Management
Problem-Solving
with APL

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

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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:

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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.

UCLA, February 1974

JWB, MRN
NLS, JWS
The Authors

John W. Buckley, Ph.D., is professor of Accounting and Information Systems; James W. Schenck, M.S., is Coordinator of Computing Services; Mallur R. Nagaraj, M.Sc. and Durwin L. Sharp, B.Sc. are currently enrolled in the Professional Masters Program, all at the Graduate School of Management, University of California, Los Angeles
Acknowledgements

The authors acknowledge the Graduate School of Management, UCLA, for furnishing the facilities and general support which made this text possible. The material has been class-tested and our appreciation goes to the many students who offered helpful suggestions leading to the improvement of text. The UCLA Campus Computing Network supported our efforts in a variety of ways and on several occasions kept the system open in order to accommodate our special needs. The efficiency of many of these programs is attributable to the power of the APL*PLUS® system of the Scientific Time-Sharing Corporation, Inc.
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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 p, i, r, l. These special codes designate APL operators. For instance, the above operators are:

<table>
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<th>Key Symbol</th>
<th>Operation</th>
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<tr>
<td>p</td>
<td>Finds the dimension of a particular variable.</td>
</tr>
<tr>
<td>i</td>
<td>Scans a particular string of numbers or characters for the first occurrence of a particular number or character.</td>
</tr>
<tr>
<td>r</td>
<td>Finds the greater of two numbers.</td>
</tr>
<tr>
<td>l</td>
<td>Finds the lesser of two numbers.</td>
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</table>

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 connected 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 $+$, $-$, $\times$, and $\div$ 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.

\]

This instruction causes the following information to be printed and breaks the connection between the computer and the terminal.
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 discrepancy 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 commands, 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, O: , 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 (\(\wedge\)) 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:

- \texttt{\textbackslash R\textit{E\textbackslash TA\texttt{NST}}}

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 (\(\wedge\)) 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.

\textbf{Exhibit 1-2}

\textbf{APL ERROR MESSAGES}

\begin{tabular}{|l|l|}
\hline
\textbf{APL ERROR} & \textbf{DESCRIPTION} \\
\hline
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. \\
\hline
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. \\
\hline
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. \\
\hline
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. \\
\hline
\end{tabular}
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. AFMT A high-speed formatting operator
2. AFI A high-speed converter from character to numeric data.
3. AVI 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.
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

C. LEVERAGE

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

Exhibit 2-2
CAPSTRUCTURE FUNCTIONS & VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEANALYSIS</td>
<td>OUTPUT</td>
<td>-</td>
</tr>
<tr>
<td>LEVERAGE</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
B. OEAANALYSIS

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 acquisition, 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. OEAANALYSIS

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
RETAINED EARNINGS
OWNERS' EQUITY

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
RETAINED EARNINGS
OWNERS' EQUITY

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
<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>735,000 stocks issued and outstanding at $10</td>
<td>7,350,000</td>
</tr>
<tr>
<td>Excess paid in capital or (discount)</td>
<td>(50,000)</td>
</tr>
<tr>
<td>Less 20,000 shares held in th.</td>
<td>350,000</td>
</tr>
<tr>
<td>Contributed capital</td>
<td>6,950,000</td>
</tr>
<tr>
<td>Retained earnings</td>
<td>300,000</td>
</tr>
<tr>
<td><strong>Owners' equity</strong></td>
<td><strong>7,250,000</strong></td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributed capital</td>
<td>7,300,000</td>
</tr>
<tr>
<td>Retained earnings</td>
<td>300,000</td>
</tr>
<tr>
<td><strong>Owners' equity</strong></td>
<td><strong>7,600,000</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PERCENTAGE BORROWING</th>
<th>AMOUNT OF O.E.</th>
<th>NO. OF SHARES</th>
<th>CREDITORS EQUITY</th>
<th>INTEREST EXPENSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1,000,000</td>
<td>100,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>800,000</td>
<td>80,000</td>
<td>200,000</td>
<td>14,000</td>
</tr>
<tr>
<td>40</td>
<td>600,000</td>
<td>60,000</td>
<td>400,000</td>
<td>28,000</td>
</tr>
<tr>
<td>EBIT</td>
<td>INCOME AFTER INTEREST 0% OF BORROWING</td>
<td>INCOME AFTER INTEREST 20% OF BORROWING</td>
<td>INCOME AFTER INTEREST 40% OF BORROWING</td>
<td>EPS 0% OF BORROWING</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td>28,000</td>
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The break even point is $70,000

Do you need a plot of these?
Yes
B. OEAALYSIS

\[ \text{V OEAALYSIS} \]

\[ \text{V OEAALYSIS}; A; AS; AX; B; C; D; E; EPC; F; RE; TP; TPS; TRS; TS \]

[1] \text{START: 'ENTER THE AUTHORIZED CAPITAL SHARES AND STOCK AND PAR VALUE'}

[2] \text{AX}+2p0

[3] \text{TPS}+TP+\text{EPC}+\text{RE}+0

[4] \text{A}+4+0

[5] \text{P}+3p0

[6] \text{C}+D+E+TS+TRS+2p0

[7] \text{B}+2p1

[8] 'IS THIS A NEW ISSUE?'

[9] +('YN'=1t~/)/Q2

[10] Q1: 'STOCK ISSUED, PRICE, DIRECTORS' AND UNDERWriters' SHARE AND PRICE, IF ANY'


[14] TPS+; TS


[16] SEE1: 'DO YOU WANT TO SEE THE TRANSACTIONS?'

