2]  REPEAT:'TYPE THE UNDERLINED WORD.'
[3]   →('I '=1↑⍞)/NOX,REPEAT
[4]   NOBSHEET
[5]  QN:→(AYN 'DO YOU WANT THE OTHER STATEMENT?')/REPEAT
[6]   →0
[7]  NOX:NOSTMT
[8]   →QN
    ∇


      ∇NOSTMT[⎕]∇

    ∇ NOSTMT;M;M1;MAT;N3;YRS;CSL;GAS;DEPR;OTHER;INCTAX;NOPI
[1]   M←'1. SALES          2. COST OF SALES3. EXPENSES        '
[2]   M←M,'4. DEPRECIATION 5. OTHER ITEMS   6. INCOME TAX     '
[3]   M1←(6,(ρM)÷6)ρM
[4]   ' '
[5]  START:'PERIODS(E.G., 69 70 ETC.,)?'
[6]   MAT←(6,N3←ρYRS←,⎕)ρ0
[7]   MAT[1;]←(1,N3) INC '1. SALES?'
[8]   MAT[2;]←(1,N3) INC '2. COST OF SALES?'
[9]   MAT[3;]←(1,N3) INC '3. G AND A AND SELLING EXPENSES?'
[10]  MAT[4;]←(1,N3) INC '4. DEPRECIATION?'
[11]  MAT[5;]←(1,N3) INC '5. OTHER ITEMS?'
[12]  MAT[6;]←(1,N3) INC '6. INCOME TAX?'
[13] SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[14] CMPT:1ρCR
[15]  (((6+10×N3)÷2)ρ' ');'INCOME STATEMENT'
[16]  ' '
[17]  (22+10×N3)ρ'*'
[18]  '⍞YEAR   ⍞,X15,10I10' ΔFMT(1,N3)ρYRS
[19]  (22+10×N3)ρ'-'
[20]  '⍞SALES⍞,X17,10F10.1' ΔFMT(1,N3)ρ100
[21]  '⍞COST OF SALES⍞,X9,10F10.1' ΔFMT(1,N3)ρCSL←100×÷⌿MAT[
      2 1 ;]
[22]  (22+10×N3)ρ'-'
[23]  '⍞GROSS PROFIT⍞,X10,10F10.1' ΔFMT(1,N3)ρ100-CSL
[24]  (22+10×N3)ρ'-'
[25]  '⍞SELLING AND ADMN.⍞,X5,10F10.1' ΔFMT(1,N3)ρGAS←100×÷⌿MAT[
      3 1 ;]
```

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[26]  '⎕DEPRECIATION⎕,X10,10F10.1' ΔFMT(1,N3)⍴DEPR←100+÷/MAT[
      4 1 ;]
[27]  (22+10×N3)⍴'-'
[28]  '⎕OPERATING EXP.⎕,X8,10F10.1' ΔFMT(1,N3)⍴GAS+DEPR
[29]  (22+10×N3)⍴'-'
[30]  '⎕NET OPER. INCOME⎕,X6,10F10.1' ΔFMT(1,N3)⍴NOPI←(100-CSL)-(GAS+
      DEPR)
[31]  (22+10×N3)⍴'-'
[32]  '⎕OTHER ITEMS⎕,X11,10F10.1' ΔFMT(1,N3)⍴OTHER←100×÷/MAT[
      5 1 ;]
[33]  '⎕INCOME TAX⎕,X12,10F10.1' ΔFMT(1,N3)⍴INCTAX←100×÷/MAT[
      6 1 ;]
[34]  (22+10×N3)⍴'-'
[35]  '⎕NET INCOME⎕,X12,10F10.1' ΔFMT(1,N3)⍴NOPI-(OTHER+INCTAX)
[36]  (22+10×N3)⍴'*'
[37]  1⍴CR
[38] CHN:→(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHA
[39]  →(AYN 'DO YOU WANT TO TRY OTHER PERIODS?')/START
[40]  →0
[41] CHA:CHANGE YRS
[42]  →SEE
[43] S1:1⍴CR
[44]  '⎕YEARS⎕,X16,10I10' ΔFMT(1,N3)⍴YRS
[45]  ' '
[46]  '16A1,X5,10F10.2' ΔFMT(M1;MAT)
[47]  1⍴CR
[48]  →(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHA
[49]  →CMPT
      ∇
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```
      ∇NOBSHEET[⎕]∇

    ∇ NOBSHEET;M;M1;MAT;YRS;N2;T
[1]   M←'1. CASH AND EQ.    2. RECEIVABLES    3. INVENTORIES     '
[2]   M←M,'4. INVESTMENTS     5. DEF. CHARGES    6. P. AND E.      '
[3]   M←M,'7. INTANGIBLES     8. CURRENT LIAB.   9. LONG TERM DEBT '
[4]   M1←(9,(⍴M)÷9)⍴M
[5]   ' '
[6]  START:'PERIODS(E.G., 69 70 ETC.,)?'
[7]   MAT←(9,N2←⍴YRS←,⎕)⍴0
[8]   MAT[1;]←(1,N2) INC '1. CASH AND EQUIVALENTS?'
[9]   MAT[2;]←(1,N2) INC '2. RECEIVABLES?'
[10]  MAT[3;]←(1,N2) INC '3. INVENTORIES?'
[11]  MAT[4;]←(1,N2) INC '4. INVESTMENTS?'
[12]  MAT[5;]←(1,N2) INC '5. DEFERRED CHARGES?'
[13]  MAT[6;]←(1,N2) INC '6. PLANT AND EQUIPMENT(NET)?'
[14]  MAT[7;]←(1,N2) INC '7. INTANGIBLES?'
[15]  MAT[8;]←(1,N2) INC '8. CURRENT LIABILITIES?'
[16]  MAT[9;]←(1,N2) INC '9. LONG TERM DEBT?'
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```
SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
CMPT:1⍴CR
 T←100÷TA←+/MAT[⍳7;]
 (((14+10×N2)÷2)⍴' ');'BALANCE SHEET'
 ' '
 (27+10×N2)⍴'*'
 '⎕YEAR⎕,X23,10I10' ΔFMT(1,N2)⍴YRS
 (27+10×N2)⍴'-'
 'ASSETS'
 '⎕CASH AND EQUIVALENTS⎕,X7,10F10.1' ΔFMT(1,N2)⍴MAT[1;]×T
 '⎕RECEIVABLES⎕,X16,10F10.1' ΔFMT(1,N2)⍴MAT[2;]×T
 '⎕INVENTORIES⎕,X16,10F10.1' ΔFMT(1,N2)⍴MAT[3;]×T
 (27+10×N2)⍴'-'
 '⎕CURRENT ASSETS⎕,X13,10F10.1' ΔFMT(1,N2)⍴T×+/MAT[⍳3;]
 (27+10×N2)⍴'-'
 '⎕INVESTMENTS⎕,X16,10F10.1' ΔFMT(1,N2)⍴MAT[4;]×T
 '⎕DEFERRED CHARGES⎕,X11,10F10.1' ΔFMT(1,N2)⍴MAT[5;]×T
 '⎕PLANT AND EQUIP. (NET)⎕,X5,10F10.1' ΔFMT(1,N2)⍴MAT[6;]×T
 '⎕INTANGIBLES⎕,X16,10F10.1' ΔFMT(1,N2)⍴MAT[7;]×T
 (27+10×N2)⍴'-'
 '⎕TOTAL⎕,X22,10F10.1' ΔFMT(1,N2)⍴100
 (27+10×N2)⍴'-'
 'EQUITIES'
 '⎕CURRENT LIABILITIES⎕,X8,10F10.1' ΔFMT(1,N2)⍴MAT[8;]×T
 '⎕LONG-TERM DEBT⎕,X13,10F10.1' ΔFMT(1,N2)⍴MAT[9;]×T
 (27+10×N2)⍴'-'
 '⎕TOTAL DEBT⎕,X17,10F10.1' ΔFMT(1,N2)⍴T×+/MAT[8 9 ;]
 (27+10×N2)⍴'-'
 '⎕OWNERS'' EQUITY⎕,X13,10F10.1' ΔFMT(1,N2)⍴100-T×+/MAT[
 8 9 ;]
 (27+10×N2)⍴'*'
 1⍴CR
CHN:→(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHA
 →(AYN 'DO YOU WANT TO TRY FOR OTHER PERIODS?')/START
 →0
CHA:CHANGE YRS
 →SEE
S1:1⍴CR
 '⎕YEAR⎕,X18,10I10' ΔFMT(1,N2)⍴YRS
 ' '
 '18A1,X4,10F10.2' ΔFMT(M1;MAT)
 1⍴CR
 →(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHA
 →CMPT
 ∇
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      ∇CHANGE[⎕]∇

    ∇ R←CHANGE YRS
[1]     N←(ρMAT)[2]
[2]     'PLEASE TYPE THE CHANGED DATA (A ZERO SIGNALS THE END)'
[3]   NEW:→((1ρNN←⎕)=0)/0
[4]     →((ρNN)=(1+N))/LX1
[5]     →((ρNN)≠3)/LX2
[6]     →(∧/NN[2]≠YRS)/LX2
[7]     →(∧/NN[1]≠ι(ρMAT)[1])/LX2
[8]     MAT[NN[1];YRSιNN[2]]←2↓NN
[9]     →NEW
[10]  LX1:→(∧/NN[1]≠ι(ρMAT)[1])/LX2
[11]    MAT[NN[1];]←1↓NN
[12]    →NEW
[13]  LX2:'WRONG ENTRY....REENTER'
[14]    →NEW
    ∇
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      ∇FINANAL2[⎕]∇

     ∇ FINANAL2;AVDAYS;M;MAT;MATRIX;MM;N;Y;YRS
[1]    'ENTER THE PERIODS (E.G., 69 70 ETC.,)'
[2]    N←ρYRS←,(⎕)
[3]    MAT←(27,N)ρ0
[4]    →(N>1)/STEP
[5]    Y←YRS
[6]    MAT← 26 1 ρ0
[7]    →NSTEP
[8]   STEP:Y←(1,N)ρYRS
[9]   NSTEP:AVDAYS←1 INC 'AVERAGE NUMBER OF DAYS IN THE PERIOD.'
[10]   MAT[1;]←(1,N) INC '1. CASH.'
[11]   MAT[2;]←(1,N) INC '2. MARKETABLE SECURITIES.'
[12]   MAT[3;]←(1,N) INC '3. ACCOUNTS RECEIVABLE BEGINNING.'
[13]   MAT[4;]←(1,N) INC '4. ACCOUNTS RECEIVABLE ENDING.'
[14]   MAT[5;]←(1,N) INC '5. INVENTORY BEGINNING.'
[15]   MAT[6;]←(1,N) INC '6. INVENTORY ENDING.'
[16]   MAT[7;]←(1,N) INC '7. PREPAID EXPENSES.'
[17]   MAT[8;]←(1,N) INC '8. LAND, BLDGS, PLANT AND EQUIPMENT(LESS ACC
       . DEPRN.).'
[18]   MAT[9;]←(1,N) INC '9. INTANGIBLE ASSES. (LESS AMORTIZATION, IF
       ANY).'
[19]   MAT[10;]←(1,N) INC '10. INVESTMENTS.'
[20]   MAT[11;]←(1,N) INC '11. CURRENT LIABILITIES (N/P, A/P, DIV./P A
       CCRUED INT. ETC.,).'
[21]   MAT[12;]←(1,N) INC '12. DEFERRED CHARGES.'
[22]   MAT[13;]←(1,N) INC '13. LONG-TERM DEBT.'
[23]   MAT[14;]←(1,N) INC '14. TOTAL OWNERS'' EQUITY.'
[24]   MAT[15;]←(1,N) INC '15. TOTAL SALES.'
[25]   MAT[16;]←(1,N) INC '16. COST OF SALES.'
[26]   MAT[17;]←(1,N) INC '17. G AND A AND SELLING EXPENSES.'
[27]   MAT[18;]←(1,N) INC '18. DEPRECIATION EXPENSES.'
[28]   MAT[19;]←(1,N) INC '19. OTHER ITEMS, IF ANY.'
[29]   MAT[20;]←(1,N) INC '20. INCOME TAX.'
[30]  LAST:MAT[21;]←(1,N) INC '21. NUMBER OF COMMON SHARES OUTSTANDING
       .'
[31]   →((×/MAT[21;])≠0)/NEXT
[32]   'YOU CANNOT HAVE ZERO COMMON SHARES....REENTER.'
[33]   →LAST
[34]  NEXT:MAT[22;]←(1,N) INC '22. COMMON STOCK EQUIVALENTS.'
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[35]  MAT[23;]←(1,N) INC '23. DIVIDEND PER SHARE DECLARED.'
[36] LAST1:MAT[24;]←(1,N) INC '24. MARKET PRICE PER SHARE.'
[37]  →((×/MAT[24;])≠0)/NEXT1
[38]  'YOU CANNOT HAVE ZERO MARKET PRICE PER SHARE....REENTER.'
[39]  →LAST1
[40] NEXT1:MAT[25;]←-⌿MAT[15 16 ;]
[41]  MAT[26;]←(-⌿MAT[15 16 ;])-(+⌿MAT[16+⍳4;])
[42] SEE:→(~(AYN 'DO YOU WANT TO SEE YOUR DATA?'))/RATIO
[43] SEEDATA:S1
[44] PD:→(~(AYN 'DO YOU WANT TO CHANGE ANY DATA?'))/RATIO
[45] CHANGE:'PLEASE ENTER THE CHANGED DATA.(A ZERO SIGNALS THE END)'
[46] NEW:NN←,(⎕)
[47]  →((1ρNN)=0)/SEE
[48]  →((ρNN)=(1+N))/LX1
[49]  →((ρNN)≠3)/LX2
[50]  →(∧/NN[2]≠YRS)/LX2
[51]  →(∧/NN[1]≠⍳25)/LX2
[52]  MAT[NN[1];YRS⍳NN[2]]←2↓NN
[53]  →NEW
[54] LX1:→(∧/NN[1]≠⍳24)/LX2
[55]  MAT[NN[1];]←1↓NN
[56]  →NEW
[57] LX2:'WRONG ENTRY....REENTER.'
[58]  →NEW
[59] RATIO:'LIQUIDITY,PROFITABLILITY,EARNING POWER'
[60]  'CREDIT MGMT., INVENTORY MGMT. AND DEBT MGMT.'
[61]  'STANDARD RATIOS, NORMALIZED STATEMENTS AND BETA ANALYSIS.'
[62] SS1:'TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.'
[63]  →('LPECIDSNB'=1↑⍞)/LR,PRO,EAR,CRE,IN,DEB,STR,NOR,BET
[64]  →SS1
[65] LR:LIQ MATRIX←MAT[1 2 4 6 7 8 9 10 15 11 ;]
[66] PT:2ρCR
[67]  →(AYN 'DO YOU WANT TO TRY OTHER RATIOS?')/SS1
[68]  →0
[69] PRO:PROF MATRIX←MAT[26 21 22 23 24 14 ;]
[70]  →PT
[71] EAR:EARN MATRIX←MAT[15 25 26 ;],[1]+⌿MAT[1 2 4 6 7 8 9
      10 ;]
[72]  →PT
[73] CRE:CRED MATRIX←MAT[15 3 4 ;]
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[74]  →PT
[75] IN:INV MATRIX←MAT[5 6 16 ;],[1]+⌿MAT[1 2 4 6 7 8 9 10 ;]
[76]  →PT
[77] DEB:DEBT MATRIX←MAT[11 13 14 ;]
[78]  →PT
[79] STR:STAN
[80]  →PT
[81] NOR:NORM
[82]  →PT
[83] BET:BETA
[84]  →PT
     ∇


     ∇S1[⎕]∇

    ∇ S1
[1]   M←' 1. CASH                             '
[2]   M←M,' 2. MARKETABLE SECURITIES            '
[3]   M←M,' 3. ACCOUNTS RECEIVABLE BEGINNING    '
[4]   M←M,' 4. ACCOUNTS RECEIVABLE ENDING       '
[5]   M←M,' 5. INVENTORY BEGINNING              '
[6]   M←M,' 6. INVENTORY ENDING                 '
[7]   M←M,' 7. PREPAID EXPENSES                 '
[8]   M←M,' 8. LAND, BLDGS, PLANT ETC.,         '
[9]   M←M,' 9. INTANGIBLE ASSETS(LESS AMORTN.)'
[10]  M←M,'10. INVESTMENTS                      '
[11]  M←M,'11. CURRENT LIABILITIES              '
[12]  M←M,'12. DEFERRED CHARGES                 '
[13]  M←M,'13. LONG-TERM DEBT                   '
[14]  M←M,'14. TOTAL OWNERS''EQUITY               '
[15]  M←M,'15. TOTAL SALES                      '
[16]  M←M,'16. COST OF SALES                    '
[17]  M←M,'17. G AND A AND SELLING EXPENSES     '
[18]  M←M,'18. DEPRECIATION                     '
[19]  M←M,'19. OTHER ITEMS                      '
[20]  M←M,'20. INCOME TAX                       '
[21]  M←M,'21. NUMBER OF COMMON SHARES O/S.     '
[22]  M←M,'22. COMMON STOCK EQUIVALENTS         '
[23]  M←M,'23. DIVIDEND PER SHARE DECLARED      '
[24]  M←M,'24. MARKET PRICE PER SHARE           '
[25]  MM← 24 35 ρM
[26]  '

      '
[27]  'NO.      ACCOUNT';(4×N+1)ρ' ';'AMOUNT'
[28]  ' '
[29]  '35A1,X2,10F8.2' ΔFMT(MM;MAT[ι24;])
    ∇
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      ∇LIQ[⎕]∇

    ∇ R1←LIQ MAT;A40;A50;A60;A70
[1]    '

       '
[2]    (((8+10×⍴YRS)÷2)⍴' ');'LIQUIDITY RATIOS',(16⍴BS),16⍴'_'
[3]    ' '
[4]    '⍞YEAR      ⍞,X16,10I10' ∆FMT(Y)
[5]    ' '
[6]    '⍞QUICK RATIO(S)⍞,X11,10F10.2' ∆FMT(1,N)⍴A40←(+⌿MAT[⍳2;])÷MAT[
       10;]
[7]    '⍞CURRENT RATIO(S)⍞,X9,10F10.2' ∆FMT(1,N)⍴A50←(+⌿MAT[⍳
       5;])÷MAT[10;]
[8]    '⍞CASH TO TOTAL ASSETS⍞,X5,10F10.2' ∆FMT(1,N)⍴A60←MAT[1;]÷+⌿MAT
       [⍳8;]
[9]    '⍞CASH TO SALES⍞,X12,10F10.2'  ∆FMT(1,N)⍴A70←MAT[1;]÷MAT[
       9;]
[10]   '

       '
[11] PD:→(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[12]  →0
[13] STP1:'CURRENT RATIO, QUICK RATIO, CASH TO TOTAL ASSETS, CASH TO
      SALES'
[14] STP2:'TYPE THE UNDERLINED LETTERS FOR THE PLOT'
[15]  →('CQAS'=1↑⍞)/S1,S2,S3,S4
[16]  →STP1
[17] S1: 30 40 PLOT A50 VS YRS
[18]  →MOREPLOT
[19] S2: 30 40 PLOT A40 VS YRS
[20]  →MOREPLOT
[21] S3: 30 40 PLOT A60 VS YRS
[22]  →MOREPLOT
[23] S4: 30 40 PLOT A70 VS YRS
[24] MOREPLOT:'

       '
[25] PP:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP2
    ∇
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      ∇PROF[⎕]∇

    ∇ R2←PROF MAT;A80;A90;A100;A110;A120
[1]   '

      '
[2]   (((4+10×⍴YRS)÷2)⍴' ');'PROFITABILITY RATIOS',(20⍴BS),20⍴'_'
[3]   ' '
[4]   '⍞YEAR    ⍞,X17,10I10' ∆FMT(Y)
[5]   ' '
[6]   '⍞EARNING PER SHARE⍞,X8,10F10.2' ∆FMT(1,N)⍴A90←÷⌿MAT[⍳
      2;]
[7]   '⍞PRO-FORMA E.P.S.⍞,X9,10F10.2' ∆FMT(1,N)⍴A80←MAT[1;]÷+⌿MAT[1+⍳
      2;]
[8]   '⍞PRICE-EARNING RATIO⍞,X6,10F10.2' ∆FMT(1,N)⍴A100←MAT[
      5;]×MAT[2;]÷MAT[1;]
[9]   '⍞YIELD⍞,X20,10F10.2' ∆FMT(1,N)⍴A110←÷⌿MAT[4 5 ;]
[10]  '⍞BOOK VALUE PER SHARE⍞,X5,10F10.2' ∆FMT(1,N)⍴A120←÷⌿MAT[
      6 2 ;]
[11]  '

      '
[12] PP:→(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[13]  →0
[14] STP1:'EPS, PE RATIO, YIELD, PRO-FORMA E.P.S. OR BOOK VALUE/SH.'
[15] STP2:'TYPE THE UNDERLINED LETTERS FOR THE PLOT'
[16]  →('EPYFB'=1↑⍞)/S1,S2,S3,S4,S5
[17]  →STP1
[18] S1: 30 40 PLOT A90 VS YRS
[19]  →MOREPLOT
[20] S2: 30 40 PLOT A100 VS YRS
[21]  →MOREPLOT
[22] S3: 30 40 PLOT A110 VS YRS
[23]  →MOREPLOT
[24] S4: 30 40 PLOT A80 VS YRS
[25]  →MOREPLOT
[26] S5: 30 40 PLOT A120 VS YRS
[27] MOREPLOT:'

      '
[28] PD:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP2
    ∇
```

```
      ∇EARN[⎕]∇

    ∇ R3←EARN MAT;A130;A140;A150
[1]     '

        '
[2]     (((4+10×⍴YRS)÷2)⍴' ');'EARNING POWER RATIOS',(20⍴BS),20⍴'_'
[3]     ' '
[4]     '⍞YEAR    ⍞,X18,10I10' ΔFMT(Y)
[5]     ' '
[6]     '⍞EARNING POWER⍞,X12,10F10.2' ΔFMT(1,N)⍴A130←÷/MAT[1 4 ;]
[7]     '⍞GROSS EARNING POWER⍞,X6,10F10.2' ΔFMT(1,N)⍴A140←÷/MAT[
        2 4 ;]
[8]     '⍞NET EARNING POWER⍞,X8,10F10.2' ΔFMT(1,N)⍴A150←÷/MAT[
        3 4 ;]
[9]     '

        '
[10] PC:→(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[11]  →0
[12] STP1:'EARNING POWER, GROSS EARNING POWER OR NET EARNING POWER.'
[13] STP2:'TYPE THE UNDERLINED LETTERS FOR THE PLOT'
[14]  →('EGN'=1↑⍞)/S1,S2,S3
[15]  →STP1
[16] S1: 30 40 PLOT A130 VS YRS
[17]  →MOREPLOT
[18] S2: 30 40 PLOT A140 VS YRS
[19]  →MOREPLOT
[20] S3: 30 40 PLOT A150 VS YRS
[21] MOREPLOT:'

        '
[22] PD:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP2
    ∇



      ∇CRED[⎕]∇

    ∇ R←CRED MAT;A10;A20;A30
[1]     '

        '
[2]     (((6+10×⍴YRS)÷2)⍴' ');'CREDIT MGMT. RATIOS',(19⍴BS),19⍴'_'
[3]     ' '
[4]     '⍞YEAR⍞,X21,10I10' ΔFMT(Y)
```

```
[5]   '
      '
[6]   '⎕COLLECTION PERIOD⎕,X8,10F10.2' ΔFMT(1,N)⍴A20←((+⌿MAT[
      2 3 ;])×AVDAYS)÷MAT[1;]
[7]   '⎕RECEIVABLES TO SALES⎕,X5,10F10.2' ΔFMT(1,N)⍴A30←(+⌿MAT[
      2 3 ;])÷2×MAT[1;]
[8]   '⎕AVERAGE SALES PER DAY⎕,X4,10F10.2' ΔFMT(1,N)⍴A10←MAT[1;]÷
      AVDAYS
[9]   '

      '
[10] PP:→(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1
[11]  →CHA
[12] STP1:'COLLECTION PERIOD OR RECEIVABLES TO SALES'
[13] STP2:'TYPE THE UNDERLINED LETTERS FOR THE PLOT'
[14]  →('CR'=1↑⍞)/S1,S2
[15]  →STP1
[16] S1: 30 40 PLOT A20 VS YRS
[17]  →MOREPLOT
[18] S2: 30 40 PLOT A30 VS YRS
[19] MOREPLOT:'

      '
[20] PD:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP2
[21] CHA:'DO YOU WANT TO SEE THE SAVINGS BY CHANGING'
[22]  →(AYN 'THE COLLECTION PERIOD FOR TWO PERIODS?')/CHI
[23]  →0
[24] CHI:ACR←2 INC 'PLEASE TYPE THE AVERAGE COLLECTION PERIOD FOR TWO
       PERIODS'
[25]  X1←|(ACR[1]-ACR[2])
[26]  X2←AVDAYS÷(+/ACR)÷2
[27]  X3←X2×X1
[28]  ASD←1 INC 'WHAT IS THE AVERAGE SALES PER DAY FOR THE SECOND YEA
      R?'
[29]  INTEREST←0.01×1 INC 'WHAT IS THE INTEREST RATE?'
[30]  IR1←INTEREST÷AVDAYS
[31]  FN←(ASD×(((1+IR1)*X3)-1))÷IR1
[32]  FN1←ASD×X3
[33]  '

      THE COST(SAVINGS) OF EXTENDING(REDUCING) THE CREDIT BY ';X1;' D
      AYS'
[34]  'IS $';2 RND(FN-FN1)
[35]  '

      '
[36] PC:→(AYN 'DO YOU WANT TRY AGAIN?')/CHI
      ∇
```

```
      ∇INV[⎕]∇

    ∇ R4←INV MAT;A170;A180;A190
[1]    '

       '
[2]    (((8+10×⍴YRS)÷2)⍴' ');'INVENTORY MGMT. RATIOS',(22⍴BS),
       22⍴'_'
[3]    ' '
[4]    '⍞YEAR⍞,X26,10I10' ΔFMT(Y)
[5]    ' '
[6]    '⍞INVENTORY TURNOVER⍞,X12,10F10.2' ΔFMT(1,N)⍴A170←MAT[
       3;]÷A←(+⌿MAT[⍳2;])÷2
[7]    '⍞INVENTORY HOLDING PERIOD⍞,X6,10F10.2' ΔFMT(1,N)⍴A180←AVDAYS×A
       ÷MAT[3;]
[8]    '⍞INVENTORY TO TOTAL ASSETS⍞,X5,10F10.2' ΔFMT(1,N)⍴A190←A÷MAT[
       4;]
[9]    '⍞AVERAGE INVENTORY⍞,X13,10F10.2' ΔFMT(1,N)⍴A
[10]   '

       '
[11] PC:→(~(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?'))/CHI
[12] STP1:'INVENTORY TURNOVER, HOLDING PERIOD, TO TOTAL ASSETS'
[13] STP2:'TYPE THE UNDERLINED LETTERS FOR THE PLOT'
[14]  →('THA'=1↑⍞)/S1,S2,S3
[15]  →STP1
[16] S1: 30 40 PLOT A170 VS YRS
[17]  →MOREPLOT
[18] S2: 30 40 PLOT A180 VS YRS
[19]  →MOREPLOT
[20] S3: 30 40 PLOT A190 VS YRS
[21] MOREPLOT:'

       '
[22] PD:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP2
[23] CHI:'DO YOU WANT TO SEE THE SAVINGS BY CHANGING'
[24]  →(~(AYN 'THE HOLDING PERIOD FOR TWO PERIODS?'))/0
[25] CHA:AHP←2 INC 'PLEASE TYPE THE INVENTORY HOLDING PERIOD FOR TWO
       PERIODS'
[26]   'PLEASE TYPE THE INTEREST RATE (I.E., CARRYING COSTS'
[27]   INT←0.01×1 INC 'EXPRESSED AS A PERCENTAGE OF C.G.S.)'
[28]   IR1←INT÷AVDAYS
[29]   FN1←(FN←(AIN×((1+IR1)*N1←((|(-/AHP))×(AVDAYS÷((+/AHP)÷
       2))))))-AIN←1 INC 'AVERAGE INVENTORY FOR THE SEOND PERIOD.'
[30]   DX←|(AHP[1]-AHP[2])
[31]   '

       THE SAVINGS(COST OF) IN REDUCING(EXTENDING) THE'
[32]   'HOLDING PERIOD BY ';DX;' DAYS IS $';2 RND FN1
[33]   '

       '
[34]  →(AYN 'DO YOU WANT TO TRY AGAIN?')/CHA
    ∇
```

```
      ∇DEBT[⎕]∇

    ∇ R5←DEBT MAT;A200;A210
[1]   '

      '
[2]   (((12+10×⍴YRS)÷2)⍴' ');'DEBT MGMT. RATIOS',(17⍴BS),17⍴'_'
[3]   ' '
[4]   '⍞YEAR   ⍞,X22,10I10' ∆FMT(Y)
[5]   ' '
[6]   '⍞DEBT TO EQUITY⍞,X15,10F10.2' ∆FMT(1,N)⍴A20←(+⌿MAT[⍳
      2;])÷MAT[3;]
[7]   '⍞LONG TERM DEBT TO EQUITY⍞,X5,10F10.2' ∆FMT(1,N)⍴A210←÷⌿MAT[
      2 3 ;]
[8]   '

      '
[9]  PC:→(~(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?'))/0
[10] STP1:'DEBT TO EQUITY OR LTD TO EQUITY'
[11] STP2:'TYPE THE UNDERLINED LETTERS FOR THE PLOT'
[12]  →('DL'=1↑⍞)/S1,S2
[13]  →STP1
[14] S1: 30 40 PLOT A200 VS YRS
[15]  →MOREPLOT
[16] S2: 30 40 PLOT A210 VS YRS
[17] MOREPLOT:'

      '
[18] PD:→(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1
    ∇
```

```
      ∇NORM[⎕]∇

    ∇ NORM
[1]   'DO YOU WANT THE INCOME STATEMENT OR BALANCE SHEET?'
[2]  REP:'TYPE THE UNDERLINED WORD.'
[3]   →('I '=1↑⍞)/NOX,REP
[4]   NORM1 MATRIX←(+/(2,N)↑MAT),[1] MAT[4 6 10 12 8 9 11 13 ;]
[5]  QN:→(~(AYN 'DO YOU WANT THE OTHER STATEMENT?'))/0
[6]  NOX:NORM2 MATRIX←MAT[14+⍳6;]
[7]   →QN
    ∇



      ∇NORM1[⎕]∇

    ∇ R7←NORM1 MAT;TA
[1]   T̲←100÷TA←+/MAT[⍳7;]
[2]   '

      '
[3]   (((14+10×N)÷2)⍴' ');'BALANCE SHEET',(13⍴BS),13⍴'_'
[4]   (27+10×N)⍴'*'
[5]   '⍞YEAR⍞,X23,10I10' ΔFMT Y
[6]   (27+10×N)⍴'-'
[7]   'ASSETS',(6⍴BS),'______'
[8]   '⍞CASH AND EQUIVALENTS⍞,X7,10F10.1' ΔFMT(1,N)⍴MAT[1;]×T̲
[9]   '⍞RECEIVABLES⍞,X16,10F10.1' ΔFMT(1,N)⍴MAT[2;]×T̲
[10]  '⍞INVENTORIES⍞,X16,10F10.1' \ FMT(1,N)⍴MAT[3;]×T̲
[11]  (27+10×N)⍴'-'
[12]  '⍞CURRENT ASSETS⍞,X13,10F10.1' ΔFMT(1,N)⍴T̲×+/MAT[⍳3;]
[13]  (27+10×N)⍴'-'
[14]  '⍞INVESTMENTS⍞,X16,10F10.1' ΔFMT(1,N)⍴MAT[4;]×T̲
[15]  '⍞DEFERRED CHARGES⍞,X11,10F10.1' ΔFMT(1,N)⍴MAT[5;]×T̲
[16]  '⍞LAND, BUILDINGS, ETC.,(NET)⍞,10F10.1' ΔFMT(1,N)⍴MAT[
      6;]×T̲
[17]  '⍞INTANGIBLES⍞,X16,10F10.1' ΔFMT(1,N)⍴MAT[7;]×T̲
[18]  (27+10×N)⍴'-'
[19]  '⍞TOTAL⍞,X22,10F10.1' ΔFMT(1,N)⍴100
[20]  (27+10×N)⍴'_'
[21]  'EQUITIES',(8⍴BS),'________'
[22]  '⍞CURRENT LIABILITIES⍞,X8,10F10.1' ΔFMT(1,N)⍴MAT[8;]×T̲
[23]  '⍞LONG-TERM DEBT⍞,X13,10F10.1' ΔFMT(1,N)⍴MAT[9;]×T̲
[24]  (27+10×N)⍴'-'
[25]  '⍞TOTAL DEBT⍞,X17,10F10.1' ΔFMT(1,N)⍴T̲×+/MAT[8 9 ;]
[26]  (27+10×N)⍴'-'
[27]  '⍞OWNERS'' EQUITY⍞,X13,10F10.1'Δ FMT(1,N)⍴100-T̲×+/MAT[
      8 9 ;]
[28]  (27+10×N)⍴'*'
    ∇
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```
      ∇NORM2[⎕]∇

    ∇ R6←NORM2 MAT;CSL;GAS;DEPR;NOPI;OTHER;INCTAX
[1]   '

      '
[2]   (((6+10×N)÷2)ρ' ');'INCOME STATEMENT'
[3]   ' '
[4]   (22+10×N)ρ'*'
[5]   '⍞YEAR   ⍞,X15,10I10' ΔFMT(Y)
[6]   (22+10×N)ρ'-'
[7]   '⍞SALES⍞,X17,10F10.1' ΔFMT(1,N)ρ100
[8]   '⍞COST OF SALES⍞,X9,10F10.1' ΔFMT(1,N)ρCSL←100×÷≠MAT[2
      1 ;]
[9]   (22+10×N)ρ'-'
[10]  '⍞GROSS PROFIT⍞,X10,10F10.1' ΔFMT(1,N)ρ100-CSL
[11]  (22+10×N)ρ'-'
[12]  '⍞SELLING AND ADMN.⍞,X5,10F10.1' ΔFMT(1,N)ρGAS←100×÷≠MAT[
      3 1 ;]
[13]  '⍞DEPRECIATION⍞,X10,10F10.1' ΔFMT(1,N)ρDEPR←100×÷≠MAT[
      4 1 ;]
[14]  (22+10×N)ρ'-'
[15]  '⍞OPERATING EXP.⍞,X8,10F10.1' ΔFMT(1,N)ρGAS+DEPR
[16]  (22+10×N)ρ'-'
[17]  '⍞NET OPER. INCOME⍞,X6,10F10.1' ΔFMT(1,N)ρNOPI←(100-CSL)-(GAS+
      DEPR)
[18]  (22+10×N)ρ'-'
[19]  '⍞OTHER ITEMS⍞,X11,10F10.1' ΔFMT(1,N)ρOTHER←100×÷≠MAT[
      5 1 ;]
[20]  '⍞INCOME TAX⍞,X12,10F10.1'\ FMT(1,N)ρINCTAX←100×÷≠MAT[
      6 1 ;]
[21]  (22+10×N)ρ'-'
[22]  '⍞NET INCOME⍞,X12,10F10.1'\ FMT(1,N)ρOTHER+INCTAX
[23]  (22+10×N)ρ'*'
[24]  '


      '
    ∇
```

```
      ∇NORM[⎕]∇

    ∇ NORM
[1]    'DO YOU WANT THE INCOME STATEMENT OR BALANCE SHEET?'
[2]   REPEAT:'TYPE THE UNDERLINED WORD.'
[3]    →('I '=1↑⍞)/NOX,REPEAT
[4]    NOBSHEET
[5]   QN:→(AYN 'DO YOU WANT THE OTHER STATEMENT?')/REPEAT
[6]    →0
[7]   NOX:NOSTMT
[8]    →QN
    ∇
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J. BETA

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      ∇BETA[⎕]∇

    ∇ BETA
[1]    BETAFACTOR
[2]   PRE:→(~(AYN 'DO YOU WANT THE FORMULA METHOD?'))/0
[3]    BETAFORMULA
    ∇
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```
      ∇STAN[⎕]∇

    ∇ STAN
[1]   RATIO:'PLEASE TYPE THE RATIO YOU WISH TO EXAMINE.(CURRENT ETC.,)
       '
[2]    RX←⍞
[3]    R←'PLEASE ENTER  ';RX;' RATIOS AS A VECTOR.'
[4]    R←⎕
[5]    N←1 INC 'PLEASE TYPE THE NUMBER OF UNITS FOR THE MOVING AVERAGE
       .'
[6]    MVAV1←R EMA(N,ρR)
[7]    MVAV←(1,ρMVAV1)ρMVAV1
[8]    RS←R[⍋R]
[9]    RMEAN←(+/R)÷(R1←ρR)
[10]   →((2|R1)=1)/ODD1
[11]  EVEN1:RMEDIAN←0.5×+/RS[⌈0.5× 0 1 +R1]
[12]   R2←RS[⍳(R1÷2)],RMEDIAN,RMEDIAN,RS[(R1÷2)+⍳(R1÷2)]
[13]   R3←(ρR2)÷2
[14]   →((2|R3)=1)/ODD2
[15]  EVEN2:IUP←(R2[R3÷2]+R2[(R3÷2)+1])÷2
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[16]   IDN←(R2[R3+(R3÷2)]+R2[R3+1+(R3÷2)])÷2
[17]   IQA←(IUP+IDN)÷2
[18]   →OUT
[19]  ODD1:RMEDIAN←0.5×+/RS[⌈0.5× 0 1 +R1]
[20]   R2←RS[⍳((R1-1)÷2)],RMEDIAN,RMEDIAN,RS[((R1+1)÷2)+⍳((R1-1)÷
       2)]
[21]   R3←(⍴R2)÷2
[22]   →((2|R3)=1)/ODD2
[23]   →EVEN2
[24]  ODD2:IUP←R2[((R3-1)÷2)+1]
[25]   IDN←R2[R3+1+((R3-1)÷2)]
[26]   IQA←(IUP+IDN)÷2
[27]  OUT:'

       '
[28]   '⎕MEAN IS⎕,X23,F10.3' ΔFMT(RMEAN)
[29]   '⎕MEDIAN IS⎕,X21,F10.3' ΔFMT(RMEDIAN)
[30]   '⎕INTERQUARTILE AVERAGE IS⎕,X6,F10.3' ΔFMT(IQA)
[31]   '⎕MOVING AVERAGE IS⎕,X13,20F10.3' ΔFMT(MVAV)
[32]   '


       '
[33]   →(AYN 'DO YOU WANT TO TRY OTHER RATIOS?.')/RATIO
       ∇




       ∇BETAFORMULA[⎕]∇

     ∇ BETAFORMULA
[1]    →(AYN 'DO YOU KNOW THE VARIOUS FACTORS TO BE ENTERED?')/START
[2]    ' '
[3]   STA:'1.  THE RISK-FREE RATE.'
[4]    '2.  THE EXPECTED RETURN ON THE MARKET AS A PERCENTAGE,'
[5]    '3.  THE ACTUAL RETURN ON THE STOCK AS A PERCENTAGE AND'
[6]    '4.  THE BETAFACTOR(FROM THE PREVIOUS PROGRAM)'
[7]    'THESE ARE IN ORDER RF,E(RM),A(RJ) AND BETA'
[8]    '(REF:''ACCOUNTING'' BY DR. BUCKLEY)'
[9]   START:'PLEASE ENTER THE FACTORS IN THE SAME ORDER. IF YOU NEED'
[10]   'HELP TYPE HELP. OTHERWISE HIT THE CARRIAGE RETURN.'
[11]   →('H'=1↑⍞)/STA
[12]   RTN←4⍴INP 4
[13]   ERJ←RTN[1]+(RTN[2]-RTN[1])×RTN[4]
[14]   AF←(RTN[3]-RTN[1])-(RTN[2]-RTN[1])×RTN[4]
[15]   '

       '
[16]  OUTPUT:'⎕ALPHA FACTOR IS⎕,X14,F10.2 ' ΔFMT(AF)
[17]   '⎕EXPECTED RTN. ON STK. IS⎕,X5,F10.2' ΔFMT(ERJ)
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```
[18]  '

      '
[19]  →(AYN 'DO YOU WANT TO TRY OTHERS?')/START
      ∇




      ∇BETAFACTOR[⎕]∇

    ∇ BETAFACTOR;N;X;Y;DPS;RM
[1]   M←'1. RETURN ON MARKET2. STOCK PRICE HIGH3. STOCK PRICE LOW '
[2]   M1← 4 19 ρM←M,'4. DIV. PER SHARE  '
[3]   →(AYN 'DO YOU KNOW HOW TO USE THIS PROGRAM?')/START
[4]  INSTR:'1.  THE NUMBER OF PERIODS SHOULD ALWAYS BE MORE THAN 5.'
[5]   '2.  THE RETURN ON MARKET, STOCK-PRICE HIGH, STOCK-PRICE'
[6]   '    LOW AND THE DIVIDENDS PER SHARE CAN BE FOUND IN THE'
[7]   '    STANDARD AND POOR''S ANALYSTS HANDBOOK.'
[8]   '    TO AVOID ERRORS IT IS ADVISABLE THAT THE DIVIDEND PER'
[9]   '    SHARE BE ENTERED AS A DECIMAL. E.G., 2.000001 INSTEAD OF 2
      .'
[10] START:'PERIODS(E.G., 69 70 ETC.,OR 1 2 3 ETC.,)?'
[11] STP0:N1←ρN←,(⎕)
[12]  MAT←(4,N1)ρ0
[13]  NAT←(N1-1)ρ0
[14]  →(N1≥5)/STP
[15]  'YOU CANNOT HAVE LESS THAN FIVE PERIODS....REENTER'
[16]  →STP0
[17] STP:'PLEASE TYPE 1. THE RETURN ON MARKET FOR THE YEARS'
[18]  N[2];' THRU ';N[(ρN)]
[19]  MAT[1;]←0,NAT←RM←(N1-1)ρINP(1,(N1-1))
[20]  MAT[2;]←X←(1,N1) INC '2. STOCK PRICE HIGH?'
[21]  MAT[3;]←Y←(1,N1) INC '3. STOCK PRICE LOW?'
[22]  MAT[4;]←DPS←(1,N1) INC '4. DIVIDENDS PER SHARE?'
[23] SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
[24] CMPT:Z←⍉(3,N1)ρX,Y,DPS
[25]  RETURN Z
[26]  ' '
[27]  ' '
[28]  '⍞ALPHA FACTOR IS⍞,X17,F8.3' ΔFMT(ARJ[1])
[29]  '⍞BETA FACTOR IS⍞,X18,F8.3' ΔFMT(ARJ[2])
[30]  '⍞ERROR TERM IS⍞,X19,F8.3' ΔFMT(ARJ[3])
[31]  '⍞INTERCEPT FOR DIV. LINE IS⍞,X6,F8.3' ΔFMT(ARJ[4])
[32]  '⍞SLOPE OF THE DIV. LINE IS⍞,X7,F8.3' ΔFMT(ARJ[5])
[33]  '⍞BEGINNING STOCK PRICE IS⍞,X8,F8.2' ΔFMT(ARJ[6])
[34]  '

      '
```

```
[35] CHN:→(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHG
[36]  →(AYN 'DO YOU WANT TO TRY FOR OTHER PERIODS?')/START
[37]  →0
[38] CHG:CHANGE YRS
[39]  →SEE
[40] S1:'⎕YEAR⎕,X16,10I13' ΔFMT(NN←(1,N1)ρN)
[41]  '19A1,X4,10F10.3' ΔFMT(M1;MAT)
[42]  1ρCR
[43]  →(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHG
[44]  →CMPT
      ∇
```

```
      ∇RETURN[⎕]∇

    ∇ RETURN X;P;R
[1]    P←(X[;1]+X[;2])÷2
[2]    R←((P[1+ι(ρP)-1]-P[ι(ρP)-1])+X[1+ι(ρP)-1;3])÷P[ι(ρP)-1]
[3]    RJ←R,P[ρP]
[4]    CALC N
    ∇
```

```
      ∇CALC[⎕]∇

    ∇ CALC N;R;D
[1]    R←RM SR RJ[ι((ρRJ)-1)]
[2]    D←(ιρRJ) SR DPS
[3]    ARJ←R[3;1],R[4;1],R[5;1],D[3;1],D[4;1],RJ[ρRJ]
    ∇
```

```
      ∇SR[⎕]∇

    ∇ T←X SR Y;N;MX;SX;MY;SY;B1;B0;R;RSQ;TV;SE;A;B
[1]   SX←((A←+/(X-MX←(+/X)÷N)*2)÷(N←(ρX))-1)*0.5
[2]   SY←((B←+/(Y-MY←(+/Y)÷N)*2)÷N-1)*0.5
[3]   B0←MY-MX×B1←(+/(X-MX)×(Y-MY))÷A
[4]   SE←((B×1-RSQ←(R←B1×SX÷SY)*2)÷N-2)*0.5
[5]   TV←B1÷SB1←(SY÷SX)÷((N-2)÷(1-RSQ))*0.5
[6]   T←(5 3)ρMX,SX,0,MY,SY,0,B0, 0 0 ,B1,SB1,TV,SE,R,RSQ
    ∇
```

```
      ∇EMA[⎕]∇

    ∇ R←IN EMA IZ
[1]   K1←IZ[1]-1
[2]   INT←((K1)ρIN[1]),IN,(K1+1)ρIN[ρIN]
[3]   N←0
[4]   INT2←ι0
[5]  T1:INT2←INT2,(+/INT[N+ιIZ[1]])÷K1+1
[6]   →((ρIN)≠N←N+1)/T1
[7]   R←K1↓INT2
    ∇
```

10
Price-Level Indices and Adjustments (PRICEINDEX)

A. General Description

The programs in this series will aid in the solution of problems involving price indices and the adjustment of financial statements for price-level effects.