[17] +('YN'=1t~/)/OUT1,QQ

[18] Q2: 'ENTER STOCKS ISSUED AND OUTSTANDING AND PRICE'

[19] X+2p0


[22] TPS+; TS

[23] 'CAPITAL IN EXCESS OF PAR OR STATED VALUE'

[24] EPC+1p0

[25] 'TREASURY STOCK HELD AND PRICE'

[26] TP+; TRS+2p0

[27] 'RETAINED EARNINGS'

[28] RE+;

[29] 'DO YOU WANT TO SEE THE DATA?'

[30] +('YN'=1t~/)/OUT1

[31] Q3: '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] Q3: 'ENTER THE TRANSACTION. FOR HELP TYPE 'HELP''

[35] +(\'EDITRSH'=4+5p0)/Q1,Q4,Q3,Q5,Q7,Q6,QQ

[36] 'WERE ANY OF THE STOCK OPTIONS EXERCISED?'

[37] +(\'YN'=1t~/)/Q9,0

[38] Q3: 'ENTER THE STOCK SPLIT(E.G., 2 1 INSTEAD OF 2 TO 1)'

[39] B+2+0


[42] TPS+; TS


[44] SEE2: 'DO YOU WANT TO SEE THE TRANSACTION?'

[45] +('YN'=1t~/)/OUT,QQ

[46] Q4: 'ENTER THE STOCK DIVIDEND RETAIINED EARNINGS AND PRICE'
\[
\begin{align*}
F &= 3tO \\
TP &= TS \\
EPC &= (EPC \times P[3]) - AS \times TS[2] \\
\text{SEE3: 'DO YOU WANT TO SEE THE TRANSACTIONS?'} \\
\rightarrow ('YN' = 1) / \text{OUT}, \text{QQ} \\
Q5: 'ENTER THE NUMBER OF SHARES AND MARKET PRICE' \\
C &= 2pO \\
TP &= TP + C \\
\text{DO YOU WANT TO SEE THE TRANSACTION?'} \\
\rightarrow ('YN' = 1) / \text{OUT}, \text{QQ} \\
Q6: 'ENTER THE NUMBER OF STOCKS SOLD AND THE PRICE' \\
D &= 2pO \\
TP &= TP - TRS \\
\text{DO YOU WANT TO SEE THE TRANSACTIONS?'} \\
\rightarrow ('YN' = 1) / \text{OUT}, \text{QQ} \\
Q7: 'ENTER THE NO. OF TR. STOCKS RETIRED AND PRICE OF ACQUISITION' \\
E &= 2pO \\
TP &= TS \\
EPC &= EPC - ((x/E) - (E[1] \times TS[2])) \\
\text{DO YOU WANT TO SEE THE TRANSACTIONS?'} \\
\rightarrow ('YN' = 1) / \text{OUT}, \text{QQ} \\
\text{OUT:}'
\end{align*}
\]
\( \text{OUTPUT}^{[□]} \) \n
\[ \text{\textbackslash V \hspace{1em} OUTPUT; CC; OE} \]

\[ [1] \quad \text{OE} = (\text{CC} + \text{TPS} + \text{EPC} - \text{TP}) + \text{RE} \]

\[ [2] \quad ,(\text{`CI8' ∆FMT TS[1]}); \quad \text{STOCKS ISSUED AND OUTSTANDING AT \$'TS[2];,(`X2,CI12' ∆FMT TPS)} \]

\[ [3] \quad \rightarrow (\text{EPC} = 0)/NQ1 \]

\[ [4] \quad 'EXCESS PAID IN CAPITAL OR (DISCOUNT)`X13,`X10,CI11,CI12' ∆FMT EPC \]

\[ [5] \quad NQ1:\rightarrow (TP=0)/NQ2 \]

\[ [6] \quad 'LESS',X2,CI10,CI11,CI12' SHARES HELD IN TR.`X12,CI12' ∆FMT(TRS[1];TP) \]

\[ [7] \quad NQ2:48p' \quad ','---------' \]

\[ [8] \quad '\text{CONTRIBUTED CAPITAL}',X29,CI12' ∆FMT CC \]

\[ [9] \quad \rightarrow (RE=0)/NQ3 \]

\[ [10] \quad '\text{RETAINED EARNINGS}',X31,CI12' ∆FMT RE \]

\[ [11] \quad NQ3:\rightarrow (CC=OE)/QN \]

\[ [12] \quad 48p' \quad ','---------' \]

\[ [13] \quad '\text{OWNERS'} EQUITY',X34,CI12' ∆FMT OE \]

\[ [14] \quad QN:' \]

\[ \text{\textbackslash V} \]
C. LEVERAGE

V LEVERAGE[A;AOE;C;EBI;EPS;IAI;IAT;IE;IR;K;NOS;PER;TAX
1] K+10
2 START;'ENTER THE AMOUNT NEEDED AND STOCK ISSUE PRICE, IF ANY'
3 A+2
4 'INTEREST RATE IF BORROWED'
5 IR+0+100
6 'TAX RATE'
7 TAX+0+100
8 'PERCENTAGES OF BORROWING'
9 PER+0+100
10 IE+AOE+100
11 'ENTER DIFFERENT AMOUNTS OF EBIT'
12 EBI+1
13 IAI+IAT+EPS+((pEBI),(pPER))0
14 NOS+(AOE+111(1-PER))+A[2]
15 IE+(A[1]-AOE)xIR
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' ΔMT((PER×100);AOE; NOS; C; IE)
21 L+1
23 →(pPER)+L)/RESULT
24 L=L+1
25 →TRB
26 RESULT:'
27 ' INCOME AFTER INTEREST EPS'
28 'EBIT ø/ø OF BORROWING ø/ø OF BORROWING'
29 ':
30 '10p ':('10I12' ΔMT(Q;Q)),('10I8' ΔMT Q=(1,(pPER)×PER×100))
31 '
32 '('CI8,X3,10CF12.2' ΔMT(EBI;IAI;IAT)),('10F8.2' ΔMT EPS)
33 2pCR
34 'THE BREAK EVEN POINT IS $':('CI10' ΔMT EBI[(A/(1+1 RND EPS)=1 RND EPS);1])
35 2pCR
36 'DO YOU NEED A PLOT OF THESE?'
37 →('Y'=1+0)/PLOT1
38 AGAIN;'DO YOU WANT TO TRY AGAIN?'
39 →('YN'=1+0)/START,0
40 '
41 PLOT1:50 PLOT EPS VS EBI
42 →AGAIN