The programs which make up the PRICEINDEX workspace are made available by executing the instruction:

```
)LOAD 7 PRICEINDEX
```

These programs are available directly to user of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

From this workspace the various functions can be utilized individually, and in any order, as illustrated by Exhibit 10-1.

Exhibit 10-1
THE PRICEINDEX WORKSPACE

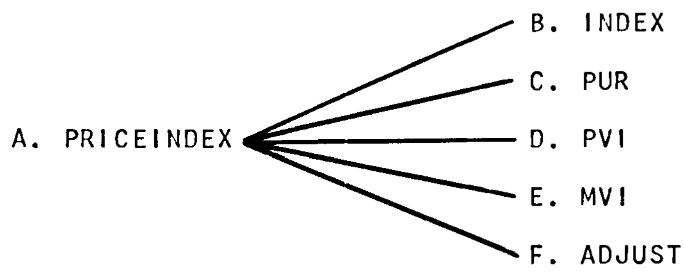


Exhibit 10-2
PRICEINDEX FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
INDEX	-	-
PUR	-	-
PVI	-	-
MVI	YLD	-
ADJUST	-	-

B. INDEX

This program can be used to calculate price-index numbers using any or all of the following formulas:

$$\text{Laspeyres} = \frac{\Sigma(p_n q_o)}{\Sigma(p_o q_o)}$$

$$\text{Paasche} = \frac{\Sigma(p_n q_n)}{\Sigma(p_o q_n)}$$

$$\text{Fisher} = \sqrt{\frac{\Sigma(p_n q_o)}{\Sigma(p_o q_o)} \times \frac{\Sigma(p_n q_n)}{\Sigma(p_o q_n)}}$$

$$\text{Fixed-Weight} = \frac{\Sigma(p_n q_a)}{\Sigma(p_o q_a)}$$

where:

p = the price of a commodity or service

q = the quantity of that commodity or service.

$p_o q_o$= the price or quantity of a commodity or service in the base period.

$p_n q_n$= the price or quantitiy of a commodity or service in a period other than the base period.

$p_a q_a$= the price or quantity of a commodity or service in some arbitrary period.

Σ= the sum of all the terms.

Applying these formulas to a simple problem produces the following index numbers. However, the INDEX program is capable of handling any reasonable number of items.

	1960 (Base)			1970	
	Average (q_a)	Quantity (q_o)	Price/(lb) (p_o)	Quantity (q_n)	Price/(lb) (p_n)
Meat-----	40	100	$1.00	200	$1.50
Potatoes-	160	200	.06	300	.12

	FORMULA	INDEX 1970	1960 Base
Laspeyres	$\frac{(M\ \$1.50 \times 100)+(P\ \$.12 \times 200)}{(M\ \$1.00 \times 100)+(P\ \$.06 \times 200)} = \frac{174}{112} \times 100 =$	155.4	100
Paasche	$\frac{(M\ \$1.50 \times 100)+(P\ \$.12 \times 300)}{(M\ \$1.00 \times 200)+(P\ \$.06 \times 300)} = \frac{336}{218} \times 100 =$	154.1	100
Fisher	$\sqrt{\left(\frac{174}{112}\right) \times \left(\frac{336}{218}\right)} = 1.5474 \times 100 =$	154.7	100
Fixed-Weight	$\frac{(M\ \$1.50 \times 40)+(P\ \$.12 \times 160)}{(M\ \$1.00 \times 40)+(P\ \$.06 \times 160)} = \frac{79.2}{49.6} \times 100 =$	159.7	100

C. PUR (Purchasing Power Index)

Given a specified period, a price and/or money value index for that period, and a rate of depreciation (appreciation) in the value of the currency, the program will compute price and/or money value indices for periods before or after the specified period.

The Input is:

1. A specified or pivotal period, e.g. 1950

2. A price index for the base period, e.g. 90.

3. A money value index for the base period, e.g. 100.

4. A rate of depreciation, which can be either an average annual rate, or specified rates for each period. Appreciation can be expressed as a negative rate, ¯8%.*

The output is:

1. Price and/or money value indices for designated periods prior to the pivotal date in (1) of the input.

2. The same for periods subsequent to the pivotal date.

For example, assuming an average rate of depreciation in the currency, and the required input data, the program will yield the following output at designated intervals before or after that date.

	Output	Input	Output
Periods:	1940	1950	1960
Indices:			
Price:	34.70	90	233.44
Money:	259.37	100	38.55
Rate of Depreciation	←10%→	←10%→	

Or, the program will accommodate a series of depreciation rates:

Input:

(1) Pivotal period: 1950
(2) Price index for the period: 90
(3) Money index for the period: 100
(4) Depreciation rates per period:

(a) periods.............	1950	1951	1952	1953	1954
(b) rates...............	10%	9%	7%	6%	8%

NOTE: When the function requests depreciation rates between periods, it will print out a complete listing of the periods in question. (In this example there are six periods, therefore five rates.) Because each rate is applied from the end of one period to the end of the next. If periods are more than one year apart, the depreciation rate should be the average rate.

* Minus sign in APL is an upper-case 2.

Output

(1) Indices per period:

(a) periods..............	1951	1952	1953	1954	1955
(b) money indices........	99.00	107.91	115.46	122.39	132.18
(c) money indices........	90.91	83.40	77.94	73.53	68.08

D. PVI

This program computes an annual rate of depreciation (appreciation) in the currency and price index, given two periods, money value indices for those periods, and a price index for the first period:

Input

(1) Two Periods, e.g..........	1950	1965
(2) Money value indices.......	100	9.4
(3) Price index...............	85	

Output

(1) Price index...............		3908.6
(2) Annual rate of depreciation...........	14.58%	

E. MVI

Given two periods, price indices for those two periods, and a money value index for the first period, the program computes a money value index and annual rate of depreciation (appreciation) in the currency.

Input

(1) Two periods...............	1950	1965
(2) Price indices.............	85	3908.6
(3) Money value index.........	100	

Output

(1) Money value index.........		9.4
(2) Annual rate of depreciation...........	←14.58%→	

F. ADJUST

Given two price indices, this program computes a conversion factor which can then be used to adjust data such as items in financial statements.

Input

(1) The current or numerator index, e.g. 130.
(2) A prior or denominator index, e.g. 79.1.

Output

(1) Conversion factor, e.g.(130/79.1) = 1.6435

At this point the program requests data for modification which will be scaled by the calculated conversion factor.

Input

(1) A series of unadjusted data, e.g. 24897, 34806, 42312.

Output

(1) A series of price-adjusted data, e.g. 40917.95, 57203.29, 69539.32

This program can be used to adjust financial statements for price-level effects, e.g. statement below. All items with a common multiplier, such as 110/108, would be adjusted with the same conversion factor. A change in the denominator would then produce another conversion factor and enable adjustment of other items, such as those multiplied by 110/100 below:

INCOME STATEMENT
FOR THE YEAR ENDED, DECEMBER 31 19xx

	Unadjusted	Multiplier	Adjusted
Sales....................	$500,000	110/108	$509.260
Cost of goods sold:			
Beginning inventory....	100,000	110/100	110,000
Purchases.............	300,000	110/108	305,560
	--------		--------
Available.............	400,000		415,560
Ending inventory.......	150,000	110/108	152,780
	--------		--------
Cost of goods sold.....	250,000		262,780
	--------		--------
Gross profit............	250,000		246,480
Expenses:			
Selling................	120,000	110/108	122,220
Administrative.........	95,000	110/108	96,760
Depreciation...........	5,000	110/100	5,500
	--------		--------
	220,000		224,480
	--------		--------
Net income before tax....	$ 30,000		$ 22,000
Income tax...............	15,000		15,000
	--------		--------
Net income after tax.....	$ 15,000		$ 7,000

B. INDEX

```
      INDEX
ENTER QUANTITIES FOR BASE PERIOD
⎕:
      100 200
ENTER CORRESPONDING PRICES FOR BASE PERIOD
⎕:
      1.00  .06
ENTER QUANTITIES FOR CURRENT PERIOD
⎕:
      200 300
ENTER CORRESPONDING PRICES FOR CURRENT PERIOD
⎕:
      1.50  0.12
ENTER CHOICE OF FORMULA: 'LASPEYRES', 'PAASCHE', 'FISHER',
                              OR 'FIXED-WEIGHT'.

LASPEYRES
INDEX FOR CURRENT YEAR (BASE=100) IS  155.4
ANOTHER FORMULA?  (YES OR NO)
YES
ENTER CHOICE OF FORMULA: 'LASPEYRES', 'PAASCHE', 'FISHER',
                              OR 'FIXED-WEIGHT'.

PAASCHE
INDEX FOR CURRENT YEAR (BASE=100) IS  154.1
ANOTHER FORMULA?  (YES OR NO)
YES
ENTER CHOICE OF FORMULA: 'LASPEYRES', 'PAASCHE', 'FISHER',
                              OR 'FIXED-WEIGHT'.

FISHER
INDEX FOR CURRENT YEAR (BASE=100) IS  154.7
ANOTHER FORMULA?  (YES OR NO)
YES
ENTER CHOICE OF FORMULA: 'LASPEYRES', 'PAASCHE', 'FISHER',
                              OR 'FIXED-WEIGHT'.

FIXED WEIGHT
ENTER QUANTITIES FOR FIXED PERIOD
⎕:
      40 160
INDEX FOR CURRENT YEAR (BASE=100) IS  159.7
ANOTHER FORMULA?  (YES OR NO)
NO
```

C-1. PUR

```
      PUR
ENTER PIVOTAL PERIOD (E.G. 1950)
⎕:
      1950
ENTER PRICE INDEX FOLLOWED BY MONEY INDEX FOR 1950
⎕:
      90 100
ENTER YEARS INDEX INFORMATION IS DESIRED - EXCLUDING 1950

⎕:
      1940 1960
ENTER DEPRECIATION RATE (AS A PERCENT) BETWEEN EACH PERIOD
IF IT REMAINS CONSTANT, ENTER SINGLE PERCENT
        1940  1950  1960
⎕:
        10



PERIOD             1940    1950    1960
PRICE INDEX       34.70   90.00  233.44
MONEY INDEX      259.37  100.00   38.55
```

C-2. PUR

```
      PUR
ENTER PIVOTAL PERIOD (E.G. 1950)
⎕:
      1950
ENTER PRICE INDEX FOLLOWED BY MONEY INDEX FOR 1950
⎕:
      90 100
ENTER YEARS INDEX INFORMATION IS DESIRED - EXCLUDING 1950

⎕:
      1951 1952 1953 1954 1955
ENTER DEPRECIATION RATE (AS A PERCENT) BETWEEN EACH PERIOD
IF IT REMAINS CONSTANT, ENTER SINGLE PERCENT
        1950  1951  1952  1953  1954  1955
⎕:
            10     9     7     6     8



PERIOD             1950    1951    1952    1953    1954    1955
PRICE INDEX       90.00   99.00  107.91  115.46  122.39  132.18
MONEY INDEX      100.00   90.91   83.40   77.95   73.53   68.09
```

C-3. PUR

```
      PUR
ENTER PIVOTAL PERIOD (E.G. 1950)
⎕:
      1936
ENTER PRICE INDEX FOLLOWED BY MONEY INDEX FOR 1936
⎕:
      85 45
ENTER YEARS INDEX INFORMATION IS DESIRED - EXCLUDING 1936

⎕:
      1920 1930 1932 1950 1973
ENTER DEPRECIATION RATE (AS A PERCENT) BETWEEN EACH PERIOD
IF IT REMAINS CONSTANT, ENTER SINGLE PERCENT
        1920  1930  1932  1936  1950  1973
⎕:
             ¯4    6     3     4     6


PERIOD             1920    1930    1932    1936    1950    1973
PRICE INDEX      101.10   67.21   75.52   85.00  147.19  562.24
MONEY INDEX       37.83   56.91   50.65   45.00   25.99    6.80
```

D. PVI

```
      PVI
ENTER FIRST YEAR  (E.G. 1959)
⎕:
      1950
ENTER FINAL YEAR  (E.G. 1969)
⎕:
      1965
ENTER INDEX OF MONEY VALUE FOR   1950
⎕:
      100
ENTER INDEX OF MONEY VALUE FOR   1965
⎕:
      9.4
ENTER PRICE INDEX FOR  1950  (E.G. 100)
⎕:
      85
THE ANNUAL DEPRECIATION RATE FROM 1950 TO 1965 IS 14.58 PERCENT
THE PRICE INDEX FOR  1965  IS  3908.6
```

E. MVI

```
      MVI
ENTER FIRST YEAR (E.G. 1959)
⎕:
      1950
ENTER FINAL YEAR (E.G. 1969)
⎕:
      1965
ENTER PRICE INDEX FOR  1950
⎕:
      85
ENTER PRICE INDEX FOR  1965
⎕:
      3908.6
ENTER MONEY VALUE INDEX FOR  1950
⎕:
      100
THE MONEY VALUE INDEX FOR  1965  IS  9.4
THE ANNUAL RATE OF DEPRECIATION IS  14.58 PERCENT
```

F. ADJUST

```
      ADJUST
ENTER NUMERATOR INDEX
⎕:
      130
ENTER DENOMINATOR INDEX
⎕:
      79.1
CONVERSION FACTOR IS  1.643489254
ENTER DATA FOR ADJUSTMENT (ZERO WILL TERMINATE)
⎕:
      24897  34806  42312
40917.95  57203.29  69539.32
⎕:
      0
NEW DENOMINATOR INDEX?  (YES OR NO)
YES
ENTER DENOMINATOR INDEX
⎕:
      128.1
CONVERSION FACTOR IS  1.014832162
ENTER DATA FOR ADJUSTMENT (ZERO WILL TERMINATE)
⎕:
      400000 321265 438210
405932.86  326030.05  444709.6
⎕:
      0
NEW DENOMINATOR INDEX?  (YES OR NO)
NO
```

B. INDEX

```
      ∇INDEX[⎕]∇
     ∇ INDEX;QO;PO;QN;PN;IX;I;QA
[1]    BA:'ENTER QUANTITIES FOR BASE PERIOD'
[2]     QO←,⎕
[3]     PO←,(ρQO) INC 'ENTER CORRESPONDING PRICES FOR BASE PERIOD'
[4]    CU:'ENTER QUANTITIES FOR CURRENT PERIOD'
[5]     QN←,⎕
[6]     PN←,(ρQN) INC 'ENTER CORRESPONDING PRICES FOR CURRENT PERIOD'
[7]    N1:→((ρQO)=ρQN)/N2
[8]     'INCORRECT NUMBER OF ENTRIES FOR CURRENT PERIOD'
[9]     →CU
[10]   N2:'ENTER CHOICE OF FORMULA: ''LASPEYRES'', ''PAASCHE'', ''FISHER'',
        '
[11]    (30ρ' '),'OR ''FIXED-WEIGHT''.',CR
[12]    IX←5ρ⍞
[13]    →(IX='LQXHC')/AA,N2,DD,CC,BB
[14]    →N2
[15]   AA:I←(+/PN×QO)÷+/PO×QO
[16]    →OUT
[17]   BB:I←(+/PN×QN)÷+/PO×QN
[18]    →OUT
[19]   CC:I←(((+/PN×QO)×+/PN×QN)÷(+/PO×QO)×+/PO×QN)*
        0.5
[20]    →OUT
[21]   DD:QA←,(ρQO) INC 'ENTER QUANTITIES FOR FIXED PERIOD'
[22]   N3:I←(+/PN×QA)÷+/PO×QA
[23]   OUT:'INDEX FOR CURRENT YEAR (BASE=100) IS  ';1 RND 100×I
[24]   Q:'ANOTHER FORMULA?  (YES OR NO)'
[25]    IX←1ρ⍞
[26]    →(('Y'=IX),('N'=IX),1)/N2,0,Q
     ∇
```

C. PUR

```
      ∇PUR[⎕]∇
    ∇ PUR;P;PM;Y;DR;I;L;M;PI;MI;D;REP;A
[1]   P←1↑IPI 'ENTER PIVOTAL PERIOD (E.G. 1950)',REP←CR,'⎕:',LF,3⍴' '
[2]   'ENTER PRICE INDEX FOLLOWED BY MONEY INDEX FOR ';P
[3]   PM←INP 2
[4]  E:'ENTER YEARS INDEX INFORMATION IS DESIRED - EXCLUDING ';P
[5]   →E×⍳1≠+/P=Y,⍳0×D←8×L←⍴Y←Y[⍋Y←P,IPI REP]
[6]   'ENTER DEPRECIATION RATE (AS A PERCENT) BETWEEN EACH PERIOD'
[7]   'IF IT REMAINS CONSTANT, ENTER SINGLE PERCENT'
[8]   (8⍴' ');Y
[9]   DR←1+(L⍴INP(1,L-1))÷100
[10]  M←L⍴I←1
[11] RE:M[I+1]←M[I]×DR[I]*Y[I+1]-Y[I]
[12]  I←I+1
[13]  →(I<L)/RE
[14]  M←M÷M[Y⍳P]
[15]  PI←M×PM[1]
[16]  MI←PM[2]÷M
[17]  A←'I8,2F8.2' ∆FMT(Y;PI;MI)
[18]  Y← 6 8 ↑A
[19]  PI← 6 8 ↑ 0 8 ↓A
[20]  MI← 0 16 ↓A
[21]  2⍴CR
[22]  'PERIOD       ';D⍴Y
[23]  'PRICE INDEX  ';D⍴PI
[24]  'MONEY INDEX  ';D⍴MI
    ∇
```

D. PVI

```
      ∇PVI[⎕]∇
    ∇ PVI;Y1;V1;Y2;V2;R;F;P;REP
[1]   Y1←1↑IPI 'ENTER FIRST YEAR  (E.G. 1959)',REP←CR,'⎕:',LF,3⍴' '
[2]   Y2←1↑IPI 'ENTER FINAL YEAR  (E.G. 1969)',REP
[3]   'ENTER INDEX OF MONEY VALUE FOR   ';Y1
[4]   V1←INP 1
[5]   'ENTER INDEX OF MONEY VALUE FOR   ';Y2
[6]   V2←INP 1
[7]   'ENTER PRICE INDEX FOR  ';Y1;'  (E.G. 100)'
[8]   P←INP 1
[9]   R←1-(V2÷V1)*1÷Y2-Y1
[10]  F←(P÷R)×((1+R)*Y2-Y1)-1
[11]  'THE ANNUAL DEPRECIATION RATE FROM ';Y1;' TO ';Y2;' IS ';2 RND
      100×R;' PERCENT'
[12]  'THE PRICE INDEX FOR  ';Y2;'  IS  ';1 RND F
    ∇
```

E. MVI

```
      ∇MVI[⎕]∇
    ∇ MVI;Y1;Y2;P1;P2;R;V1;V2;REP;N
[1]   Y1←1↑IPI 'ENTER FIRST YEAR (E.G. 1959)',REP←CR,'⎕:',LF,3ρ' '
[2]   Y2←1↑IPI 'ENTER FINAL YEAR (E.G. 1969)',REP
[3]   'ENTER PRICE INDEX FOR  ';Y1
[4]   P1←INP 1
[5]   'ENTER PRICE INDEX FOR  ';Y2
[6]   P2←INP 1
[7]   'ENTER MONEY VALUE INDEX FOR  ';Y1
[8]   V1←⎕
[9]   R←(N YLD(2,N+1)ρ(Nρ0),P2,0,(N←Y2-Y1)ρP1)-1
[10]  V2←V1×(1-R)*Y2-Y1
[11]  'THE MONEY VALUE INDEX FOR  ';Y2;'  IS  ';1 RND V2
[12]  'THE ANNUAL RATE OF DEPRECIATION IS  ';2 RND R×100;' PERCENT'
    ∇
```

F. ADJUST

```
      ∇ADJUST[⎕]∇
    ∇ ADJUST;N;C;E
[1]   N←1 INC 'ENTER NUMERATOR INDEX'
[2]  ND:C←N÷1 INC 'ENTER DENOMINATOR INDEX'
[3]   'CONVERSION FACTOR IS  ';C
[4]   'ENTER DATA FOR ADJUSTMENT (ZERO WILL TERMINATE)'
[5]  A:E←⎕
[6]   →(E=0)/NDQ
[7]   2 RND E×C
[8]   →A
[9]  NDQ:'NEW DENOMINATOR INDEX?  (YES OR NO)'
[10]  →('Y'=1ρ⍞)/ND
    ∇
```

```
      ∇YLD[⎕]∇
    ∇ Y←A YLD X;R;D
[1]   R←(÷/+/X)*1÷A
[2]  RE:D←÷/+/X÷R*(2,A+1)ρ(⍳A+1)-1
[3]   R←R×D*1÷A
[4]   →RE×⍳(|D-1)>5E¯5
[5]   Y←R
    ∇
```

11
Capital Budgeting (CAPBUDGET)

A. General Description

These functions can be applied to basic capital budgeting problems, and to elementary utility theory as it applies to capital budgeting decisions.

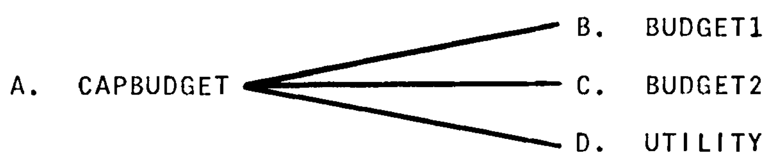
Access to the functions in this workspace is obtained via the instruction:

```
)LOAD 7 CAPBUDGET
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The CAPBUDGET workspace contains three major functions which are illustrated in Exhibit 11-1:

Exhibit 11-1
THE CAPBUDGET WORKSPACE



The supporting functions and variables for this workspace are noted in Exhibit 11-2:

Exhibit 11-2
CAPBUDGET FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
BUDGET1	DPR, YLD	-
BUDGET2	DPR, YLD	-
UTILITY	INTP	-

B. BUDGET1

This function can be used to compute the net cash flows from a capital budgeting investment under fairly complex conditions. Investments must be handled separately. However the resulting cash flows from these individual investments can be processed further via visual inspection or by the use of the BUDGET2 function which follows.

Input to BUDGET1 consists of:

1. The number of periods under consideration, which is 6 in the example which follows.

2. The required investment in year zero (e.g., $10,000).

3. The required investment, if any, in subsequent years. If further investments are in the nature of an annuity, as in the example, enter the amount once. (In this case it is assumed that a further investment of $750 is needed in each of the six years of the investment.) If further investments are not in the nature of an annuity, enter the amounts for each year, and enter a zero for each period in which an investment is not made.

4. EBDT ("Earnings Before Depreciation and Taxes") for each year -- or as an annuity. (Follow the procedures in #3 above).

5. The amount of the investment that is depreciable.

6. The depreciation life (in years).

7. The depreciation method, where SL=straight-line, DB=declining-balance, IR=internal-rate-of-return, and SYD=sum-of-years'-digits. (Where DB is indicated it becomes necessary to specify the percentage involved where 200 = double-declining, 150 = 150% straight-line and so forth. Hence the range for DB is 100 to 200).

8. The ordinary income tax rate as a percentage.

9. The capital gains tax rate as a percentage.

10. The cost of capital as a percentage, i.e., the opportunity rate of interest that is used for making capital investment decisions.

11. The gain (or loss) on the purchase of the new asset, i.e., on the retirement of the old asset which the new one replaces.

12. The sale or trade-in value of the new asset at the end of the investment period.

The output consists of the schedule which is contained in the example. Operating cash position concludes the first section of the schedule, while the second section concludes with net cash flow after tax and following the recovery of the investment(s).

The program also outputs:

1. The present value of the investment, using the cost of capital furnished earlier.

2. The net present value of the investment.

3. The profitability index.

4. The yield or internal rate of return based on operating cash flow.

5. The yield or internal rate of return based on net cash flow.

C. BUDGET2

This function can be used to compare alternative investment decisions, and as noted above, data derived from BUDGET1 for individual investments can be employed for comparative purpose through the use of this function.

Input to BUDGET2 consists of:

1. The number of investment alternatives.

2. The maximum number of periods, i.e., the life of the longest investment.

3. For each alternative:

(a) The amount of the investment required, which can be specified per period if necessary.

(b) The return per period, which may be any of the conventional return figures which the user elects to employ for this purpose: e.g., operating cash, cash-flow after tax, or net cash flow after tax and recovery of investment.

(c) The cost of capital or opportunity rate of interest.

4. Equating investments with unequal lives is done by scaling the investments according to either "perpetuity" or "lowest common multiple" methods.

The lowest common multiple method, as the name suggests, involves the lowest common multiple of the investment periods and computing the present value of benefits, assuming reinvestment at the same rate of interest. The computation, of course, is performed automatically by this function.

In the case of uneven benefits, the program will calculate the present value of the benefits and project a perpetuity. The present value that is stated by the program is the present value of that perpetuity. Data in the example is summarized as follows:

Investment	Expected Life	Initial Cost	CAT Benefits Per Annum	Rate
1	5	\$10,000	\$3,000	6%
2	6	\$15,000	\$4,000	8%

The lowest common multiple of five and six years is 5 x 6 = 30 years. The present value of the two investments for thirty years each is:

$$PV(1) = \$3,000 \left[\frac{1 - (1.06)^{-30}}{.06}\right] = \$3,000\ (13.7648) = \$41,294$$

$$PV(2) = \$4,000 \left[\frac{1 - (1.08)^{-30}}{.08}\right] = \$4,000\ (11.2578) = \$45,031$$

These answers appear in the example under "present value". The function also outputs the payback period, net present value, the profitability index, and the yield of each investment.

The perpetuity method makes the same assumption as above, but extends the benefits to infinity. The first step in this procedure is to compute the net present value of each investment (this is accomplished automatically through this program), which is the difference between cost and benefits. In the example above, the net present values for investments #1 and #2 are \$2,637 and \$3,492 respectively. The objective is to now find an annuity for which investment #1 will equal \$2,637 in five years at 6% interest, and for investment #2 will equal \$3,492 at 8% interest in six years. These annuities are \$626.01 and \$755.37 respectively. The present value of the perpetuities for investments 1 and 2 are computed readily by dividing annuities by the interest rates of the investments. Thus the present value of the perpetuity for investment 1 is 626.01/.06 = \$10,433, and for investment 2 is 755.37/.08 = \$9,442.

The second example under BUDGET2 illustrates the analysis of comparative investment decisions using the perpetuities method.

D. UTILITY

This function copes with elementary problems involving the application of an individual's utility values to a capital budgeting decision. Input comprises:

1. The set of possible cash flows.

2. The corresponding set of utility values. The example shows both cash flows and utilities arranged in ascending order, however, it is only necessary that the two sets of values detail a monotonically increasing function. If a utility function is entered which represents increased utility for decreased cash flow or vice-versa, the program will respond with "utility function inconsistent" and will request that the data be re-entered.

3. The cash flows which attached to a given set of alternatives.

4. The respective probability that those alternatives (and hence their relative cash flows) will materialize.

Given this information the program computes the: (1) expected value, (2) utility measure, (3) point of indifference, and (4) risk discount, where these terms are defined as follows:

Expected value = $P(A_i) \times A_i = E$

Utility measure = $P(A_i) \times U(A_i) = U$

Point of indifference = the cash flow associated with U

Risk discount = E - point of indifference

P is the probability associated with each alternative A, and U is the measure of utility.

B. BUDGET1

```
      BUDGET1
NUMBER OF PERIODS UNDER CONSIDERATION
⎕:
      6
REQUIRED INVESTMENT IN YEAR ZERO
⎕:
      10000
REQUIRED INVESTMENT IN SUBSEQUENT YEARS (SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      750
EBDT FOR EACH YEAR (SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      3500
DEPRECIABLE AMOUNT
⎕:
      11000
DEPRECIATION LIFE
⎕:
      8
ENTER METHOD OF DEPRECIATION - SL, DB, IR, SYD
SYD
ORDINARY INCOME TAX RATE (AS A PERCENT)
⎕:
      50
CAPITAL GAINS TAX RATE (AS A PERCENT)
⎕:
      30
COST OF CAPITAL (AS A PERCENT)
⎕:
      9
GAIN (LOSS) ON PURCHASE
⎕:
      1000
TERMINAL SALE OR TRADE-IN VALUE
⎕:
      2000
```

ANALYSIS OF CAPITAL INVESTMENT

PERIOD	*EBT*	*DEPR*	*EBT*	*TAX*	*EAT*	*DEPR*	*OPR CAT*
0	0	0	0	0	0	0	0
1	3500	2444	1056	528	528	2444	2972
2	3500	2139	1361	681	681	2139	2819
3	3500	1833	1667	833	833	1833	2667
4	3500	1528	1972	986	986	1528	2514
5	3500	1222	2278	1139	1139	1222	2361
6	3500	917	2583	1292	1292	917	2208
TOTALS	21000	10083	10917	5458	5458	10083	15542

PERIOD	*OPR CAT*	*GAIN B.T.*	*TAX*	*GAIN A.T.*	*CAT*	*COST*	*NET*
0	0	1000	300	700	700	10000	(9300)
1	2972	0	0	0	2972	750	2222
2	2819	0	0	0	2819	750	2069
3	2667	0	0	0	2667	750	1917
4	2514	0	0	0	2514	750	1764
5	2361	0	0	0	2361	750	1611
6	2208	(2417)	(725)	(1692)	517	750	(233)
TOTALS	15542	(1417)	(425)	(992)	14550	14500	50

PRESENT VALUE IS ¯1881.87
NET PRESENT VALUE IS ¯16381.87
PROFITABILITY INDEX IS ¯1.13
OPERATING YIELD IS 3.13 *PERCENT*
AFTER TAX YIELD IS 0.19 *PERCENT*

C. BUDGET2

```
      BUDGET2
NUMBER OF INVESTMENT ALTERNATIVES
⎕:
      2
NUMBER OF PERIODS (MAXIMUM)
⎕:
      6
INVESTMENT REQUIRED FOR ALTERNATIVE 1
⎕:
      10000
LIFE OF INVESTMENT (PERIODS)
⎕:
      5
RETURNS FOR ALTERNATIVE 1 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      3000
OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
⎕:
      6
INVESTMENT REQUIRED FOR ALTERNATIVE 2
⎕:
      15000
LIFE OF INVESTMENT (PERIODS)
⎕:
      6
RETURNS FOR ALTERNATIVE 2 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      4000
OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
⎕:
      8
SCALE UNEQUAL LIVES USING LOWEST COMMON MULTIPLE OR PERPETUITY?


ALTERNATIVE                              1              2

                     PERIOD
INVESTMENT                          10,000         15,000
RETURNS                 1            3,000          4,000
                        2            3,000          4,000
                        3            3,000          4,000
                        4            3,000          4,000
                        5            3,000          4,000
                        6                           4,000


PAYBACK PERIOD                        3.33           3.75

PRESENT VALUE                    41,294.49      45,031.13

NET PRESENT VALUE                31,294.49      30,031.13

PROFITABILITY INDEX                   4.13           3.00

YIELD (PERCENT)                      15.24          15.34
```

```
      BUDGET2
NUMBER OF INVESTMENT ALTERNATIVES
⎕:
      3
NUMBER OF PERIODS (MAXIMUM)
⎕:
      6
INVESTMENT REQUIRED FOR ALTERNATIVE 1
⎕:
      10000
LIFE OF INVESTMENT (PERIODS)
⎕:
      5
RETURNS FOR ALTERNATIVE 1 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      3000 2000 6000 2000 3000
OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
⎕:
      6
INVESTMENT REQUIRED FOR ALTERNATIVE 2
⎕:
      15000
LIFE OF INVESTMENT (PERIODS)
⎕:
      6
RETURNS FOR ALTERNATIVE 2 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      2000 6000 4000 8000 2000 3000
OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
⎕:
      8
INVESTMENT REQUIRED FOR ALTERNATIVE 3
⎕:
      25000
LIFE OF INVESTMENT (PERIODS)
⎕:
      6
RETURNS FOR ALTERNATIVE 3 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
⎕:
      6000
OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
⎕:
      10
```

UNEQUAL LIVES WILL BE SCALED BY CALCULATING PV OF THE BENEFITS AND PROJECTING PERPETUITIES.

ALTERNATIVE		1	2	3
	PERIOD			
INVESTMENT		10,000	15,000	25,000
RETURNS	1	3,000	2,000	6,000
	2	2,000	6,000	6,000
	3	6,000	4,000	6,000
	4	2,000	8,000	6,000
	5	3,000	2,000	6,000
	6		3,000	6,000
PERPETUITY		3,198.65	4,175.56	6,000.00
PAYBACK PERIOD		2.83	3.38	4.17
PRESENT VALUE		53,310.76	52,194.54	60,000.00
NET PRESENT VALUE		43,310.76	37,194.54	35,000.00
PROFITABILITY INDEX		5.33	3.48	2.40
YIELD (PERCENT)		17.88	16.85	11.53

D. UTILITY

```
      UTILITY
ENTER POSSIBLE CASH FLOWS
⎕:
      ¯400 ¯200 0 75 200 300 500 600 800 1000 1600 2000
ENTER RESPECTIVE UTILITY MEASURES
⎕:
      0 .4 .6 .685 .75 .8 .86 .88 .91 .95 .98 1
CASH RETURNS OF POSSIBLE ALTERNATIVES
⎕:
      ¯400 600 1600
RESPECTIVE PROBABILITIES OF RETURNS
⎕:
      25 50 25

EXPECTED VALUE IS   600
UTILITY MEASURE IS  0.685
POINT OF INDIFFERENCE IS 75
RISK DISCOUNT IS    525

ANOTHER ALTERNATIVE SET? (YES OR NO)
YES
CASH RETURNS OF POSSIBLE ALTERNATIVES
⎕:
      ¯200 550
RESPECTIVE PROBABILITIES OF RETURNS
⎕:
      50 50

EXPECTED VALUE IS   175
UTILITY MEASURE IS  0.635
POINT OF INDIFFERENCE IS 30.88
RISK DISCOUNT IS    144.12

ANOTHER ALTERNATIVE SET? (YES OR NO)
NO
```

B. BUDGET1

```
    ∇BUDGET1[⎕]∇
  ∇ BUDGET1;P;I;E;C;L;DP;TR;CR;R;GP;GS;EBT;CAT;T;GL;CT;GT;GAT;NC;REP;IT;
    NP;PV;EAT
[1]   P←1↑IPI 'NUMBER OF PERIODS UNDER CONSIDERATION',REP←CR,'⎕:',LF,
      3ρ' '
[2]   I←1 INC 'REQUIRED INVESTMENT IN YEAR ZERO'
[3]   I←I,Pρ(1,P) INC 'REQUIRED INVESTMENT IN SUBSEQUENT YEARS (SINGLE AMO
      UNT IF LEVEL ANNUITY)'
[4]   E←0,Pρ(1,P) INC 'EBDT FOR EACH YEAR (SINGLE AMOUNT IF LEVEL ANNUITY)
      '
[5]  DQ:→ER×⍳(IT←+/I)<C←1 INC 'DEPRECIABLE AMOUNT'
[6]   L←1↑IPI 'DEPRECIATION LIFE',REP
[7]   DP←((P+1),3)↑(DPR IT,(IT-C),L)[; 5 6 7]
[8]   TR←0.01×1 INC 'ORDINARY INCOME TAX RATE (AS A PERCENT)'
[9]   CR←0.01×1 INC 'CAPITAL GAINS TAX RATE (AS A PERCENT)'
[10]  R←0.01×1 INC 'COST OF CAPITAL (AS A PERCENT)'
[11]  GP←1 INC 'GAIN (LOSS) ON PURCHASE'
[12]  GL←GP,((P-1)ρ0),(GS←1 INC 'TERMINAL SALE OR TRADE-IN VALUE')-DP[P+1;
      3]
[13]  CAT←DP[;1]+EAT←EBT-T←TR×EBT←E-DP[;1]
[14]  CT←CAT+GAT←GL-GT←GL×CR
[15]  PV←+/(NC←CT-I)÷(1+R)*0,⍳P
[16]  (3ρCR),(42ρ' '),'ANALYSIS OF CAPITAL INVESTMENT',(30ρBS),30ρ'_'
[17]  (2ρCR),' PERIOD          EBT           DEPR              EBT
        TAX          EAT             DEPR          OPR CAT',CR
[18]  'I6,7M⍞(⍞N⍞)⍞Q⍞ ⍞I15' ΔFMT((⍳P+1)-1;E;DP[;1];EBT;T;EAT;DP[;1];CAT)
[19]  (6ρ' '),(105ρ(5ρ' '),10ρ'_'),CR,'TOTALS',,'7M⍞(⍞N⍞)⍞Q⍞ ⍞I15' ΔFMT(+/
      E;+/DP[;1];+/EBT;+/T;+/EAT;+/DP[;1];+/CAT)
[20]  3ρCR
[21]  '   PERIOD      OPR CAT        GAIN B.T.          TAX       GAIN A.T.
               CAT            COST              NET',CR
[22]  'I6,7M⍞(⍞N⍞)⍞Q⍞ ⍞I15' ΔFMT((⍳P+1)-1;CAT;GL;GT;GAT;CT;I;CT-I)
[23]  (6ρ' '),(105ρ(5ρ' '),10ρ'_'),CR,'TOTALS',,'7M⍞(⍞N⍞)⍞Q⍞ ⍞I15' ΔFMT(+/
      CAT;+/GL;+/GT;+/GAT;+/CT;+/I;+/CT-I)
[24]  CR,'PRESENT VALUE IS ';2 RND PV
[25]  'NET PRESENT VALUE IS ';2 RND NP←PV-IT
[26]  'PROFITABILITY INDEX IS ';2 RND NP÷IT
[27]  'OPERATING YIELD IS ';2 RND 100×(P YLD CAT,[0.5] I)-1;' PERCENT'
[28]  'AFTER TAX YIELD IS ';2 RND 100×(P YLD CT,[0.5] I)-1;' PERCENT'
[29]  →0
[30] ER:'DEPRECIABLE AMOUNT CANNOT EXCEED TOTAL INVESTMENT'
[31]  →DQ
  ∇
```

C. BUDGET2

```
      ∇BUDGET2[⎕]∇
    ∇ BUDGET2;N;P;I;M;Y;C;PI;PV;NP;G;GM;G1;A;B;M1;SM;PB;F;REP;CB
[1]    →ER3×⍳1≥N←1↑IPI 'NUMBER OF INVESTMENT ALTERNATIVES',REP←CR,'⎕:',LF,
       3⍴' '
[2]    P←1+1↑IPI 'NUMBER OF PERIODS (MAXIMUM)',REP
[3]    M←((N+1),P)⍴GM←C←PB←PV←Y←N⍴SM←0
[4]    CB←(N,P)⍴G←I←F←1
[5]   RE:I←I+1
[6]    'INVESTMENT REQUIRED FOR ALTERNATIVE ';I-1
[7]    M[I;1]←INP 1
[8]   E1:→ER1×⍳P≤GM[I-1]←(A←1+1↑IPI 'LIFE OF INVESTMENT (PERIODS)',REP)-1
[9]    'RETURNS FOR ALTERNATIVE ';I-1;' (ENTER SINGLE AMOUNT IF LEVEL ANNUI
       TY)'
[10]   F←F×(⍴M[I;A])=+/M[I;A]=1↑M[I;1+⍳P-1]←(P-1)↑(A-1)⍴INP 1,A-1
[11]   C[I-1]←1+0.01×1 INC 'OPPORTUNITY COST OF CAPITAL (AS A PERCENT)'
[12]   Y[I-1]←(P-1) YLD(0,M[I;1+⍳P-1]),[0.5] M[I;1],(P-1)⍴0
[13]  NEXT:→RE×⍳I<N+1
[14]   M← 1 0 ↓M
[15]   →N2×⍳=/GM
[16]   →Q1×⍳F
[17]   PV←(+/(0 1 ↓M)÷C∘.*⍳P-1)÷1-C*-GM
[18]   'UNEQUAL LIVES WILL BE SCALED BY CALCULATING PV OF THE BENEFITS'
[19]   'AND PROJECTING PERPETUITIES.'
[20]   →N3
[21]  Q1:'SCALE UNEQUAL LIVES USING LOWEST COMMON MULTIPLE OR PERPETUITY?'
[22]   →Q1×⍳1≠+/'LP'=SM←1↑⍞
[23]   →N2×⍳SM='P'
[24]  R1:→N1×⍳1=G1←GCV GM÷G
[25]   G←G×G1
[26]   →R1
[27]  N1:G←(×/GM)÷G
[28]   M1←(N,G)⍴0
[29]   I←1
[30]  R2:M1[I;]←G⍴M[I;1+⍳GM[I]]
[31]   →R2×⍳(I←I+1)≤N
[32]   PV←+/M1÷C∘.*⍳G
[33]   →N3
[34]  N2:PV←((+/(0 1 ↓M)÷C∘.*(⍳P-1))-M[;1])÷1-C*-GM
[35]  N3:PI←PV÷M[;1]
[36]   NP←PV-M[;1]
[37]   I←1
[38]  RE4:PB[I]←PBK M[I;]
[39]   →RE4×⍳N≥I←I+1
[40]   (3⍴CR),'ALTERNATIVE',(13⍴' '),(,'I15' ∆FMT⍳N),CR
[41]   (22⍴' '),'PERIOD'
[42]   (TTB[1 2 ;],[1]((P-2),20)⍴' '),'BCI6,20BCI15' ∆FMT((⍳P)-1;⍉M)
[43]   ((SM='P')∨F=0)/CR,'PERPETUITY',(16⍴' '),,'CF15.2' ∆FMT PV×C-1
[44]   CR,TTB[2+⍳5;],(5 6 ⍴' '),'CF15.2' ∆FMT PB,[1] PV,[1] NP,[1] PI,[
       0.5](Y-1)×100
[45]   →0
[46]  ER1:'INVESTMENT LIFE GREATER THAN STATED MAXIMUM'
[47]   →E1
[48]  ER3:'FOR SINGLE INVESTMENT USE <BUDGET1>'
    ∇
```

D. UTILITY

```
      ∇UTILITY[⎕]∇
    ∇ UTILITY;A;C;E;I;M;N;P;U;UF;Z
[1]    'ENTER POSSIBLE CASH FLOWS'
[2]    →ER1×⍳1≥⍴C←,⎕
[3]    UF←(⍴C) INC 'ENTER RESPECTIVE UTILITY MEASURES'
[4]    UF←UF[⍋C]
[5]    C←C[⍋C],[1.5] UF
[6]    →ER2×⍳(1↑⍴C)≠+/(⍳1↑⍴C)=⍋C[;2]
[7]   ALT:U←⍳0
[8]    'CASH RETURNS OF POSSIBLE ALTERNATIVES'
[9]    N←⍴A←,⎕
[10]   P←P÷+/P←,N INC 'RESPECTIVE PROBABILITIES OF RETURNS'
[11]   I←1
[12]  RE:U←U,A[I] INTP C
[13]   →RE×⍳N≥I←I+1
[14]   CR,'EXPECTED VALUE IS    ';2 RND E←+/P×A
[15]   'UTILITY MEASURE IS   ';M←+/P×U
[16]   'POINT OF INDIFFERENCE IS ';2 RND I←M INTP C[; 2 1]
[17]   'RISK DISCOUNT IS      ';2 RND E-I
[18]  Q:CR,'ANOTHER ALTERNATIVE SET? (YES OR NO)'
[19]   →(('N'=Z),('Y'=Z←1↑⍞),1)/0,ALT,Q
[20]  ER1:'MUST BE AT LEAST TWO ALTERNATIVES'
[21]   →1
[22]  ER2:'UTILITY FUNCTION INCONSISTENT'
[23]   →1
    ∇
```

```
      ∇INTP[⎕]∇
    ∇ IV←A INTP B;L;H
[1]    B←B[⍋B[;1];]
[2]    →0×⍳0=IV←(A≥B[1;1])×A≤1⍴ ¯1 1 ↑B
[3]    →0×⍳A= ¯1 1 ↑B+0×IV←1⍴ ¯1 ¯1 ↑B
[4]    IV←B[L;2]+(A-B[L;1])×(-/B[H,L;2])÷-/B[(H←L+1),L←+/A≥B[;1];1]
    ∇
```

12
Cost Accounting (COSTACCOUNT)

A. General Description

This series of programs can be applied to the solution of cost accounting problems.

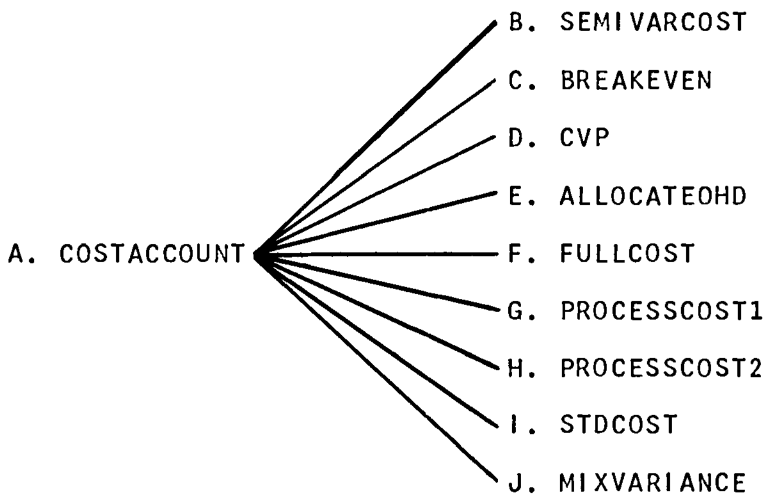
These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

To Access the COSTACCOUNT workspace use the following instruction:

```
)LOAD 7 COSTACCOUNT
```

The configuration of the COSTACCOUNT series is illustrated in Exhibit 12-1.

Exhibit 12-1
THE COSTACCOUNT WORKSPACE



As with other programs in this text, use is made of certain supporting functions and variables. Those used in the COSTACCOUNT series are:

Exhibit 12-2
COSTACCOUNT FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
SEMIVARCOST	-	-
BREAKEVEN	-	-
CVP	-	-
ALLOCATEOHD	-	-
FULLCOST	-	-
PROCESSCOST1	PCIN	-
PROCESSCOST2	PCOUT	TTP
STDCOST	INV	TTV
MIXVARIANCE	-	TTV

The functions and variables, as noted, are used to support the various programs and therefore have no direct output.

B. SEMIVARCOST

This program separates the variable and fixed components of semivariable accounts using the least squares formula:

$$\Sigma X_i Y_i = a\Sigma X_i + \Sigma b X_i^2$$

$$\Sigma Y_i = na + \Sigma b X_i$$

where:

X_i = activity data (independent variable)

Y_i = cost data (dependent variable)

n = number of periods (observations)

a = fixed costs (or intercept)

b = variable cost rate (or slope)

For regression problems involving more than one independent variable see Chapter 14 on statistical methods.

Input to SEMIVARCOST consists of entering "n" pairs of activity (X) and associated cost (Y) data; e.g., in the illustration, period one data are 700 and 750, representing activity and cost respectively.

The output is the intercept or level of fixed costs per period, and the slope is the variable cost rate expressed in dollars per unit of activity. In the illustration, fixed costs are $247.94 per period and the variable cost rate is $0.752 per unit of activity. The program also furnishes the standard error of the estimate and variance of the expression $(a + X_i b) - Y_i$. In this example, the standard error of the estimate is 21.86 and the variance 477.95. A smaller variance, comparatively, indicates a closer fit between the regression function and the data it represents.

C. BREAKEVEN

Given fixed costs, unit variable cost, unit selling price, and total actual sales (volume x unit selling price), program output consists of breakeven volume (in units), the margin of safety in dollars, and the margin of safety ratio, utilizing the equation:

$$M_s = \frac{(S_a - S_b)}{S_a}$$

where:

M_s = margin of safety ratio

S_a = actual sales

S_b = break-even sales

D. CVP (Cost-Volume-Profit)

This program produces pro forma marginal income statements of the form:

$$\begin{array}{ll} & \text{Sales} \\ - & \underline{\text{Variable Cost}} \\ = & \text{Marginal Income} \\ - & \underline{\text{Fixed Costs}} \\ = & \underline{\underline{\text{Profit}}} \end{array}$$

The CVP program operates on five variables, any four of which can be specified as independent (input), and the remaining one as the dependent variable. The five variables are:

1. Volume (number of units sold).

2. Unit selling price.

3. Unit variable cost.

4. Fixed costs (as a specified amount).

5. Profit (a specified amount of percentage of sales).

E. ALLOCATEOHD

This program is used to allocate overhead among a specified number of cost centers. Six alternative allocation methods can be accommodated:

1. Direct material cost.

2. Direct labor cost.

3. Prime cost (direct material + direct labor).

4. Direct labor hours.

5. Sales.

6. Contribution to margin.

Input consists of specifying sales, direct costs, and labor hours for each cost center. Total overhead is the remaining input factor. The program allocates overhead per method selected and prepares pro forma income statements.

A change in the method of allocation can be effected without re-entering the input data. Finally, the program prepares a summary based on profit ratios for each of the methods previously selected.

F. FULLCOST

The FULLCOST program allocates a specified number of service departments to a specified number of producing departments, given bases of allocation for each service department.

Input to the program consists of specifying the number of producing and service departments, the direct cost of each, and the basis of allocation for each service department.

Output consists of the allocation schedule and full costs for each department. The program can also be used to compute the point of indifference with respect to a replacement decision affecting a service department. The point of indifference is achieved by specifying the residual costs for each service department, following the proposed replacement and subtracting the sum of these residuals from the aggregate direct cost of the service departments.

G. PROCESSCOST1

Input to this program consists of the following:

1. The number of stages in a given process, where the final stage is defined as finished goods, i.e., all items in the last stage are complete with respect to all components of cost.

2. Cost data for the current period, specified in terms of materials, labor, and overhead.

3. The engineering cost flows within the process, e.g., the cumulative percentages in which materials, labor, and overhead occur for each stage in the process. The last stage, as mentioned above, is defined as being 100% complete with respect to materials, labor, and overhead.

4. The number of units at each stage in the process at a given point in time, which is usually the closing date of an accounting period.

The program yields a detailed schedule of finished goods and work-in-process for the current period, and the costs required to complete the work-in-process in the ensuing period.

H. PROCESSCOST2

This program accommodates interperiod or departmental process costing. The distinction between interperiod and departmental process costing is that the former requires only beginning inventory data in addition to current costs, while the latter requires both beginning inventory in that department as well as items transferred from the previous department in the current period, in addition to current costs.

Inputs consists of a quantity schedule, which specifies:

1. Beginning units of work-in-process.

2. Units started in the current period.

3. Units from preceeding department (only in the case of department process costing).

4. Units "lost" in process.

5. Units transferred to the next department.

6. Units in ending work-in-process.

Additionally, the costs attached to beginning work-in-process and units received from a previous department are specified, as are current production costs in the form of materials, labor, and overhead.

The program outputs a comprehensive cost of production schedule for one period or department. Other periods and departments can be obtained through iteration. Interperiod and departmental illustrations are demonstrated in the text.

I. STDCOST

The program can be used to compute materials, labor and overhead variances in conventional standard costing problems.

Input consists of:

1. The expected (normal capacity) production, (in units), followed by actual units produced. Subsequent standards are restated for actual production levels, i.e., flexible budgeting is employed.

2. Standard and actual materials per unit, which in the case of actual materials can be expressed as a ratio of actual materials divided by the actual number of units produced, i.e., 12000/9000.

3. Standard and actual fixed overhead.

4. Standard and actual variable overhead.

5. Standard and actual labor hours.

6. Standard and acutal labor rate per hour.

7. Standard unit cost of materials, followed by the computation of actual material costs where LIFO, FIFO, or AVERAGE inventory pricing is used.

8. Specification of basis for allocating overhead, e.g., on the basis of direct labor hours.

The program outputs a comprehensive schedule of standard costs on a flexible budget, actual costs, net variances, and subvariances, for each element of cost. Variances are tagged as being favorable or unfavorable.

J. MIXVARIANCE

This program computes price, mix and yield variances under product-mix conditions.

Inputs consist of:

1. The standard quantity and prices for each type of ingredient

in the mix.

2. Actual input and prices for each ingredient in the mix.

3. Standard and actual yield in units.

The output is the price, mix, yield, and net variances; and the designation of whether they are favorable or unfavorable.

K. Variables Used in the Cost Accounting Programs.

The variables which support the above programs are detailed in Exhibit 12-2. These variables can be created using the function, TITLE, and the following procedure:

```
      TTA←TITLE
NUMBER OF HEADINGS: 5
MAXIMUM NUMBER OF CHARACTERS IN ANY HEADING: 15
HEADING 1
SALES
HEADING 2
VARIABLE COSTS
HEADING 3
MARGINAL INCOME
HEADING 4
FIXED COSTS
HEADING 5
PROFIT
```

Note that where TTV and TTP are involved, that it is necessary to offset the entries by two and five spaces respectively. This is evident in the listing of these variables at the end of the chapter.

B. SEMIVARCOST

```
      SEMIVARCOST
ENTER ACTIVITY DATA FOLLOWED BY COST DATA FOR EACH OBSERVATION (PERIOD)
ZERO WILL SIGNAL END OF ENTRIES
⎕:
      700 750
⎕:
      800 840
⎕:
      900 930
⎕:
      1000 1015
⎕:
      1100 1090
⎕:
      1200 1170
⎕:
      1350 1205
⎕:
      1250 1200
⎕:
      1150 1130
⎕:
      950 970
⎕:
      850 900
⎕:
      750 800
⎕:
      0
FIXED COST IS $247.94
VARIABLE COST RATE IS $0.7520618557
STANDARD ERROR OF THE ESTIMATE Y=A+BX IS 21.8621403
VARIANCE IS 477.9531787
```

C. BREAKEVEN

```
      BREAKEVEN
FIXED COSTS
⎕:
      5000
VARIABLE COST PER UNIT
⎕:
      4.00
SALES PRICE PER UNIT
⎕:
      6.00
ACTUAL SALES (IN DOLLARS)
⎕:
      18000
BREAK EVEN SALES ARE 2500 UNITS
MARGIN OF SAFETY IS $3000
M-S RATIO IS 16.67 PERCENT
```

D. CVP

```
      CVP
ENTER THE FOLLOWING DATA FROM INITIAL MARGINAL INCOME STATEMENT
SALES
⎕:
      10000
VARIABLE COSTS
⎕:
      6000
FIXED COSTS
⎕:
      3000
SOLVE FOR VOLUME; SELLING PRICE; VARIABLE COST; FIXED COST; OR PROFIT?
V
PERCENT CHANGE IN UNIT SALES PRICE
⎕:
      10
PERCENT CHANGE IN UNIT VARIABLE COST
⎕:
      ¯5
CHANGE IN FIXED COST
⎕:
      1200
CHANGE IN PROFIT (ENTER ZERO IF PROFIT TO BE A PERCENTAGE OF NEW SALES)
⎕:
      0
PROFIT AS A PERCENTAGE OF NEW SALES
⎕:
      13


                         PRESENT  PCT          PROJECTED  PCT
SALES                      10000  100.0            11938  100.0
VARIABLE COSTS              6000   60.0             6186   51.8
MARGINAL INCOME             4000   40.0             5752   48.2
FIXED COSTS                 3000   30.0             4200   35.2
PROFIT                      1000   10.0             1552   13.0

NEW SALES VOLUME IS 108.53 PERCENT OF ORIGINAL SALES


ANOTHER CHANGE FROM SAME INITIAL DATA? (YES OR NO)
YES
```

```
SOLVE FOR VOLUME; SELLING PRICE; VARIABLE COST; FIXED COST; OR PROFIT?
S
PERCENT CHANGE IN VOLUME
⎕:
      ¯10
PERCENT CHANGE IN UNIT VARIABLE COST
⎕:
      5
CHANGE IN FIXED COST
⎕:
      ¯500
CHANGE IN PROFIT (ENTER ZERO IF PROFIT TO BE A PERCENTAGE OF NEW SALES)
⎕:
      705

                     PRESENT  PCT           PROJECTED  PCT
SALES                  10000  100.0             11365  100.0
VARIABLE COSTS          6000   60.0              7160   63.0
MARGINAL INCOME         4000   40.0              4205   37.0
FIXED COSTS             3000   30.0              2500   22.0
PROFIT                  1000   10.0              1705   15.0

NEW SALES VOLUME IS 90 PERCENT OF ORIGINAL SALES


ANOTHER CHANGE FROM SAME INITIAL DATA? (YES OR NO)
NO
```

E. ALLOCATEOHD

```
      ALLOCATEOHD
NUMBER OF COST CENTERS: 4
DIRECT MATERIALS COSTS FOR EACH COST CENTER
⎕:
      8000 12000 15000 20000
DIRECT LABOR COSTS FOR EACH COST CENTER
⎕:
      10000 15000 20000 30000
DIRECT LABOR HOURS FOR EACH COST CENTER
⎕:
      1000 2100 2500 3500
GROSS SALES FOR EACH COST CENTER
⎕:
      35000 42000 55000 75000
TOTAL OVERHEAD TO BE ALLOCATED
⎕:
      55000
METHOD OF OVERHEAD ALLOCATION? - DIRECT MATERIAL; DIRECT LABOR;
 PRIME COSTS; DIRECT LABOR HOURS; SALES; CONTRIBUTION TO MARGIN
L
```

COST_CENTER	1	2	3	4	TOTAL
SALES	35000	42000	55000	75000	207000
PRIME COSTS	18000	27000	35000	50000	130000
OVERHEAD	7333	11000	14667	22000	55000
TOTAL COSTS	(25333)	(38000)	(49667)	(72000)	(185000)
PROFIT	9667	4000	5333	3000	22000
PCT OF SALES	27.62	9.52	9.70	4.00	10.63

```
ANOTHER ALLOCATION METHOD? (ENTER METHOD OR 'NO')
H
```

COST_CENTER	1	2	3	4	TOTAL
SALES	35000	42000	55000	75000	207000
PRIME COSTS	18000	27000	35000	50000	130000
OVERHEAD	6044	12692	15110	21154	55000
TOTAL COSTS	(24044)	(39692)	(50110)	(71154)	(185000)
PROFIT	10956	2308	4890	3846	22000
PCT OF SALES	31.30	5.49	8.89	5.13	10.63

```
ANOTHER ALLOCATION METHOD? (ENTER METHOD OR 'NO')
C
```

COST_CENTER	1	2	3	4	*TOTAL*
SALES	35000	42000	55000	75000	207000
PRIME COSTS	18000	27000	35000	50000	130000
OVERHEAD	12143	10714	14286	17857	55000
TOTAL COSTS	(30143)	(37714)	(49286)	(67857)	(185000)
PROFIT	4857	4286	5714	7143	22000
PCT OF SALES	13.88	10.20	10.39	9.52	10.63

ANOTHER ALLOCATION METHOD? (ENTER METHOD OR 'NO')
S

COST_CENTER	1	2	3	4	*TOTAL*
SALES	35000	42000	55000	75000	207000
PRIME COSTS	18000	27000	35000	50000	130000
OVERHEAD	9300	11159	14614	19928	55000
TOTAL COSTS	(27300)	(38159)	(49614)	(69928)	(185000)
PROFIT	7700	3841	5386	5072	22000
PCT OF SALES	22.00	9.14	9.79	6.76	10.63

ANOTHER ALLOCATION METHOD? (ENTER METHOD OR 'NO')
NO
COMPARISON SUMMARY? (YES OR NO)
YES

PROFIT AS A PERCENT OF SALES

COST_CENTER	1	2	3	4	*TOTAL*
METHOD					
DIRECT LABOR COST	27.62	9.52	9.70	4.00	10.63
DIRECT LABOR HOURS	31.30	5.49	8.89	5.13	10.63
CONTRIBUTION TO MARGIN	13.88	10.20	10.39	9.52	10.63
SELLING PRICE	22.00	9.14	9.79	6.76	10.63

```
    FULLCOST
NUMBER OF PRODUCING CENTERS: 3
NUMBER OF SERVICE CENTERS: 3
DIRECT COSTS - PRODUCING CENTERS FOLLOWED BY SERVICE CENTERS
⎕:
      10000 8000 7000 5000 6000 9000
BASIS OF ALLOCATION TO ALL DEPARTMENTS (PRODUCING FIRST) FOR:
SERVICE DEPARTMENT 1
⎕:
      3000 2500 2050 2500 4000 4000
SERVICE DEPARTMENT 2
⎕:
      700 600 400 300 200 200
SERVICE DEPARTMENT 3
⎕:
      60 40 30 20 40
```

PRODUCING CENTER	1	2	3				TOTAL
SERVICE CENTER				1	2	3	
CENTER COST	10000	8000	7000	5000	6000	9000	45000
ALLOCATE S-1	1483	1236	1013	(7686)	1977	1977	
ALLOCATE S-2	3337	2861	1907	1430	(10489)	954	
ALLOCATE S-3	3768	2512	1884	1256	2512	(11931)	
PRODUCING CENTERS	18588	14608	11804				45000
SERVICE CENTERS				7686	10489	11931	30106

```
DO YOU WANT TO CONSIDER REPLACING A SERVICE DEPARTMENT? (YES OR NO)
YES
EXPECTED DIRECT COSTS IN EACH SERVICE DEPARTMENT AFTER CHANGE IS MADE
⎕:
      5000 10000 9000
POINT OF INDIFFERENCE IS $¯4000
ANOTHER REPLACEMENT CONSIDERATION? (YES OR NO)
YES
EXPECTED DIRECT COSTS IN EACH SERVICE DEPARTMENT AFTER CHANGE IS MADE
⎕:
      4000 1000 9000
POINT OF INDIFFERENCE IS $6000
ANOTHER REPLACEMENT CONSIDERATION? (YES OR NO)
NO
```

G. PROCESSCOST1

```
      PROCESSCOST1
ENTER THE NUMBER OF STAGES IN THE PROCESS
(THE LAST STAGE IS FINISHED INVENTORY): 5
ENTER THE FOLLOWING COST DATA FOR THIS PERIOD (DEPARTMENT)
MATERIALS, LABOR, OVERHEAD
⎕:
      7800 104000 30000
ENTER COST FLOWS FOR EACH PERIOD AS CUMULATIVE PERCENTAGES FOR:
MATERIALS
⎕:
      50 70 80 90 100
LABOR
⎕:
      20 30 40 70 100
OVERHEAD
⎕:
      20 40 60 80 100
ENTER NUMBER OF UNITS AT EACH STAGE AT THE END OF THE PERIOD

⎕:
      20 20 20 20 20
```

FINISHED GOODS

	UNITS FINISHED	COST PER FINISHED UNIT	TOTAL
MATERIALS	20	100	2000
LABOR	20	2000	40000
OVERHEAD	20	500	10000
TOTAL	20	2600	52000

WORK IN PROCESS

	EQUIVALENT UNITS	TOTAL COSTS	FINISHED GOODS	WORK-IN-PROCESS
MATERIALS	58	7800	2000	5800
LABOR	32	104000	40000	64000
OVERHEAD	40	30000	10000	20000
TOTAL		141800	52000	89800

PERCENTAGE COMPLETION BASED ON WORK-IN-PROCESS

MATERIALS	72.50
LABOR	40.00
OVERHEAD	50.00

```
ENTER UNIT COSTS TO COMPLETE WORK-IN-PROCESS (MATERIAL, LABOR, OVERHEAD)
⎕:
      1000 2000 500
```

	EQUIVALENT UNITS TO COMPLETE	COST PER FINISHED UNIT	TOTAL COST
MATERIALS	22	1000	22000
LABOR	48	2000	96000
OVERHEAD	40	500	20000
TOTAL		3500	138000

H. PROCESSCOST2

```
      PROCESSCOST2
ENTER THE FOLLOWING QUANTITY DATA:
BEGINNING W-I-P (UNITS)
⎕:
      0
UNITS STARTED
⎕:
      0
UNITS FROM PREVIOUS DEPARTMENT
⎕:
      8000
UNITS LOST
⎕:
      1000
UNITS TRANSFERRED TO NEXT DEPARTMENT
⎕:
      6000
ENTER UNITS FOLLOWED BY UNIT COST TRANSFERRED FROM PREVIOUS DEPARTMENT
⎕:
      8000 10.50
ENTER EQUIVALENT UNITS FOLLOWED BY UNIT COST FOR BEGINNING W-I-P:
FROM PRECEDING DEPARTMENT
⎕:
      0
PRESENT MATERIALS
⎕:
      0
PRESENT LABOR
⎕:
      0
PRESENT OVERHEAD
⎕:
      0
ENTER CURRENT PRODUCTION COSTS - MATERIALS, LABOR, OVERHEAD
⎕:
      34000 44800 39000
ENTER PERCENTAGE COMPLETION BASED ON W-I-P (MATERIAL, LABOR, OVERHEAD)
BEGINNING
⎕:
      0
ENDING
⎕:
      80 40 50
```

1. *QUANTITY SCHEDULE*

BEGINNING W-I-P		
UNITS STARTED		
UNITS/PREC. DEPT.		8,000
UNITS LOST	1,000	
UNITS TRANS./NEXT DEPT.	6,000	
ENDING W-I-P	1,000	
	8,000	8,000

	EQUIV. UNITS	*UNIT COST*	*TOTAL COST*
2. *INPUT FROM PRECEDING DEPARTMENT COSTS*			
COST/PREC. DEPT.	8,000	10.50	84,000
ADJ. FOR UNITS LOST	(1,000)	1.50	
ADJ. COST/PREC. DEPT.	7,000	12.00	84,000
3. *BEGINNING W-I-P*			
PRECEDING DEPT.			
PRESENT: MATERIALS			
LABOR			
OVERHEAD			
SUB-TOTAL			
4. *CURRENT PRODUCTION COSTS*			
MATERIALS	6,800	5.00	34,000
LABOR	6,400	7.00	44,800
OVERHEAD	6,500	6.00	39,000
SUB-TOTAL		18.00	117,800
TOTAL CUMULATIVE COSTS		30.00	201,800
5. *TRANSFERRED COST*			
TRANSFERRED/NEXT DEPT.:			
FINISH BEGINNING W-I-P			
UNITS STARTED AND FIN.	6,000	30.00	180,000
TOTAL	6,000	30.00	180,000
6. *ENDING W-I-P*			
PRECEDING DEPT.	1,000	12.00	12,000
PRESENT: MATERIALS	800	5.00	4,000
LABOR	400	7.00	2,800
OVERHEAD	500	6.00	3,000
TOTAL W-I-P			21,800
TOTAL			201,800

7. *PERCENTAGE COMPLETION (BASED ON WORK-IN-PROCESS)*	*MATERIAL*	*LABOR*	*OVERHEAD*
BEGINNING W-I-P	0.00	0.00	0.00
ENDING W-I-P	80.00	40.00	50.00

DO YOU WISH TO USE THIS DATA AS AN ITERATIVE BASIS? (YES OR NO)
YES

```
DEPARTMENT OR PERIOD ITERATION?
P
ENTER THE FOLLOWING QUANTITY DATA:
UNITS STARTED
⎕:
      0
UNITS FROM PREVIOUS DEPARTMENT
⎕:
      14000
UNITS LOST
⎕:
      1000
UNITS TRANSFERRED TO NEXT DEPARTMENT
⎕:
      12000
ENTER UNITS FOLLOWED BY UNIT COST TRANSFERRED FROM PREVIOUS DEPARTMENT
⎕:
      14000 10.98
ENTER CURRENT PRODUCTION COSTS - MATERIALS, LABOR, OVERHEAD
⎕:
      60480 94500 71250
ENTER PERCENTAGE COMPLETION BASED ON W-I-P (MATERIAL, LABOR, OVERHEAD)
ENDING
⎕:
      70 50 50
```

1. *QUANTITY SCHEDULE*

BEGINNING W-I-P		1,000
UNITS STARTED		
UNITS/PREC. DEPT.		14,000
UNITS LOST	1,000	
UNITS TRANS./NEXT DEPT.	12,000	
ENDING W-I-P	2,000	
	15,000	15,000

	EQUIV. UNITS	*UNIT COST*	*TOTAL COST*
2. *INPUT FROM PRECEDING DEPARTMENT COSTS*			
COST/PREC. DEPT.	14,000	10.98	153,720
ADJ. FOR UNITS LOST	(1,000)	0.84	
ADJ. COST/PREC. DEPT.	13,000	11.82	153,720
3. *BEGINNING W-I-P*			
PRECEDING DEPT.	1,000	12.00	12,000
PRESENT: MATERIALS	800	5.00	4,000
LABOR	400	7.00	2,800
OVERHEAD	500	6.00	3,000
SUB-TOTAL			21,800
4. *CURRENT PRODUCTION COSTS*			
MATERIALS	12,600	4.80	60,480
LABOR	12,600	7.50	94,500
OVERHEAD	12,500	5.70	71,250
SUB-TOTAL		18.00	226,230
TOTAL CUMULATIVE COSTS		29.82	401,750
5. *TRANSFERRED COST*			
TRANSFERRED/NEXT DEPT.:			
FINISH BEGINNING W-I-P	1,000	30.11	30,110
UNITS STARTED AND FIN.	11,000	29.82	328,071
TOTAL	12,000	29.85	358,181
6. *ENDING W-I-P*			
PRECEDING DEPT.	2,000	11.82	23,649
PRESENT: MATERIALS	1,400	4.80	6,720
LABOR	1,000	7.50	7,500
OVERHEAD	1,000	5.70	5,700
TOTAL W-I-P			43,569
TOTAL			401,750

7. *PERCENTAGE COMPLETION (BASED ON WORK-IN-PROCESS)*	*MATERIAL*	*LABOR*	*OVERHEAD*
BEGINNING W-I-P	80.00	40.00	50.00
ENDING W-I-P	70.00	50.00	50.00

```
DEPARTMENT OR PERIOD ITERATION?
D
ENTER THE FOLLOWING QUANTITY DATA:
BEGINNING W-I-P (UNITS)
⎕:
      1000
UNITS STARTED
⎕:
      0
UNITS LOST
⎕:
      1000
UNITS TRANSFERRED TO NEXT DEPARTMENT
⎕:
      10000
ENTER EQUIVALENT UNITS FOLLOWED BY UNIT COST FOR BEGINNING W-I-P:
FROM PRECEDING DEPARTMENT
⎕:
      1000 36.00
PRESENT MATERIALS
⎕:
      1000 4.00
PRESENT LABOR
⎕:
      500 6.00
PRESENT OVERHEAD
⎕:
      500 4.00
ENTER CURRENT PRODUCTION COSTS - MATERIALS, LABOR, OVERHEAD
⎕:
      48840 61800 42800
ENTER PERCENTAGE COMPLETION BASED ON W-I-P (MATERIAL, LABOR, OVERHEAD)
BEGINNING
⎕:
      100 50 50
ENDING
⎕:
      100 40 60
```

1. *QUANTITY SCHEDULE*			
BEGINNING W-I-P			1,000
UNITS STARTED			
UNITS/PREC. DEPT.			12,000
UNITS LOST	1,000		
UNITS TRANS./NEXT DEPT.	10,000		
ENDING W-I-P	2,000		
	13,000		13,000

	EQUIV. UNITS	*UNIT COST*	*TOTAL COST*
2. *INPUT FROM PRECEDING DEPARTMENT COSTS*			
COST/PREC. DEPT.	12,000	29.85	358,181
ADJ. FOR UNITS LOST	(1,000)	2.71	
ADJ. COST/PREC. DEPT.	11,000	32.56	358,181
3. *BEGINNING W-I-P*			
PRECEDING DEPT.	1,000	36.00	36,000
PRESENT: MATERIALS	1,000	4.00	4,000
LABOR	500	6.00	3,000
OVERHEAD	500	4.00	2,000
SUB-TOTAL			45,000
4. *CURRENT PRODUCTION COSTS*			
MATERIALS	11,000	4.44	48,840
LABOR	10,300	6.00	61,800
OVERHEAD	10,700	4.00	42,800
SUB-TOTAL		14.44	153,440
TOTAL CUMULATIVE COSTS		47.00	556,621
5. *TRANSFERRED COST*			
TRANSFERRED/NEXT DEPT.:			
FINISH BEGINNING W-I-P	1,000	50.00	50,000
UNITS STARTED AND FIN.	9,000	47.00	423,017
TOTAL	10,000	47.30	473,017
6. *ENDING W-I-P*			
PRECEDING DEPT.	2,000	32.56	65,124
PRESENT: MATERIALS	2,000	4.44	8,880
LABOR	800	6.00	4,800
OVERHEAD	1,200	4.00	4,800
TOTAL W-I-P			83,604
TOTAL			556,621

7. *PERCENTAGE COMPLETION (BASED ON WORK-IN-PROCESS)*	*MATERIAL*	*LABOR*	*OVERHEAD*
BEGINNING W-I-P	100.00	50.00	50.00
ENDING W-I-P	100.00	40.00	60.00

DO YOU WISH TO USE THIS DATA AS AN ITERATIVE BASIS? (YES OR NO)
NO

I. STDCOST

```
      STDCOST
ENTER THE FOLLOWING INFORMATION - STANDARD DATA FOLLOWED BY ACTUAL DATA
UNITS PRODUCED
⎕:
      10000 9000
UNITS OF MATERIAL PER UNIT OF OUTPUT
⎕:
      10 13.3333
FIXED OVERHEAD
⎕:
      80000 85000
VARIABLE OVERHEAD
⎕:
      600000 650000
LABOR HOURS
⎕:
      150000 145000
LABOR RATE
⎕:
      8.00 8.50
ENTER STANDARD UNIT MATERIAL COST
⎕:
      3.00
ENTER BEGINNING INVENTORY: UNIT PRICE FOLLOWED BY QUANTITY
ZERO SIGNALS END OF ENTRIES
⎕:
      3.00  20000
⎕:
      3.10  80000
⎕:
      3.20  40000
⎕:
      0
INVENTORY METHOD - LIFO, FIFO, OR AVERAGE
F
OVERHEAD ALLOCATED ON THE BASIS OF LABOR HOURS? (YES OR NO)
YES
```

COST ELEMENT	STANDARD AT ACTUAL VOLUME	ACTUAL COST	NET VARIANCE	SUB-VARIANCES TYPE	AMOUNT
MATERIALS	$270,000	$371,999	$101,999(*U*)	QUANTITY	$89,999(*U*)
				PRICE	$12,000(*U*)
LABOR	$1,080,000	$1,232,500	$152,500(*U*)	EFFICIENCY	$80,000(*U*)
				RATE	$72,500(*U*)
FIXED				BUDGET	$8,000(*U*)
OVERHEAD	$72,000	$85,000	$13,000(*U*)	EFFICIENCY	$2,667(*F*)
				CONTROLLABLE	$7,667(*U*)
VARIABLE				BUDGET	$0(*F*)
OVERHEAD	$540,000	$650,000	$110,000(*U*)	EFFICIENCY	$40,000(*U*)
				CONTROLLABLE	$70,000(*U*)
TOTAL				BUDGET	$8,000(*U*)
OVERHEAD	$612,000	$735,000	$123,000(*U*)	EFFICIENCY	$37,333(*U*)
				CONTROLLABLE	$77,667(*U*)
TOTAL COSTS	$1,962,000	$2,339,499	$377,499(*U*)		

J. MIXVARIANCE

```
      MIXVARIANCE
ENTER STANDARD INPUT QUANTITY FOLLOWED BY STANDARD COST PER UNIT
FOR EACH INPUT FACTOR. ZERO WILL SIGNAL END OF INPUT FACTORS.
⎕:
      50   .20
⎕:
      75   .40
⎕:
      75   .80
⎕:
      0    0
ENTER ACTUAL INPUT QUANTITY FOLLOWED BY ACTUAL COST PER UNIT
FOR EACH INPUT FACTOR.
⎕:
      100000   .27
⎕:
      120000   .35
⎕:
      140000   .76
ENTER STANDARD YIELD FOLLOWED BY ACTUAL YIELD (IN UNITS)
⎕:
      200   340000

PRICE VARIANCE IS $4600 FAVORABLE
MIX VARIANCE IS $0
YIELD VARIANCE IS $10000 UNFAVORABLE
NET VARIANCE IS $5400 UNFAVORABLE
```

B. SEMIVARCOST

```
      ∇SEMIVARCOST[⎕]∇
    ∇ SEMIVARCOST;M;A;X;V
[1]    M← 1 2 ρ0
[2]   RES:'ENTER ACTIVITY DATA FOLLOWED BY COST DATA FOR EACH OBSERVATION (
       PERIOD)'
[3]    'ZERO WILL SIGNAL END OF ENTRIES'
[4]   I:→(0=+/A←INP 1 2)/C
[5]    M←M,[1] A
[6]    →I
[7]   C:M← 1 0 ↓M
[8]    X←M[;2]⌹1,[1.5] M[;1]
[9]    'FIXED COST IS $';2 RND X[1]
[10]   'VARIABLE COST RATE IS $';X[2]
[11]   V←+/(((X[1]+M[;1]×X[2])-M[;2])*2)÷1↑ρM
[12]   'STANDARD ERROR OF THE ESTIMATE Y=A+BX IS ';V*
       0.5
[13]   'VARIANCE IS ';V
    ∇
```

C. BREAKEVEN

```
      ∇BREAKEVEN[⎕]∇
    ∇ BREAKEVEN;F;V;SP;BES;S;MS
[1]   RES:F←1 INC 'FIXED COSTS'
[2]    V←1 INC 'VARIABLE COST PER UNIT'
[3]    SP←1 INC 'SALES PRICE PER UNIT'
[4]    S←1 INC 'ACTUAL SALES (IN DOLLARS)'
[5]    'BREAK EVEN SALES ARE ';BES←0 RND F÷SP-V;' UNITS'
[6]    'MARGIN OF SAFETY IS $';MS←S-BES×SP
[7]    'M-S RATIO IS ';2 RND 100×MS÷S;' PERCENT'
    ∇
```

D. CVP