V
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:

\[ \text{LOAD 7 CASHMAN} \]

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

- A. CASHMAN
- B. CASHBUDGET
- C. MMODEL
- D. MMODEmd
- E. CASHDISCOUNT
- F. INVCA$HDISCOUNT
- G. OPCASHPOSITION
- H. FLOAT
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 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.


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

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

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:

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

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<th>AMOUNT</th>
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DO YOU WANT TO CHANGE ANY DATA?
YES

PLEASE TYPE THE CHANGED DATA. (A ZERO SIGNALS THE END)
☐: 4 30 30 10
☐:
DO YOU WANT TO SEE YOUR DATA?
NO
DO YOU WANT TO SEE THE NET OPERATING CASH POSITION?
YES

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DO YOU WANT TO INCLUDE NON-OPERATING ITEMS IN THE BUDGET?
YES

9. INTEREST INCOME
0: 5

10. SALE OF INVESTMENTS
0: 50 30 0

11. SALE OF FIXED ASSETS
0

12. SALE OF STOCK
0: 0 0 100

13. LOANS, BONDS OR OTHER LONG-TERM CREDITORS' EQUITY
0

14. INTEREST EXPENSE
0: 10

15. INVESTMENTS
0: 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

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DO YOU WANT TO CHANGE ANY DATA?
NO
# CASH BUDGET

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<td>30.00</td>
<td>10.00</td>
<td>70.00</td>
</tr>
<tr>
<td>Payments on A/P</td>
<td>500.00</td>
<td>600.00</td>
<td>500.00</td>
<td>1600.00</td>
</tr>
<tr>
<td>Wages and Salaries</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Other Op. Expenses</td>
<td>80.00</td>
<td>140.00</td>
<td>140.00</td>
<td>360.00</td>
</tr>
<tr>
<td>Taxes Paid</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>TOTAL OP. USES</strong></td>
<td>610.00</td>
<td>770.00</td>
<td>650.00</td>
<td>2030.00</td>
</tr>
<tr>
<td><strong>NET OPERATING CASH</strong></td>
<td>67.00</td>
<td>22.00</td>
<td>216.50</td>
<td>305.50</td>
</tr>
<tr>
<td><strong>NON-OPERATING SOURCES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest Income</td>
<td>5.00</td>
<td>5.00</td>
<td>5.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Sale of Investments</td>
<td>50.00</td>
<td>30.00</td>
<td>0.00</td>
<td>80.00</td>
</tr>
<tr>
<td>Sale of P/A</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Contributed Capital</td>
<td>0.00</td>
<td>0.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Loans, Bonds Etc.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>TOTAL NON-OP. SOURCES</strong></td>
<td>55.00</td>
<td>35.00</td>
<td>105.00</td>
<td>195.00</td>
</tr>
<tr>
<td><strong>USES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest Expense</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Investments</td>
<td>50.00</td>
<td>90.00</td>
<td>100.00</td>
<td>240.00</td>
</tr>
<tr>
<td>Purchase of P/A Etc.</td>
<td>0.00</td>
<td>70.00</td>
<td>50.00</td>
<td>120.00</td>
</tr>
<tr>
<td>Dividends Declared</td>
<td>20.00</td>
<td>20.00</td>
<td>20.00</td>
<td>60.00</td>
</tr>
<tr>
<td><strong>TOTAL NON-OP. USES</strong></td>
<td>80.00</td>
<td>190.00</td>
<td>180.00</td>
<td>450.00</td>
</tr>
<tr>
<td><strong>NET NON-OP. CASH</strong></td>
<td>(25.00)</td>
<td>(155.00)</td>
<td>(75.00)</td>
<td>(255.00)</td>
</tr>
<tr>
<td><strong>NET CASH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Balance-Beg.</td>
<td>42.00</td>
<td>(133.00)</td>
<td>141.50</td>
<td>50.50</td>
</tr>
<tr>
<td><strong>CASH BALANCE ENDING</strong></td>
<td>192.00</td>
<td>59.00</td>
<td>200.50</td>
<td>200.50</td>
</tr>
</tbody>
</table>

Do you want to try for other periods? No
(EXAMPLE B-2)

CASHBUDGET

NUMBER OF PERIODS

1: 4

1. CASH SALES FOR 4 PERIODS

2: 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

3: 30000 40000 30000 30000

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)

4: 20 70 10

CREDIT SALES FOR THE PAST 3 PERIOD(S)

5: 10000 10000 20000

THE COLLECTION SCHEDULE IS---

6: 21000.00 31000.00 35000.00 22000.00

4. CASH PURCHASES

7: 28000 14000 14000 7000

5. PAYMENTS ON ACCOUNTS PAYABLE

8: 21000 28000 14000 14000

6. WAGES AND SALARIES

9: 2000 2500 1500 1500

7. OTHER CASH OPERATING EXPENSES

10: 500

8. TAXES PAID.

11: 8000 0 0 0

DO YOU WANT TO SEE YOUR DATA?

DO YOU WANT TO SEE THE NET OPERATING CASH POSITION?