```
     ∇CVP[⎕]∇
    ∇ CVP;V;VC;MI;FC;P;P2;PP2;D;S2;VC2;F;F2;V2;M
[1]    R←1
[2]   RES:→(R=⍳2)/P1,Q
[3]   P1:'ENTER THE FOLLOWING DATA FROM INITIAL MARGINAL INCOME STATEMENT'
[4]    V←1 INC 'SALES'
[5]    MI←V-V×VC←(1 INC 'VARIABLE COSTS')÷V
[6]    P←MI-F←1 INC 'FIXED COSTS'
[7]    R←2
[8]   Q:'SOLVE FOR VOLUME; SELLING PRICE; VARIABLE COST; FIXED COST; OR PRO
       FIT?'
[9]    S2←P2←PP2←0
[10]   →(1≠+/'VSCFP'=D←1↑⍞)/Q
[11]   →N1×⍳D='V'
[12]   V2←V×(1+(1 INC 'PERCENT CHANGE IN VOLUME')÷100)
[13]  N1:→N2×⍳D='S'
[14]   S2←1+(1 INC 'PERCENT CHANGE IN UNIT SALES PRICE')÷100
[15]  N2:→N3×⍳D='C'
[16]   VC2←(VC×1+(1 INC 'PERCENT CHANGE IN UNIT VARIABLE COST')÷100)÷1+(D≠'
       S')×S2-1
[17]  N3:→N4×⍳D='F'
[18]   F2←F+1 INC 'CHANGE IN FIXED COST'
[19]  N4:→N5×⍳D='P'
[20]   'CHANGE IN PROFIT (ENTER ZERO IF PROFIT TO BE A PERCENTAGE OF NEW SA
       LES)'
[21]   →(P≠P+P2←INP 1)/N5
[22]   PP2←0.01×1 INC 'PROFIT AS A PERCENTAGE OF NEW SALES'
[23]  N5:→(D='VSCFP')/C1,C2,C3,C4,C5
[24]  C1:V2←(F2+P2)÷S2×1-VC2+PP2
[25]   →OUT
[26]  C2:S2←((P2+F2+P×PP2=0)÷1-VC2+PP2)÷V2
[27]   →OUT
[28]  C3:VC2←((S2×V2)-F2+P+P2+V2×PP2)÷V2
[29]   →OUT
[30]  C4:F2←(V2×S2-VC2)-P+P2+V2×PP2
[31]   →OUT
[32]  C5:P2←(V2×(S2-VC2))-F2
[33]  OUT:(2⍴CR),(21⍴' '),'PRESENT  PCT        PROJECTED  PCT'
[34]   S2←V2×S2
[35]   M← 5 2 ⍴V,S2,(V×VC),(S2×VC2),MI,(S2×1-VC2),F,F2,P,(S2×1-VC2)-F2
[36]   TTA,'I12,F7.1,I15,F7.1' ΔFMT(M[;1];(100×M[;1]÷M[1;1]);M[;2];(
       100×M[;2]÷M[1;2]))
[37]   CR,'NEW SALES VOLUME IS ';2 RND 100×V2÷V;' PERCENT OF ORIGINAL SALES
       ',2⍴CR
[38]  Q1:'ANOTHER CHANGE FROM SAME INITIAL DATA? (YES OR NO)'
[39]   →('YN'=1↑⍞)/Q,0
[40]   →Q1
    ∇
```

E. ALLOCATEOHD

```
      ∇ALLOCATEOHD[⎕]∇
    ∇ ALLOCATEOHD;N;DM;DL;DH;S;M;P;AO;OM;B;O;TC;PP;PS;I;SI;T;FC;CO
[1]   FC←'M⍞(⍞N⍞)⍞Q⍞ ⍞'
[2]   I←0,SI←PS←T←⍳0
[3]   N←1↑IPI 'NUMBER OF COST CENTERS:'
[4]   DM←N INC 'DIRECT MATERIALS COSTS FOR EACH COST CENTER'
[5]   P←DM+DL←N INC 'DIRECT LABOR COSTS FOR EACH COST CENTER'
[6]   DH←N INC 'DIRECT LABOR HOURS FOR EACH COST CENTER'
[7]   S←N INC 'GROSS SALES FOR EACH COST CENTER'
[8]   O←1 INC 'TOTAL OVERHEAD TO BE ALLOCATED'
[9]  RES:'METHOD OF OVERHEAD ALLOCATION? - DIRECT MATERIAL; DIRECT LABOR;'
[10]  ' PRIME COSTS; DIRECT LABOR HOURS; SALES; CONTRIBUTION TO MARGIN'[
      11⎕]
[11]  M←1↑⍞
[12] RQ:→(1≠+/'MLPHSC'=M)/RES
[13]  B←O÷(M='MLPHSC')/(+/DM),(+/DL),(+/P),(+/DH),(+/S),+/S-P
[14]  AO←,B×(M='MLPHSC')⌿DM,[1] DL,[1] P,[1] DH,[1] S,[
      0.5] S-P
[15]  TC←P+AO
[16]  OM←(⍳N),[1] S,[1] P,[1] AO,[1](-TC),[0.5](S-TC)
[17]  CO←((FC,'I12') ΔFMT OM),[1],('B',FC,'F12.2') ΔFMT PP←(100×(S-TC)÷S)
[18]  2ρCR
[19]  TTO,CO,'        TOTAL ',[1](('B',FC,'I12') ΔFMT(1↓+/OM)),[1](FC,'F12.2
      ') ΔFMT 100×(+/S-TC)÷+/S
[20]  PS←PS,PP,100×(+/S-TC)÷+/S
[21]  T←T,M
[22]  2ρCR
[23] Q1:'ANOTHER ALLOCATION METHOD? (ENTER METHOD OR ''NO'')'
[24]  →('NMLPHSC'=M←1↑⍞)/Q2,6ρRQ
[25]  →RES
[26] Q2:'COMPARISON SUMMARY? (YES OR NO)'
[27]  →('YN'=1↑⍞)/OS,0
[28]  →Q2
[29] OS:PS←((ρT),N+1)ρPS
[30] RE:I←I+1
[31]  SI←SI,'MLPHSC'⍳T[I]
[32]  →(I<ρT)/RE
[33]  (2ρCR),(20ρ' '),'PROFIT AS A PERCENT OF SALES',2ρCR
[34]  'COST_CENTER           ',(,'I10' ΔFMT(⍳N)),'     TOTAL'
[35]  CR
[36]  '  METHOD'
[37]  TTS[SI;],'F10.2' ΔFMT PS
    ∇
```

F. FULLCOST

```
      ∇FULLCOST[⎕]∇
    ∇ FULLCOST;NP;NS;N;DC;B;I;FSC;OM;AC;PC;RSC;T;OUT
[1]  RES:NP←1↑IPI 'NUMBER OF PRODUCING CENTERS:'
[2]   N←NP+NS←1↑IPI 'NUMBER OF SERVICE CENTERS:'
[3]   DC←N INC 'DIRECT COSTS - PRODUCING CENTERS FOLLOWED BY SERVICE CENTE
      RS'
[4]   B←(NS,N)ρI←0
[5]   'BASIS OF ALLOCATION TO ALL DEPARTMENTS (PRODUCING FIRST) FOR:'
[6]  RE:I←I+1
[7]   'SERVICE DEPARTMENT ';I
[8]   B[I;]←INP N
[9]   B[I;]←B[I;]÷(+/B[I;])-B[I;NP+I]
[10]  B[I;NP+I]←¯1
[11]  →(I<NS)/RE
[12]  FSC←-(NP↓DC)⌹⍉(0,NP)↓B
[13]  AC←B×FSC∘.×Nρ1
[14]  PC←+⌿DC,[1] AC
[15]  OM← 2 1 ρ(+/PC),+/FSC
[16]  OM←(DC,[1] AC,[1] PC,[0.5](NPρ0),FSC),(+/DC),[1]((NS,1)ρ0),[1] OM
[17]  OM←((ιNP),(NS+1)ρ0),[1]((NPρ0),(ιNS),0),[1] OM
[18]  T←((3ρ1),(NSρ1),((11-NS)ρ0),2ρ1)⌿TTC
[19]  ''
[20]  ''
[21]  OUT←T,'BM⍞(⍞N⍞)⍞Q⍞ ⍞I10' ΔFMT OM
[22]  OUT[1;(1↓ρOUT)-5-ι5]←'TOTAL'
[23]  OUT
[24]  ''
[25]  ''
[26] Q:'DO YOU WANT TO CONSIDER REPLACING A SERVICE DEPARTMENT? (YES OR NO
      )'
[27] QT:→('YN'=1↑⍞)/RP,0
[28]  →Q
[29] RP:RSC←NS INC 'EXPECTED DIRECT COSTS IN EACH SERVICE DEPARTMENT AFTER
        CHANGE IS MADE'
[30]  'POINT OF INDIFFERENCE IS $';0 RND(+/DC[NP+ιNS])-+/RSC
[31] Q1:'ANOTHER REPLACEMENT CONSIDERATION? (YES OR NO)'
[32]  →QT
    ∇
```

G. PROCESSCOST1

```
      ∇PROCESSCOST1[⎕]∇
    ∇ PROCESSCOST1;N;F;C;B;T;CPU;EU;FT;CU;C2
      R←1
     RES:→(R=⍳2)/P1,P2
     P1:PCIN
      R←2
     P2:FT←B[N]×CPU←C÷EU←+/F×(3,N)⍴B←N INC 'ENTER NUMBER OF UNITS AT EACH
      STAGE AT THE END OF THE PERIOD'
      (2⍴CR),'FINISHED GOODS'
      (20⍴' '),'UNITS            COST PER'
      (18⍴' '),'FINISHED         FINISHED UNIT      TOTAL'
      T,'I16' ΔFMT(4⍴B[N];CPU,+/CPU;FT←FT,+/FT)
      CR,'WORK IN PROCESS'
      (18⍴' '),'EQUIVALENT         TOTAL            FINISHED          WORK-IN-'
      (20⍴' '),'UNITS            COSTS            GOODS             PROCESS'
      T,'I16' ΔFMT(EU-B[N];C;FT;(C←C,+/C)-FT)
      (2⍴CR),'PERCENTAGE COMPLETION BASED ON WORK-IN-PROCESS'
      T[⍳3;],'F8.2' ΔFMT 100×(EU-B[N])÷+/B[⍳N-1]
      CR,'ENTER UNIT COSTS TO COMPLETE WORK-IN-PROCESS (MATERIAL, LABOR, O
      VERHEAD)'
      C2←INP 3
      (2⍴CR),(17⍴' '),'EQUIVALENT UNITS    COST PER          TOTAL'
      (18⍴' '),'TO COMPLETE       FINISHED UNIT      COST'
      T,'BI16' ΔFMT(CU;C2,+/C2;(CU×C2),+/C2×CU←(+/B)-EU)
    ∇
```

```
      ∇PCIN[⎕]∇
    ∇ PCIN;I
      T← 4 9 ⍴'MATERIALSLABOR    OVERHEAD TOTAL     '
      'ENTER THE NUMBER OF STAGES IN THE PROCESS'
      F←(3,N←1↑IPI '(THE LAST STAGE IS FINISHED INVENTORY):')⍴0
      'ENTER THE FOLLOWING COST DATA FOR THIS PERIOD (DEPARTMENT)'
      C←3 INC 'MATERIALS, LABOR, OVERHEAD'
      'ENTER COST FLOWS FOR EACH PERIOD AS CUMULATIVE PERCENTAGES FOR:'
      I←1
     F1:(I= 1 2 3 4)⌿T
      F[I;]←0.01×INP N
      →(F[I;N]=1)/F2
      'MUST BE CUMULATIVE PERCENTAGES WITH LAST ENTRY = 100'
      →F1
     F2:→(0=+/(⍋F[I;])≠⍳N)/F3
      'MUST BE CUMULATIVE PERCENTAGES!'
      →F1
     F3:I←I+1
      →(I≤3)/F1
    ∇
```

H. PROCESSCOST2

```
      ∇PROCESSCOST2[⎕]∇
    ∇ PROCESSCOST2;D;P;Q;I;T;B;C;E;PC;Z;REP
[1]    R←1
[2]    E← 6 3 ρC←B← 5 3 ρT←I← 3 3 ρPC← 2 3 ρQ←7ρD←P←0
[3]   RES:→(R=ι3)/AGAIN,P1,P2
[4]   AGAIN:'ENTER THE FOLLOWING QUANTITY DATA:'
[5]    →S1×ιP
[6]    Q[1]←1 INC 'BEGINNING W-I-P (UNITS)'
[7]   S1:Q[2]←1 INC 'UNITS STARTED'
[8]    →S2×ιD
[9]    Q[3]←1 INC 'UNITS FROM PREVIOUS DEPARTMENT'
[10]  S2:Q[4]←1 INC 'UNITS LOST'
[11]   Q[5]←1 INC 'UNITS TRANSFERRED TO NEXT DEPARTMENT'
[12]   Q[6]←(Q[7]←+/Q[ι3])-+/Q[4 5]
[13]   →S3×ιD
[14]   I[3;3]←I[1;3]←×/I[1; 1 2]←2ρ 1 2 INC 'ENTER UNITS FOLLOWED BY UNIT C
       OST TRANSFERRED FROM PREVIOUS DEPARTMENT'
[15]  S3:→S4×ιP
[16]   'ENTER EQUIVALENT UNITS FOLLOWED BY UNIT COST FOR BEGINNING W-I-P:'
[17]   B[1; 1 2]←2ρ 1 2 INC 'FROM PRECEDING DEPARTMENT'
[18]   B[2; 1 2]←2ρ 1 2 INC 'PRESENT MATERIALS'
[19]   B[3; 1 2]←2ρ 1 2 INC 'PRESENT LABOR'
[20]   B[4; 1 2]←2ρ 1 2 INC 'PRESENT OVERHEAD'
[21]   B[;3]←×/B[;ι2]
[22]   B[5;3]←+⌿B[;3]
[23]  S4:C[5;3]←B[5;3]+C[4;3]←+/C[ι3;3]←3 INC 'ENTER CURRENT PRODUCTION COS
       TS - MATERIALS, LABOR, OVERHEAD'
[24]   'ENTER PERCENTAGE COMPLETION BASED ON W-I-P (MATERIAL, LABOR, OVERHE
       AD)'
[25]   →S5×ιP
[26]   PC[1;]←0.01×3ρ 1 3 INC 'BEGINNING'
[27]  S5:PC[2;]←0.01×3 INC 'ENDING'
[28]   R←2
[29]  P1:C[ι3;2]←C[ι3;3]÷C[ι3;1]←Q[5]+-⌿PC[2 1 ;]×⍉ 3 2 ρQ[6 1]
[30]   C[4; 2 3]←+⌿C[ι3; 2 3]
[31]   I[2;2]←(E[1;2]←I[3;2]←Z×I[3;3]÷I[3;1]←I[1;1]+I[2;1]←-Q[4]×Z←I[
       3;3]≠0)-I[1;2]
[32]   E[6;3]←1↓C[5; 2 3]←1↓+⌿I[3;ι3],[1] B[5;ι3],[0.5] C[4;ι3]
[33]   E[1+ι3;3]←(E[1+ι3;1]←PC[2;]×Q[6])×E[1+ι3;2]←C[ι3;2]
[34]   E[1;3]←E[1;2]×E[1;1]←0⌈(+/Q[1 3])-+/Q[4 5]
[35]   E[5;3]←+/E[ι4;3]
[36]   T[3;3]←C[5;3]-E[5;3]
[37]   T[3;2]←T[3;3]÷T[3;1]←Q[5]
[38]   T[1;2]←Z×(T[1;3]←(Z←Q[1]≠0)×T[3;3]-T[2;3]←(T[2;2]←C[5;2])×T[
       2;1]←T[3;1]-T[1;1])÷T[1;1]←Q[1]
[39]   3ρCR
[40]   R←3
[41]  P2:PCOUT
[42]   3ρCR
[43]  Q1:'DO YOU WISH TO USE THIS DATA AS AN ITERATIVE BASIS? (YES OR NO)'
```

```
[44]  →('YN'=1↑⍞)/SET,0
[45]  →Q1
[46] SET:'DEPARTMENT OR PERIOD ITERATION?'
[47]  →(1≠+/D←'DP'=1↑⍞)/SET
[48]  P←~D←1↑D
[49]  →S6×⍳P
[50]  I[3;3]←2↓I[1;]←T[3;]
[51]  Q[3]←Q[5]
[52] S6:→AGAIN×⍳D
[53]  B←E[⍳5;]
[54]  Q[1]←Q[6]
[55]  PC[1;]←PC[2;]
[56]  →AGAIN
    ∇
```

```
    ∇PCOUT[⎕]∇
    ∇ PCOUT;F
[1]   F←'BCN⍞)⍞M⍞(⍞Q⍞ ⍞I16,BF16.2'
[2]   '1. QUANTITY SCHEDULE'
[3]   (TTP[⍳6;],[1] 30ρ' '),'BCI20' ΔFMT((3ρ0),Q[3+⍳4];Q[⍳3],(3ρ0),Q[7])
[4]   (2ρCR),(38ρ' '),'EQUIV.                  UNIT            TOTAL'
[5]   (38ρ' '),'UNITS                COST              COST'
[6]   CR,'2. INPUT FROM PRECEDING'
[7]   '   DEPARTMENT COSTS'
[8]   TTP[6+⍳3;],F ΔFMT I
[9]   CR,'3. BEGINNING W-I-P'
[10]  TTP[9+⍳5;],F ΔFMT B
[11]  CR,'4. CURRENT PRODUCTION COSTS'
[12]  TTP[17 18 19 14 20 ;],F ΔFMT C
[13]  CR,'5. TRANSFERRED COST'
[14]  '   TRANSFERRED/NEXT DEPT.:'
[15]  TTP[21 22 16 ;],F ΔFMT T
[16]  CR,'6. ENDING W-I-P'
[17]  TTP[(9+⍳4), 15 16 ;],F ΔFMT E
[18]  (2ρCR),'7. PERCENTAGE COMPLETION                  MATERIAL              LAB
      OR         OVERHEAD'
[19]  '   (BASED ON WORK-IN-PROCESS)'
[20]  TTP[1 6 ;],'F16.2' ΔFMT 100×PC
    ∇
```

I. STDCOST

```
      ∇STDCOST[⎕]∇
    ∇ STDCOST;A;U;M;FO;VO;H;R;I;MT;OR;P;VQ;VP;NM;VE;VR;NL;O;OB;SV;NV;SA;B
[1]    O← 9 3 ρ0,I←ι0
[2]    B← 1 1
[3]    'ENTER THE FOLLOWING INFORMATION - STANDARD DATA FOLLOWED BY ACTUAL
       DATA'
[4]    U←2 INC 'UNITS PRODUCED'
[5]    M←2 INC 'UNITS OF MATERIAL PER UNIT OF OUTPUT'
[6]    FO←2 INC 'FIXED OVERHEAD'
[7]    VO←2 INC 'VARIABLE OVERHEAD'
[8]    H←2 INC 'LABOR HOURS'
[9]    R←2 INC 'LABOR RATE'
[10]   P←1 INC 'ENTER STANDARD UNIT MATERIAL COST'
[11]   'ENTER BEGINNING INVENTORY: UNIT PRICE FOLLOWED BY QUANTITY'
[12]   'ZERO SIGNALS END OF ENTRIES'
[13]  BI:→(0=+/A←2↑⎕)/IM
[14]   I←I,A
[15]   →BI
[16]  IM:I←((0.5×ρI),2)ρI
[17]  Q:'INVENTORY METHOD - LIFO, FIFO, OR AVERAGE'
[18]   →(0=+/MT←'LFA'=1↑⍞)/Q
[19]   MT←MT/ 1 0 ¯1
[20]  Q1:'OVERHEAD ALLOCATED ON THE BASIS OF LABOR HOURS? (YES OR NO)'
[21]   →(0=+/OB←'YN'=1↑⍞)/Q1
[22]   →(OB[1]=1)/OL
[23]  Q2:'ENTER STANDARD BASIS FOLLOWED BY ACTUAL BASIS'
[24]   →(∨/0=B←2↑⎕)/Q2
[25]  OL:OR←(FO[1],VO[1])÷OB/H[1],B[1]
[26]   →(0=ρρA←INV(MT,M[2]×U[2]),[1] I)/SO
[27]   P←P,A[1;2]÷M[2]×U[2]
[28]   OB←,OB⌿H,[0.5] B
[29]   VQ←P[1]×(M[1]×U[1]×÷/U[2 1])-M[2]×U[2]
[30]   NM←VQ+VP←(U[2]×M[2])×-/P
[31]   VE←R[1]×(U[2]×H[1]÷U[1])-H[2]
[32]   NL←VE+VR←H[2]×-/R
[33]   O[1; 1 2]←(OB[1]×÷/U[2 1])×OR
[34]   O[2; 1 2]←FO[1],OB[1]×OR[2]×÷/U[2 1]
[35]   O[3; 1 2]←OB[2]×OR
[36]   O[4; 1 2]←FO[2],VO[2]
[37]   O[ι4;3]←+/O[ι4; 1 2]
[38]   O[5;]←-⌿O[1 4 ;]
[39]   O[6;]←-⌿O[1 2 ;]
[40]   O[7;]←-⌿O[2 3 ;]
[41]   O[8;]←-⌿O[3 4 ;]
[42]   O[9;]←+⌿O[6 7 8 ;]
[43]   SV←VQ,VP,VE,VR,,⍉O[6 7 8 ;]
[44]   NV←NM,NL,,O[5;]
[45]   SA←(U[2]×M×P),[1](H×R×(÷/U[2 1]),1),[1]⍉O[1 4 ;]
```

```
[46]  NV←NV,+/NV[1 2 5]
[47]  SA←SA,[1]+⌿SA[1 2 5 ;]
[48]  SV←'CM⎕$⎕N⎕(U)⎕P⎕$⎕Q⎕(F)⎕I16' ΔFMT SV
[49]  NV←'CM⎕$⎕N⎕(U)⎕P⎕$⎕Q⎕(F)⎕I16' ΔFMT NV
[50]  SA←'CP⎕$⎕I16' ΔFMT SA
[51]  (3ρCR),'    COST        |   STANDARD AT  |     ACTUAL      |     NET
        |       SUB-VARIANCES'
[52]  '  ELEMENT     | ACTUAL  VOLUME |      COST       |   VARIANCE     |
      TYPE       |     AMOUNT'
[53]  CR,'MATERIALS    ',SA[1;],NV[1;],'  QUANTITY     ',SV[1;]
[54]  (62ρ' '),'PRICE          ',SV[2;]
[55]  CR,'LABOR              ',SA[2;],NV[2;],TTV[2;],SV[3;]
[56]  (62ρ' '),'RATE           ',SV[4;]
[57]  CR,'FIXED              ',(48ρ' '),TTV[1;],SV[5;]
[58]  (2↓TTV[4;]),SA[3;],NV[3;],TTV[2;],SV[6;]
[59]  (60ρ' '),TTV[3;],SV[7;]
[60]  CR,'VARIABLE       ',(48ρ' '),TTV[1;],SV[8;]
[61]  (2↓TTV[4;]),SA[4;],NV[4;],TTV[2;],SV[9;]
[62]  (60ρ' '),TTV[3;],SV[10;]
[63]  CR,'TOTAL              ',(48ρ' '),TTV[1;],SV[11;]
[64]  (2↓TTV[4;]),SA[5;],NV[5;],TTV[2;],SV[12;]
[65]  (60ρ' '),TTV[3;],SV[13;]
[66]  CR,'TOTAL              ',SA[6;],NV[6;]
[67]  'COSTS'
[68]  →0
[69] SO:'STATED INVENTORY IS INSUFFICIENT FOR STATED PRODUCTION'
[70]  →1
    ∇

      ∇INV[⎕]∇
    ∇ OM←INV IM;MQ;M;R;T1;C
[1]   C←0
[2]   MQ←, 1 2 ↑IM
[3]   IM← 1 0 ↓IM
[4]   →(MQ[2]>+/IM[;2])/SO
[5]   →(+/MQ[1]= 1 0)/L
[6]   IM← 1 2 ρ((+/×/IM)÷+/IM[;2]),(+/IM[;2])-MQ[2]
[7]   C←IM[1;1]×MQ[2]
[8]   →OUT
[9]  L:R←1+((1↑ρIM)-1)×MQ[1]
[10]  T1←IM[R;2]-MQ[2]
[11]  C←C+IM[R;1]×MQ[2]+T1×T1<0
[12]  IM[R;2]←T1
[13]  IM←(IM[;2]>0)⌿IM
[14]  →(T1≥0)/OUT
[15]  MQ[2]←-T1
[16]  →L
[17] SO:OM←0
[18]  →0
[19] SO:OM←¯1
[20]  →0
[21] OUT:OM←(1 2 ρMQ[1],C),[1] IM
    ∇
```

J. MIXVARIANCE

```
      ∇MIXVARIANCE[⎕]∇
    ∇ MIXVARIANCE;S;A;I;W;VP;VM;VY;C;VN;Y
[1]     I←0,S←⍳0
[2]     'ENTER STANDARD INPUT QUANTITY FOLLOWED BY STANDARD COST PER UNIT'
[3]     'FOR EACH INPUT FACTOR. ZERO WILL SIGNAL END OF INPUT FACTORS.'
[4]   RI:→(0=+/W←INP 2)/EI
[5]     S←S,W
[6]     →RI
[7]   EI:A←S←(((⍴S)÷2),2)⍴S
[8]     'ENTER ACTUAL INPUT QUANTITY FOLLOWED BY ACTUAL COST PER UNIT'
[9]     'FOR EACH INPUT FACTOR.'
[10]  AI:I←I+1
[11]    A[I;]←INP 2
[12]    →(I<1↑⍴S)/AI
[13]    'ENTER STANDARD YIELD FOLLOWED BY ACTUAL YIELD (IN UNITS)'
[14]    Y←INP 2
[15]    VP←+/A[;1]×S[;2]-A[;2]
[16]    A←A,×/A
[17]    S[;1]←S[;1]×C←(+/A[;1])÷+/S[;1]
[18]    S←S,×/S
[19]    Y[1]←C×Y[1]
[20]    VM←+/S[;2]×S[;1]-A[;1]
[21]    VN←VP+VM+VY←((+/S[;3])÷Y[1])×-/Y[2 1]
[22]    ''
[23]    'PRICE VARIANCE IS $';0 RND|VP;((VP<¯0.5)/' UNFAVORABLE'),(VP>
        0.5)/' FAVORABLE'
[24]    'MIX VARIANCE IS $';0 RND|VM;((VM<¯0.5)/' UNFAVORABLE'),(VM>
        0.5)/' FAVORABLE'
[25]    'YIELD VARIANCE IS $';0 RND|VY;((VY<¯0.5)/' UNFAVORABLE'),(VY>
        0.5)/' FAVORABLE'
[26]    'NET VARIANCE IS $';0 RND|VN;((VN<¯0.5)/' UNFAVORABLE'),(VN>
        0.5)/' FAVORABLE'
    ∇
```

VARIABLES USED IN COSTACCOUNT

TTA

SALES
VARIABLE COSTS
MARGINAL INCOME
FIXED COSTS
PROFIT

TTC

PRODUCING CENTER
SERVICE CENTER
CENTER COST
ALLOCATE S-1
ALLOCATE S-2
ALLOCATE S-3
ALLOCATE S-4
ALLOCATE S-5
ALLOCATE S-6
ALLOCATE S-7
ALLOCATE S-8
ALLOCATE S-9
ALLOCATE S-10
ALLOCATE S-11
PRODUCING CENTERS
SERVICE CENTERS

TTO

COST CENTER
SALES
PRIME COSTS
OVERHEAD
TOTAL COSTS
PROFIT
PCT OF SALES

TTP

BEGINNING W-I-P
UNITS STARTED
UNITS/PREC. DEPT.
UNITS LOST
UNITS TRANS./NEXT DEPT.
ENDING W-I-P
COST/PREC. DEPT.
ADJ. FOR UNITS LOST
ADJ. COST/PREC. DEPT.
PRECEDING DEPT.
PRESENT: MATERIALS
LABOR
OVERHEAD
SUB-TOTAL
TOTAL W-I-P
TOTAL
MATERIALS
LABOR
OVERHEAD
TOTAL CUMULATIVE COSTS
FINISH BEGINNING W-I-P
UNITS STARTED AND FIN.

TTS

DIRECT MATERIALS COST
DIRECT LABOR COST
PRIME COSTS
DIRECT LABOR HOURS
SELLING PRICE
CONTRIBUTION TO MARGIN

TTV

BUDGET
EFFICIENCY
CONTROLLABLE
OVERHEAD

NOTE: *THE FIRST FIVE COLUMNS OF TTP AND THE FIRST TWO COLUMNS OF TTV ARE BLANK!*

13
Forecasting (FORECAST)

A. General Description

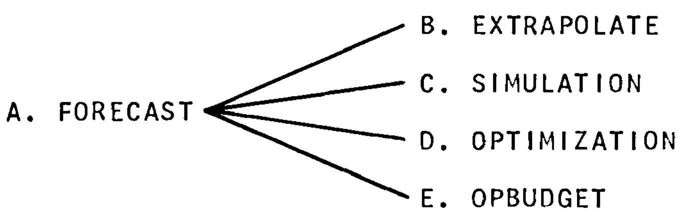
This workspace is concerned with certain aspects of technological forecasting and is referred to as FORECAST. The workspace can be accessed by the instruction:

```
)LOAD 7 FORECAST
```

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The major functions in the FORECAST workspace are displayed in Exhibit 13-1.

Exhibit 13-1
THE FORECAST WORKSPACE



The supporting functions and variables are classified in Exhibit 13-2.

Exhibit 13-2
FORECAST FUNCTIONS & VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
EXTRAPOLATE	MONBUD, YEARFORE, MIDPERAV, FOREC, WTDMOVAV, FORE, EXPSMOOTH	-
SIMULATION	SENSITY	-
OPTIMIZATION	OUTPUT, NOUTPUT	-
OPBUDGET	-	-

B. EXTRAPOLATE

This function can be used to extrapolate trend or time-series data.

Input consists of:

1. Specifying each existing period which forms the data base for the forecast. In the example which follows, the three periods 69, 70 and 71 are specified.

2. Enter the number of the months, where January = 1 and the sales for that month for each of the periods specified in #1 above. In the example, January 69 sales were 1.8, January 70 sales were 2.1 and January 71 sales were 2.

3. Repeat for the remaining months of the year, using numbers to represent the months, i.e., February = 2, March = 3, April = 4, and so forth.

At this point it is necessary to indicate the period for which the forecast(s) is (are) to be made from among these options:

1. Monthly.

2. Yearly.

3. Middle-period average.

It is also necessary to specify the extrapolation technique to be employed. The two methods which are available for this purpose are:

1. Moving average.

2. Exponential smoothing.

In the example a yearly forecast for the next period is input as a variable, in this case 28.6. Given this information the program outputs the forecast for each month in the future period and the index of seasonal variation.

The next illustration applies to a middle-period forecast; and in this case the output is the forecast for the month of October, both seasonalized and deseasonalized.

The illustration continues by showing how the moving average method applied to a series of historic data can furnish a forecast for the ensuing period. Provision is made for appropriate weighting in the moving average method. The weight may be applied only to the last observation (one place) or to the two most recent observations (multiple place).

The use of exponential smoothing as a tool of extrapolation is demonstrated in this example. Again it is necessary to weight the most recent observation -- in this case the last observation is given a weight of 30.

C. SIMULATION

This function applies probabilistic estimates to these financial parameters:

1. Market size.
2. Share of the market.
3. Selling price.
4. Variable cost per unit.
5. Fixed costs (as a lump sum)

There are six probability estimates for each of these parameters:

1. Most likely.
2. Pessismistic.
3. Lower quarter.
4. Middle.
5. Upper quarter.
6. Optimistic.

Input consists of:

1. The market size under each of the above conditions in the above order, followed by the probability estimates which are

attached to each of these states of the world.

2. The share of the market in the same order, followed by the probability estimates.

3. The selling price(s) and the probabilities which attach to each. (If only one selling price is expected, then obviously the probability is one.)

4. The variable cost per unit and their related probabilities.

5. The fixed costs and their related probabilities.

The data is summarized, and the program computes expected market size, market share, selling price, variable cost per unit, fixed costs and profit under the conditions specified.

Sensitivity analysis can then be applied to this data as illustrated in the example.

D. OPTIMIZATION

This function compares two investment alternatives under stochastic conditions.

Input consists of:

1. Specifying the cost of producing one item.

2. The selling price of the existing item.

3. The opportunity selling price of a new, replacement item.

4. Different levels of demand for the existing (old) item.

5. The related probabilities which attach to those demands.

6. Enter the number of items left over (which remain unsold).

7. Different levels of demand for the new item.

8. The probabilities associated with those demands.

9. The production capabilities, i.e., do we plan to produce 15, 16, 17, 18 or 19 units per period.

The program prepares a detailed schedule which supports expected profit for the existing product and the new one, where C.V. = conditional value and E.V. = expected value respectively.

By entering the revenue per unit, variable cost per unit, total fixed costs for the period, the expected number of units to be produced each period, and the probabilities which attach to those various levels of demand, the DOCT supporting function produces a schedule which results in an estimate of the expected daily profit under the specified conditions.

E. OPBUDGET

This function can be used to construct operating budgets which involve the aggregation of manufacturing costs. The example involves developing operating budgets for two products: frisbees and balls.

Input consists of:

1. The sales forecast and selling price of each product.

2. Materials inventory at the beginning and end of the period, as a percent of sales.

3. The work-in-process inventory as above.

4. The finished goods inventory as above.

5. Enter each type of material required in the manufacturing process, its price and quantity.

6. The same information with respect to labor and overhead.

The user may now select the object of analysis from among these options: (1) a sales budget; (2) a production quota; (3) materials usage; (4) materials purchases; (5) direct labor cost; (6) overhead; or (7) ending finished goods inventory.

B. EXTRAPOLATE

```
      EXTRAPOLATE

ENTER THE YEARS FOR WHICH YOU HAVE SALES DATA
⎕:
      69 70 71
ENTER THE MONTH AND DATA(IN MILLIONS) FOR THE 3 PERIODS
FORMAT: 1 2.3 4.5 3.4 INSTEAD JAN 2.3 4.5 3.4
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      1 1.8 2.1 2
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      2 1.6 2 1.8
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      3 2 2.1 1.9
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      4 2.2 2.3 2.1
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      5 2.5 2.5 2.4
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      6 2.5 2.6 2.7
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      7 2.8 2.7 2.9
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      8 2.7 2.5 2.7
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      9 2.2 2.1 2.2
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      10 2 1.8 2.2
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      11 2.4 2.5 2.4
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      12 2.8 2.7 2.7
ENTER THE DATA(TO END TYPE A ZERO)
⎕:
      0
DO YOU WANT TO SEE THE SUMMARY OF DATA?
YES
```

SEASONAL INDEXES AS RATIO-TO-SAME-YEAR-AVERAGE

MONTH	*ACTUAL MONTHLY SALES (IN MILLIONS)* 69	70	71	*ACTUAL MONTHLY SALES AS A °/° OF AVERAGE SALES FOR:* 69	70	71	*SEASONAL INDEX (AVERAGE °/°)*
1	1.80	2.10	2.00	0.79	0.90	0.86	0.85
2	1.60	2.00	1.80	0.70	0.86	0.77	0.78
3	2.00	2.10	1.90	0.87	0.90	0.81	0.86
4	2.20	2.30	2.10	0.96	0.99	0.90	0.95
5	2.50	2.50	2.40	1.09	1.08	1.03	1.06
6	2.50	2.60	2.70	1.09	1.12	1.16	1.12
7	2.80	2.70	2.90	1.22	1.16	1.24	1.21
8	2.70	2.50	2.70	1.18	1.08	1.16	1.14
9	2.20	2.10	2.20	0.96	0.90	0.94	0.94
10	2.00	1.80	2.20	0.87	0.77	0.94	0.86
11	2.40	2.50	2.40	1.05	1.08	1.03	1.05
12	2.80	2.70	2.70	1.22	1.16	1.16	1.18
	27.50	27.90	28.00	12.00	12.00	12.00	12.00

MONTHLY BUDGET, YEARLY FORECAST OR MIDDLE PER. AVERAGE
MOVING AVERAGE OR EXPONENTIAL SMOOTHING
ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN

YEARLY FORECAST
ENTER THE FORECAST OF YEARLY SALES
⎕:
      28.6

MONTH	AVERAGE MONTHLY SALES (BASED ON YEARLY SALES OF 28.6 MILLION)	INDEX OF SEASONAL VARIATION	MONTHLY FORECAST
JAN.	2.383	0.85	2.02
FEB.	2.383	0.78	1.85
MAR.	2.383	0.86	2.06
APR.	2.383	0.95	2.26
MAY	2.383	1.06	2.54
JUNE	2.383	1.12	2.67
JULY	2.383	1.21	2.88
AUG.	2.383	1.14	2.71
SEP.	2.383	0.94	2.23
OCT.	2.383	0.86	2.06
NOV.	2.383	1.05	2.50
DEC.	2.383	1.18	2.81
	28.600	12.00	28.60

```
DO YOU WANT TO TRY FOR OTHERS?
NO
ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN


MONTHLY
ENTER THE MONTH FOR WHICH YOU WANT THE FORECAST
USE 1 FOR JAN. 2 FOR FEB. ETC.,
⎕:
      10
HOW MANY MONTHS MOVING AVERAGE YOU ARE USING?
⎕:
      4
ENTER THE SALES FOR JUNE    JULY    AUG.     AND SEP.
⎕:
      2.9 3.1 2.8 2.3
```

	JUNE	JULY	AUG.	SEP.	FORECAST FOR OCT.
ACTUAL DATA(SEASONALIZED)	2.9	3.1	2.8	2.3	
	÷	÷	÷	÷	
SEASONAL INDEX	1.12	1.21	1.14	0.94	
	=	=	=	=	
DESEASONALIZED DATA	2.6	2.6	2.5	2.5	
DESEASONALIZED FORECAST					2.55
					×
SEASONAL INDEX					0.86
					=
SEASONALIZED FORECAST					2.2

DO YOU WANT FOR OTHER MONTHS?
NO
ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN

MOVING
ENTER THE PERIOD FOR WHICH YOU NEED FORECASTING (E.G., 1 FOR JAN. ETC.,)
⎕:
      1
ENTER THE PAST OBSERVATIONS TO BE USED
⎕:
      25 26 30 31 32 35 36 33.5 30.5 27 26.5 25.5
ENTER MOVING AVERAGE OR EXPONENTIAL SMOOTHING
MOVING

DO YOU WANT ONE PLACE OR MULTIPLE PLACE
ONE
WEIGHT TO BE ASSIGNED TO THE LAST OBSERVATION (AS A PERCENT)
⎕:
      50

FORECAST FOR THE MONTH JAN. IS 27.86

DO YOU WANT THE OTHER METHOD?
YES

```
DO YOU WANT ONE PLACE OR MULTIPLE PLACE
MUL
ENTER THE WEIGHTS FOR THE LAST PERIODS
⎕:
      25 25


FORECAST FOR THE MONTH JAN. IS 28.3


DO YOU WANT THE OTHER METHOD?
NO
ENTER MOVING AVERAGE OR EXPONENTIAL SMOOTHING


EXP
ENTER THE PERCENTAGE WEIGHTING TO CURRENT OBSERVATION
⎕:
      30
DO YOU WANT THE SUMMARY?
YES


PERIOD        FORECAST        ACTUAL
    1             25              25
    2             25              26
    3             25              30
    4             27              31
    5             28              32
    6             29              35
    7             31              36
    8             32              34
    9             33              31
   10             32              27
   11             31              27
   12             29              26
    1             28
ENTER MOVING AVERAGE OR EXPONENTIAL SMOOTHING

ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN
```

MIDDLE
ENTER THE NUMBER OF MONTHS TO BE USED
⎕:
13

YEAR	*MONTH*	*FORECAST*
69	*JULY*	2.031
69	*AUG.*	2.085
69	*SEP.*	2.108
69	*OCT.*	2.146
69	*NOV.*	2.223
69	*DEC.*	2.277
70	*JAN.*	2.354
70	*FEB.*	2.408
70	*MAR.*	2.469
70	*APR.*	2.531
70	*MAY*	2.554
70	*JUNE*	2.585
70	*JULY*	2.592
70	*AUG.*	2.562
70	*SEP.*	2.538
70	*OCT.*	2.508
70	*NOV.*	2.454
70	*DEC.*	2.423
71	*JAN.*	2.400
71	*FEB.*	2.377
71	*MAR.*	2.354
71	*APR.*	2.346
71	*MAY*	2.346
71	*JUNE*	2.362

DO YOU WANT TO TRY AGAIN?
NO
ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN

C. SIMULATION

```
      SIMULATION

ENTER THE MARKET SIZE AND THE CORRESPONDING PROBABILITIES FOR
THE SIX DIFFERENT SITUATIONS. FOR HELP TYPE HELP. IF NOT HIT
TAB AND RETURN. INPUT FORMAT: 20000 23000 ETC., FOLLOWED BY .1 .2 ETC.,
HELP
MOST LIKELY
PESSIMISTIC
LOWER QUARTER
MIDDLE
UPPER QUARTER
OPTIMISTIC
ENTER THE MARKET SIZE UNDER EACH CONDITION, FOLLOWED BY THEIR RESPECTIVE
PROBABILITY ASSESSMENTS.
⎕:
      2800000 2000000 2300000 2600000 2900000 3200000 .3 .05 .15 .2 .25 .05
ENTER THE MARKET SHARE AND THE PROBABILITY.
⎕:
      15 10 11.75 13.5 15.25 17 .4 .05 .05 .1 .35 .05
ENTER THE SELLING PRICE AND THE CORRESPONDING PROBABILITY.
INPUT FORMAT FOR THIS: 8 .2 7 .3 ETC., (PRICE FOLLOWED BY PROBABILITY)
IF ONLY ONE SELLING PRICE ENTER IT ONLY ONCE, IF NOT ENTER ALL
⎕:
      8 1
ENTER VARIABLE COST PER UNIT AND THE PROBABILITY
⎕:
      7.25 7.4 7.3 7.2 7.1 7 .6 .05 .05 .2 .05 .05
ENTER THE FIXED COSTS AND THE PROBABILITY
⎕:
      260000 300000 282500 265000 247500 230000 .4 .05 .1 .35 .05 .05
DO YOU WANT A SUMMARY OF THE RESULTS?
YES
```

	MARKET SIZE	MARKET SHARE	SELLING PRICE	VARIABLE COST	FIXED COSTS
	EXPECTED VALUE	EXPECTED VALUE	EXPECTED VALUE	EXPECTED VALUE	EXPECTED VALUE
MOST LIKELY	840,000	6.0000	8.00	4.350	104,000
PESSIMISTIC	100,000	0.5000		0.370	15,000
LOWER QUARTER	345,000	0.5875		0.365	28,250
MIDDLE	520,000	1.3500		1.440	92,750
UPPER QUARTER	725,000	5.3375		0.355	12,375
OPTIMISTIC	160,000	0.8500		0.350	11,500
	2,690,000	14.6250	8.00	7.230	263,875

THE PROFIT IS $ 39,052.63

DO YOU WANT TO TRY AGAIN?
NO
DO YOU WANT TO LOOK AT THE SENSITIVITY ANALYSIS?
YES

SENSITIVITY TO PESSIMISTIC VALUES

VARIABLE CHANGED	*PROFIT*	*CHANGE*	*PERCENT*
NO CHANGE	55,000	0	0
MARKET SIZE	¯35,000	¯90,000	¯164
MARKET SHARE	¯50,000	¯105,000	¯191
SELLING PRICE	55,000	0	0
VARIABLE COST	¯8,000	¯63,000	¯115
FIXED COST	15,000	¯40,000	¯73

SENSITIVITY TO OPTIMISTIC VALUES

VARIABLE CHANGED	*PROFIT*	*CHANGE*	*PERCENT*
NO CHANGE	55,000	0	0
MARKET SIZE	100,000	45,000	82
MARKET SHARE	97,000	42,000	76
SELLING PRICE	55,000	0	0
VARIABLE COST	160,000	105,000	191
FIXED COST	85,000	30,000	55

DO YOU WANT TO TRY AGAIN?
NO

D. OPTIMIZATION

```
      OPTIMIZATION

ENTER THE COST OF PRODUCING THE ITEM
⎕:
      .18
ENTER THE PRICE OF THE OLD PRODUCT(E.G., SANDWICH ETC.,)
⎕:
      .25
ENTER THE PRICE OF THE NEW PRODUCT
⎕:
      .40
ENTER THE DIFFERENT DEMANDS FOR THE OLD PRODUCT
⎕:
      1 2 3 4 5
ENTER THE CORRESPONDING PROBABILITIES
⎕:
      .05 .25 .3 .3 .1
ENTER THE DIFFERENT LEFT-OVER POSSIBILITIES
⎕:
      1 2 3 4 5
ENTER THE DIFFERENT DEMANDS FOR THE NEW PRODUCT
⎕:
      15 16 17 18 19
ENTER THE CORRESPONDING PROBABILITIES
⎕:
      .1 .2 .45 .15 .1
ENTER THE DIFFERENT PRODUCTION POSSIBILITIES
⎕:
      15 16 17 18 19
```

EXPECTED PROFIT FROM THE OLD PRODUCT

DEMAND PER DAY	*PROBA-BILITY*	1		2		3		4		5	
		C.V.	*E.V.*	*C.V.*	*E.V.*	*C.V.*	*E.V.*	*C.V.*	*E.V.*	*C.V.*	*E.V.*
1	0.05	0.0700	0.0035	(0.1100)	(0.0055)	(0.2900)	(0.0145)	(0.4700)	(0.0235)	(0.6500)	(0.0325)
2	0.25	0.0700	0.0175	0.1400	0.0350	(0.0400)	(0.0100)	(0.2200)	(0.0550)	(0.4000)	(0.1000)
3	0.30	0.0700	0.0210	0.1400	0.0420	0.2100	0.0630	0.0300	0.0090	(0.1500)	(0.0450)
4	0.30	0.0700	0.0210	0.1400	0.0420	0.2100	0.0630	0.2800	0.0840	0.1000	0.0300
5	0.10	0.0700	0.0070	0.1400	0.0140	0.2100	0.0210	0.2800	0.0280	0.3500	0.0350
EXPECTED VALUE			0.0700		0.1275		0.1225		0.0425		(0.1125)

EXPECTED PROFIT FROM THE NEW PRODUCT

DEMAND PER DAY	*PROBA-BILITY*	15		16		17		18		19	
		C.V.	*E.V.*	*C.V.*	*E.V.*	*C.V.*	*E.V.*	*C.V.*	*E.V.*	*C.V.*	*E.V.*
15	0.10	3.3000	0.3300	3.3700	0.3370	3.4275	0.3428	3.4225	0.3423	3.3425	0.3343
16	0.20	3.3000	0.6600	3.5200	0.7040	3.5900	0.7180	3.6475	0.7295	3.6425	0.7285
17	0.45	3.3000	1.4850	3.5200	1.5840	3.7400	1.6830	3.8100	1.7145	3.8675	1.7404
18	0.15	3.3000	0.4950	3.5200	0.5280	3.7400	0.5610	3.9600	0.5940	4.0300	0.6045
19	0.10	3.3000	0.3300	3.5200	0.3520	3.7400	0.3740	3.9600	0.3960	4.1800	0.4180
EXPECTED VALUE			3.3000		3.5050		3.6787		3.7762		3.8256

```
DOCT

ENTER THE TOTAL REVENUE AND TOTAL VARIABLE EXPENSE PER UNIT
⎕:
      2.25 .6
ENTER THE TOTAL FIXED COSTS
⎕:
      20
ENTER THE NUMBER OF UNITS PER DAY (E.G., CARS ETC.,)
⎕:
      25 30 35 40 45
ENTER THE CORRESPONDING PROBABILITIES
⎕:
      .1 .35 .2 .2 .15
DO YOU WANT THE SUMMARY?
YES



                                                 CONDITIONAL          EXPECTED
UNITS PER DAY        PROB. OF OCCURENCE             VALUE              VALUE.