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

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

BMODEL

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

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 INVENTORY HOLDING PERIOD SHOULD EXCEED 60 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 AVG. 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
<table>
<thead>
<tr>
<th>PAYEE</th>
<th>AVERAGE FLOAT</th>
<th>AVERAGE TRANSACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAGARAJ</td>
<td>3.75</td>
<td>500.00</td>
</tr>
<tr>
<td>DURWIN SHARP</td>
<td>3.67</td>
<td>241.67</td>
</tr>
<tr>
<td>JIM SCHENCK</td>
<td>3.75</td>
<td>562.50</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>3.72</td>
<td>434.72</td>
</tr>
</tbody>
</table>

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 GIVEN 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

VCASHBUDGET[[]]V

\[CASHBUDGET;N;MAT;CBBF;CBBF\\]

[1] \[\text{START: 'NUMBER OF PERIODS'}\]
[2] \[N=\] \[\text{MAT}(17, N)\]
[3] \[\text{MAT}(1;1)+Np\]
[4] \[\text{MAT}(1;1)+Np\]
[5] \[\text{MAT}(1;1)+Np\]
[6] \[\text{MAT}(1;1)+Np\]
[7] \[\text{MAT}(1;1)+Np\]
[8] \[\text{MAT}(1;1)+Np\]
[9] \[\text{MAT}(1;1)+Np\]
[10] \[\text{MAT}(1;1)+Np\]
[11] \[\text{MAT}(1;1)+Np\]
[12] \[\text{MAT}(1;1)+Np\]
[13] \[\text{MAT}(1;1)+Np\]
[14] \[\text{MAT}(1;1)+Np\]
[15] \[\text{MAT}(1;1)+Np\]
[16] \[\text{MAT}(1;1)+Np\]
[17] \[\text{MAT}(1;1)+Np\]
[18] \[\text{MAT}(1;1)+Np\]
[19] \[\text{MAT}(1;1)+Np\]
[20] \[\text{MAT}(1;1)+Np\]
[21] \[\text{MAT}(1;1)+Np\]
[22] \[\text{MAT}(1;1)+Np\]
[23] \[\text{MAT}(1;1)+Np\]
[24] \[\text{MAT}(1;1)+Np\]
[25] \[\text{MAT}(1;1)+Np\]
[26] \[\text{MAT}(1;1)+Np\]
[27] \[\text{MAT}(1;1)+Np\]
[28] \[\text{MAT}(1;1)+Np\]
[29] \[\text{MAT}(1;1)+Np\]
[30] \[\text{MAT}(1;1)+Np\]
[31] \[\text{MAT}(1;1)+Np\]
[32] \[\text{MAT}(1;1)+Np\]
[33] \[\text{MAT}(1;1)+Np\]
[34] \[\text{MAT}(1;1)+Np\]
[35] \[\text{MAT}(1;1)+Np\]
[36] \[\text{MAT}(1;1)+Np\]
[37] \[\text{MAT}(1;1)+Np\]
[38] \[\text{MAT}(1;1)+Np\]
[39] \[\text{MAT}(1;1)+Np\]
[40] \[\text{MAT}(1;1)+Np\]
[41] \[\text{MAT}(1;1)+Np\]
[42] \[\text{MAT}(1;1)+Np\]
[43] \[\text{MAT}(1;1)+Np\]
[44] \[\text{MAT}(1;1)+Np\]
[45] \[\text{MAT}(1;1)+Np\]
[46] \[\text{MAT}(1;1)+Np\]
[47] \[\text{MAT}(1;1)+Np\]
[48] \[\text{MAT}(1;1)+Np\]
[49] \[\text{MAT}(1;1)+Np\]
[50] \[\text{MAT}(1;1)+Np\]

\[\text{SEE} 1: \text{DO YOU WANT TO SEE YOUR DATA?}\]
\[\text{SEE} 2: \text{DO YOU WANT TO SEE THE NET OPERATING CASH POSITION?}\]
\[\text{SEE} 3: \text{DO YOU WANT TO SEE YOUR DATA?}\]
\[\text{SEE} 4: \text{DO YOU WANT TO SEE YOUR DATA?}\]
3-20

[51] SEE:2pCR
[52] SMAT+(7,N)p(\MAT[1,(2+t6);])
[53] \text{,}'\text{\PERIOD},X17,10I10' \text{ AFMT}(1,N)p(N),'; ' \text{ TOTAL}'
[54] 
[55] CBUDGET SMAT
[56] 1pCR
[57] →PP11
[58] SEE1:SEEDATA1
[59] 1pCR
[60] PA:'DO YOU WANT TO CHANGE ANY DATA?'
[61] \text{(YN}=1)'/CHANGE,XXX
[62] →PA
[63] SEE2:SEEDATA2
[64] 1pCR
[65] PB:'DO YOU WANT TO CHANGE ANY DATA?'
[66] \text{(YN}=1)'/CHANGE1,OUT
[67] →PB
[68] PP11:'DO YOU WANT TO INCLUDE NON-OPERATING ITEMS IN THE BUDGET?'
[69] \text{(YN}=1)'/PP12,0
[70] →PP11
[71] OUT:2pCR
[72] [((12+N x 10)x2)p' '); 'CASH BUDGET',(11pBS),'__________'
[73] 1pCR
[74] \text{,}'\text{\PERIOD},X17,10I10' \text{ AFMT}(1,N)p(N),'; ' \text{ TOTAL}'
[75] 
[76] CBUDGET SMAT+(7,N)p(\MAT[1,(2+t6);])
[77] 
[78] CBUDGET XMAT+(9,N)p(\MAT[8+t9;])
[79] 
[80] \text{UNET CASH},X16,10M\text{([M]+CBB)} EF10.2' \text{ AFMT}(((1,N)pXYZ)+/XYZ+2+ZZ)
[81] CB+NP0
[82] CB[1]+CBB
[83] J+1
[85] J=J+1
[86] \rightarrow(J<N)/TRA
[87] \text{ECASH BALANCE-BEGIN},X7,10M\text{([M]+CBB)} EF10.2' \text{ AFMT}(((1,N)pCBB)+CBBF)
[88] (2p' '),\text{(10x(N+1)p')-'}
[89] \text{ECASH BALANCE ENDING},X5,10M\text{([M]+CBB)} EF10.2' \text{ AFMT}(((1,N)pXY2+CBB)+((N-1)+(XYZ+CBB))]
[90] (2p' '),\text{(10x(N+1)p')-'}
[91] PC:'DO YOU WANT TO TRY FOR OTHER PERIODS?'
[92] \text{(YN}=1)'/START,0
[93] →PC
[94] CHANGE:'
'PLEASE TYPE THE CHANGED DATA. (A ZERO SIGNALS THE END)'

NEW:NN+(I)

[((1+NN)=0)/SEE3

[((0NN)=(1+NN))/LX1

((0NN)*3)/ERROR

(\NN[1]=18)/ERROR

(\NN[2]=18)/ERROR

MAT[NN[1];(\N)]+NN[2]]+2*NN

NEW

LX1:=(\NN[1]=18)}/ERROR

MAT[NN[1];]+1*NN

NEW

ERROR: 'WRONG ENTRY...REENTER'

NEW

CHANGE1:

PLEASE TYPE THE CHANGED DATA. (A ZERO SIGNALS THE END)'

NEW:NN+(I)

[((1+NN)=0)/SEE4

[((0NN)=(1+NN))/LX2

((0NN)*3)/ERROR1

(\NN[1]=18)/ERROR1

(\NN[2]=18)/ERROR1

MAT[NN[1];(\N)]+NN[2]]+2*NN

NEW1

LX2:=(\NN[1]=18)/ERROR1

MAT[NN[1];]+1*NN

NEW1

ERROR1: 'WRONG ENTRY...REENTER'

NEW1

\
VCBUDGET[[]]

VCBUDGET M

[1] ' OPERATING SOURCES', (17pBS), '_________________________
[2] ' CASH SALES', X5, 10F10.2' ΔMFT(((1,N)pM[1;])=/M[1;])
[3] ' COLLECTIONS ON A/R', X5, 10F10.2' ΔMFT(((1,N)pM[2;])=/M[2;])
[4] (23p'), (10x(N+1))p'-'
[5] ' TOTAL OP. SOURCES', X6, 10F10.2' ΔMFT(((1,N)pX);+/X++M[12;])

USES', (4pBS), '_____

[7] ' CASH PURCHASES', X9, 10F10.2' ΔMFT(((1,N)pM[3;])=/M[3;])
[8] ' PAYMENTS ON A/P', X8, 10F10.2' ΔMFT(((1,N)pM[4;])=/M[4;])
[9] ' WAGES AND SALARIES', X5, 10F10.2' ΔMFT(((1,N)pM[5;])=/M[5;])
[10] ' OTHER OP. EXPENSES', X5, 10F10.2' ΔMFT(((1,N)pM[6;])=/M[6;])
[11] ' TAXES PAID', X12, 10F10.2' ΔMFT(((1,N)pM[7;])=/M[7;])
[12] (23p'), (10x(N+1))p'-'
[13] ' TOTAL OP. USES', X9, 10F10.2' ΔMFT(((1,N)pY);+/Y++M[2+15;])

USES', (4pBS), '_____

[16] ' NET OPERATING CASH', X5, 10F10.2' ΔMFT(((1,N)pX);+/X-Y)

VSBIUDGET[[]]

VSBIUDGET K

[1] ' NON-OPERATING SOURCES', (21pBS), '_________________________
[2] ' INTEREST INCOME', X5, 10F10.2' ΔMFT(((1,N)pK[1;])=/K[1;])
[3] ' SALE OF INVESTMENTS', X5, 10F10.2' ΔMFT(((1,N)pK[2;])=/K[2;])
[4] (23p'), (10x(N+1))p'-'
[5] ' CONTRIBUTED CAPITAL', X5, 10F10.2' ΔMFT(((1,N)pK[4;])=/K[4;])
[6] ' LOANS, BONDS ETC.', X5, 10F10.2' ΔMFT(((1,N)pK[5;])=/K[5;])
[7] (23p'), (10x(N+1))p'-'
[8] ' TOTAL NON-OP. SOURCES', X2, 10F10.2' ΔMFT(((1,N)pXX;+/XX++K[15;])
[9] (23p'), (10x(N+1))p'-'

USES', (4pBS), '_____

[11] ' INTEREST EXPENSE', X7, 10F10.2' ΔMFT(((1,N)pK[6;])=/K[6;])
[12]  "INVESTMENTS",X12,10F10.2' ΔFMT(((1,N)p[K7]);+/K[7;])
[13]  "PURCHASE OF F/A ETC."X2,10F10.2' ΔFMT(((1,N)p[K8]);+/K[8;])
[14]  "DIVIDENDS DECLARED",X5,10F10.2' ΔFMT(((1,N)p[K9]);+/K[9;])
[15]  (23p' '), (10×(N+1))p'-'
[16]  "TOTAL NON-OP. USES",X5,10F10.2' ΔFMT(((1,N)p[YY]);+/YY++K[5;4;])
[17]  (23p' '), (10×(N+1))p'-'
[18]  "NET NON-OP. CASH",X8,10F10.2' ΔFMT(((1,N)p[2Z]);+/2Z+XX-YY)
[19]  (23p' '), (10×(N+1))p'-'

\[\]

\textbf{USEDATA1[]}√

\[\]

\textbf{SEEDATA1}

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]"NO. ACCOUNT";((X10)-6)+2)p' ';' AMOUNT'
\[\]