      25                   0.10                     41.25               4.1250
      30                   0.35                     49.50              17.3250
      35                   0.20                     57.75              11.5500
      40                   0.20                     66.00              13.2000
      45                   0.15                     74.25              11.1375
                                                                    ----------
                                                  EXPECTED VALUE      57.3375
                                                LESS:FIXED COSTS      20.0000
                                                                    ----------
                                             EXPECTED DAILY PROFIT    37.3375


DO YOU WANT TO TRY AGAIN?
NO
```

```
DO YOU WANT TO TRY AGAIN?
NO
```

E. OPBUDGET

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      OPBUDGET

ENTER THE NAME OF THE PRODUCT (TO END HIT TAB AND RETURN).
FRISBEES
ENTER THE NAME OF THE PRODUCT (TO END HIT TAB AND RETURN).
BALLS
ENTER THE NAME OF THE PRODUCT (TO END HIT TAB AND RETURN).

ENTER SALES FORECAST AND PRICE FOR THE ABOVE
⎕:
      1000000 .25 750000 .3
ENTER MATERIAL INVENTORY - BEG. AND END. (AS A PERCENT OF SALES).
⎕:
      0 10 0 10
ENTER WORK-IN-PROCESS INVENTORY - BEG. AND END (AS A PERCENT OF SALES).
⎕:
      0 10 0 10
ENTER THE PERCENTAGE OF COMPLETION
⎕:
      50
ENTER FINISHED GOODS INVENTORY - BEG. AND END (AS A PERCENT OF SALES).
⎕:
      0 10 0 10
ENTER THE NAME OF THE MATERIAL (TO END HIT TAB AND RETURN).
FOAM
ENTER PRICE PER POUND AND MATERIAL REQUIRED FOR ABOVE PRODUCTS (IN POUNDS).
⎕:
      .2 .05 .05
ENTER THE NAME OF THE MATERIAL (TO END HIT TAB AND RETURN).
DYE
ENTER PRICE PER POUND AND MATERIAL REQUIRED FOR ABOVE PRODUCTS (IN POUNDS).
⎕:
      .1 .03 .05
ENTER THE NAME OF THE MATERIAL (TO END HIT TAB AND RETURN).
PACKAGING
ENTER PRICE PER POUND AND MATERIAL REQUIRED FOR ABOVE PRODUCTS (IN POUNDS).
⎕:
      .1 .05 .05
ENTER THE NAME OF THE MATERIAL (TO END HIT TAB AND RETURN).

ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).
STAMPING
ENTER THE RATE AND TIME IN MINS.
⎕:
```

```
⎕:
      6 .25 .25
ENTER OVERHEAD VARIABLE RATE AND FIXED AMOUNT
⎕:
      1 10000
ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).
DECORATING
ENTER THE RATE AND TIME IN MINS.
⎕:
      6 .25 .25
ENTER OVERHEAD VARIABLE RATE AND FIXED AMOUNT
⎕:
      1 10000
ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).
PACKAGING
ENTER THE RATE AND TIME IN MINS.
⎕:
      6 .5 .5
ENTER OVERHEAD VARIABLE RATE AND FIXED AMOUNT
⎕:
      1 10000
ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).

SALES, PRODUCTION QUOTA, MATERIAL USAGE, MATERIAL PURCHASE
DIRECT LABOR COST, OVERHEAD OR ENDING FINISHED GOODS INVENTORY
ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.


SALES

SALES BUDGET
```

ITEM(S)	UNITS	SELLING PRICE	TOTAL SALES
FRISBEES	1,000,000.00	0.25	250,000.00
BALLS	750,000.00	0.30	225,000.00
TOTAL	1,750,000.00	0.28	481,250.00

```
ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.
```

USAGE

MATERIALS USAGE BUDGET

	FRISBEES		BALLS			TOTAL	
MATERIAL REQ.	*LB/UNIT*	*PROD. LBS*	*LB/UNIT*	*PROD. LBS*	*USAGE*	*UNIT COST*	*COST OF USAGE*
FOAM	0.05	57,500	0.05	43,125	100,625	0.20	20,125
DYE	0.03	34,500	0.05	43,125	77,625	0.10	7,762
PACKAGING	0.05	57,500	0.05	43,125	100,625	0.10	10,063
TOTAL							37,950

ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.

PUR

MATERIALS PURCHASES BUDGET

PRODUCTION DATA	*FOAM*	*DYE*	*PACKAGING*
PRODUCTION NEEDS	100,625.00	77,625.00	100,625.00
PLANNED BALANCE - ENDING MATERIALS INV.	8,750.00	6,750.00	8,750.00
TOTAL NEEDS	109,375.00	84,375.00	109,375.00
LESS: BEGINNING INVENTORY	0.00	0.00	0.00
PURCHASE REQUIRED	109,375.00	84,375.00	109,375.00
PRICE PER UNIT	0.20	0.10	0.10
COST OF PURCHASES	21,875.00	8,437.50	10,937.50
TOTAL			41,250.00

ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.

DIRECT

DIRECT LABOR COST BUDGET

		STAMPING		DECORATING		PACKAGING		TOTAL
PRODUCT	PRODUCTION	TOT. HRS.	TOTAL	TOT. HRS.	TOTAL	TOT. HRS.	TOTAL	BUDGET
FRISBEES	1,150,000.00	4,791.67	28,750.00	4,791.67	28,750.00	9,583.33	57,500.00	115,000.00
BALLS	862,500.00	3,593.75	21,562.50	3,593.75	21,562.50	7,187.50	43,125.00	86,250.00
TOTAL	2,012,500	8,385	50,312	8,385	50,312	16,771	100,625	201,250

ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.

OVERHEAD

OVERHEAD BUDGET

COSTS	STAMPING	DECORATING	PACKAGING	TOTAL
VARIABLE OVERHEAD	8,385.42	8,385.42	16,770.83	33,541.67
FIXED OVERHEAD	10,000.00	10,000.00	10,000.00	30,000.00
TOTAL OVERHEAD	18,385.42	18,385.42	26,770.83	63,541.67
DIVIDE BY DIRECT LABOR HOURS	8,385.42	8,385.42	16,770.83	33,541.67
OVERHEAD PER DIRECT LABOR HOUR	2.19	2.19	1.60	1.99

ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.

PRO

PRODUCTION QUOTA BUDGET

ITEM(S)	*FRISBEES*	*BALLS*
SALES (IN UNITS)	1,000,000	750,000
PLANNED BALANCE - FINISHED INVENTORY	100,000	75,000
PLANNED BALANCE - EQUIVALENT UNITS WIP	50,000	37,500
TOTAL INVENTORY REQUIRED	1,150,000	862,500
LESS: BEGINNING FINISHED INVENTORY	0	0
BEGINNING UNITS WORK-IN-PROCESS	0	0
PRODUCTION QUOTA	1,150,000	862,500

ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.

END

ENDING FINISHED GOODS INVENTORY BUDGET

		FRISBEES		*BALLS*	
ITEM(S)	*UNIT COST*	*UNITS REQUIRED*	*AMOUNT*	*UNITS REQUIRED*	*AMOUNT*
MATERIALS					
FOAM	0.2000	0.0500	0.0100	0.0500	0.0100
DYE	0.1000	0.0300	0.0030	0.0500	0.0050
PACKAGING	0.1000	0.0500	0.0050	0.0500	0.0050
DIRECT LABOR					
STAMPING	6.0000	0.0042	0.0250	0.0042	0.0250
DECORATING	6.0000	0.0042	0.0250	0.0042	0.0250
PACKAGING	6.0000	0.0083	0.0500	0.0083	0.0500
OVERHEAD					
STAMPING	2.1925	0.0042	0.0091	0.0042	0.0091
DECORATING	2.1925	0.0042	0.0091	0.0042	0.0091
PACKAGING	1.5963	0.0083	0.0133	0.0083	0.0133
UNIT COST			0.1496		0.1516
PLANNED INVENTORY			100,000		75,000
ENDING FIN. INV.			14,957		11,368
TOTAL INVENTORY					26,325

ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.

B. EXTRAPOLATE

```
      ∇EXTRAPOLATE[⎕]∇

    ∇ EXTRAPOLATE;X;N;PRD;MATRIX;AA;AB;AC;AD;AE;AF;AG;AH;D;MAT;Z;AMAT;SI
[1]   X←24ρι12
[2]   'ENTER THE YEARS FOR WHICH YOU HAVE SALES DATA'
[3]   N←ρPRD←⎕
[4]   MATRIX←(12,N+1)ρ0
[5]   AA←((((1+2×N)×10)-42)÷2)ρ' '
[6]   AB←((5+N×10)+((N×5)-10))ρ' '
[7]   AD←(AC←((N×5)-8)ρ' '),(AE←((N×5)-6)ρ' ')
[8]   AG←(AF←((N×5)-4)ρ' '),(AH←((N×5)-9)ρ' ')
[9]   'ENTER THE MONTH AND DATA(IN MILLIONS) FOR THE ';N;' PERIODS'
[10]  'FORMAT: 1 2.3 4.5 3.4 INSTEAD JAN 2.3 4.5 3.4'
[11] BEGIN:'ENTER THE DATA(TO END TYPE A ZERO)'
[12]  →((1↑D←(N+1)ρ⎕)=0)/NEXT
[13]  →(∧/((1↑D)>12),((ρD)>N+1))/ERROR
[14]  MATRIX[(1↑D);]←D
[15]  →BEGIN
[16] NEXT:MAT←MATRIX[;1+ιN]
[17]  Z←,MAT
[18]  AMAT←(12,N)ρ(12×N)ρ(TT←+/⍉MAT)÷12
[19]  SI←(+/(MAT÷AMAT))÷N
[20]  'DO YOU WANT TO SEE THE SUMMARY OF DATA?'
[21]  →('Y'=1↑⍞)/SUMMARY
[22] MET:'MONTHLY BUDGET, YEARLY FORECAST OR MIDDLE PER. AVERAGE'
[23]  'MOVING AVERAGE OR EXPONENTIAL SMOOTHING'
[24] METH:'ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN'
[25]  →('NADVP '=2↓3↑⍞)/M1,M2,M3,M4,M4,0
[26]  →MET
[27] SUMMARY:2ρCR
[28]  AA,'SEASONAL INDEXES AS  RATIO-TO-SAME-YEAR-AVERAGE'
[29]  ' '
[30]  AB,'ACTUAL MONTHLY SALES'
[31]  AC,'ACTUAL MONTHLY SALES',AD,' AS A ∘/∘ OF',AE,'     SEASONAL'
[32]  AF,'(IN MILLIONS)',AG,'AVERAGE SALES FOR:',AH,'     INDEX'
[33]  ('⍞MONTH⍞,10I10' ΔFMT(1,2×N)ρ(2×N)ρPRD);' (AVERAGE ∘/∘)'
[34]  'I5,10F10.2' ΔFMT(ι12;MAT;MAT÷AMAT;SI)
[35]  ' '
[36]  'X5,10F10.2' ΔFMT(1,1+2×N)ρTT,((N+1)ρ12)
[37]  1ρCR
[38]  →MET
[39] ERROR:'WRONG ENTRY....REENTER'
[40]  →BEGIN
[41] M1:MONBUD
[42]  →METH
[43] M2:YEARFORE
[44]  →METH
[45] M3:MIDPERAV
[46]  →METH
[47] M4:FOREC
[48]  →METH
    ∇
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      ∇MONBUD[⎕]∇

    ∇ MONBUD;FC;F;MV;MS;SL;M
[1]    M←'JAN.     FEB.     MAR.     APR.     MAY      JUNE     JULY    '
[2]    M← 12 8 ρM←M,'AUG.     SEP.     OCT.     NOV.     DEC.     '
[3]   START:'ENTER THE MONTH FOR WHICH YOU WANT THE FORECAST'
[4]    'USE 1 FOR JAN. 2 FOR FEB. ETC.,'
[5]    FC←12+X⍳F←1ρ⎕
[6]    'HOW MANY MONTHS MOVING AVERAGE YOU ARE USING?'
[7]    MV←1ρ⎕
[8]    MS←X[(FC-MV+1)+⍳MV]
[9]    'ENTER THE SALES FOR ';,M[¯1↓MS;];' AND ';,M[MS[ρMS];]
[10]   SL←(ρMS)ρ⎕
[11]   2ρCR
[12]   (25+8×ρMS)ρ' ';'       FORECAST'
[13]   ((30ρ' '),,'A1' ΔFMT,M[MS;]);' FOR ';,M[1+MS[ρMS];]
[14]   ' '
[15]   '⍞ACTUAL DATA(SEASONALIZED)⍞,10F8.1' ΔFMT(1,ρSL)ρSL
[16]   'X25,10A8' ΔFMT(1,ρMS)ρ'÷'
[17]   '⍞SEASONAL INDEX⍞,X11,10F8.2' ΔFMT(1,ρMS)ρ2 RND SI[MS]
[18]   'X25,10A8' ΔFMT(1,ρMS)ρ'='
[19]   '⍞DESEASONALIZED DATA⍞,X6,10F8.1' ΔFMT(1,ρMS)ρDD←SL÷SI[MS]
[20]   ' '
[21]   'DESEASONALIZED FORECAST';(7+8×ρMS)ρ' ';2 RND((+/1 RND DD)÷ρMS)
[22]   (30+8×ρMS)ρ' ';'×'
[23]   'SEASONAL INDEX';(16+8×ρMS)ρ' ';2 RND SI[F]
[24]   (30+8×ρMS)ρ' ';'='
[25]   'SEASONALIZED FORECAST';(9+8×ρMS)ρ' ';1 RND((+/SL÷SI[MS])÷ρMS)×SI[F]
[26]   2ρCR
[27]   'DO YOU WANT FOR OTHER MONTHS?'
[28]   →('Y'=1↑⍞)/START
    ∇


      ∇YEARFORE[⎕]∇

    ∇ YEARFORE;FC;M
[1]    M← 12 4 ρ'JAN.FEB.MAR.APR.MAY JUNEJULYAUG.SEP.OCT.NOV.DEC.'
[2]   START:'ENTER THE FORECAST OF YEARLY SALES'
[3]    FC←1ρ⎕
[4]    2ρCR
[5]    '                   AVERAGE MONTHLY SALES        INDEX OF'
[6]    '                   (BASED ON YEARLY SALES       SEASONAL'
[7]    'MONTH                  OF ';FC;' MILLION)          VARIATION          MONTHLY FORE
       CAST'
[8]    ' '
[9]    ('A1' ΔFMT M),('X15,F10.3,X10,F10.2,X13,F10.2' ΔFMT(12ρFC÷12;SI;SI×FC÷
       12))
[10]   ' '
[11]   'X19,F10.3,X10,F10.2,X13,F10.2' ΔFMT(FC;+/SI;+/SI×FC÷12)
[12]   'DO YOU WANT TO TRY FOR OTHERS?'
[13]   →('Y'=1↑⍞)/START
    ∇
```

```
      ∇MIDPERAV[⎕]∇

    ∇ MIDPERAV;MM;YC;NNN;B;A;NN;I;I̲;FCS;J;K;NFMAT;AX;AY;AZ;AW
[1]    MM← 12 4 ⍴'JAN.FEB.MAR.APR.MAY JUNEJULYAUG.SEP.OCT.NOV.DEC.'
[2]    YC←⍳0
[3]   START:'ENTER THE NUMBER OF MONTHS TO BE USED'
[4]    NNN←(B←(A-1)÷2)+⍳NN←(⍴Z)-(A←⎕)-1
[5]    AX←(NN,7)⍴'       '
[6]    I←1+I̲←0
[7]    FCS←NN⍴0
[8]   TRA:FCS[I]←(+/Z[I̲+⍳A])÷A
[9]    →(I=NN)/OUT1
[10]   I←I+1
[11]   I←1+I̲←I̲+1
[12]   →TRA
[13]  OUT1:J←K←1
[14]  TRB:→(NNN[J]>K×12)/NQ1
[15]   YC←YC,PRD[K],(NNN[J]-(K-1)×12),FCS[J]
[16]   →(J=⍴NNN)/OUT2
[17]   J←J+1
[18]   →TRB
[19]  NQ1:K←K+1
[20]   →TRB
[21]  OUT2:NFMAT←(((⍴YC)÷3),3)⍴YC
[22]   AY←'I4' ∆FMT NFMAT[;1]
[23]   AZ←'A1' ∆FMT MM[NFMAT[;2];]
[24]   AW←'F10.3' ∆FMT NFMAT[;3]
[25]   2⍴CR̲
[26]   'YEAR        MONTH    FORECAST'
[27]   AY,AX,AZ,AW
[28]   2⍴CR̲
[29]   'DO YOU WANT TO TRY AGAIN?'
[30]   →('Y'=1↑⍞)/START
    ∇
```

```
      ∇FOREC[⎕]∇

    ∇ FOREC
[1]    FORE
[2]   ST:'ENTER MOVING AVERAGE OR EXPONENTIAL SMOOTHING'
[3]    →('ME '=1↑⍞)/M̲1,M̲2,0
[4]    →ST
[5]   M̲1:WTDMOVAV
[6]    →ST
[7]   M̲2:EXPSMOOTH
[8]    →ST
    ∇
```

```
      ∇WTDMOVAV[⎕]∇

    ∇ WTDMOVAV;PO;RW;LW;FC;N
[1]   PO←MOS
[2]  BEGIN:'DO YOU WANT ONE PLACE OR MULTIPLE PLACE'
[3]   →('M'=1↑⍞)/MULT
[4]   'WEIGHT TO BE ASSIGNED TO THE LAST OBSERVATION (AS A PERCENT)'
[5]   RW←1-LW←1⍴⎕÷100
[6]   FC←(((+/PO[⍳(NN-1)])÷(NN-1))×RW)+PO[NN]×LW
[7]  FCST:2⍴CR
[8]   'FORECAST FOR THE MONTH ';M[FCP;];' IS ';2 RND FC
[9]   2⍴CR
[10]  'DO YOU WANT THE OTHER METHOD?'
[11]  →('YN'=1↑⍞)/BEGIN,0
[12] MULT:'ENTER THE WEIGHTS FOR THE LAST PERIODS'
[13]  RW←1-+/LW←⎕÷100
[14]  FC←(((+/PO[⍳N])÷N)×RW)++/PO[(N←NN-⍴LW)+⍳⍴LW]×LW
[15]  →FCST
    ∇



      ∇EXPSMOOTH[⎕]∇

    ∇ EXPSMOOTH;ACT;AL;MOST;FC;I
[1]   'ENTER THE PERCENTAGE WEIGHTING TO CURRENT OBSERVATION'
[2]   ACT←MOS×AL←1⍴⎕÷100
[3]   MOST←MOS×(1-AL)
[4]   FC←(NN+1)⍴0
[5]   FC[1]←MOS[1]
[6]   I←2
[7]  TRA:FC[I]←ACT[I-1]+FC[I-1]×(1-AL)
[8]   →(I=NN)/NEXT
[9]   I←I+1
[10]  →TRA
[11] NEXT:FC[I+1]←(FC[I]×(1-AL))+ACT[I]
[12]  'DO YOU WANT THE SUMMARY?'
[13]  →('Y'=1↑⍞)/SUM
[14]  2⍴CR
[15]  'THE FORECAST FOR THE PERIOD ';FCP;' IS ';FC[I+1]
[16]  →0
[17] SUM:2⍴CR
[18]  'PERIOD        FORECAST        ACTUAL'
[19]  'I5,X5,CI10,X5,CI10' ∆FMT((C,FCP);FC;MOS)
[20]  →0
    ∇

      ∇FORE[⎕]∇
    ∇ FORE
[1]   M← 12 4 ⍴'JAN.FEB.MAR.APR.MAY JUNEJULYAUG.SEP.OCT.NOV.DEC.'
[2]   'ENTER THE PERIOD FOR WHICH YOU NEED FORECASTING (E.G., 1 FOR JAN. ETC.,)'
[3]   FCP←⎕
[4]   'ENTER THE PAST OBSERVATIONS TO BE USED'
[5]   C←(D←((12+X⍳FCP)-NN)-1)+⍳NN←⍴MOS←⎕
    ∇
```

C. SIMULATION

```
      ∇SIMULATION[⎕]∇

    ∇ SIMULATION;UL;QQ;QW;EVENT;MAT;NMAT;A
[1]    UL←'________       '
[2]    QQ←'EXPECTED       '
[3]    QW←' VALUE         '
[4]    EVENT←'MOST LIKELY    PESSIMISTIC    LOWER QUARTER  '
[5]    EVENT←EVENT,'MIDDLE         UPPER QUARTER  OPTIMISTIC     '
[6]    EVENT← 6 15 ⍴EVENT
[7]    MAT← 6 10 ⍴0
[8]   START:'ENTER THE MARKET SIZE AND THE CORRESPONDING PROBABILITIES FOR'
[9]    'THE SIX DIFFERENT SITUATIONS. FOR HELP TYPE HELP. IF NOT HIT'
[10]   'TAB AND RETURN. INPUT FORMAT: 20000 23000 ETC., FOLLOWED BY .1 .2 ETC.,'
[11]   →('H'=1↑⍞)/HELP
[12]  ENTRY:MAT[;⍳2]←⍉(2 6 ⍴12⍴⎕)
[13]   'ENTER THE MARKET SHARE AND THE PROBABILITY.'
[14]   MAT[;2+⍳2]←⍉(2 6 ⍴12⍴⎕)
[15]   'ENTER THE SELLING PRICE AND THE CORRESPONDING PROBABILITY.'
[16]   'INPUT FORMAT FOR THIS: 8 .2 7 .3 ETC., (PRICE FOLLOWED BY PROBABILITY)'
[17]   'IF ONLY ONE SELLING PRICE ENTER IT ONLY ONCE, IF NOT ENTER ALL'
[18]   MAT[;4+⍳2]← 6 2 ⍴12↑⎕
[19]   'ENTER VARIABLE COST PER UNIT AND THE PROBABILITY'
[20]   MAT[;6+⍳2]←⍉(2 6 ⍴12⍴⎕)
[21]   'ENTER THE FIXED COSTS AND THE PROBABILITY'
[22]   MAT[;8+⍳2]←⍉(2 6 ⍴12⍴⎕)
[23]   NMAT← 6 5 ⍴0
[24]   NMAT[;1]←×/MAT[;⍳2]
[25]   NMAT[;2]←×/MAT[;2+⍳2]
[26]   NMAT[;3]←×/MAT[;4+⍳2]
[27]   NMAT[;4]←×/MAT[;6+⍳2]
[28]   NMAT[;5]←×/MAT[;8+⍳2]
[29]   A←+/⍉NMAT
[30]   'DO YOU WANT A SUMMARY OF THE RESULTS?'
[31]   →('Y'=1↑⍞)/SUM
[32]  OPR:2⍴CR
[33]   'THE PROFIT IS $',,('CF12.2' ΔFMT(((×/A[⍳3])-(×/A[1 2 4]))÷100)-A[5])
[34]   2⍴CR
[35]  TRY:'DO YOU WANT TO TRY AGAIN?'
[36]   →('Y'=1↑⍞)/START
[37]   'DO YOU WANT TO LOOK AT THE SENSITIVITY ANALYSIS?'
[38]   →('YN'=1↑⍞)/SENS,0
[39]  SUM:2⍴CR
[40]   (28⍴' ');' MARKET         MARKET        SELLING        VARIABLE        FIXED'
[41]   (28⍴' ');'  SIZE          SHARE          PRICE           COST          COSTS'
[42]   ' '
[43]   (28⍴' '),,('5A1' ΔFMT(1,70)⍴QQ)
[44]   (28⍴' '),,('5A1' ΔFMT(1,70)⍴QW)
[45]   (28⍴' '),,('5A1' ΔFMT(1,70)⍴UL)
[46]   ' '
[47]   ('A1' ΔFMT EVENT),('X10,CI10,X3,F10.4,X3,BF10.2,X5,F10.3,X5,CI10' ΔFMT NMAT)
[48]   (28⍴' '),,('5A1' ΔFMT(1,70)⍴UL)
[49]   'X25,CI10,X3,F10.4,X3,F10.2,X5,F10.3,X5,CI10' ΔFMT 1 5 ⍴A
[50]   2⍴CR
```

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[51]  →OPR
[52] HELP:EVENT
[53]  'ENTER THE MARKET SIZE UNDER EACH CONDITION, FOLLOWED BY THEIR RESPECTIVE'
[54]  'PROBABILITY ASSESSMENTS.'
[55]  →ENTRY
[56] SENS:SENSITY
[57]  2ρCR
[58]  'DO YOU WANT TO TRY AGAIN?'
[59]  →('Y'=1↑⍞)/START
      ∇
```

```
      ∇SENSITY[⎕]∇

    ∇ SENSITY;M;MX;PR1;PR2;A;B;CH1;CH2;PER1;PER2
[1]   M←'NO CHANGE      MARKET SIZE    MARKET SHARE   '
[2]   M←M,'SELLING PRICE  VARIABLE COST  FIXED COST     '
[3]   M← 6 15 ρM
[4]   MX←MAT[;(2×⍳5)-1]
[5]   →(MX[2;3]≠0)/NXT
[6]   MX[;3]←6ρMX[1;3]
[7]  NXT:PR1←PR2←6ρ0
[8]   A←MX[1;1]×MX[1;2]÷100
[9]   B←MX[1;3]-MX[1;4]
[10]  PR1[1]←(A×B)-MX[1;5]
[11]  PR1[2]←(MX[2;1]×MX[1;2]×B÷100)-MX[1;5]
[12]  PR1[3]←(MX[1;1]×MX[2;2]×B÷100)-MX[1;5]
[13]  PR1[4]←(A×MX[2;3]-MX[1;4])-MX[1;5]
[14]  PR1[5]←(A×MX[1;3]-MX[2;4])-MX[1;5]
[15]  PR1[6]←(A×B)-MX[2;5]
[16]  PR2[1]←PR1[1]
[17]  PR2[2]←(MX[6;1]×MX[1;2]×B÷100)-MX[1;5]
[18]  PR2[3]←(MX[1;1]×MX[6;2]×B÷100)-MX[1;5]
[19]  PR2[4]←(A×MX[6;3]-MX[1;4])-MX[1;5]
[20]  PR2[5]←(A×MX[1;3]-MX[6;4])-MX[1;5]
[21]  PR2[6]←(A×B)-MX[6;5]
[22]  CH1←PR1-PR1[1]
[23]  CH2←PR2-PR2[1]
[24]  PER1←(CH1÷PR1[1])×100
[25]  PER2←(CH2÷PR2[1])×100
[26]  2ρCR
[27]  '          SENSITIVITY TO PESSIMISTIC VALUES',(33ρBS),33ρ'_'
[28]  'VARIABLE CHANGED          PROFIT      CHANGE      PERCENT'
[29]  ' '
[30]  ('A1' ∆FMT M),('X5,2CI12,X5,I4' ∆FMT(PR1;CH1;PER1))
[31]  1ρCR
[32]  '          SENSITIVITY TO OPTIMISTIC VALUES',(32ρBS),32ρ'_'
[33]  'VARIABLE CHANGED          PROFIT      CHANGE      PERCENT'
[34]  ' '
[35]  ('A1' ∆FMT M),('X5,2CI12,X5,I4' ∆FMT(PR2;CH2;PER2))
    ∇
```

D. OPTIMIZATION

```
     ∇OPTIMIZATION[⎕]∇

    ∇ OPTIMIZATION;B;C;AA;CO;PO;PN;DE1;PR1;PR2;PP;LOP;DE2
[1]   B←'__________'
[2]   C←B,'        '
[3]   AA←'    C.V.       E.V.    '
[4]  START:CO←1 INC 'ENTER THE COST OF PRODUCING THE ITEM'
[5]   PO←1 INC 'ENTER THE PRICE OF THE OLD PRODUCT(E.G., SANDWICH ETC.,)'
[6]   PN←1 INC 'ENTER THE PRICE OF THE NEW PRODUCT'
[7]   'ENTER THE DIFFERENT DEMANDS FOR THE OLD PRODUCT'
[8]   DE1←⎕
[9]   'ENTER THE CORRESPONDING PROBABILITIES'
[10]  PR1←(⍴DE1)⍴⎕
[11]  'ENTER THE DIFFERENT LEFT-OVER POSSIBILITIES'
[12]  LOP←⎕
[13]  'ENTER THE DIFFERENT DEMANDS FOR THE NEW PRODUCT'
[14]  DE2←⎕
[15]  'ENTER THE CORRESPONDING PROBABILITIES'
[16]  PR2←(⍴DE2)⍴⎕
[17]  'ENTER THE DIFFERENT PRODUCTION POSSIBILITIES'
[18]  PP←⎕
[19]  2⍴CR
[20]  'EXPECTED PROFIT FROM THE OLD PRODUCT',(36⍴BS),36⍴'_'
[21]  ' '
[22]  LOP OUTPUT PO,CO,DE1,PR1
[23]  1⍴CR
[24]  'EXPECTED PROFIT FROM THE NEW PRODUCT',(36⍴BS),36⍴'_'
[25]  ' '
[26]  PP NOUTPUT PN,CO,DE2,PR2
[27]  1⍴CR
[28]  'DO YOU WANT TO TRY AGAIN?'
[29]  →('Y'=1↑⍞)/START
    ∇
```

```
      ∇OUTPUT[⎕]∇

    ∇ X̲ OUTPUT X;N;DE;K;L;I;J;M;MAT;I̲;NMAT;N2
[1]    N←(ρ(2↓X))÷2
[2]    MAT←(N,2+2×N2←ρX̲)ρ0
[3]    MAT[;1]←DE←N↑2↓X
[4]    MAT[;2]←(2+N)↓X
[5]    K←L←2+I←J←1+M←0
[6]   TRA:MAT[M+⍳(N-M);K]←(N-M)ρ((-/X[⍳2])×DE[I])
[7]    →(M=N-1)/TRB
[8]    MAT[J;L+(2×⍳(N2-J))]←(DE[J]×X[1])-DE[J+⍳(N2-J)]×X[2]
[9]    I←J←1+M←M+1
[10]   K←L←L+2
[11]   →TRA
[12]  TRB:I̲←2
[13]  TRC:MAT[;I̲+2]←×/MAT[;2,I̲+1]
[14]   →(I̲=2×N)/OUT
[15]   I̲←I̲+2
[16]   →TRC
[17]  OUT:2ρC̲R̲
[18]   S←(16ρ' '),,'A1' ΔFMT(1,N2×ρAA)ρAA
[19]   NMAT←MAT[;2+⍳(2×N)]
[20]   '⍞DEMAND⍞,X2,10I20' ΔFMT(1,N2)ρX̲
[21]   '  PER     PROBA-'
[22]   '  DAY     BILITY'
[23]   S
[24]   (16ρ' '),,'A1' ΔFMT(1,2×N2×ρB)ρB
[25]   'I5,X1,F8.2,15M⍞(⍞W⍞)⍞Q⍞ ⍞F10.4' ΔFMT(MAT[;1];MAT[;2];NMAT)
[26]   (24ρ' '),,'A1' ΔFMT(1,N2×ρC)ρC
[27]   '⍞EXPECTED VALUE⍞,10M⍞(⍞W⍞)⍞Q⍞ ⍞F20.4' ΔFMT(1,N2)ρ(E̲V̲←+/⍉NMAT[;2×⍳N2])
[28]   2ρC̲R̲
    ∇
```

```
    ∇NOUTPUT[⎕]∇

  ∇ Y NOUTPUT Z;N;N1;DE;K;L;I;J;M;I̲;NMAT
[1]   N←(ρ(2↓Z))÷2
[2]   MAT←(N,2+2×N1←ρY)ρ0
[3]   MAT[;1]←DE←N↑2↓Z
[4]   MAT[;2]←(2+N)↓Z
[5]   K←L←2+I←J←1+M←0
[6]  TRA:MAT[M+⍳(N-M);K]←(N-M)ρ((-/Z[⍳2])×DE[I])
[7]   →(M=N-1)/TRB
[8]   MAT[J;L+(2×⍳(N1-J))]←(DE[J]×-/Z[⍳2])+(N1-J)↑E̲V̲
[9]   I←J←1+M←M+1
[10]  K←L←L+2
[11]  →TRA
[12] TRB:I̲←2
[13] TRC:MAT[;I̲+2]←×/MAT[;2,I̲+1]
[14]  →(I̲=2×N1)/OUT
[15]  I̲←I̲+2
[16]  →TRC
[17] OUT:2ρC̲R̲
[18]  S←(16ρ' '),,'A1' ΔFMT(1,N1×ρAA)ρAA
[19]  NMAT←MAT[;2+⍳(2×N1)]
[20]  '⎕DEMAND⎕,X2,10I20' ΔFMT(1,N1)ρY
[21]  '  PER       PROBA-'
[22]  '  DAY       BILITY'
[23]  S
[24]  (16ρ' '),,'A1' ΔFMT(1,2×N1×ρB)ρB
[25]  'I5,X1,F8.2,15M⎕(⎕W⎕)⎕Q⎕ ⎕F10.4' ΔFMT(MAT[;1];MAT[;2];NMAT)
[26]  (24ρ' '),,'A1' ΔFMT(1,N1×ρC)ρC
[27]  '⎕EXPECTED VALUE⎕,10M⎕(⎕W⎕)⎕Q⎕ ⎕F20.4' ΔFMT(1,N1)ρ(+/⍉NMAT[;2×⍳N1])
[28]  2ρC̲R̲
  ∇
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      ∇DOCT[⎕]∇

     ∇ DOCT;TRV;TFC;NU;CP;EDP;TEV;EV;CV
[1]   START:'ENTER THE TOTAL REVENUE AND TOTAL VARIABLE EXPENSE PER UN
      IT'
[2]   TRV←2ρ⎕
[3]   'ENTER THE TOTAL FIXED COSTS'
[4]   TFC←1ρ⎕
[5]   'ENTER THE NUMBER OF UNITS PER DAY (E.G., CARS ETC.,)'
[6]   NU←⎕
[7]   'ENTER THE CORRESPONDING PROBABILITIES'
[8]   CP←(ρNU)ρ⎕
[9]   EDP←(TEV←(+/EV←(CV←(NU×TRV[1])-(NU×TRV[2]))×CP))-TFC
[10]  'DO YOU WANT THE SUMMARY?'
[11]  →('Y'=1↑⍞)/SUM
[12]  '