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]

\[\]"21A1,X2,10F11.2' ΔFMT(M2;MATRIX1)"
\texttt{\textbackslash VSEEDATA2[\[\]V}

\texttt{\textbackslash VSSEDETA2}

\begin{verbatim}
[1] \texttt{M3=M1,'9. INTEREST INCOME 10.SALE OF INVEST. '}
[5] \texttt{M3=M3,'17.PAYMENT OF DIV. 18.BEG. CASH BALANCE '}
[6] \texttt{N4=18 21 \texttt{PM}3}
[7] \texttt{'}
[8] \texttt{'}
[9] \texttt{'M4, ACCOUNT',((N×10)-6)\texttt{PM}1 '}
[10] \texttt{'AMOUNT'}
[11] \texttt{21A1,X2,10F11.2 \texttt{AMT}(N4;MAT) \textbackslash V}
\end{verbatim}

\texttt{\textbackslash VCOLSCHED[\[\]V}

\begin{verbatim}
\texttt{\textbackslash VCOLSCHED;CSHED;CSCHED;CPAST;CSCHED;MATRAX}
[1] \texttt{'2. CREDIT SALES FOR 'N;' PERIODS'}
[2] \texttt{MAT[2;]+N[1]}
[3] \texttt{'COLLECTION SCHEDULE. INPUT FORMAT--- ENTER THE PERCENTAGES'}
[4] \texttt{'OF COLLECTION FOR EACH PERIOD, BEGINNING IN THE PERIOD OF'}
[5] \texttt{'SALES. THESE PERCENTAGES SHOULD ADD TO 100 IF THE COLLECTION'}
[6] \texttt{'PERIOD IS LESS THAN THE BUDGETING PERIOD. (E.G., 20 50 20 10)'}
[7] \texttt{PP00:CSHEDULx,([})}
[8] \texttt{+(([(pCSHEDULx)\texttt{PM}0)+((\texttt{CSHEDULx}\texttt{PM}0)+100))/ERROR}
[9] \texttt{CSHEDLx+1+CSHEDULx}
[10] \texttt{+START}
[11] \texttt{ERROR:'THE TOTAL PERCENT SHOULD BE 100....REENTER'}
[12] \texttt{+PP00}
[13] \texttt{START:'CREDIT SALES FOR THE PAST ',pCSHEDULx,' PERIOD(S)'}
[14] \texttt{CPAST+(pCSHEDULx)+[]}
[15] \texttt{CSHEDLx+CPAST,MAT[2;]}
[16] \texttt{MATRAX=(CSHEDULx*100)+xCSHEDLx}
[17] \texttt{I+1}
[18] \texttt{TRA:MATRAX[I]+(pCSHEDULx)+((I-1)p0),MATRAX[I;]}
[19] \texttt{I+I+1}
[20] \texttt{+(I\texttt{PM}0CSHEDULx)/TRA}
[21] \texttt{OUT:'THE COLLECTION SCHEDULE IS---'}
[22] \texttt{10F10.2 'AMT((1,N)pMAT[3;]+(pCPAST)+/\texttt{MATRIX}) \textbackslash V}
\end{verbatim}
C. BMODEL

\[ \text{VBMODEL}[]\]

\[ \text{BMODEL;T;I;INT;B;C;A;KD} \]

1. INC 'ENTER TOTAL CASH AVAILABLE DURING THE PERIOD'
2. 'INVESTMENTS IN SHORT-TERM INVESTMENT PORTFOLIOS'
3. I=1
4. INT=0.01x1 INC 'ENTER THE INTEREST RATE (INTEREST OPPORTUNITY COST) AS A PERCENT'
5. B+1 INC 'ENTER BROKERS' FEE PER WITHDRAWAL'
6. A+((2xBxT)+INT)*0.5+2
7. 2pCR
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. 1pCR
12. PA:'DO YOU WANT TO TRY OTHERS?'
13. +('YN'='1+0)/1,0
14. →PA

D. MOMODEL

\[ \text{VMODEL}[]\]

\[ \text{MOMODEL;CAPZ;GAMMA;H;I;M;NU;2;ZSTAR} \]

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+2+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+2xZSTAR+((3xGAMMAx(M+2)xT)x4xNU+100)x(1+3)
9. HSTAR+3xZSTAR
10. 2pCR
11. XX+4x3x((3xGAMMAx(M+2)xT)x4xNU+100)x(1+3)
12. 'THE OPTIMAL AVERAGE CASH BALANCE IS $';2 RND XX
13. YY+4x2xZSTAR+CAPZSTAR+GAMMAx2xCAPZSTAR+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 3xZSTAR
17. 2pCR
18. PA:'DO YOU WANT TO TRY AGAIN?'
19. +('YN'='1+0)/START,0
20. →PA

\[ \]
E. CASHDISCOUNT

\[ \text{CASHDISCOUNT}(\text{CSALES}, \text{DRATE}, \text{BIRATE}, \text{AVDAYS}, \text{ACTAMT}, \text{ERAT}, \text{INTAMT}) \]

[1] \text{START} \text{CSALES}+1 \text{ INC 'PLEASE ENTER THE PRINCIPAL AMOUNT.'}
[2] \text{ Enter the discount rate in the form: '}
[3] \text{XX:DRATE+3 INC 'E.G., 5 10 30 instead of 5/10,N/30.'}
[4] \text{BIRATE}+0.01 \text{ INC 'INTEREST RATE CHARGED BY THE BANK.'}
[5] \text{AVDAYS}+1 \text{ INC 'NUMBER OF DAYS IN THE YEAR.'}
[6] \text{ACTAMT} \text{CSALES} \text{DRATE[1]} \text{100}
[7] \text{ERAT}+(\text{ACTAMT}) \text{CSALES} \text{ACTAMT} \text{DRATE[3]} \text{DRATE[2]} \text{AVDAYS} \text{100}
[8] \text{INTAMT}+(\text{DRATE[3]} \text{DRATE[2]} \text{BIRATE} \text{CSALES} \text{ACTAMT} \text{AVDAYS}}
[9] \text{1pCR}
[10] \text{CASH DISCOUNT IS $';2 RND ACTAMT}
[11] \text{COST OF BORROWING FROM THE BANK IS $';2 RND INTAMT}
[12] \text{'SAVINGS(COST) REALIZED BY BORROWING FROM THE BANK IS', \text{RND(TM)TM} \text{'%0.2'}}
[13] \text{APMT ACTAMT-INTAMT}
[14] \text{EFFECTIVE RATE OF INTEREST IN DISCOUNT EXPRESSION IS ',2 RND(AVDAYS+} \text{DRATE[3]} \text{DRATE[2]} \text{DRATE[1]}}
[15] \text{2pCR}
[16] \text{PA: 'DO YOU WANT TO TRY OTHERS?'}
[17] \text{->('YN'=1'4))/START,0}
[18] \text{->PA}

F. INVNCASHDISCOUNT

\[ \text{INVNCASHDISCOUNT}(\text{DRATE}, \text{APMGN}, \text{ADAYS}, \text{INT}, \text{BTC}) \]

[1] \text{'ENTER THE DISCOUNT RATE IN THE FORM: '}
[2] \text{DRATE}+3 \text{ INC 'E.G., 3 10 30 instead of 3/10,N/30.'}
[3] \text{APMGN}+1 \text{ INC 'ENTER THE AVERAGE PROFIT MARGIN ON INVENTORY AS A PERCENTAGE.'}
[4] \text{ADAYS}+1 \text{ INC 'THE NUMBER OF DAYS IN THE PERIOD.'}
[5] \text{INT}+\text{DRATE[1]} \text{ADAYS} \text{DRATE[3]} \text{DRATE[2]}
[6] \text{BTC} \text{ADAYS} \text{INT} \text{APMGN} \text{100}
[7] \text{1pCH}
[8] \text{FOR POSITIVE LEVERAGE YOUR INVENTORY HOLDING PERIOD SHOULD EXCEED ',2 RND BTC}
[9] \text{DAYS GIVEN THE AVERAGE GROSS PROFIT MARGIN IS ',2 RND APMGN,' PERCENT.'}
[10] \text{PA: 'DO YOU WANT TO TRY OTHERS?(YES OR NO).'}
[11] \text{->('YN'=1'4))/1,0}
[12] \text{->PA}
G. OPCASHPOSITION

```
V OPCASHPOSITION[□]V

V OPCASHPOSITION;NP;NR;DT;DA;CB;CB1;CE;CE1;CB2
[1] NP+1 INC 'ENTER THE NUMBER OF DAYS IN THE PERIOD'
[3] DT+1 INC 'ENTER THE TOTAL DISBURSEMENT FOR THE PERIOD'
[4] CB+NRxDA+DT+NP
[5] 2pCR
[6] 'THE CASH BALANCE IS $';2 RND CB
[7] 'THE AVERAGE DAILY DISBURSEMENT IS $';2 RND DA
[8] 1pCR
[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] 2pCR
[15] 'THE NUMBER OF DAYS OF AVERAGE DAILY CASH' EXPENDITURES ARE ';2 RND CB1+CE+NP;' DAYS'
[16] 1pCR
[17] NEXT:'DO YOU WANT TO VARY THE NUMBER OF DAYS OF AVERAGE'

DAILY CASH EXPENDITURE?'
[18] ->('YN'='1')/PC,NEXT1
[19] +NEXT
[20] PC:CB2+1 INC 'ENTER THE CASH BALANCE'
[21] CE2+1 INC 'ENTER THE NUMBER OF DAYS OF AVERAGE CASH EXP.'
[22] 2pCR
[23] 'THE ESTIMATED TOTAL CASH EXPENDITURE FOR'
[24] 'THE YEAR IS $';2 RND(CB2+CE2)xNP
[25] 1pCR
[26] NEXT1:'DO YOU WANT TO TRY AGAIN?'
[27] ->('YN'='1')/START,0
[28] +NEXT1
```

V
H. FLOAT

VFLOAT[]V

VFLOAT;N;NAMES;X;Y;XX;MN;WM;MN

[1] MN=XX+X;0
[2] START:'ENTER THE NUMBER OF PAYEES YOU ARE ENTERING?'
[3] N=1+U
[5] I+1
[6] 'INPUT FORMAT FOR AMOUNT AND FLOAT: 35 0 2 45 5 3 ETC.'
[7] 'THE AMOUNT OF EACH TRANSACTION FOLLOWED BY THE FLOAT'
[9] NAMES[I];I+25+U
[10] 'ENTER THE AMOUNT AND FLOAT FOR ':';NAMES[I];
[12] +(pX)=1/ERROR
[13] XX+XX,X
[14] MN=(X-(pX)+2,2)pX
[15] MN=(M+MN)+X
[16] MN=MN,MN
[17] +(I=N)/OUT
[18] I=I+1
[19] →ENTER
[20] OUT:'