      THE EXPECTED DAILY PROFIT IS ';2 RND EDP
[13]  2ρCR
[14] TR:2ρCR
[15]  'DO YOU WANT TO TRY AGAIN?'
[16]  →('YN'=1↑⍞)/START,0
[17] SUM:2ρCR
[18]  '                                                     CONDITIONAL
         EXPECTED'
[19]  'UNITS PER DAY        PROB. OF OCCURENCE          VALUE
          VALUE.'
[20]  ' '
[21]  'I8,X14,F10.2,X12,F10.2,X10,F10.4' ΔFMT(NU;CP;CV;EV)
[22]  64ρ' ';'__________'
[23]  49ρ' ';' EXPECTED VALUE',,('F10.4' ΔFMT TEV)
[24]  48ρ' ';'LESS:FIXED COSTS',,('F10.4' ΔFMT TFC)
[25]  64ρ' ';'__________'
[26]  43ρ' ';'EXPECTED DAILY PROFIT',,('F10.4' ΔFMT EDP)
[27]  →TR
     ∇
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E. OPBUDGET

```
      ∇OPBUDGET[⎕]∇

    ∇ OPBUDGET;PR;MAT;MRQ;LB;RT;VF;PR;MAT;MRQ;LB;VF;RT;M1;M2;M40;M41;M50;M51;M6;SFP;
      W;B;WBE;FBE;N;N;NN;SB1;PQB;MUB;MPB;DLCB;OHB;EFCIB;TOT;DTOT;UC;PI;EFI;PQ;AA;AB;
      MP;OB
[1]   PR←MAT←MRQ←LB←RT←VF←⍳0
[2]  ST:'ENTER THE NAME OF THE PRODUCT (TO END HIT TAB AND RETURN).'
[3]   PR←PR,PR←20↑⍞
[4]   →(' '=1↑PR)/NXT
[5]   →ST
[6]  NXT:M1←((N←((⍴PR)÷20)-1),20)⍴PR
[7]   SFP←(2×N) INC 'ENTER SALES FORECAST AND PRICE FOR THE ABOVE'
[8]   MBE←0.01×(N,2)⍴(2×N) INC 'ENTER MATERIAL INVENTORY - BEG. AND END. (AS A PERCE
      NT OF SALES).'
[9]   W←0.01×(2×N) INC 'ENTER WORK-IN-PROCESS INVENTORY - BEG. AND END (AS A PERCENT
       OF SALES).'
[10]  B←0.01×1 INC 'ENTER THE PERCENTAGE OF COMPLETION'
[11]  WBE←(N,2)⍴W×B
[12]  FBE←0.01×(N,2)⍴(2×N) INC 'ENTER FINISHED GOODS INVENTORY - BEG. AND END (AS A
      PERCENT OF SALES).'
[13] NQ:'ENTER THE NAME OF THE MATERIAL (TO END HIT TAB AND RETURN).'
[14]  MAT←MAT,MAT←20↑⍞
[15]  →(' '=1↑MAT)/NQ1
[16]  MRQ←MRQ,MRQ←(1+N) INC 'ENTER PRICE PER POUND AND MATERIAL REQUIRED FOR ABOVE P
      RODUCTS (IN POUNDS).'
[17]  →NQ
[18] NQ1:'ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).'
[19]  LB←LB,LB←20↑⍞
[20]  →(' '=1↑LB)/NQ2
[21]  RT←RT,RT←(1+N) INC 'ENTER THE RATE AND TIME IN MINS.'
[22]  VF←VF,VF←2 INC 'ENTER OVERHEAD VARIABLE RATE AND FIXED AMOUNT'
[23]  →NQ1
[24] NQ2:M40←((N←((⍴MAT)÷20)-1),20)⍴MAT
[25]  M41←(N,1+N)⍴MRQ
[26]  M50←((NN←((⍴LB)÷20)-1),20)⍴LB
[27]  M51←((NN,1+N)⍴RT)÷(NN,1+N)⍴ 1 60 60
[28]  M6←(NN,2)⍴VF
[29]  SB1←((N+1),3)⍴0
[30]  SB1[⍳N;]←M2,(N,1)⍴×/M2←(N,2)⍴SFP
[31]  SB1[N+1;3]←(SB1[N+1;1]←+/SB1[⍳N;1])×SB1[N+1;2]←(+/SB1[⍳N;2])÷N
[32]  PQB←(7,N)⍴0
[33]  PQB[4;]←PQB[1;]+(PQB[2;]←M2[;1]×FBE[;2])+PQB[3;]←(PQB[1;]←M2[;1])×WBE[;
      2]
[34]  PQB[5;]←M2[;1]×FBE[;1]
[35]  PQB[6;]←M2[;1]×WBE[;1]
[36]  PQB[7;]←PQB[4;]-+⌿PQB[5 6 ;]
[37]  MUB←(N,3+2×N)⍴0
[38]  MUB[;3+2×N]←(MUB[;1+2×N]←+/MUB[;2×⍳N]←M41[;1+⍳N]×(N,N)⍴PQB[7;])×MUB[;
      2+2×N]←M41[;1]
[39]  MUB[;¯1+2×⍳N]←M41[;1+⍳N]
[40]  TOT←+/MUB[;3+2×N]
[41]  MPB←(7,N)⍴0
[42]  MPB[3;]←(,MPB[1;]←MUB[;1+2×N])+(,MPB[2;]←+/((N,N)⍴M2[;1])×((N,N)⍴MBE[;
      2])×M41[;1+⍳N])
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```
[43]  MPB[4;]←+/((N,N)ρ,M2[;1])×((N,N)ρ,MBE[;1])×M41[;1+ιN]
[44]  MPB[5;]←-⌿MPB[3 4 ;]
[45]  MPB[6;]←M41[;1]
[46]  MPB[7;]←×⌿MPB[5 6 ;]
[47]  DLCB←(N,2+2×NN)ρ0
[48]  DLCB[;1+2×ιNN]←(DLCB[;2×ιNN]←(⍉M51[;1+ιN])×⍉(NN,N)ρ,DLCB[;1]←PQB[7;])×⍉(NN,N)ρ
      ,M51[;1]
[49]  DLCB[;2+2×NN]←+/DLCB[;1+2×ιNN]
[50]  DTOT←+⌿DLCB
[51]  OHB←(5,NN)ρ0
[52]  OHB[3;]←(OHB[1;]←DTOT[2×ιNN]×M6[;1])+OHB[2;]←M6[;2]
[53]  OHB[4;]←DTOT[2×ιNN]
[54]  OHB[5;]←÷⌿OHB[3 4 ;]
[55]  OTOT←(+/OHB[ι4;]),(+/OHB[5;ιNN])÷NN
[56]  EFCIB←((N+2×NN),1+2×N)ρ0
[57]  EFCIB[;1]←,M41[;1],M51[;1],OHB[5;]
[58]  EFCIB[;2×ιN]←(M41[;1+ιN],[1] M51[;1+ιN]),[1] M51[;1+ιN]
[59]  EFCIB[;1+2×ιN]←EFCIB[;2×ιN]×⍉(N,N+2×NN)ρEFCIB[;1]
[60]  UC←+⌿EFCIB[;1+2×ιN]
[61]  PI←M2[;1]×FBE[;2]
[62]  EFI←UC×PI
[63]  'SALES, PRODUCTION QUOTA, MATERIAL USAGE, MATERIAL PURCHASE'
[64]  'DIRECT LABOR COST, OVERHEAD OR ENDING FINISHED GOODS INVENTORY'
[65] BUD:'ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.'
[66]  →('ARSUIVN '=1↑2↑⍞)/B1,B2,B3,B4,B5,B6,B7,0
[67]  →BUD
[68] B1:'
      SALES BUDGET
      '
[69]  M44←((N+1),20)ρ(,M1),'TOTAL               '
[70]  'ITEM(S)                     UNITS       SELLING PRICE      TOTAL SALES'
[71]  ' '
[72]  ('A1' ΔFMT M44),('3CF15.2' ΔFMT SB1)
[73]  1ρCR
[74]  →BUD
[75] B2:'
      PRODUCTION QUOTA BUDGET
      '
[76]  PQ←'SALES (IN UNITS)                        '
[77]  PQ←PQ,'PLANNED BALANCE - FINISHED INVENTORY    '
[78]  PQ←PQ,'PLANNED BALANCE - EQUIVALENT UNITS WIP  '
[79]  PQ←PQ,'TOTAL INVENTORY REQUIRED                '
[80]  PQ←PQ,'LESS: BEGINNING FINISHED INVENTORY      '
[81]  PQ←PQ,'      BEGINNING UNITS WORK-IN-PROCESS   '
[82]  PQ←PQ,'PRODUCTION QUOTA                        '
[83]  PQ← 7 40 ρPQ
[84]  'ITEM(S)';33ρ' ';,('A1' ΔFMT(1,20×N)ρ,M1)
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[85]  ' '
[86]  ('A1' ∆FMT PQ),('10CI12' ∆FMT PQB)
[87]  1ρCR
[88]  →BUD
[89] B3:'
      MATERIALS USAGE BUDGET
      '
[90]  AA←'LB/UNIT    PROD. LBS   '
[91]  30ρ' ';,('A1' ∆FMT(1,20×N)ρ,M1);'           TOTAL'
[92]  'MATERIAL REQ.';7ρ' ';,('A1' ∆FMT(1,N×ρAA)ρAA);' USAGE   UNIT COST   COST OF U
      SAGE'
[93]  ' '
[94]  ('A1' ∆FMT M40),('F5.2,CI12,X5, F5.2,X3, 2CI12,X3,F5.2,X3,CI12' ∆FMT MUB)
[95]  'TOTAL';(29+17×N+1)ρ' ';,('CI12' ∆FMT+/TOT)
[96]  1ρCR
[97]  →BUD
[98] B4:'
      MATERIALS PURCHASES BUDGET
      '
[99]  MP←'PRODUCTION NEEDS                       '
[100] MP←MP,'PLANNED BALANCE - ENDING MATERIALS INV. '
[101] MP←MP,'TOTAL NEEDS                            '
[102] MP←MP,'LESS: BEGINNING INVENTORY              '
[103] MP←MP,'PURCHASE REQUIRED                      '
[104] MP←MP,'PRICE PER UNIT                         '
[105] MP←MP,'COST OF PURCHASES                      '
[106] MP← 7 40 ρMP
[107] 'PRODUCTION DATA';28ρ' ';,('A1' ∆FMT(1,20×N)ρ,M40)
[108] ' '
[109] ('A1' ∆FMT MP),('10CF16.2' ∆FMT MPB)
[110] 'TOTAL';(15+27×N-1)ρ' ';,('CF14.2' ∆FMT+/,MPB[7;])
[111] 1ρCR
[112] →BUD
[113]B5:'
      DIRECT LABOR COST BUDGET


      '
[114] AB←'TOT. HRS. TOTAL      '
[115] 40ρ' ';,('A1' ∆FMT(1,NN×20)ρ,M50);'        TOTAL'
[116] 'PRODUCT';12ρ' ';'PRODUCTION         ';,('A1' ∆FMT(1,NN×ρAB)ρAB);'          BUD
      GET'
[117] ('A1' ∆FMT M1),('10CF12.2' ∆FMT DLCB)
[118] ' '
[119] 'TOTAL';12ρ' ';,('10CI12' ∆FMT(1,2+2×NN)ρDTOT)
[120] 1ρCR
[121] →BUD
[122]B6:'
      OVERHEAD BUDGET
      '
[123] OB←'VARIABLE OVERHEAD                       '
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[124] OB←OB,'FIXED OVERHEAD                            '
[125] OB←OB,'TOTAL OVERHEAD                            '
[126] OB←OB,'DIVIDE BY DIRECT LABOR HOURS              '
[127] OB←OB,'OVERHEAD PER DIRECT LABOR HOUR            '
[128] OB← 5 40 ρOB
[129] ' COSTS ';38ρ' ';,('A1' ΔFMT(1,20×NN)ρ,M50);' TOTAL'
[130] ('A1' ΔFMT OB),('10CF17.2' ΔFMT OHB),('CF17.2' ΔFMT 5 1 ρOTOT)
[131] 1ρCR
[132] →BUD
[133]B7:'
      ENDING FINISHED GOODS INVENTORY BUDGET
      '
[134] AC←'UNITS              '
[135] AD←'REQUIRED  AMOUNT   '
[136] 38ρ' ';,('A1' ΔFMT(1,20×N)ρ,M1)
[137] 24ρ' ';'UNIT      ';,('A1' ΔFMT(1,N×ρAC)ρAC)
[138] 'ITEM(S)';17ρ' ';'COST      ';,('A1' ΔFMT(1,N×ρAD)ρAD)
[139] 'MATERIALS',(9ρBS),9ρ'_'
[140] ' '
[141] ('A1' ΔFMT M40),('10F10.4' ΔFMT EFCIB[ιN;])
[142] ' '
[143] 'DIRECT LABOR',(12ρBS),12ρ'_'
[144] ' '
[145] ('A1' ΔFMT M50),('10F10.4' ΔFMT EFCIB[N+ιNN;])
[146] ' '
[147] 'OVERHEAD',(8ρBS),8ρ'_'
[148] ' '
[149] ('A1' ΔFMT M50),('10F10.4' ΔFMT EFCIB[N+NN+ιNN;])
[150] ' '
[151] '⎕UNIT COST⎕,X21,10F20.4' ΔFMT(1,ρUC)ρUC
[152] '⎕PLANNED INVENTORY⎕,X13,10CI20' ΔFMT(1,ρPI)ρPI
[153] '⎕ENDING FIN. INV.⎕,X14,10CI20' ΔFMT(1,ρEFI)ρEFI
[154] ' '
[155] 'TOTAL INVENTORY';(15+10×N)ρ' ';,('CI20' ΔFMT+/EFI)
[156] 1ρCR
[157] →BUD
      ∇
```

14
Statistical Analysis

A. General Description

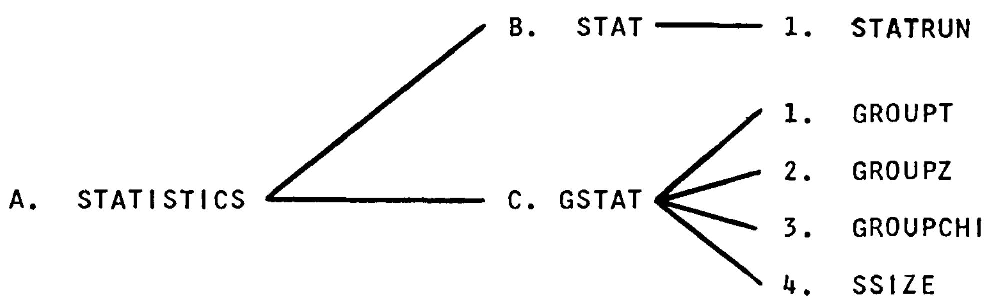
This workspace contains functions which facilitate statistical analysis. There are two workspaces associated with this chapter, STAT and GSTAT. The first workspace contains a program to do statistical analysis on ungrouped data. The second workspace contains a few functions for doing statistical analysis on grouped data and a few functions dealing with sampling decisions. These workspaces can be accessed by the instruction:

)LOAD 2 STAT and)LOAD 2 GSTAT

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The functions contained in the statistical workspaces are detailed in Exhibit 14-1.

Exhibit 14-1
THE STATISTICAL WORKSPACES



The functions and supporting variables for these workspaces are defined further in Exhibit 14-2.

Exhibit 14-2
STATISTICAL FUNCTIONS AND VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
STATRUN	NORM, BINOM, CHT, CHI, TM, TT, TP, ZZ, ZT, ZM, UGROUP, REGRESS, REG, BASIC, FT, CT	SET, LL, PP, N
GROUPT	READ,	-
GROUPZ	READ,ZT	-
GROUPCHI	READ,CHT,NORM,BINOM, UNI	-
SSIZE	ZT	-

B. STAT

This workspace contains a system for the statistical analysis of sets of numbers. There is one major program in this workspace, STATRUN. Once this program is entered the user may do the following things:

1. Enter data to be analyzed

2. Produce basic descriptive analysis on the data including minimum, maximum, mean, etc.

3. Produce dispersion statistics including range, standard deviation, variance, etc.

4. Perform hypothesis testing including t-Test, z-Test, f-Test, and Chi-square Analysis.

5. Perform regression analysis, both simple and multiple.

6. QUIT

Each time the program is ready to perform a new task the user receives a request in the form:

STATISTICAL MODE:

The user should respond in one of the following ways:

1. Enter

When the programs requests that you enter the next statistical mode, type ENTER or E. The first message from the computer is the number of sets currently in existence. In this statistical system "set" refers to a group of numbers. The user can store many sets at one time. The constraint on storage is the workspace size. The computer will inquire which ENTRY TYPE the user wishes. The options are:

a. Add data to the end of an existing set of numbers in the system, or create a new set of numbers in the system. This is specified for example, by entering:

```
ADD 2 5
```

This instruction will cause the program to request the user to enter 5 numbers which will be tagged on to the end set number 2 or if there is no set number 2, it will create a new set and put those five values in it.

b. Change data in an existing set. This is accomplished for example by the following instruction:

```
CHANGE 2 4 5
```

This istruction causes the program to accept 2 numbers and place them in positions 4 5 in set number 2.

c. Delete data from an existing set. This is accomplished by the instruction:

```
DELETE 2 3 5
```

This instruction causes the program to delete item 3 through 5 in set number 2. If the user specifies the whole set of numbers, that set will be deleted and the set number associated with it will be absorbed.

d. List data sets. The system has the facility to list the current values of any of the user's sets. This is accomplished by the following instruction:

```
LIST 1
```

This instruction will solicit a list of the values stored in set number 1. The user can specify more that one set number at a time to be printed.

e. By typing SUMMARY or S, the user can solicit the lengths of the sets currently in the system.

f. Quit exits from the ENTRY MODE and returns the user to where he can specify the next step in his analysis.

2. Basic Statistics

Under this mode the user can ascertain:

(a) The length of the set.
(b) The minimum value of the set.
(c) The maximum value of the set.
(d) The median.
(e) The arithmetic mean.
(f) The geometric mean.
(g) The harmonic mean.

These are solicited by responding to the computer request STATISTICAL MODE by typing BASIC followed by the set numbers for which the user wishes information.

3. Dispersion Statistics

Under this mode the user can ascertain information regarding the dispersion of a set of data around its mean. The information available is:

a. The range of numbers.

b. The standard error of the mean.

c. The standard deviation.

d. The variance.

e. The skewness of the sample. (This is only accomplished if there is a single mode. Otherwise the skewness is replaced by asterisks.)

To request this information respond to the request, STATISTICAL mode, with DISP followed by the desired set numbers.

4. Hypothesis Testing

This mode operates like the entry mode in that to utilize it the user must reply with the name of the mode required, in this case the instruction is:

HYPOTHESIS

The program responds by asking which HYPOTHESIS TYPE the user wishes. To this the user responds with a choice of either a t-Test, z-Test, f-Test, or Chi-Square.

a. The t-Test allows the user to examine relatively small samples to determine differences between a sample mean and population mean or another sample mean. The instruction to solicit this information is:

T 2 or T 2 3

One set number denotes a sample mean being compared to a population mean and two set numbers denote a comparison of two sample means. The user must specify the level of significance he wishes. In addition, in the case of the comparison of a sample against a known population, the user must enter the population mean, standard deviation (if known), and a designation as to whether a one or two tailed test is desired. Output consists of a decision to accept or reject the null hypothesis at the specific level of significance.

b. The z-Test function is identical to the t-Test. It uses the z distribution and is more useful on sample sizes which are greater than 30. The user replaces T in the above example with Z.

c. The f-Test allows the user to compare the variances of two or more sets to ascertain if they are similar. To request an f-Test the user responds to the request HYPOTHESIS TYPE by typing F followed by the set numbers he wishes to compare. The program requests the level of significance the user desires. The program then prints out the needed information to ascertain if the null hypothesis should be accepted or rejected.

d. The Chi-Square test allows the user to test his sample against a number of distributions for goodness of fit. These distributions are (1) the normal, (2) the binomial, and (3) uniform distributions. Also the user has the ability to compare one set against another. The instuction: C 2 or C 2 3 solicits this test. The program then inquires as to the grouping to be used as well as the level of significance desired. The program returns the appropriate information specifying if the null hypothesis should be accepted or rejected.

5. Regression Analysis

Under this mode the user compares sets against each other to determine their intercorrelation. To utilize this routine the user responds to the request STATISTICAL MODE by typing R, followed by the sets he wishes to regress. The last set number entered is assumed to be the dependent variable. The program responds with the regression equation and the regression coefficient. The user can request a table of actual vs. expected values of the dependent variable. A correlation matrix is also available upon request.

NOTE: If the user is using a large amount of data, it is in his interest to eliminate the plot since it requires a large amount of storage. Erasing the plot is accomplished by the command:

```
)ERASE PLOTGRP
```

6. Quit

The last mode is QUIT. This is used in response to the request STATISTICAL MODE when the user has completed his analysis.

C. GSTAT

This workspace contains function to do basic statistics on grouped data. In addition there is one function for determining sample size and one function to print statistical tables. To access this workspace use instruction:

```
)LOAD 2 GSTAT
```

The programs GROUPT, GROUPZ, AND GROUPCHI all begin their execution by requesting the user to enter his grouped data. This is accomplised by the user entering (1) the class minimum value, (2) the maximum class value, and (3) the class size. Each program prints basic statistical analysis on this data, including the mean and standard deviation.

1. GROUPT

This function performs a t-Test to determine whether the sample mean is the same as the population mean. Input consists of:

a. Group class information.
(low value, high value, class size)

b. Level of confidence.

c. One or two tailed test.

d. Population mean.

e. Population standard deviation (if known).

The output consists of:

a. Mean of sample.

b. Standard error of mean.

c. t-Value.

d. Critical value in test.

e. A statement of whether the null hypothesis should be accepted.

2. GROUPZ

This function acts exactly like GROUPT except the z distribution is used.

3. GROUPCHI

This function performs a Chi-square test on grouped data. The inputs once the data has been entered are identical to the Chi-square program in STAT. Users should consult that description for further information.

4. SSIZE

This program calculates the additional sample size that must be taken to obtain the desired error factor. Input consists of:

a. The preliminary sample mean.

b. The level of confidence desired.

c. The preliminary sample size.

d. desired sample error.

The program produces the desired sample size.

```
      STATRUN

IF AT ANY TIME WHILE YOU ARE USING THIS STAT PACKAGE
YOU ARE UNCLEAR AS TO WHAT YOU SHOULD ENTER, JUST STRIKE
THE CARRIAGE RETURN AND YOU WILL RECEIVE ADDTIONAL INFORMATION
STATISTICAL MODE:E
THERE ARE 0 SETS OF DATA STORED CURRENTLY
ENTRY TYPE:
THE VALID ENTRIES ARE: ADD,CHANGE,DELETE,LIST, SUMMARY AND QUIT
ENTRY TYPE:A 1 4
ENTER 4 VALUES TO BE ADDED TO THE SET NUMBER 1
⎕:
      74 65 72 69
ENTRY TYPE:A 2 5
ENTER 5 VALUES TO BE ADDED TO THE SET NUMBER 2
⎕:
      75 78 74 76 72
ENTRY TYPE:A 3 4
ENTER 4 VALUES TO BE ADDED TO THE SET NUMBER 3
⎕:
      56 55 53 52
ENTRY TYPE:S
SET      LENGTH
  1          4
  2          5
  3          4
ENTRY TYPE:L 1 2 3
```

```
SET NUMBER 1
TERM      VALUE
   1     74.000
   2     65.000
   3     72.000
   4     69.000

SET NUMBER 2
TERM      VALUE
   1     75.000
   2     78.000
   3     74.000
   4     76.000
   5     72.000

SET NUMBER 3
TERM      VALUE
   1     56.000
   2     55.000
   3     53.000
   4     52.000
ENTRY TYPE:Q
STATISTICAL MODE:
THE VALID MODES ARE:ENTER, BASIC, DISPERSION, HYPOTHESIS, REGRESSION,
      AND QUIT
STATISTICAL MODE:B 1 2 3

 NO. LENGTH       MIN         MAX        MEDIAN       ARITH        GEO.        HARM.
                                                       MEAN        MEAN        MEAN
   1    4       65.000      74.000      69.000      70.000      69.917      69.833
   2    5       72.000      78.000      75.000      75.000      74.973      74.947
   3    4       52.000      56.000      53.000      54.000      53.977      53.954
STATISTICAL MODE:D 1 2 3
```

```
NO.       RANGE       AVERAGE    STANDARD      VARIANCE    SKEWNESS
                     DEVIATION   DEVIATION

  1       9.000       3.000       3.391       11.500     **********
  2       6.000       1.600       2.000        4.000     **********
  3       4.000       1.500       1.581        2.500     **********
STATISTICAL MODE:H
HYPOTHESIS TYPE: F 1 2 3
LEVEL OF SIGNIFICANCE:  .05
VARIATION        VARIATION         F-VALUE     CRITICAL
BTWM CLASSES     WITHIN CLASSES                POINT
        7.60       516.00            4.10      67.89

     -> ACCEPT <-
STATISTICAL MODE:H
HYPOTHESIS TYPE: Z 1 2
LEVEL OF SIGNIFICANCE: .05
MEAN 1       MEAN 2      ST ERROR      Z-VALUE         CRITICAL
                         OF MEAN                       VALUE
    70.000     75.000       1.117      1.960    ¯2.189    2.189

     -> REJECT <-
STATISTICAL MODE:H
HYPOTHESIS TYPE: Z 2
LEVEL OF SIGNIFICANCE .05
ONE OR TWO TAILED TEST ONE
LEFT OR RIGHT TEST: R
POPULATION MEAN: 65
ENTER POPULATION STANDARD DEVIATION OR ? IF UNKNOWN: ?

     MEAN       S.D. ST. ERROR    Z-VALUE          CRITICAL
                                                   POINT(S)
     75.00       2.00       1.00      1.96     66.96

     -> REJECT <-
STATISTICAL MODE:E
```

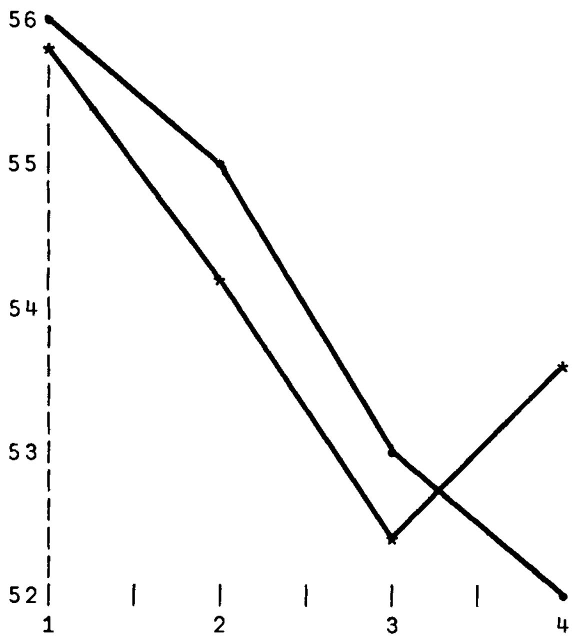
```
THERE ARE 3 SETS OF DATA STORED CURRENTLY
ENTRY TYPE:A 4 100
ENTER 100 VALUES TO BE ADDED TO THE SET NUMBER 4
⎕:
      (15ρ0),(30ρ1),(45ρ2),10ρ3
ENTRY TYPE:S
SET      LENGTH
  1         4
  2         5
  3         4
  4       100
ENTRY TYPE:Q
STATISTICAL MODE:H
HYPOTHESIS TYPE: C 4
ENTER PROBABILITY DISTRIBUTION DESIRED: B
ENTER A LOW VALUE AND CLASS WIDTH FOR SET   4: 0 1
ENTER PROBABILITY OF EVENT: .5
ENTER LEVEL OF SIGNIFICANCE: .05
X-SQUARED =      4.000   CRITICAL VALUE IS      7.815

     -> ACCEPT <-
STATISTICAL MODE:R 2 1 3

THE RESULTING EQUATION IS:
X3 = ¯142.395   + 1.860 X2   + 0.793 X1
THE SQUARE OF THE MULTIPLE CORR COEFF IS:      0.610
THE ST ERROR OF EXTIMATE IS:      1.975
  THE STANDARD ERROR AND T-VALUES OF THE INDEPENDENT VARIABLES ARE:
       STANDARD ERROR      T-VALUE

 X2          1.512          1.230
 X1          0.659          1.203
DO YOU WISH TO SEE A CORRELATION MATRIX? YES
```

	2	1	3
2	1.000	0.989	0.999
1	0.989	1.000	0.990
3	0.999	0.990	1.000

DO YOU WISH A TABLE OF THE ACTUAL VS THE EXPECTED VALUES OF THE DEPENDENT VARIABLE? YES

PERIOD	*ACTUAL*	*EXPECTED*	*DIFFERENCE*	o/o
1	56.000	55.777	0.223	0.40
2	55.000	54.220	0.780	1.42
3	53.000	52.331	0.669	1.26
4	52.000	53.672	¯1.672	¯3.22

DO YOU WISH A PLOT OF THE ACTUAL VS THE EXPECTED? YES



STATISTICAL MODE:Q

```
      GROUPT
ENTER NUMBER OF CLASSES: 5
ENTER THE CLASS MINIMUM VALUE, THE CLASS MAXIMUM VALUE, AND THE CLASS SIZE
IN THAT ORDER
ENTER CLASS 1 VALUES
⎕:
      0 2 2
ENTER CLASS 2 VALUES
⎕:
      2 4 5
ENTER CLASS 3 VALUES
⎕:
      4 6 4
ENTER CLASS 4 VALUES
⎕:
      6 8 8
ENTER CLASS 5 VALUES
⎕:
      8 10 1
DO YOU WISH TO SEE YOUR INPUT? N


   LENGTH    ARITH  VARIANCE    STD DEV
             MEAN
     20.00      5.10      4.99      2.23
LEVEL OF SIGNIFICANCE .05
ONE OR TWO TAILED TEST ONE
LEFT OR RIGHT TEST: R
POPULATION MEAN: 5
ENTER POPULATION STANDARD DEVIATION OR ? IF UNKNOWN: ?

      MEAN      S.D.  ST.ERROR    T-VALUE  CRITICAL
                                           POINT(S)
      5.10      2.23      0.51      1.73      5.88

     -> ACCEPT <-
```

```
      GROUPZ
ENTER NUMBER OF CLASSES: 4
ENTER THE CLASS MINIMUM VALUE, THE CLASS MAXIMUM VALUE, AND THE CLASS SIZE
IN THAT ORDER
ENTER CLASS 1 VALUES
⎕:
      0 2 2
ENTER CLASS 2 VALUES
⎕:
      2 4 5
ENTER CLASS 3 VALUES
⎕:
      4 6 4
ENTER CLASS 4 VALUES
⎕:
      6 8 8
DO YOU WISH TO SEE YOUR INPUT? YES
CLASS   MINIMUM   MAXIMUM     CLASS   AVERAGE      F(X)
NO.     VALUE     VALUE       SIZE    VALUE
    1     0.000     2.000     2.000     1.000     2.000
    2     2.000     4.000     5.000     3.000    15.000
    3     4.000     6.000     4.000     5.000    20.000
    4     6.000     8.000     8.000     7.000    56.000


   LENGTH    ARITH  VARIANCE    STD DEV
             MEAN
     19.00      4.89      4.41      2.10
LEVEL OF SIGNIFICANCE .05
ONE OR TWO TAILED TEST TWO
POPULATION MEAN: 5
ENTER POPULATION STANDARD DEVIATION OR ? IF UNKNOWN: ?

      MEAN      S.D. ST. ERROR    Z-VALUE         CRITICAL
                                                  POINT(S)
      4.89      2.10      0.49      2.24      3.89      6.11

     -> ACCEPT <-
```

```
      GROUPCHI
ENTER NUMBER OF CLASSES: 4
ENTER THE CLASS MINIMUM VALUE, THE CLASS MAXIMUM VALUE, AND THE CLASS SIZE
IN THAT ORDER
ENTER CLASS 1 VALUES
⎕:
      0 0 15
ENTER CLASS 2 VALUES
⎕:
      1 1 35
ENTER CLASS 3 VALUES
⎕:
      2 2 40
ENTER CLASS 4 VALUES
⎕:
      3 3 10
DO YOU WISH TO SEE YOUR INPUT? NO


   LENGTH    ARITH  VARIANCE    STD DEV
             MEAN
    100.00      1.45      0.75      0.86
ENTER PROBABILITY DISTRIBUTION DESIRED:
DISTRIBUTIONS AVAILABLE ARE: UNIFORM, BINOMIAL, OR NORMAL

ENTER PROBABILITY DISTRIBUTION DESIRED: B
ENTER PROBABILITY OF EVENT: .5
ENTER LEVEL OF SIGNIFICANCE: .05
X-SQUARED =       1.333   CRITICAL VALUE IS       7.815

     -> ACCEPT <-
```

```
      SSIZE
ENTER PRELIMINARY SAMPLE STANDARD DEVIATION 15.3
ENTER PRELIMINARY SAMPLE SIZE 100
ENTER DESIRED LEVEL OF SIGNIFICANCE .05
STANDARD ERROR OF PRELIMINARY SAMPLE IS + OR - 2.9988
ENTER DESIRED SAMPLE ERROR  1.5

SAMPLE SIZE SHOULD BE 400
```

C-4 SSIZE

B-1 STATRUN

```
      ∇STATRUN[⎕]∇
    ∇ STATRUN;A
[1]   '
      IF AT ANY TIME WHILE YOU ARE USING THIS STAT PACKAGE
      YOU ARE UNCLEAR AS TO WHAT YOU SHOULD ENTER, JUST STRIKE
      THE CARRIAGE RETURN AND YOU WILL RECEIVE ADDTIONAL INFORMATION'
[2]   TOP:→('EBDHRQ'=1↑A←AKI 'STATISTICAL MODE: ',2ρBS)/ENTER,BAS,DISP
      ,HYP,REGRE,0
[3]   'THE VALID MODES ARE:ENTER, BASIC, DISPERSION, HYPOTHESIS, REGR
      ESSION, AND QUIT'
[4]   →TOP
[5]   ENTER:UGROUP
[6]   →TOP
[7]   BAS:BASIC A
[8]   →TOP
[9]   DISP:DISPS A
[10]  →TOP
[11]  HYP:HYPO
[12]  →TOP
[13]  REGRE:REGRESS A
[14]  →TOP
    ∇
```

```
      ∇BASIC[⎕]∇
    ∇ BASIC A;V;V̲;J
[1]   →(∧/(0≠ρV),V←ΔVI A←(Aι' ')↓A)/B1
[2]   'THE PROPER FORM OF A BASIC REQUEST IS:
      B, FOLLOWED BY A SERIES OF SET NUMBERS'
[3]   →0
[4]   B1:→(∧/(0<V),(ρL̲L̲)≥V←,ΔFI A)/B2
[5]   'SET NUMBER OUT OF RANGE'
[6]   →0
[7]   B2:'
       NO. LENGTH      MIN          MAX       MEDIAN        ARITH
       GEO.        HARM.
                                                            MEAN
       MEAN        MEAN'
[8]   B3:J←((+/V̲)÷ρV̲),((×/V̲)*÷ρV̲),÷+/(÷V̲+1E¯74)÷ρV̲←S̲E̲T̲[P̲P̲[V[1]]+ιL̲L̲[V[
      1]]]
[9]   '2I4,6F12.3' ΔFMT(1 8 ρV[1],L̲L̲[V[1]],(⌊/V̲),(⌈/V̲),((V̲[⍋V̲])[⌈(ρV̲)
      ÷2]),J)
[10]  →(0=ρV←1↓V)/0
[11]  →B3
    ∇
```

```
      ∇UGROUP[⎕]∇
    ∇ UGROUP;L̲;P̲;S̲E̲T̲;V̲;V;J;JJ;I
[1]    L̲←L̲L̲
[2]    P̲←P̲P̲
[3]    S̲E̲T̲←S̲E̲T̲
[4]    'THERE ARE ';(ρP̲);' SETS OF DATA STORED CURRENTLY'
[5]   TOP:→('ACDLQS'=1↑A←AKI 'ENTRY TYPE: ',2ρBS)/ADD,CHANGE,DELETE,
       LIST,END,SUM
[6]    'THE VALID ENTRIES ARE: ADD,CHANGE,DELETE,LIST, SUMMARY AND QUI
       T'
[7]    →TOP
[8]   ADD:→((∨/~ΔVI A)∨2≠ρV←ΔFI A←(A⍳' ')↓A)/ERRA
[9]    →((ρP̲)≥V[1])/UG12
[10]   P̲←P̲,(¯1↑P̲)+¯1↑L̲
[11]   L̲←L̲,0
[12]   V[1]←ρP̲
[13]  UG12:J←⍳0
[14]   'ENTER ';V[2];' VALUES TO BE ADDED TO THE SET NUMBER ';V[1]
[15]  UG5:J←INP V[2]
[16]   S̲E̲T̲←(JJ↑S̲E̲T̲),J,(JJ←P̲[V[1]]+L̲[V[1]])↓S̲E̲T̲
[17]   JJ←(0,V[1]≤⍳¯1+ρP̲)\ρJ
[18]   L̲[V[1]]←L̲[V[1]]+V[2]
[19]   P̲←P̲+JJ
[20]   →(0=ρV←2↓V)/TOP
[21]   →ADD
[22]  CHANGE:→(∨/~ΔVI A)∨3≠ρV←FI A←(A⍳'  ')↓A)/ERRC
[23]   →((ρP̲)≥V[1])/CH1
[24]   'INVALID SET NUMBER'
[25]   →TOP
[26]  CH1:→(L̲[V[1]]≥V[3])/CH2
[27]   'INVALID TERM NUMBER REFERENCED'
[28]   →TOP
[29]  CH2:I←⍳0
[30]   'ENTER ';(J←1+-/V[3 2]);' VALUES'
[31]  CH21:→(0=ρA←AKI CR,'⎕:    ')/TOP
[32]   →(∧/ΔVI A)/CH3
[33]   'INVALID NUMERIC ENTRY'
[34]   →CH21
[35]  CH3:→(J≥(ρI)+ρV̲←ΔFI A)/CH4
[36]   'TOO MANY TERMS, PLEASE REENTER LAST LINE'
[37]   →CH21
[38]  CH4:→(J=(ρI)+ρV̲)/CH5
[39]   I←I,V̲
[40]   →CH21
[41]  CH5:S̲E̲T̲[P̲[V[1]]+V[2]+0,⍳(-/V[3 2])]←I,V̲
[42]   →TOP
[43]  DELETE:→((∨/~ΔVI A)∨3≠ρV←ΔFI A←(A⍳' ')↓A)/ERRD
[44]   →(((ρP̲)≥V[1])∧V[1]>0)/D1
[45]   'INVALID SET NUMBER'
[46]   →TOP
[47]  D1:→((L̲[V[1]]≥V[3])∧V[2]≥1)/D2
[48]   'TERM SPECIFIED DOES NOT EXIST'
[49]   →TOP
[50]  D2:S̲E̲T̲←((P̲[V[1]]+V[2]-1)↑S̲E̲T̲),(P̲[V[1]]+V[3])↓S̲E̲T̲
[5
```

```
[51]  J←(0,V[1]≤ι¯1+ρP)\(-/V[3 2])+1
[52]  P←P-J
[53]  →(0≠L[V[1]]←L[V[1]]-1+-/V[3 2])/D3
[54]  L←(V←(V[1]≠ιρL))/L
[55]  P←V/P
[56] D3:→TOP
[57] LIST:→(∨/~ΔVI A←(Aι' ')↓A)/ERRL
[58]  →(∧/((ρP)≥V),0<V←ΔFI A)/L1
[59]  'INVALID SET NUMBER'
[60]  →TOP
[61] L1:V←SET[P[V[1]]+ιL[V[1]]]
[62]  '
      SET NUMBER ';V[1];'
      TERM      VALUE'
[63]  'I4,F10.3' ΔFMT((((ρV),1)ριρV),((ρV),1)ρV)
[64]  →(0=ρV←1↓V)/TOP
[65]  →L1
[66] SUM:'SET       LENGTH'
[67]  'I3,I10' ΔFMT((((ρL),1)ριρL),((ρL),1)ρL)
[68]  →TOP
[69] ERRA:'THE PROPER FORM OF AN ADD COMMAND IS:
      ADD, SET NUMBER,NO. OF TERMS '
[70]  →TOP
[71] ERRC:'THER PROPER FORM OF A CHANGE COMMAND IS:'
[72]  'CHANGE, SET NUMBER, FIRST TERM TO CHANGE, LAST TERM TO CHANGE'
[73]  →TOP
[74] ERRD:'THE PROPER FORM OF A DELETE COMMAND IS:'
[75]  'DELETE, SET NUMBER, FIRST TERM TO DELETE, LAST TERM TO DELETE'
[76]  →TOP
[77] ERRL:'THE PROPER FORM OF THE LIST COMMAND IS:'
[78]  'LIST, SET NUMBER'
[79]  →TOP
[80] END:SET←SET
[81]  PP←P
[82]  LL←L
```

```
      ∇DISPS[⎕]∇
    ∇ DISPS A;V;V̲;S;I
[1]    →(∧/(0≠ρV),V←ΔVI A←(A⍳' ')↓A)/D1
[2]    'THE PROPER FORM OF A DISPERSION REQUEST IS:
       D, FOLLOWED BY A SERIES OF SET NUMBERS'
[3]    →0
[4]   D1:→(∧/(0<V),(ρL̲L̲)≥V←ΔFI A)/7
[5]    'SET NUMBER OUT OF RANGE'
[6]    →0
[7]    '
        NO.       RANGE       AVERAGE     STANDARD      VARIANCE     SKEWNE
       SS
                                DEVIATION   DEVIATION
       '
[8]   D3:I←(A-MD V̲)÷S←(VA←((X←V̲-(A←(+/V̲)÷ρV̲))+.*2)÷ρV̲←S̲E̲T̲[P̲P̲[V[1]]+⍳L̲L̲
       [V[1]]])*0.5
[9]    'I4,4F12.3,X3,F10.2' ΔFMT(1 6 ρV[1],(-/(V̲[⍋V̲])[(ρV̲),1]),((+/|X)
       ÷ρV̲),S,VA,I)
[10]   →(0=ρV←1↓V)/0
[11]   →D3
    ∇
```

```
      ∇HYPO[⎕]∇
    ∇ HYPO;V;I;T̲
[1]   H0:→(5≠T̲←'TZCF'⍳1↑A←AKI 'HYPOTHESIS TYPE:')/L0
[2]    →0,ρ⍞←'THE VALID TYPES ARE:
       T-TEST, Z-TEST, CHI-SQUARE, AND F-TEST',CR
[3]   L0:→(∧/1=ΔVI A←(A⍳' ')↓A)/L1
[4]    →H0,ρ⍞←'INVALID SET NUMBER',CR
[5]   L1:→(∧/(∧/V>0),(∧/V=⌈V),∧/(ρL̲L̲)≥V←ΔFI A)/L2
[6]    →H0,ρ⍞←'SET NUMBER OUT OF RANGE',CR
[7]   L2:→(T̲= 1 2 3 4)/T,Z,CHC,FTC
[8]    →H0,ρ⍞←'SOMETHING WRONG',CR
[9]   T:→(1 2 =ρV)/T1,T3
[10]   →H0,ρ⍞←'THE PROPER FORM OF A T-TEST REQUEST IS:
       T, SET NUMBER OR TWO SET NUMBERS',CR
[11]  T1:TT S̲E̲T̲[P̲P̲[V[1]]+⍳L̲L̲[V[1]]]
[12]   →0
[13]  T3:S̲E̲T̲[P̲P̲[V[1]]+⍳L̲L̲[V[1]]] TM S̲E̲T̲[P̲P̲[V[2]]+⍳L̲L̲[V[2]]]
[14]   →0
[15]  Z:→(1 2 =ρV)/Z1,Z2
[16]   →H0,ρ⍞←'THE PROPER FORM OF A Z-TEST REQUEST IS:
       Z, SET NUMBER OR TWO SET NUMBERS',CR
[17]  Z1:ZZ S̲E̲T̲[P̲P̲[V[1]]+⍳L̲L̲[V[1]]]
[18]   →0
[19]  Z2:S̲E̲T̲[P̲P̲[V[1]]+⍳L̲L̲[V[1]]] ZM S̲E̲T̲[P̲P̲[V[2]]+⍳L̲L̲[V[2]]]
[20]   →0
[21]  CHC:→(∨/ 1 2 =ρV)/CH2
[22]   'THE PROPER FORM OF A CHI-SQUARE REQUEST IS:
       C, FOLLOWED BY ONE OR TWO SET NUMBERS'
```

```
[23]  →H0
[24] CH2:CHI A
[25]  →0
[26] FTC:I←1
[27]  TAB←((T←⌈/LL[V]),0)⍴0
[28] LP:TAB←TAB,(T,1)⍴T↑SET[PP[V[I]]+⍳LL[V[I]]]
[29]  →((⍴V)≥I←I+1)/LP
[30]  LL[V] FT⍉TAB
```

```
      ∇REGRESS[⎕]∇
    ∇ REGRESS V;DATA;SI;S;N;E;A;E;R;T;D
[1]   →(∧/(0≠⍴J),J←ΔVI V←(V⍳' ')↓V)/R1
[2]   →0,⍴⍞←'THE PROPER FORM OF A REGRESSION REQUEST IS:
      R, FOLLOWED BY A SERIES OF SET NUMBERS WHERE THE LAST NUMBER
      IS THE DEPENDENT VARIABLE',CR
[3]  R1:→(∧/(0<V),(⍴LL)≥N←¯1⌽⍳⍴V←,ΔFI V)/B2
[4]   →0⍴⍞←'SET NUMBER OUT OF RANGE',CR
[5]  B2:J←⍳0
[6]   I←1
[7]   DATA←(0,SI←⌊/LL[V])⍴0
[8]  R4:DATA←DATA,[1] SET[PP[V[I]]+⍳SI]
[9]   →((⍴V)≥I←I+1)/R4
[10]  R←(⍳¯1+¯1↑⍴DATA) REG DATA←⍉(DATA,[1](⍳¯1↑⍴DATA))
[11]  R[;1]←((+/ 1 ¯1 +⍴V),1)⍴(¯1⌽V),(¯1+⍴V)⍴0
[12]  N←¯1⌽⍳⍴V
[13]  'THE RESULTING EQUATION IS:'
[14]  (,('⎕X⎕,I1,⎕ = ⎕,F8.3' ΔFMT 1 2 ⍴R[1; 1 2])),(,(FORMAT ΔFMT(1,(
      2×⍴1↓N))⍴R[(1↓⍳⍴N); 2 1]))
[15]  '⎕THE SQUARE OF THE MULTIPLE CORR COEFF IS: ⎕,F10.3  ' ΔFMT R[(
      3+(⍴N));5]
[16]  '⎕THE ST ERROR OF EXTIMATE IS: ⎕,F10.3' ΔFMT R[(3+(⍴N));
      4]
[17]  '  THE STANDARD ERROR AND T-VALUES OF THE INDEPENDENT VARIABLES
       ARE:'
[18]  '        STANDARD ERROR      T-VALUE
      '
[19]  '⎕ X⎕,I1,X5,F10.3,X4,F10.3' ΔFMT R[(1↓⍳⍴N); 1 3 4]
[20]  E←(SI,(⍴N))⍴0
[21]  E[;(⍳⍴1↓N)]←DATA[;(1↓N)]
[22]  E[;(¯1↑⍴E)]←R[1;2]+(E[;(⍳⍴1↓N)]+.×((⍴1↓N),1)⍴1↓R[(⍳⍴N);
      2])
[23]  E←,E[;(¯1↑⍴E)]
[24]  D←A←,DATA[;(1↑N)]
[25]  D[(0=D)/⍳⍴D]←9.999999999999999E¯66
[26]  E←(⍉(5,SI)⍴((T←,DATA[;(¯1↑⍴DATA)]),A,E,(A-E),100×(A-E)÷D))
[27]  →(~AYN 'DO YOU WISH TO SEE A CORRELATION MATRIX?')/TAB1
[28]  'X9,10I9' ΔFMT(1,(⍴V))⍴V
[29]  'I9,8F9.3' ΔFMT((((⍴V),1)⍴V),CM⍉DATA[(⍳⍴V);])
[30] TAB1:→(~AYN 'DO YOU WISH A TABLE OF THE ACTUAL VS THE EXPECTED V
      ALUES OF THE DEPENDENT VARIABLE?')/PLT
```

```
[31]  FORM COLNAMES 'αPERIODαACTUALαEXPECTEDαDIFFERENCEα○/○ '
[32]  FORM ΔFMT E
[33] PLT:→(~AYN 'DO YOU WISH A PLOT OF THE ACTUAL VS THE EXPECTED?')/
      END
[34]  20 40 PLOT A AND E VS T
[35] END:→0


      ∇CHT[⎕]∇
    ∇ R←L CHT V;T;VA
[1]   →(∨/A←0,(FF 19)∧.=22↑'          1 STATTAB')/L0
[2]   '1 STATTAB' FF 4,(T←((⍳11)∊0,FF 18)⍳0),32948
[3]   →L1
[4]  L0:T←(1↓A)/FF 18
[5]  L1:→(L≥ 0.1 0.05 0.001)/L11,L2,L3
[6]  L11:R←,(FF 6,T,5,32948)[3;V⌊30]
[7]   →0
[8]  L2:R←VA[2]+((0.1-L)÷0.05)×-/VA←,(FF 6,T,5,32948)[2 3 ;V⌊
      30]
[9]   →0
[10] L3:R←VA[2]+((0.05-L)÷0.049)×-/VA←,(FF 6,T,5,32948)[1 2 ;V⌊
      30]
    ∇


      ∇CHI[⎕]∇
    ∇ CHI B;V;F;F1;F2;L
[1]  L0:→(∧/(2≥ρV),V←ΔVI B)/L1
[2]   →L0,ρ⍞←'INVALID SET NUMBER'
[3]  L1:→(∧/((⌊V)=V),((ρLL)≥V),0<V←ΔFI B)/L12
[4]   →L1,ρ⍞←'INVALID SET NUMBER',CR
[5]  L12:→((ρV)>1)/DOU
[6]  L2:→((⍳4)='UBN'⍳D←1↑AKI 'ENTER PROBABILITY DISTRIBUTION DESIRED:
      ')/UN,BI,NO,ERR
[7]  ERR:'DISTRIBUTIONS AVAILABLE ARE: UNIFORM, BINOMIAL, OR NORMAL',
      CR
[8]   →L2
[9]  UN:F←(F1←LL[V[1]] UNIρE)-E←FRE SET[PP[V[1]]+⍳LL[I←V[1]]]
[10]  →OUTPUT
[11] BI:F←(F1←LL[V[1]] BINOMρE)-E←FRE SET[PP[V[1]]+⍳LL[I←V[1]]]
[12]  →OUTPUT
[13] NO:F←(F1←LL[V[1]] NORMρE)-E←FRE SET[PP[V[1]]+⍳LL[I←V[1]]]
[14]  →OUTPUT
[15] DOU:→((ρF1←FRE SET[PP[V[1]]+⍳LL[V[1]]])=ρF2←FRE SET[PP[V[1]]+⍳LL
      [V[1]]])/L5
[16]  →(AYN 'THE TWO GROUPINGS JUST SETUP HAVE DIFFERENT NUMBERS OF C
      LASSES',CR,'DO YOU WISH TO RE-SPECIFY?')/DOU
[17]  →0
[18] L5:→(20>ρF←F1-F2)/OUTPUT
```

```
[19]  →(AYN 'TOO MANY CLASSES, MUST BE LESS THAN 20',CR,'DO YOU WISH
      TO RE-SPECIFY?')/DOU
[20]  →0
[21] OUTPUT:→(∧/(0.001≤L),0.1≥L←NIP 'ENTER LEVEL OF SIGNIFICANCE:')/
      L6
[22]  →OUTPUT,ρ⍞←'THE VALUE ENTERED MUST BE BETWEEN .001 AND .1',CR
[23] L6:'⎕X-SQUARED = ⎕,F10.3,⎕   CRITICAL VALUE IS ⎕,F10.3' ΔFMT(
      1 2 ρ(F1←+/(F*2)÷F1),F2←L CHT(ρF)-1)
[24]  →(F1≤F2)/ACC
[25]  LF,(5ρ' '),'-> REJECT <-'
[26]  →0
[27] ACC:LF,(5ρ' '),'-> ACCEPT <-'
```

```
      ∇FT[⎕]∇
    ∇ N FT A;N;L;D1;D2;D;F;W;FV
[1]   D←(+/((ρA)ρV\(V←,N∘.≥⍳⌈/N)/W←,(A-⍉((⌈/N),ρN)ρ(+/A)÷N))+.*
      2)
[2]   F←(W←(+/N×(((+/A)÷N)-(+/+/A)÷+/N)*2)÷D2←(ρN)-1)÷D←D÷D1←(+/N)-
      3
[3]  L0:→((0<L),1>L←NIP 'LEVEL OF SIGNIFICANCE:')/L1
[4]   →L0,ρ⍞←'VALUE SHOULD BE BETWEEN 0.0 AND 1.0',CR
[5]  L1:'VARIATION         VARIATION         F-VALUE      CRITICAL '
[6]   'BTWM CLASSES    WITHIN CLASSES                   POINT'
[7]   '4F12.2' ΔFMT(D;W;(FV←(L FF D1,D2));F)
[8]   →(F≥FV)/ACC
[9]   LF,(5ρ' '),'-> REJECT <-'
[10]  →0
[11] ACC:LF,(5ρ' '),'-> ACCEPT <-'
    ∇
```

```
      ∇ZM[⎕]∇
    ∇ C ZM B;SE;C;B;C;ME;T
[1]   LR←0
[2]  L0:→((0<L),1≥L←NIP 'LEVEL OF SIGNIFICANCE:')/L1
[3]   →L0,ρ⍞←'VALUE MUST BE BETWEEN 0.0 AND 1.0'
[4]  L1:C←(T←ZT 1,1-L)×SE←(((MS C)[1]÷ρC)+(MS B)[1]÷ρB)*
      0.5
[5]   'MEAN 1     MEAN 2     ST ERROR     Z-VALUE        CRITICAL'
[6]   '                      OF MEAN                     VALUE'
[7]   '4F10.3,2F9.3' ΔFMT(1 6 ρ(ME←(MS C)[2],(MS B)[2]),SE,T,C←
      ¯1 1 ×C)
[8]   LF,(5ρ' '),(2 12 ρ'-> REJECT <--> ACCEPT <-')[(∧/(C[1]<ME),(C[
      2]>ME←-/ME))+1;]
    ∇
```

```
      ∇TM[⎕]∇
    ∇ C TM B;SE;C;B;C̲;M̲E̲;T̲
[1]   L̲R̲←0
[2]  L0:→((0<L̲),1≥L̲←NIP 'LEVEL OF SIGNIFICANCE:')/L1
[3]   →L0,ρ⍞←'VALUE MUST BE BETWEEN 0.0 AND 1.0'
[4]  L1:C̲←(T̲←L̲ TP ¯1+(ρC)⌊ρB)×SE←(((MS C)[1]÷ρC)+(MS B)[1]÷ρB)*
      0.5
[5]   'MEAN 1     MEAN 2     ST ERROR     T-VALUE     CRITICAL'
[6]   '                      OF MEAN                  POINT(S)'
[7]   '4F10.3,2F9.3' ΔFMT(1 6 ρ(M̲E̲←(MS C)[2],(MS B)[2]),SE,T̲,C̲←
      ¯1 1 ×C̲)
[8]   L̲F̲,(5ρ' '),(2 12 ρ'-> REJECT <--> ACCEPT <-')[(∧/(C̲[1]<M̲E̲),(C̲[
      2]>M̲E̲←-/M̲E̲))+1;]
    ∇
```

```
      ∇BINOM[⎕]∇
    ∇ R←N̲ BINOM C̲;P̲
[1]   →((P̲≤1),0≤P̲←NIP 'ENTER PROBABILITY OF EVENT:')/L1
[2]   →L0,ρ⍞←'ENTER NUMBER BETWEEN 0 AND 1'
[3]  L1:R←((((1-P̲)*⌽C̲)×P̲*C̲)×(C̲←0,¯1+⍳C̲)!C̲-1)×N̲
    ∇
```

```
      ∇FRE[⎕]∇
    ∇ R←FRE B;V;C;S
[1]  L0:→(∧/(2=ρV),V←ΔVI A←AKI 'ENTER A LOW VALUE AND CLASS WIDTH FOR
       SET ',(,'I3' ΔFMT I),':')/L1
[2]   →L0,ρ⍞←'ENTER TWO NUMBERS'
[3]  L1:→((V[2]>0)∧(V←ΔFI A)[1]≤⌊/B)/C2
[4]   →L0,ρ⍞←'IMPROPER ENTRIES',CR
[5]  C2:R←+/((⍳ρS)∘.≤C)∧(⍳ρS)∘.≥C←1⊥(⍉B∘.≥V[1]+(0,S←⍳⌈(1+(⌈/B)-V[1])÷
      V[2])×V[2])
    ∇
```

```
      ∇UNI[⎕]∇
    ∇ R←N̲ UNI C̲
[1]   R←(C̲)ρN̲÷C̲
    ∇
```

```
      ∇TT[⎕]∇
    ∇ TT B;L;T;C;OT;ME;M;SE;SD;A
[1]   LO:→((0<L),1>L←NIP 'LEVEL OF SIGNIFICANCE')/L1
[2]    →LO,ρ⍞←'THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0'
[3]   L1:→(1=+/OT←(4 3 ρ'ONETWO1  2  ')∧.=3↑AKI 'ONE OR TWO TAILED TES
       T')/L2
[4]    →L1,ρ⍞←'ENTER ONE, TWO, 1 OR 2'
[5]   L2:→(2=OT←OT/ 1 2 1 2)/L3
[6]   L25:→(0≠OT←(1 ¯1 0)['LR'⍳1↑AKI 'LEFT OR RIGHT TEST:'])/L3
[7]    →L25,ρ⍞←'ENTER LEFT OR RIGHT'
[8]   L3:→(1=ρ,M←NIP 'POPULATION MEAN:')/L4
[9]    →L3,ρ⍞←'ENTER ONE VALUE'
[10]  L4:→('?'≠1↑A←AKI 'ENTER POPULATION STANDARD DEVIATION:')/L5
[11]   →L6,SD←(MS B)[1]×(÷/ 0 ¯1 +ρB)*0.5
[12]  L5:→(1=ΔVI A)/L55
[13]   →L3,ρ⍞←'ENTER ONE VALUE, OR IF UNKNOWN, ?'
[14]  L55:SD←ΔFI A
[15]  L6:'MEAN     S.D.     ST. ERROR      T-VALUE       CRITICAL '
[16]   '                  OF MEAN                      POINT(S)'
[17]   '6F10.2' ΔFMT(1,4+|OT)ρ((ME←MS B)[2 1]),SE,T,C←M+(T←L TP
       ¯1+ρB)×(SE←SD÷((ρB)*0.5))×(OT)↑(1 ¯1)
[18]   →(∧/(×C-ME[2])=(OT)↑ ¯1 1)/AC
[19]   LF,(5ρ' '),'-> REJECT <-'
[20]   →0
[21]  AC:LF,(5ρ' '),'-> ACCEPT <-'
    ∇
```

```
      ∇ZZ[⎕]∇
    ∇ ZZ B;L;T;C;OT;ME;M;SE;SD;A
[1]   LO:→((0<L),1>L←NIP 'LEVEL OF SIGNIFICANCE')/L1
[2]    →LO,ρ⍞←'THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0'
[3]   L1:→(1=+/OT←(4 3 ρ'ONETWO1  2  ')∧.=3↑AKI 'ONE OR TWO TAILED TES
       T')/L2
[4]    →L1,ρ⍞←'ENTER ONE, TWO, 1 OR 2'
[5]   L2:→(2=OT←OT/ 1 2 1 2)/L3
[6]   L25:→(0≠OT←(1 ¯1 0)['LR'⍳1↑AKI 'LEFT OR RIGHT TEST:'])/L3
[7]    →L25,ρ⍞←'ENTER LEFT OR RIGHT'
[8]   L3:→(1=ρ,M←NIP 'POPULATION MEAN:')/L4
[9]    →L3,ρ⍞←'ENTER ONE VALUE'
[10]  L4:→('?'≠1↑A←AKI 'ENTER POPULATION STANDARD DEVIATION OR ? IF UN
       KNOWN:')/L5
[11]   →L6,SD←(MS B)[1]×(÷/ 0 ¯1 +ρB)*0.5
[12]  L5:→(1=ΔVI A)/L55
[13]   →L3,ρ⍞←'ENTER ONE VALUE, OR IF UNKNOWN, ?'
[14]  L55:SD←ΔFI A
[15]  L6:'
           MEAN       S.D. ST. ERROR    Z-VALUE          CRITICAL
                                                         POINT(S)'
[16]   '6F10.2' ΔFMT(1,4+|OT)ρ((ME←MS B)[2 1]),SE,T,C←M+(T←ZT 1,1-L÷|
       OT)×(SE←SD÷((ρB)*0.5))×(OT)↑(¯1 1)
```

```
[17]  →(∧/(×C-ME[2])=(OT)↑ ¯1 1)/AC
[18]  LF,(5ρ' '),'-> REJECT <-'
[19]  →0
[20] AC:LF,(5ρ' '),'-> ACCEPT <-'
```

```
      ∇TP[⎕]∇
    ∇ R←L TP V;T;VA
[1]   →(∨/A←0,(FF 19)∧.=22↑'          1 STATTAB')/L0
[2]   '1 STATTAB' FF 4,(T←((⍳11)∊0,FF 18)⍳0),32948
[3]   →L1
[4]  L0:T←(1↓A)/FF 18
[5]  L1:→(30≤V)/LARGE
[6]   →(L≥ 0.1 0.05 0.001)/L11,L2,L3
[7]  L11:R←(FF 6,T,4,32948)[3;V⌊30]
[8]   →0
[9]  L2:R←VA[2]+((0.1-L)÷0.05)×-/VA←,(FF 6,T,4,32948)[2 3 ;V⌊
      30]
[10]  →0
[11] L3:R←VA[2]+((0.05-L)÷0.049)×-/VA←,(FF 6,T,4,32948)[1 2 ;V⌊
      30]
[12]  →0
[13] LARGE:R←ZT 1,1-L
    ∇
```

C-1 GROUPT

```
      ∇GROUPT[⎕]∇

    ∇ GROUPT
[1]   READ
[2]  L0:→((0<L),1>L←NIP 'LEVEL OF SIGNIFICANCE')/L1
[3]   →L0,ρ⍞←'THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0'
[4]  L1:→(1=+/OT←(4 3 ρ'ONETWO1  2  ')∧.=3↑AKI 'ONE OR TWO TAILED TES
      T')/L2
[5]   →L1,ρ⍞←'ENTER ONE, TWO, 1 OR 2',CR
[6]  L2:→(2=OT←OT/ 1 2 1 2)/L3
[7]  L25:→(0≠OT←(1 ¯1 0)['LR'⍳1↑AKI 'LEFT OR RIGHT TEST:'])/L3
[8]   →L25,ρ⍞←'ENTER LEFT OR RIGHT'
[9]  L3:→(1=ρ,M←NIP 'POPULATION MEAN:')/L4
[10]  →L3,ρ⍞←'ENTER ONE VALUE'
[11] L4:→('?'≠1↑A←AKI 'ENTER POPULATION STANDARD DEVIATION OR ? IF UN
      KNOWN:')/L5
[12]  →L6,SD←D[4]×(÷/ 0 ¯1 +D[1])*0.5
[13] L5:→(1=ΔVI A)/L55
[14]  →L3,ρ⍞←'ENTER ONE VALUE, OR IF UNKNOWN, ?'
[15] L55:SD←ΔFI A
[16] L6:'
             MEAN      S.D.   ST.ERROR     T-VALUE  CRITICAL
                                                    POINT(S)'
[17]  '6F10.2' ΔFMT(1,4+|OT)ρ((ME←D[2 4])),SE,T,C←M+(T←(1-L÷|OT) TP D
      [1]-1)×(SE←SD÷(D[1]*0.5))×(OT)↑(¯1 1)
[18]  →(∧/(×C-ME[2])=(OT)↑ ¯1 1)/AC
[19]  LF,(5ρ' '),'-> REJECT <-'
[20]  →0
[21] AC:LF,(5ρ' '),'-> ACCEPT <-'
    ∇
```

C-2 GROUPZ

```
      ∇GROUPZ[⎕]∇

    ∇ GROUPZ
[1]   READ
[2]  L0:→((0<L),1>L←NIP 'LEVEL OF SIGNIFICANCE')/L1
[3]   →L0,ρ⍞←'THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0'
[4]  L1:→(1=+/OT←(4 3 ρ'ONETWO1  2  ')∧.=3↑AKI 'ONE OR TWO TAILED TES
      T')/L2
[5]   →L1,ρ⍞←'ENTER ONE, TWO, 1 OR 2',CR
[6]  L2:→(2=OT←OT/ 1 2 1 2)/L3
[7]  L25:→(0≠OT←(1 ¯1 0)['LR'⍳1↑AKI 'LEFT OR RIGHT TEST:'])/L3
[8]   →L25,ρ⍞←'ENTER LEFT OR RIGHT'
[9]  L3:→(1=ρ,M←NIP 'POPULATION MEAN:')/L4
[10]  →L3,ρ⍞←'ENTER ONE VALUE'
[11] L4:→('?'≠1↑A←AKI 'ENTER POPULATION STANDARD DEVIATION OR ? IF UN
      KNOWN:')/L5
[12]  →L6,SD←D[4]×(÷/ 0 ¯1 +D[1])*0.5
[13] L5:→(1=ΔVI A)/L55
[14]  →L3,ρ⍞←'ENTER ONE VALUE, OR IF UNKNOWN, ?'
[15] L55:SD←ΔFI A
```

```
[16] L6:'
             MEAN       S.D. ST. ERROR    Z-VALUE         CRITICAL
                                                          POINT(S)'
[17]  '6F10.2' ΔFMT(1,4+|OT)ρ((ME←D[2 4])),SE,T,C←M+(T←ZT 1,1-L÷|OT)×
      (SE←SD÷(D[1]*0.5))×(OT)↑(¯1 1)
[18]  →(∧/(×C-ME[2])=(OT)↑ ¯1 1)/AC
[19]  LF,(5ρ' '),'-> REJECT <-'
[20]  →0
[21] AC:LF,(5ρ' '),'-> ACCEPT <-'
     ∇
```

C-3 GROUPCHI

```
      ∇GROUPCHI[⎕]∇

    ∇ GROUPCHI;V
[1]   READ
[2]  L2:→((⍳4)='UBN'⍳D←1↑AKI 'ENTER PROBABILITY DISTRIBUTION DESIRED:
      ')/UN,BI,NO,ERR
[3]  ERR:'DISTRIBUTIONS AVAILABLE ARE: UNIFORM, BINOMIAL, OR NORMAL',
      CR
[4]   →L2
[5]  UN:F←(F1←D[1] UNIρE)-E←TAB[;3]
[6]   →OUTPUT
[7]  BI:F←(F1←D[1] BINOMρE)-E←TAB[;3]
[8]   →OUTPUT
[9]  NO:F←(D[1] NORMρE)-E←TAB[;3]
[10]  →OUTPUT
[11] OUTPUT:→(∧/(0.001≤L),0.1≥L←NIP 'ENTER LEVEL OF SIGNIFICANCE:')/
      L6
[12]  →OUTPUT,ρ⍞←'THE VALUE ENTERED MUST BE BETWEEN .001 AND .1',CR
[13] L6:'⍞X-SQUARED = ⍞,F10.3,⍞   CRITICAL VALUE IS ⍞,F10.3' ΔFMT(
      1 2 ρ(F1←+/(F*2)÷F1),F2←L CHT(ρF)-1)
[14]  →(F1≤F2)/ACC
[15]  LF,(5ρ' '),'-> REJECT <-'
[16]  →0
[17] ACC:LF,(5ρ' '),'-> ACCEPT <-'
    ∇
```

C-4 SSIZE

```
      ∇SSIZE[⎕]∇
    ∇ SSIZE;M;S;N;L;E
[1]   S←NIP 'ENTER PRELIMINARY SAMPLE STANDARD DEVIATION'
[2]  S0:→(0<N←NIP 'ENTER PRELIMINARY SAMPLE SIZE')/S1
[3]   →S0,ρ⍞←'SIZE MUST BE GREATER THAN 0'
[4]  S1:→((1>L),0<L←NIP 'ENTER DESIRED LEVEL OF SIGNIFICANCE')/S2
[5]   →S1,ρ⍞←'VALUE MUST BE BETWEEN 0 AND 1'
[6]  S2:'STANDARD ERROR OF PRELIMINARY SAMPLE IS + OR - ';((S÷N*
      0.5)×Z←(ZT 1,1-L))
[7]   E←NIP 'ENTER DESIRED SAMPLE ERROR '
[8]   '
      SAMPLE SIZE SHOULD BE ';(⌈((Z*2)×S*2)÷E*2)
    ∇
```

```
      ∇READ[⎕]∇

    ∇ READ
[1]   L0:→(∧/(N≤20),0≤N←IPI 'ENTER NUMBER OF CLASSES:')/L1
[2]    →L0,ρ⍞←'ENTER ONE VALUE BETWEEN 1 AND 20',CR
[3]   L1:'ENTER THE CLASS MINIMUM VALUE, THE CLASS MAXIMUM VALUE, AND
       THE CLASS SIZE',CR,'IN THAT ORDER'
[4]    I←1
[5]    TAB← 0 3 ρ0
[6]   L2:'ENTER CLASS ';I;' VALUES'
[7]    →(≤/(A←INP 3)[1 2])/L25
[8]    →L2,ρ⍞←'THE FIRST VALUE SHOULD BE LESS THAN THE SECOND VALUE',
       CR
[9]   L25:TAB←TAB,[1] 1 3 ρA
[10]   →(N≥I←I+1)/L2
[11]   TAB←TAB,D,((N,1)ρTAB[;3])×D←(N,1)ρ(+/TAB[; 1 2])÷2
[12]   →(~AYN 'DO YOU WISH TO SEE YOUR INPUT?')/NO
[13]   'CLASS   MINIMUM   MAXIMUM     CLASS   AVERAGE       F(X)'
[14]   'NO.     VALUE     VALUE       SIZE    VALUE          '
[15]   'I5,5F10.3' ΔFMT(((N,1)ρ⍳N),TAB)
[16]  NO:CR
[17]   D←N,ME,V,(V←(+/(TAB[;3]×(TAB[;4]-ME←((+/TAB[;5])÷N))*2))÷N←+/
       TAB[;3])*0.5
[18]   '    LENGTH    ARITH  VARIANCE    STD DEV'
[19]   '              MEAN'
[20]   '4F10.2' ΔFMT(1 4 ρD)
    ∇
```

15
Mathematical Functions

A. General Description

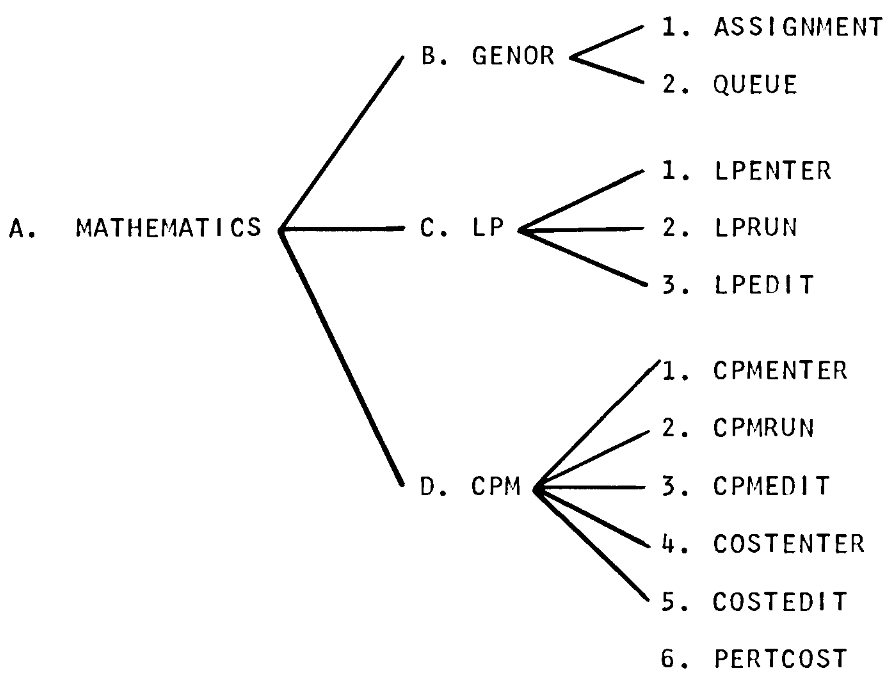
This workspace contains functions which facilitate the solution of these elementary problems: (1) the assignment method; (2) queuing; (3) linear programming; and (4) network analysis.

There are three workspaces which make up this section. The specific instructions to access them will be given in each section:

These programs are available directly to users of the APL system at UCLA. Other installations will need to type in the programs before they can be used. The program code is available at the end of the chapter for this purpose.

The functions contained in the mathematical series are detailed in Exhibit 15-1.

Exhibit 15-1
THE MATHEMATICAL WORKSPACES



The functions and supporting variables in these workspaces are: defined further in Exhibit 15-2.

Exhibit 15-2
MATHEMATICAL FUNCTIONS AND VARIABLES

MAJOR FUNCTIONS	SUPPORTING FUNCTIONS	SUPPORTING VARIABLES
ASSIGNMENT	-	-
QUEUE	-	-
LPENTER	PICK	TABLE
LPRUN	PICK, EX, ADDN, MM	TABLE
LPEDIT	LINEEDIT, MM	TABLE
CPMENTER	ENT, COMOUT	TABLE
CPMRUN	COMOUT, MM, CHK, CRT	TABLE
CPMEDIT	LINEEDIT, MM	TABLE
COSTENTER	MM	TABLE, COSTS
COSTEDIT	LINEEDIT, MM	COSTS
PERTCOST	CHECK, MM, CHK, COMOUT, CPM2R, CHECK, PERT	COSTS

B. GENOR

This workspace contains two minor operations research related functions ASSIGNMENT and QUEUE. Access to the functions in this workspace is via the instruction:

)LOAD 11 GENOR

1. ASSIGNMENT

This function solves assignment-type problems. Input consists of specifying:

1. The number of tasks and the number of workers to complete such tasks.

2. For each worker specified in #1 above, it is necessary to enter the cost associated with completing each of the tasks. Output consists of an optimal assignment schedule. The example

in the text has four tasks and four workers. The cost per worker of completing each task is input, and the assignment is achieved. In this case worker #1 is assigned to job #4, worker #2 to job #2, worker #3 to job #1, and worker #4 to job #3. The program also computes the total cost of completing the tasks.

2. QUEUE

This function handles the most elementary forms of queuing problems. Input consists simply of:

a. The arrival and service rate.

b. The length of the queue.

The programs output consists of:

a. The average waiting time in the queue.

b. The average waiting time in queue and service.

c. The length of the queue.

C. LP

The LP workspace contains three programs to facilitate the analysis of linear programming problems. Access to this workspace is gained by the instruction:

)LOAD 11 LP

1. LPENTER

This program enters the LP problem. The input consists of:

a. A statement as to whether the objective is to maximize or minimize.

b. The objective function in the form Z=9X1+10X2

c. The constraint equations in the form 11X1+9X2 9900.

After the last constraint has been entered, the user signifies his desire to end the entry phase by striking the carriage return. This procedure stores the user's LP problem. He then can proceed to run the problem or edit it.

2. LPRUN

The function LPRUN produces the optimal combination of the variables involved. The user is then given the option of applying sensitivity analysis to the previous output.

3. LPEDIT

If the user wishes to modify the LP problem data at any time he should execute the function LPEDIT. The user has the ability to print the LP problem, add a constraint, change a constraint, delete a constaint, or QUIT to end the editing program.

a. Print the LP problem.

The user need only reply to the request 'COMMAND' with a P or the word print. This will cause the program to print the entire problem. The program will then ask for the next command.

b. Add a constraint.

The user can add a constraint to the end of the other constraints by typing A or Add. The program will then request the next line in sequence and the user should enter the new constraint.

c. Change a constraint.

To change a constraint the user types C or CHANGE followed by the line number he wishes to change. The program will type out the current form of that line and position the type element at the start of the next line. The user then types a '/' character under every character he would like to delete and a number, one through nine, under the character just to the right of where he wishes to insert some new information. The number entered specifies the number of characters to be inserted. The terminal will retype the line with the deletion of characters which were underscored by the '/' character, and spaces inserted where the user had specified he wished to insert characters. The type element will be positioned at the end of the new line and the user should backspace and insert the new characters.

d. Delete a line.

The user should enter a D or DELETE followed by the line numbers he wishes to delete. The numbers entered should be the beginning and ending line numbers. So if the user wished to delete lines 3, 4, and 5, he would enter 'D 3 5'. If he wished to delete only line 3 he would enter, 'D 3 3'.

e. QUIT

Quit ends the program and replaces the old stored copy with the new LP problem. If the user abnormally ends this program the changed model will not be stored.

D. CPM

The CPM workspace contains six functions geared to network analysis. These programs are designed to solve both basic network problems as well as cost reduction problems. To access the functions in this workspace, enter the following instruction:

```
)LOAD 11 CPM
```

1. CPMENTER

This program is used to enter CPM network problems. We recall that CPM networks consist of one time value, rather than the three (pessimistic, most likely, and optimistic) which are associated with PERT.

The user will receive a request for each node in the network. The user should respond with the node identifier (any alphanumber name up to 6 characters), the duration time, and the nodes preceeding this node. (Note: If there is no single beginning or ending node the user should enter dummy nodes with zero time duration). To end entry of the network, the user strikes the carriage return.

2. CPMRUN

The CPMRUN function takes the network entered through CPMENTER and produces the following output:

a. The critical path.

b. The length of the critical path.

c. For each node the early start, the early finish, the late start, the late finish, the total slack, and the free slack.

3. CPMEDIT

This routine allows the user to modify his network. The program operates identically to LPEDIT described above. Users should consult that description for how to use CPMEDIT.

4. COSTENTER

In addition to the network description, the PERTCOST routine described in #6 requires the user to specify a cost distribution for each node. This cost distribution denotes the cost associated with reducing the time required by some amount. The program will request the user to enter the cost distribution for each node specifically. The user should respond with the current cost of that node followed by a series of two number groups where the first number represents the incremental time savings and the second number represent the cost for that time savings. The user can enter up to ten of these groups. Users should consult the example for further information.

5. COSTEDIT

The COSTEDIT program allows the user to modify his cost distributions as in CPMEDIT and LPEDIT. Users should consult the description of LPEDIT to determine how to use this function.

6. PERTCOST

This program accommodates three values for each activity, as noted above. The user need not use this feature if he does not have the necessary data. The network is input using the CPMENTER program described above. The user enters the cost distribution using COSTENTER described above. In the example below the manager wishes to reduce a critical path time from 14 units to 11 units. The problem involves the determination of which activities to reduce. The program yields the information provided in CPMRUN, the changes in the costs of each node, and the total increase in the cost of the project in order to obtain the reduction in time. Users should take care in editing both the network and the cost distribution that the one-for-one relationship is not destroyed.

B-1 ASSIGNMENT

```
      ASSIGNMENT
ENTER NUMBER OF TASKS AND NUMBER OF WORKERS TO COMPLETE TASKS: 4
ENTER THE TOTAL COSTS FOR THE 4 TASKS BY WORKER
WORKER 1
⎕:
      22 10 18 8
WORKER 2
⎕:
      18 9 15 9
WORKER 3
⎕:
      10 15 10 18
WORKER 4
⎕:
      17 16 13 13

 ASSIGN JOB 4     TO WORKER 1         AT THE COST OF 8.000
 ASSIGN JOB 2     TO WORKER 2         AT THE COST OF 9.000
 ASSIGN JOB 1     TO WORKER 3        AT THE COST OF 10.000
 ASSIGN JOB 3     TO WORKER 4        AT THE COST OF 13.000
     TOTAL COST IS 40.00
```

B-2 QUEUE

```
      QUEUE
ENTER ARRIVAL RATE AND SERVICE RATE:  3 4

LENGTH OF QUEUE IS: 2.25

AVERAGE WAITING TIME IN QUEUE IS: 0.75

AVERAGE WAITING TIME IN QUEUE AND SERVICE IS: 1
```

C-1 LPENTER

```
      LPENTER
ENTER THE NAME OF THIS PROJECT  LINEAR PROGRAMMING EXAMPLE
MAXIMIZE OR MINIMIZE:  MA
OBJECTIVE FUNCTION: Z=9PROD1+10PROD2
ENTER CONSTRAINT EQUATIONS, (STRIKE JUST A CARRIAGE RETURN TO STOP INPUT)
   [1] 11PROD1+9PROD2≤9900
   [2] 7PROD1+12PROD2≤8400
   [3] 6PROD1+16PROD2≤9600
   [4]
```

C-2 LPRUN

```
      LPRUN
                         LINEAR PROGRAMMING EXAMPLE


THE OPTIMAL VALUE OF THE OBJECTIVE FUNCTION IS:    8982.609


                    THE VARIABLES IN THE SOLUTION ARE


VARIABLE  PROD1  AT LEVEL    6.2609E2
          PROD2              3.3478E2
          SLK3               4.8696E2


DO YOU WISH SENSITIVITY ANALYSIS? YES

                      SHADOW        LB          CURRENT        UB
CONSTRAINT     1     5.5072E¯1   9.0600E3     9.9000E3     1.3200E4
               2     4.2029E¯1   6.3000E3     8.4000E3     8.6754E3
               3     0.0000E0    9.1130E3     9.6000E3     7.2370E75

PRICE         PROD1              5.8333E0     9.0000E0     1.2222E1
              PROD2              7.3636E0     1.0000E1     1.5429E1
 -> END <-
```

C-3 LPEDIT

```
      LPEDIT
COMMAND _
THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT
COMMAND P
 [1] MA
 [2] Z=9PROD1+10PROD2
 [3] 11PROD1+9PROD2≤9900
 [4] 7PROD1+12PROD2≤8400
 [5] 6PROD1+16PROD2≤9600
COMMAND C 1
          v
          3
 [3] 11PROD1+9PROD2≤9900
                      //2
 [3] 11PROD1+9PROD2≤6600
COMMAND Q
```

```
      LPRUN
                           LINEAR PROGRAMMING EXAMPLE


THE OPTIMAL VALUE OF THE OBJECTIVE FUNCTION IS:   6826.230


                        THE VARIABLES IN THE SOLUTION ARE


VARIABLE  PROD1  AT LEVEL   1.5738E2
          PROD2             5.4098E2
          SLK2              8.0656E2


DO YOU WISH SENSITIVITY ANALYSIS? YES

                        SHADOW       LB        CURRENT       UB
CONSTRAINT    1      6.8852E¯1   5.4000E3   6.6000E3   9.0600E3
              2      0.0000E0    7.5934E3   8.4000E3   7.2370E75
              3      2.3770E¯1   3.6000E3   9.6000E3   1.1026E4

PRICE        PROD1               3.7500E0   9.0000E0   1.2222E1
             PROD2               7.3636E0   1.0000E1   2.4000E1
 -> END <-
```

D-1 *CPMENTER*

```
      CPMENTER
ENTER PROJECT TITLE  CPM EXAMPLE
DO YOU WANT TO USE THE LONG FORM OF EXPECTED TIME? NO
THE PROPER ENTRY FORMAT IS:
ACTIVITY TITLE, ACTIVITY TIME, PRECEEDING ACTIVITIES

   [1] START 0
   [2] A-B 2 START
   [3] A-C 4 START
   [4] C-D 4 A-C
   [5] B-D 5 A-B
   [6] B-E 3 A-B
   [7] E-F 3 B-E
   [8] D-F 6 B-D C-D
   [9] FIN 0 E-F D-F
  [10]
```

D-2 *CPMRUN*

```
      CPMRUN
                                  PROJECT CPM EXAMPLE
```

THE CRITICAL PATH IS

START -> A-C -> C-D -> D-F -> FIN

THE LENGTH OF THE CRITICAL PATH IS 14

NODE	DURATION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL SLACK	FREE SLACK
START	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-B	2.00	0.00	2.00	1.00	3.00	1.00	0.00
A-C	4.00	0.00	4.00	0.00	4.00	0.00	0.00
C-D	4.00	4.00	8.00	4.00	8.00	0.00	0.00
B-D	5.00	2.00	7.00	3.00	8.00	1.00	1.00
B-E	3.00	2.00	5.00	8.00	11.00	6.00	0.00
E-F	3.00	5.00	8.00	11.00	14.00	6.00	6.00
D-F	6.00	8.00	14.00	8.00	14.00	0.00	0.00
FIN	0.00	14.00	14.00	14.00	14.00	0.00	0.00

D-3 CPMEDIT

```
      CPMEDIT
COMMAND _
THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT
COMMAND P
 [1] START 0
 [2] A-B 2 START
 [3] A-C 4 START
 [4] C-D 4 A-C
 [5] B-D 5 A-B
 [6] B-E 3 A-B
 [7] E-F 3 B-E
 [8] D-F 6 B-D C-D
 [9] FIN 0 E-F D-F
COMMAND C 3
 [3] A-C 4 START
         /1
 [3] A-C 7 START
COMMAND Q
```

```
      CPMRUN
                                    PROJECT CPM EXAMPLE
```

THE CRITICAL PATH IS

START -> A-C -> C-D -> D-F -> FIN

THE LENGTH OF THE CRITICAL PATH IS 17

NODE	DURATION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL SLACK	FREE SLACK
START	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-B	2.00	0.00	2.00	4.00	6.00	4.00	0.00
A-C	7.00	0.00	7.00	0.00	7.00	0.00	0.00
C-D	4.00	7.00	11.00	7.00	11.00	0.00	0.00
B-D	5.00	2.00	7.00	6.00	11.00	4.00	4.00
B-E	3.00	2.00	5.00	11.00	14.00	9.00	0.00
E-F	3.00	5.00	8.00	14.00	17.00	9.00	9.00
D-F	6.00	11.00	17.00	11.00	17.00	0.00	0.00
FIN	0.00	17.00	17.00	17.00	17.00	0.00	0.00

```
      CPMENTER
ENTER PROJECT TITLE  COST/PERT EXAMPLE
DO YOU WANT TO USE THE LONG FORM OF EXPECTED TIME? NO
THE PROPER ENTRY FORMAT IS:
ACTIVITY TITLE, ACTIVITY TIME, PRECEEDING ACTIVITIES

   [1] START 0
   [2] A-B 2 START
   [3] A-C 4 START
   [4] B-E 3 A-B
   [5] C-D 4 A-C
   [6] B-D 5 A-B
   [7] E-F 6 B-E
   [8] D-F 6 C-D B-D
   [9] FIN 0 E-F D-F
  [10]
```

D-4 COSTENTER

```
      COSTENTER
ENTER COST DISTRIBUTION FOR EACH OF THE FOLLOWING ACTIVITIES

THE PROPER ENTRY FORM IS:
ORIGINAL COST, TIME INCREMENT, INCREASE IN COST, ETC.

START : 0
A-B   : 120 1 30
A-C   : 150 1 45 1 50 1 25
B-E   : 85 1 50 1 45
C-D   : 130 1 30 1 40 1 75
B-D   : 190 1 35 1 45 1 40 1 40
E-F   : 70 1 50 1 60
D-F   : 115 1 40 1 45 1 40 1 55 1 55
FIN   : 0
ENTER THE AMOUNT OF TIME AVAILABLE FOR THIS PROJECT 11
```

D-5 COSTEDIT

```
      COSTEDIT
COMMAND P
 [1]  0
 [2]  120 1 30
 [3]  150 1 45 1 50 1 25
 [4]  85 1 50 1 45
 [5]  130 1 30 1 40 1 75
 [6]  190 1 35 1 45 1 40 1 40
 [7]  70 1 50 1 60
 [8]  115 1 40 1 45 1 40 1 55 1 55
 [9]  0
COMMAND C 8
 [8]  115 1 40 1 45 1 40 1 55 1 55
                          /1   /1
 [8]  115 1 40 1 45 1 40 1 25 1 25
COMMAND Q
```

PERTCOST

COST/PERT EXAMPLE

THE CRITICAL PATH IS

START -> A-B -> B-D -> D-F -> FIN

THE LENGTH OF THE CRITICAL PATH IS 11

THE TOTAL FREE SLACK IS 0

NODE	DURATION	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL SLACK	FREE SLACK	TOTAL FREE SLACK
START	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-B	2.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00
A-C	4.00	0.00	4.00	0.00	4.00	0.00	0.00	0.00
B-E	3.00	2.00	5.00	5.00	8.00	3.00	0.00	3.00
C-D	3.00	4.00	7.00	4.00	7.00	0.00	0.00	0.00
B-D	5.00	2.00	7.00	2.00	7.00	0.00	0.00	0.00
E-F	3.00	5.00	8.00	8.00	11.00	3.00	3.00	3.00
D-F	4.00	7.00	11.00	7.00	11.00	0.00	0.00	0.00
FIN	0.00	11.00	11.00	11.00	11.00	0.00	0.00	0.00

ACTIVITY	ORIGINAL COST	OPTIMIZED COST
START	0.00	0.00
A-B	120.00	120.00
A-C	150.00	150.00
B-E	85.00	85.00
C-D	130.00	160.00
B-D	190.00	190.00
E-F	70.00	70.00
D-F	115.00	200.00
FIN	0.00	0.00
TOTAL INCREASE IN COST		115.00

B-1 *ASSIGNMENT*

```
      ∇ASSIGNMENT[⎕]∇
    ∇ ASSIGNMENT;L;A;TAB;V;B;Z;RR;R;W;WW;J;JJ;I;JOBS;WORK;TOT;T
[1]   L0:A←NIP 'ENTER NUMBER OF TASKS AND NUMBER OF WORKERS TO COMPLET
      E TASKS:'
[2]   L2:L←1
[3]    'ENTER THE TOTAL COSTS FOR THE ';A[1];' TASKS BY WORKER'
[4]    TAB←(0,A[1])ρ0
[5]   L3:'WORKER ';L
[6]    TAB←TAB,[1](A)ρINP 1,A
[7]    →(A≥L←L+1)/L3
[8]    STAB←TAB
[9]    TAB←(TAB-⍉(A,A)ρ⌊/TAB)
[10]   TAB←(TAB-(A,A)ρ⌊⌿TAB)
[11]  LP:V←2≤+/Z←0=TAB
[12]   Z[;(B←2≤+⌿Z)/⍳A]←0
[13]   Z[(V/⍳A);]←0
[14]   →(A≤+/V,B,,Z)/SOL
[15]   TAB[J;L]←TAB[(J←(V/⍳A));L←B/⍳A]+MIN←⌊/,TAB
[16]   RR←,TAB
[17]   R←(A,A)ρ1
[18]   R[(V/⍳A);]←0
[19]   R[;(B/⍳A)]←0
[20]   RR[R]←RR[R←(,R)/⍳A×A]-MIN
[21]   TAB←(A,A)ρRR
[22]   →LP
[23]  SOL:W←JOBS←⍳ρWORK←(A)ρ0
[24]  LP2:I←1
[25]  LP25:→(0≠ρJ←(JJ←I=+⌿Z←0=TAB)/⍳¯1↑ρTAB)/LP3
[26]   →((¯1↑ρTAB)≥I←I+1)/LP25
[27]  LP3:WORK[W[WW←(~⌽⍉Z[;J])⊥1]]←JOBS[J]
[28]   →(∧/0≠WORK)/FIN
[29]   TAB←(~JJ)/TAB
[30]   JOBS←(~JJ)/JOBS
[31]   TAB←(~(⍳1↑ρTAB)∊WW)⌿TAB
[32]   W←(~(⍳ρW)∊WW)/W
[33]   →LP2
[34]  FIN:J←WORK
[35]   TOT←0
[36]   I←1
[37]  L6:'P⍞ASSIGN JOB ⍞I13,X3,P⍞TO WORKER ⍞I13,X4,P⍞AT THE COST OF ⍞F
      24.3' ΔFMT(1 3 ρJ[I],I,STAB[I;J[I]])
[38]   TOT←TOT+STAB[I;J[I]]
[39]   →(A≥I←I+1)/L6
[40]   'P⍞TOTAL COST IS ⍞F24.2' ΔFMT TOT
[41]  ERR:→0
    ∇
```

B-2 QUEUE

```
     ∇QUEUE[⎕]∇
    ∇ QUEUE
[1]    →((∧/0<A)∧2=ρA←ΔFI AKI 'ENTER ARRIVAL RATE AND SERVICE RATE: ')
       /L1
[2]    →1,ρ⍞←'ENTER TWO POSITIVE NUMBERS REPRESENTING ARRIVAL RATES AN
       D SERVICE RATES',CR
[3]   L1:'
       LENGTH OF QUEUE IS: ';(A[1]×A[1])÷S←A[2]×-/A[2 1]
[4]    '
       AVERAGE WAITING TIME IN QUEUE IS: ';A[1]÷S
[5]    '
       AVERAGE WAITING TIME IN QUEUE AND SERVICE IS: ';÷-/A[2
       1]
    ∇
```

C-1 ***LPENTER***

```
      ∇LPENTER[⎕]∇
     ∇ LPENTER
[1]    TITLE←AKI 'ENTER THE NAME OF THIS PROJECT'
[2]    N←0×L←1
[3]   CK:→(3≠TYPE←((2 2 ρ'MAMI')∧.=2↑TABLE←AKI 'MAXIMIZE OR MINIMIZE:
       ')⍳1)/CONT1
[4]    'PLEASE SPECIFY IF THIS IS A MAXIMUM OR MINIMUM PROBLEM'
[5]    →CK
[6]   CONT1:→((1 2 ρ'Z=')∧.=2↑B←(A≠' ')/A←AKI 'OBJECTIVE FUNCTION:')/
       CONT2
[7]    'YOU SHOULD ENTER THE CONSTRAINT EQUATION IN THE FOLLOWING FORM
       :'
[8]    'Z=2.5X1+2X2'
[9]    →CONT1
[10]  CONT2:→(0=PICK 2↓B)/CONT2
[11]   ZACT←M
[12]   CONST←T
[13]   TABLE←TABLE,' ',B
[14]   'ENTER CONSTRAINT EQUATIONS, (STRIKE JUST A CARRIAGE RETURN TO
       STOP INPUT)'
[15]  IN:→(0=ρA←AKI(,'P⍞[⍞I5,⍞]⍞' ∆FMT L))/END
[16]   →(0≠+/C←(B←(A≠' ')/A)∊'≥=≤')/CONT3
[17]   'YOU HAVE NOT ENTERED A PROPER CONTRAINT.',CR,'THE CONSTRAINT S
       HOULD LOOK LIKE THIS:',CR,'2X1+3X2≤10'
[18]   →IN
[19]  CONT3:→(0=PICK((C/⍳ρB)-1)↑B)/IN
[20]   →(∧/2>+/A←ZACT∧.=⍉M)/CONT4
[21]   'YOU HAVE USED THE SAME TERM TWICE.',CR,'PLEASE REENTER LAST LI
       NE.'
[22]   →IN
[23]  CONT4:→((ρT)=+/+⌿A)/CONT5
[24]   'YOU HAVE ENTERED A TERM NOT DESCRIBED IN THE OBJECTIVE FUNCTIO
       N.'
[25]   →(AYN 'DO YOU WISH TO RESTART THIS PROBLEM?')/2
[26]   →IN
[27]  CONT5:L←L+1
[28]   TABLE←TABLE,' ',B
[29]   →IN
[30]  END:→0
     ∇
```

C-2 LPRUN

```
     ∇LPRUN[⎕]∇
    ∇ LPRUN
[1]   SLA←⍳(S←0)
[2]   SLAS← 0 6 ⍴' '
[3]   →(0≠⍴T←∆MI TABLE)/CONT1
[4]   'PROBLEM HAS NOT BEEN DEFINED.',CR,'EXECUTE LPENTER TO ENTER PROBLEM
      .'
[5]   →0
[6]  CONT1:→(0=PICK 2↓(¯1+(T[L;]=' ')⍳1)↑T[(L←2);])/ERR
[7]   ZACT←M
[8]   MAT←(1,(1+⍴T))⍴(T×MM←¯1*M←1-((2 2 ⍴'MAMI')∧.=2↑T[1;])⍳1),0
[9]  LOOP:→((⍴T)[1]<L←L+1)/RUN
[10]  →('≤=≥'∊T[L;])/LT,EQ,GT
[11]  →ERR
[12] LT:→(0≤B1←∆FI(I←(T[L;]='≤')/⍳¯1↑⍴T)↓T[L;])/LT2
[13]  →(0=PICK(¯1+I)↑T[L;])/ERR
[14]  MAT←MAT,[1](EX 1)\(¯1×T),¯1,|B1
[15]  SLA←SLA,¯1
[16]  ADDN ¯1
[17]  →LOOP
[18] LT2:→(0=PICK(¯1+I)↑T[L;])/ERR
[19]  MAT←MAT,[1](EX 1)\T,1,B1
[20]  SLA←SLA,1
[21]  ADDN 1
[22]  →LOOP
[23] EQ:→(0≤B1←∆FI(I←(T[L;]='=')/⍳¯1↑⍴T)↓T[L;])/EQ2
[24]  →(0=PICK(¯1+I)↑T[L;])/ERR
[25]  MAT←MAT,[1](EX 0)\(¯1×T),|B1
[26]  SLA←SLA,0
[27]  ADDN 0
[28]  →LOOP
[29] EQ2:→(0=PICK(¯1+I)↑T[L;])/ERR
[30]  MAT←MAT,[1](EX 0)\T,B1
[31]  SLA←SLA,0
[32]  ADDN 0
[33]  →LOOP
[34] ERR:'PROBLEM HAS BECOME ERRONEOUS, PLEASE REENTER.'
[35]  →0
[36] GT:→(0≤B1←∆FI(I←(T[L;]='≥')/⍳¯1↑⍴T)↓T[L;])/GT2
[37]  →(0=PICK(¯1+I)↑T[L;])/ERR
[38]  MAT←MAT,[1](EX 1)\(¯1×T),1,|B1
[39]  SLA←SLA,1
[40]  ADDN 1
[41]  →LOOP
[42] GT2:→(0=PICK(¯1+I)↑T[L;])/ERR
[43]  MAT←MAT,[1](EX 1)\T,¯1,B1
[44]  SLA←SLA,¯1
[45]  ADDN ¯1
[46]  →LOOP
[47] RUN:VAR←(⍴ZACT)[1]
[48]  ZACT←ZACT,[1] SLAS
[49]  (25⍴' '),TITLE,CR2
[50]  →(2=⍴R←RSIM2 MAT)/FIF
[51]  →DIN,⍴⎕←R,⎕←' '
```

C-3 *LPEDIT*

```
[52] FIF:'⎕THE OPTIMAL VALUE OF THE OBJECTIVE FUNCTION IS: ⎕,F10.3'
     ΔFMT ¯1↑,R
[53]  CR2,(20ρ' '),'THE VARIABLES IN THE SOLUTION ARE',CR2
[54]  E←'E12.5' ΔFMT(R←R[(⍋¯1↓R[;1]);])[;2]
[55]  ((S,10)ρ(10×S)↑'VARIABLE'),ZACT[R[;1];],((S,10)ρ(10×S←(1↑ρR)-1)
      ↑' AT LEVEL'),E
[56]  →(~AYN CR2,'DO YOU WISH SENSITIVITY ANALYSIS?')/DIN
[57]  (¯1↓R[;1]) LPSOLN MAT
[58] DIN:' -> END <-
      '
```

```
      ∇LPEDIT[⎕]∇
    ∇ LPEDIT;TT;P;L;T;N;LL
[1]   N←1↑ρTT←' ' MM TABLE,' '
[2]   TT←(,(L←(1+¯1↑ρTT)-(TT=' ')⍳1)∘.≥⍳¯1↑ρTT)/,TT
[3]   P←(ρL)↑0,+/(N,N)ρT\(T←,((⍳N)∘.≥⍳N))/(N×N)ρL
[4]  LP10:→('PADCQ'=1↑A←AKI 'COMMAND _',2ρBS)/PR,ADD,DEL,CHANGE,END
[5]   →LP10,0ρ⎕←'THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT
      ',CR
[6]  PR:('P⎕[⎕I3,⎕] ⎕' ΔFMT⍳N),(N,⌈/L)ρ(,L∘.≥⍳⌈/L)\TT
[7]   →LP10
[8]  CHANGE:→(∧/0≠LL←1↑ΔFI A←(A⍳' ')↓A)/CH2
[9]  LNERR:→LP10,0ρ⎕←'IMPROPER LINE NUMBER'
[10] CH2:→(∧/(LL>N),L≤0)/LNERR
[11]  (T←(5↑(,'P⎕[⎕I3,⎕] ⎕' ΔFMT LL)),TT[P[LL]+⍳L[LL]])
[12]  TT←(P[LL]↑TT),(T←LINEEDIT T),P[LL+1]↓TT
[13]  P[LL+⍳N]←P[LL+⍳N]-L[LL]-ρT
[14]  L[LL]←ρT
[15]  →LP10
[16] DEL:→(∨/0=LL←2ρΔFI A←(A⍳' ')↓A)/LNERR
[17]  →(∧/(≤/LL),(0≥LL←N⌊LL))/LNERR
[18]  TT←(P[LL[1]]↑TT),P[1+LL[2]]↓TT
[19]  N←ρP←P-1↑P←(T←~(LL[1]≤⍳N)∧LL[2]≥⍳N)/P
[20]  L←T/L
[21]  →LP10
[22] ADD:TT←TT,T←AKI,'P⎕[⎕I3,⎕] ⎕' ΔFMT N←N+1
[23]  P←P,¯1↑P+¯1↑L←L,ρT
[24]  →LP10
[25] END:T←(N+ρTT)ρ1
[26]  T[(1↓P,ρTT)+⍳N]←0
[27]  TABLE←T\TT
    ∇
```

```
      ∇PICK[⎕]∇
    ∇ R←PICK IN
[1]    →(1>+/IN∊BAD)/4
[2]    'AN ILLEGAL CHARACTER WAS USED IN THIS EQUATION'
[3]    →R←0
[4]    A1←IN∊ALPHA
[5]    F←(V\(V←~(A2∧0,¯1↓A2))/A2←IN∊ALPHA)/⍳⍴A←IN←,IN
[6]    E←((1↓A3←IN∊'+-¯'),1)/⍳⍴IN
[7]    →((⍴E)=⍴F)/10
[8]    'THE SYNTAX IS IMPROPER'
[9]    →R←0
[10]   →(0=⍴A̲←((2+¯1,¯1↓E)=F)/F)/16
[11]   AA←((⍴A̲)+⍴IN)⍴1
[12]   AA[A̲←(0,⍳¯1+⍴A̲)+A̲]←0
[13]   IN←AA\IN
[14]   IN[A̲]←'1'
[15]   →4
[16]   G←⌈/H←1+E-F
[17]   A4←(A1←(∨⌿(E∘.≥(⍳⍴IN))∧F∘.≤(⍳⍴IN)))/IN
[18]   M←((⍴H),6)⍴(,H∘.≥(⍳6))\A4
[19]   A[(A1∨A3)/⍳⍴IN]←' '
[20]   →0,R←⍴T←(∆FI A)×¯1*(-⍴H)↑'+'≠(A3)/IN
    ∇
```

```
      ∇ADDN[⎕]∇
    ∇ ADDN Z
[1]   SLAS←SLAS,[1] 6↑(3 3 ρ'SURARTSLK')[(2+Z);],'0123456789'[((1+⌊
      10⍟(L-2))ρ10)⊤(L-1)]
    ∇
```

```
      ∇EX[⎕]∇
    ∇ R←EX N
[1]   →(N=0)/CONT1
[2]   R←((¯1+(ρMAT)[2])ρ1),0,1
[3]   MAT←R\MAT
[4]   S←S+1
[5]  CONT1:R←(I←(ρMAT)[2])ρ0
[6]   R←(∨/ZACT∧.=⍉M),((S-N)ρ0),(Nρ1),1
    ∇
```

```
      ∇LINEEDIT[⎕]∇
    ∇ Z←LINEEDIT A;V;W;I
[1]   Z←(W←('/0123456789ABCDEFGHIJKLMN'⍳5↓(ρA)↑⍞)-I←2)≥10
[2]   V←(1,((W←((W×~Z)+(W≠24)×5×Z×W-9),0)>0)/⍳¯4+ρA),¯4+ρA
[3]   Z←5ρ1
[4]  L2:Z←Z,((V[I]-V[I-1])ρ1),W[V[I]]ρ0
[5]   →((ρV)≥I←I+1)/L2
[6]   ⍞←(~Z\(5ρ0),¯1↓W<0)/Z\A
[7]   →(W≥ρZ←5↓⍞)/0
    ∇
```

```
      ∇MM[⎕]∇
    ∇ R←CH MM MT;G
[1]   R←(MT=CH)/⍳ρMT
[2]   G←⌈/R←R-1,1+¯1↓R
[3]   MT←(MT≠CH)/MT
[4]   R←((ρR),G)ρ(,R∘.≥⍳G)\(MT≠CH)/MT
    ∇
```

```
      ∇CHECK[⎕]∇
    ∇ R←CHECK A̲
[1]    ACT←6ρ((I←A̲ι' ')↑A̲),6ρ' '
[2]    →(~∨/J←ZACT∧.=ACT)/CONT
[3]    →(0=T[J←J/ιρT])/CONT2
[4]    'THIS ACTIVITY HAS ALREADY BEEN ENTERED, PLEASE CONTINUE.'
[5]    →0,ρR←1
[6]   CONT:ZACT←ZACT,[1] 1 6 ρACT
[7]    PREDESS←PREDESS,[1](1,N̲)ρ0
[8]    J←ρT←T,0
[9]   CONT2:A←I↓A̲
[10]   →R←0
    ∇
```

```
      ∇CHK[⎕]∇
    ∇ R←CHK V
[1]    R←(∧/V∊' .¯0123456789')∧(1≥+/V='.')∧~∨/(0 1 ↓V)='¯'
    ∇
```

```
      ∇COMOUT[⎕]∇
    ∇ R←COMOUT
[1]    R←AKI,'P⍞[⍞I5,⍞]⍞' ΔFMT N̲+1
[2]    R[(R∊',')/ιρR]←' '
    ∇
```

```
      ∇CPM2R[⎕]∇
    ∇ CPM2R;I1;I2;V
[1]    ENDP←ιN̲
[2]    R̲←0
[3]   R̲E̲S̲:→1
[4]    TAB←((N̲,1)ρT[OR]),(N̲,7)ρ0
[5]    V←1ρ0
[6]   LP0:→(N̲>ρV←V,⌈/V[J]+TAB[(J←(,PREDESS[;1+ρV]=1)/ιN̲);1])/LP0
[7]    TAB[;2]←V
[8]    TAB[;3]←+/TAB[; 1 2]
[9]    V←1ρTAB[N̲;3]
[10]  LP1:→(N̲>ρV←(⌊/V[I1+(ρV)-N̲]-TAB[(I1←(,PREDESS[N̲-ρV;]=1)/ιN̲);1]),V
       )/LP1
[11]   TAB[;5]←V
[12]   TAB[;4]←-/TAB[; 5 1]
[13]   TAB[;6]←-/TAB[; 4 2]
[14]   V←ι0
```

```
[15] LP2:→((N-1)>⍴V←V,⌊/(,TAB[((,PREDESS[I2;]=1)/⍳N);2])-,TAB[(I2←1+⍴
      V);3])/LP2
[16]  TAB[;7]←V,0
[17]  CP←(,TAB[;6]=0)/⍳N
[18]  TAB[;8]←TAB[;6]+D←L-LIM←⌈/TAB[;3]


      ∇CRT[⎕]∇
    ∇ STK←CRT C;I;J
[1]   I←(I)⍴(I←1↑⍴PREDESS)
[2]   STK←J←,⌈/C
[3]  LP1:→(,~PREDESS[I[J];J])/LP2
[4]   STK←STK,J←I[J]
[5]   →LP1
[6]  LP2:→(0≠I[J]←I[J]-1)/LP1
[7]   STK←STK[⍋STK]
    ∇


      ∇K
      ∇LINEEDIT[⎕]∇
    ∇ Z←LINEEDIT A;V;W;I
[1]   Z←(W←('/0123456789ABCDEFGHIJKLMN'⍳5↓(⍴A)↑⍞)-I←2)≥10
[2]   V←(1,((W←((W×~Z)+(W≠24)×5×Z×W-9),0)>0)/⍳¯4+⍴A),¯4+⍴A
[3]   Z←5⍴1
[4]  L2:Z←Z,((V[I]-V[I-1])⍴1),W[V[I]]⍴0
[5]   →((⍴V)≥I←I+1)/L2
[6]   ⍞←(~Z\(5⍴0),¯1↓W<0)/Z\A
[7]   →(W≥⍴Z←5↓⍞)/0
[8]   'LINE LONGER THAN ';W;' CHARACTERS.'
    ∇


      ∇MM[⎕]∇
    ∇ R←CH MM MT;G
[1]   R←(MT=CH)/⍳⍴MT
[2]   G←⌈/R←R-1,1+¯1↓R
[3]   MT←(MT≠CH)/MT
[4]   R←((⍴R),G)⍴(,R∘.≥⍳G)\(MT≠CH)/MT
    ∇
```

D-1 *CPMENTER*

```
      ∇CPMENTER[⎕]∇
    ∇ CPMENTER
[1]   ZACT← 0 6 ρ' '
[2]   E←,TABLE← 0 0 ρN←0
[3]   →(0=ρPROJECT←AKI 'ENTER PROJECT TITLE ')/0
[4]   E←AYN 'DO YOU WANT TO USE THE LONG FORM OF EXPECTED TIME?'
[5]   INSTR[(E+1);]
[6]  IN:→(0=ρC←ΔVI ENT←COMOUT)/0
[7]   →(∧/(0 1 ,((2×E)ρ1),(0⌈¯2+ρC)ρ0)=C)/PUT
[8]   'THE ENTRY FORM SHOULD BE:'
[9]   'ACTIVITY TITLE, EXPECTED TIME(S), ACTIVITY(S) PRECEEDING'
[10]  'THIS ACTIVITY'
[11]  →IN
[12] PUT:→(~∨/ZACT∧.=NEXT←6↑(ENT⍳' ')↑ENT)/GOOD
[13]  'THIS ACTIVITY HAS ALREADY BEEN ENTERED'
[14]  →IN
[15] GOOD:ZACT←ZACT,[1] NEXT
[16]  →(0≤D←(¯1↑ρTABLE)-ρENT)/ADD
[17]  TABLE←TABLE,((1↑ρTABLE),|D)ρ' '
[18]  D←0
[19] ADD:TABLE←TABLE,[1] ENT,(D)ρ' '
[20]  N←N+1
[21]  →IN
    ∇
```

D-2 *CPMRUN*

```
      ∇CPMRUN[⎕]∇
    ∇ CPMRUN
[1]   ENDP←⍳N←1↑ρTABLE
[2]   R←0
[3]  RES:→(R=⍳2)/CPM0,CPM2
[4]   ZACT← 0 6 ρ' '
[5]   PREDESS←(0,N)ρ0
[6]   T←⍳0
[7]   I←0
[8]   →(E)/RD2
[9]  READ:→(N<I←I+1)/COMPUTE
[10]  A←TABLE[I;],' '
[11] CPM0:→(CHECK A)/READ
[12]  T[J]←1↑ΔFI A
[13]  A←(A⍳' ')↓A
[14]  →CPM2
[15] RD2:→(N<I←I+1)/COMPUTE
[16]  A←TABLE[I;],' '
[17] CPM4:→(CHECK A)/RD2
[18]  T[J]←(+/ 1 4 1 ×3↑ΔFI A)÷6
[19]  A←((A=' ')/⍳ρA)[3]↓A
[20] CPM2:X←⍳0
[21] CPM3:→(∧/A=' ')/BACK
[22]  →(∨/JJ←ZACT∧.=PRE←6ρ((I←A⍳' ')↑A),6ρ' ')/MATCH
[23]  ZACT←ZACT,[1] 1 6 ρPRE
[24]  PREDESS←PREDESS,[1](1,N)ρ0
[25]  JJ←(ρT←T,0)=⍳1↑ρZACT
```

```
[26] MATCH:X←X,JJ/⍳1↑ρZACT
[27]  A←I↓A
[28]  →CPM3
[29] BACK:PREDESS[J;X]←1
[30]  →((E+1)=⍳2)/READ,RD2
[31] COMPUTE:OR←⍳0
[32]  PREDESS←⍉PREDESS
[33]  V←Nρ1
[34]  V[I2←(V\~∨/[1] V/V/[1] PREDESS)⍳1]←0
[35]  →(N>ρOR←OR,I2)/34
[36]  PREDESS←PREDESS[OR;OR]
[37]  TAB←((N,1)ρT[OR]),(N,6)ρ0
[38]  V←1ρ0
[39] MA1:→(N>ρV←V,⌈/V[J]+TAB[(J←(,PREDESS[;1+ρV]=1)/⍳N);1])/MA1
[40]  TAB[;2]←V
[41]  TAB[;3]←+/TAB[; 1 2]
[42]  V←1ρTAB[N;3]
[43] MA2:→(N>ρV←(⌊/V[I1+(ρV)-N]-TAB[(I1←(,PREDESS[N-ρV;]=1)/⍳N);1]),V
      )/MA2
[44]  TAB[;5]←V
[45]  TAB[;4]←-/TAB[; 5 1]
[46]  TAB[;6]←-/TAB[; 4 2]
[47]  V←⍳0
[48] MA3:→((N-1)>ρV←V,⌊/(,TAB[((,PREDESS[I2;]=1)/⍳N);2])-,TAB[(I2←1+ρ
      V);3])/MA3
[49]  TAB[;7]←V,0
[50]  CP←(,TAB[;6]=0)/⍳N
[51]  LIM←⌈/TAB[;3]
[52]  (30ρ' '),'PROJECT ',PROJECT,4ρCR
[53]  'THE CRITICAL PATH IS'
[54]  ''
[55]  NOS,ZACT[OR[CP];],((ρCP),4)ρ((4×¯1+ρCP)ρ' -> '),'     '
[56]  ''
[57]  'THE LENGTH OF THE CRITICAL PATH IS ';LIM
[58]  ''
[59]  '
      NODE   DURATION      EARLY     EARLY      LATE     LATE        TOTAL
        FREE
                           START   FINISH     START    FINISH      SLACK
        SLACK
      '
[60]  ZACT[OR;],('X1,8F9.2' ΔFMT TAB)

        ∇
```

D-3 *CPMEDIT*

```
      ∇CPMEDIT[⎕]∇
    ∇ CPMEDIT;TT;P;L;T;N;LL
[1]   N←1↑⍴TT←TABLE
[2]   TT←(,(L←(1+¯1↑⍴TT)-(TT=' ')⊥1)∘.≥⍳¯1↑⍴TT)/,TT
[3]   P←(⍴L)↑0,+/(N,N)⍴T\(T←,((⍳N)∘.≥⍳N))/(N×N)⍴L
[4]  LP10:→('PADCQ'=1↑A←AKI 'COMMAND _',2⍴BS)/PR,ADD,DEL,CHANGE,END
[5]   →LP10,0⍴⍞←'THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT
      ',CR
[6]  PR:('P⍞[⍞I3,⍞] ⍞' ΔFMT⍳N),(N,⌈/L)⍴(,L∘.≥⍳⌈/L)\TT
[7]   →LP10
[8]  CHANGE:→(∧/0≠LL←1↑ΔFI A←(A⍳' ')↓A)/CH2
[9]  LNERR:→LP10,0⍴⍞←'IMPROPER LINE NUMBER'
[10] CH2:→(∧/(LL>N),L≤0)/LNERR
[11]  (T←(5↑(,'P⍞[⍞I3,⍞] ⍞' ΔFMT LL)),TT[P[LL]+⍳L[LL]])
[12]  TT←(P[LL]↑TT),(T←LINEEDIT T),P[LL+1]↓TT
[13]  P[LL↓⍳N]←P[LL↓⍳N]-L[LL]-⍴T
[14]  L[LL]←⍴T
[15]  →LP10
[16] DEL:→(∨/0=LL←2⍴ΔFI A←(A⍳' ')↓A)/LNERR
[17]  →(∧/(≤/LL),(0≥LL←N⌊LL))/LNERR
[18]  TT←(P[LL[1]]↑TT),(P[LL[2]]+L[LL[2]])↓TT
[19]  N←⍴P←P-1↑P←(T←~(LL[1]≤⍳N)∧LL[2]≥⍳N)/P
[20]  L←T/L
[21]  →LP10
[22] ADD:TT←TT,T←AKI,'P⍞[⍞I3,⍞] ⍞' ΔFMT N←N+1
[23]  P←P,¯1↑P+¯1↑L←L,⍴T
[24]  →LP10
[25] END:TABLE←(N,⌈/L)⍴(,L∘.≥⍳⌈/L)\TT
    ∇
```

D-4 *COSTENTER*

```
      ∇COSTENTER[⎕]∇
    ∇ COSTENTER
[1]   COSTS←⍳0
[2]   'ENTER COST DISTRIBUTION FOR EACH OF THE FOLLOWING ACTIVITIES'
[3]   '
      THE PROPER ENTRY FORM IS:
      ORIGINAL COST, TIME INCREMENT, INCREASE IN COST, ETC.
      '
[4]   I←1
[5]  P1:→(1=⍴A←' ',AKI ZACT[I;],':')/P15
[6]   →(((⍴J)=⍴JJ)∧2|⍴IN←(J←ΔVI A)/JJ←ΔFI A)/P2
[7]  P15:→P1,0⍴⍞←'IMPROPER NUMERIC DISTRIBUTION',CR,'PLEASE REENTER '
[8]  P2:COSTS←COSTS,A,CR
[9]   →(N≥I←I+1)/P1
[10] CALC:→(0<L←1↑IPI 'ENTER THE AMOUNT OF TIME AVAILABLE FOR THIS PR
      OJECT')/P3
[11]  →CALC,0⍴⍞←'IMPROPER ENTRY',CR,'PLEASE REENTER '
[12] P3:→0
    ∇
```

D-5 COSTEDIT

```
      ∇COSTEDIT[⎕]∇
    ∇ COSTEDIT;TT;P̲;L̲;T;N̲;LL
[1]    N̲←1↑ρTT←CR MM COSTS
[2]    TT←(,(L̲←(1+¯1↑ρTT)-(TT=' ')⊥1)∘.≥ι¯1↑ρTT)/,TT
[3]    P̲←(ρL̲)↑0,+/(N̲,N̲)ρT\(T←,((ιN̲)∘.≥ιN̲))/(N̲×N̲)ρL̲
[4]   LP10:→('PADCQ'=1↑A←AKI 'COMMAND _',2ρBS)/PR,ADD,DEL,CHANGE,END
[5]    →LP10,0ρ⍞←'THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT
       ',CR
[6]   PR:('P⍞[⍞I3,⍞] ⍞' ΔFMTιN̲),(N̲,⌈/L̲)ρ(,L̲∘.≥ι⌈/L̲)\TT
[7]    →LP10
[8]   CHANGE:→(∧/0≠LL←1↑ΔFI A←(Aι' ')↓A)/CH2
[9]   LNERR:→LP10,0ρ⍞←'IMPROPER LINE NUMBER'
[10]  CH2:→(∧/(LL>N̲),L̲≤0)/LNERR
[11]   (T←(5↑(,'P⍞[⍞I3,⍞] ⍞' ΔFMT LL)),TT[P̲[LL]+ιL̲[LL]])
[12]   TT←(P̲[LL]↑TT),(T←LINEEDIT T),P̲[LL+1]↓TT
[13]   P̲[LL↓ιN̲]←P̲[LL↓ιN̲]-L̲[LL]-ρT
[14]   L̲[LL]←ρT
[15]   →LP10
[16]  DEL:→(∨/0=LL←2ρΔFI A←(Aι' ')↓A)/LNERR
[17]   →(∧/(≤/LL),(0≥LL←N̲⌊LL))/LNERR
[18]   TT←(P̲[LL[1]]↑TT),P̲[1+LL[2]]↓TT
[19]   N̲←ρP̲←P̲-1↑P̲←(T←~(LL[1]≤ιN̲)∧LL[2]≥ιN̲)/P̲
[20]   L̲←T/L̲
[21]   →LP10
[22]  ADD:TT←TT,T←AKI,'P⍞[⍞I3,⍞] ⍞' ΔFMT N̲←N̲+1
[23]   P̲←P̲,¯1↑P̲+¯1↑L̲←L̲,ρT
[24]   →LP10
[25]  END:T←(N̲+ρTT)ρ1
[26]   T[(1↓P̲,ρTT)+ιN̲]←0
[27]   COSTS←T\TT
[28]   COSTS[(~T)/ιρCOSTS]←CR
    ∇
```

D-6 PERTCOST

```
        ∇PERTCOST[⎕]∇
    ∇ PERTCOST;ZACT;T;I;A;X;JJ;OR;DIST;TIME;COST;M;M;CP
[1]     ENDP←⍳N
[2]     R←0
[3]   RES:→(R=⍳2)/CPM0,CPM2
[4]     ZACT← 0 6 ρ' '
[5]     PREDESS←(0,N←1↑ρTABLE)ρ0
[6]     T←⍳0
[7]     I←0
[8]     →(E)/RD2
[9]   READ:→(N<I←I+1)/COMPUTE
[10]    A←TABLE[I;],' '
[11]  CPM0:→(CHECK A)/READ
[12]    T[J]←1↑ΔFI A
[13]    A←(A⍳' ')↓A
[14]    →CPM2
[15]  RD2:→(N<I←I+1)/COMPUTE
[16]    A←TABLE[I;],' '
[17]  CPM4:→(CHECK A)/RD2
[18]    T[J]←(+/ 1 4 1 ×3↑ΔFI A)÷6
[19]    A←((A=' ')/⍳ρA)[3]↓A
[20]  CPM2:X←⍳0
[21]  CPM3:→(∧/A=' ')/BACK
[22]    →(∨/JJ←ZACT∧.=PRE←6ρ((I←A⍳' ')↑A),6ρ' ')/MATCH
[23]    ZACT←ZACT,[1] 1 6 ρPRE
[24]    PREDESS←PREDESS,[1](1,N)ρ0
[25]    JJ←(ρT←T,0)=⍳1↑ρZACT
[26]  MATCH:X←X,JJ/⍳1↑ρZACT
[27]    A←I↓A
[28]    →CPM3
[29]  BACK:PREDESS[J;X]←1
[30]    →((E+1)=⍳2)/READ,RD2
[31]  COMPUTE:OR←⍳0
[32]    →(≠/ρPREDESS←⍉PREDESS)/SHPERR
[33]    V←Nρ1
[34]    V[I2←(V\~∨/[1] V/V/[1] PREDESS)⍳1]←0
[35]    →(N>ρOR←OR,I2)/34
[36]    PREDESS←PREDESS[OR;OR]
[37]    TAB←((N,1)ρT[OR]),(N,7)ρ0
[38]    COST←DIST←W←TIME←⍳0
[39]    I←1
[40]    CX←CR MM COSTS
[41]  P1:→(((ρJ)=ρJJ)∧2|ρIN←(J←ΔVI A)/JJ←ΔFI A←' ',CX[I;])/P2
[42]    →ERR,0ρ⍞←'ERROR IN COST DISTRIBUTION PLEASE REENTER'
[43]  P2:COST←COST,1↑IN
[44]    IN←((J←(ρIN)÷2),2)ρIN←1↓IN
[45]    DIST←DIST,IN[;2],LAR
[46]    TIME←TIME,IN[;1],LAR
[47]    →(N≥I←I+1)/P1
[48]  CALC:DIST←((LAR MM DIST),((+/LAR=DIST),1)ρ0)[OR;]
[49]    TIME←((LAR MM TIME),((+/LAR=TIME),1)ρ0)[OR;]
[50]    OCOST←COST←COST[OR]
[51]  P3:V←1ρ0
```

```
[52] MA1:→(N>ρV←V,⌈/V[J]+TAB[(J←(,PREDESS[;1+ρV]=1)/ιN);1])/MA1
[53]  TAB[;2]←V
[54]  TAB[;3]←+/TAB[; 1 2]
[55]  V←1ρTAB[N;3]
[56] MA2:→(N>ρV←(⌊/V[I1+(ρV)-N]-TAB[(I1←(,PREDESS[N-ρV;]=1)/ιN);1]),V
      )/MA2
[57]  TAB[;5]←V
[58]  TAB[;4]←-/TAB[; 5 1]
[59]  TAB[;6]←-/TAB[; 4 2]
[60]  V←ι0
[61] MA3:→((N-1)>ρV←V,⌊/(,TAB[((,PREDESS[I2;]=1)/ιN);2])-,TAB[(I2←1+ρ
      V);3])/MA3
[62]  TAB[;7]←V,0
[63]  CP←(,TAB[;6]=0)/ιN
[64]  TAB[;8]←TAB[;6]+D←L-LIM←⌈/TAB[;3]
[65]  →(L≥LIM)/OUTPUT
[66]  PERT
[67] OUTPUT:CPM2R
[68]  CP←CRT(,TAB[;6]=0)/ιN
[69]  (40ρ' '),PROJECT,CR,CR
[70]  'THE CRITICAL PATH IS'
[71]  ''
[72]  NOS,ZACT[OR[CP];],((ρCP),4)ρ((4×¯1+ρCP)ρ' -> '),'    '
[73]  ''
[74]  'THE LENGTH OF THE CRITICAL PATH IS ';LIM
[75]  ''
[76]  'THE TOTAL FREE SLACK IS ';D
[77]  ''
[78]  '
      NODE   DURATION     EARLY     EARLY     LATE     LATE      TOTAL
        FREE    TOTAL FREE
                          START    FINISH    START    FINISH     SLACK
        SLACK       SLACK
      '
[79]  ZACT[OR;],('X1,8F9.2' ΔFMT TAB)
[80]  CR
[81]  'ACTIVITY ORIGINAL COST OPTIMIZED COST'
[82]  ZACT[OR;],('X5,2F10.2' ΔFMT(⍉(2,(ρCOST))ρOCOST,COST))
[83]  '⎕TOTAL INCREASE IN COST⎕,F9.2' ΔFMT+/COST-OCOST
[84] ERR:→0
[85] UNSOLVE:→0
[86] SHPERR:'THERE IS A NODE DEFINED AS PRECEEDING ANOTHER THAT DOES
      NOT EXIST'
      ∇
```

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