[21] MN=(MN+2,2)pMN
[22] 'PAYEE       AVERAGE FLOAT      AVERAGE TRANSACTION'
[23] '
[24] '25A1,F5.2,F15.2' $\text{FMT}(NAMES[MN;2];WM;1])
[25] '5
[26] 'AVERAGEU.X18,F5.2,F15.2' $\text{FMT}(+(MN;2)+N;+(MN;1)+N)
[27] 2pCR
[28] XX=(X-(pX)+2,2)pXX
[29] WM=(WM;1)+N
[30] DM=(DM;1)+N
[31] SPM=STD X;1
[32] DPM=STD X;2
[33] PA:'DO YOU WANT TO TRY, VARY THE CONFIDENCE LEVEL OR RANGE?'
[34] 'IF NONE HIT THE TAB AND CARRIAGE RETURN.'
[35] +(T+C';=1+U)/TRY,CONF,RANGE,0
[36] ERROR:'WRONG ENTRY.... REENTER'
[37] →INPUT
[38] TRY::START
[39] →PA
[40] CONF:Z2=Z,10.01*CO+1 INC 'ENTER THE CONFIDENCE LEVEL AS A PERCENT.'
[41] 1pCR
[42] 'THE RANGE FOR THE PORTFOLIOS IS ':';RND FM+SPM*Z2;' AND ':';RND FM-SPM*Z2
[43] 1pCR
```
[45] 1pCR
[46] →PA
[47] RANGE:RN+2 INC 'ENTER THE RANGE FOR THE PORTFOLIO AND FLOAT'
[48] 1pCR
[49] 'CONFIDENCE LEVEL FOR THE GIVEN RANGE FOR THE PORTFOLIO IS ';2 RND 2×(CT,1,RN[1]*SPM)
[50] 1pCR
[51] 'CONFIDENCE LEVEL FOR THE GIVEN RANGE FOR THE FLOAT IS ';2 RND 2×(CT,1,RN[2]*DPM)
[52] →PA
[53] ERROR:'WRONG ENTRY...REENTER'
[54] →INPUT

VRND([])\n
\n\nR×N RND X
[1] \xrightarrow{w×1\sqrt{x/(N≤0,\times(2×31)≥X}}
[2] R×X=R|X+X+0.5×N+10=N
[3] →0
[4] R+0.5+N×0.5+X×N+10=N

VSTD([])\n
\n\nR+STD X:A:B:N
[1] R+((A+(B+,×B+(+/X)*N))*(N+pX)-1)*0.5

V2([])\n
\n\nR+Z N:A:C;T
[1] \xrightarrow{(\sqrt{A+0,\sqrt{FE} 19})^2=22^+} 1 \text{ STATTAB'}/L0
[2] '1 \text{ STATTAB' } FE 4,((\pm((i11)e0,\sqrt{FE} 18)10),32948
[3] →L1
[4] L0;=\text{FE} 18
[5] L1:+\text{FE} 18
[6] 'WRONG SHAPE OF INPUT'
[7] →0
[8] L3:=(\text{FE} 6,\text{T},2,32948)≥N[1])/L4
[9] 'TABLE NUMBER TWO LARGE'
```
L4: (1+2)+M(2)/L5

'WRONG TABLE ELEMENT REF.'

L5: R = 0.01 {(A - C[D]) + (-/C[1 0 +D])} + D + ((A + 0.5 + M(2) + 2) × 100000) + C + FE 6, 2 + (2 + M[1]), 32948) / 1 - 1

V

VCT[[]]V

V R = CT N; A; C; T

L0: T + (1 + A) / FE 18
L1: L + (2 = pM) / L3

'WRONG SHAPE OF INPUT'

L2: 0

L3: L + ((FE 6, 2 + 32948) ≥ M[1]) / L4

'TABLE NUMBER TWO LARGE'


'WRONG TABLE ELEMENT REF.'

L5: R = 1E - 5 × 0.5 + C[A - D] + (D + 1 + 100 × M[2]) × -/C[1 0 - 1 + A]

V
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
C. CREDITRISK
D. NOTESDISCOUNT

Exhibit 4-2
CREDITMAN FUNCTIONS & VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFAC</td>
<td>OUTPUT, METHOD1, METHOD2, METHOD3</td>
<td>-</td>
</tr>
<tr>
<td>CREDITRISK</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NOTESDISCOUNT</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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..)

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

---

<table>
<thead>
<tr>
<th>PERCENTAGE OF CREDIT SALES METHOD</th>
<th>ALLOWANCE ACCOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>BALANCE: BEG.</td>
<td>0</td>
</tr>
<tr>
<td>AMOUNT ADDED</td>
<td>30,000</td>
</tr>
<tr>
<td>TOTAL AVAILABLE</td>
<td>30,000</td>
</tr>
<tr>
<td>LESS: BAD DEBTS</td>
<td>16,000</td>
</tr>
<tr>
<td>BALANCE: END</td>
<td>14,000</td>
</tr>
</tbody>
</table>

---

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
☐: 6000000 6000000 7000000 9000000 8000000

ENTER THE PERCENTAGE OF A/R THAT IS DOUBTFUL
☐:
<table>
<thead>
<tr>
<th>PERCENTAGE OF AVERAGE BALANCE IN ACCOUNTS</th>
<th>ALLOWANCE ACCOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>BÉALANCE: BEG.</td>
<td>0</td>
</tr>
<tr>
<td>AMOUNT ADDED</td>
<td>40,000</td>
</tr>
<tr>
<td>TOTAL AVAILABLE</td>
<td>40,000</td>
</tr>
<tr>
<td>LESS: BAD DEBTS</td>
<td>16,000</td>
</tr>
<tr>
<td>BALANCE: END</td>
<td>24,000</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th></th>
<th>1 350000 400000 500000 400000</th>
</tr>
</thead>
</table>
|   | ENTER THE AGE BETWEEN 31 AND 60 DAYS
ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.

<table>
<thead>
<tr>
<th></th>
<th>3 150000 210000 220000 200000</th>
</tr>
</thead>
</table>
|   | ENTER THE AGE BETWEEN 61 AND 90 DAYS
ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.

<table>
<thead>
<tr>
<th></th>
<th>10 40000 70000 140000 150000</th>
</tr>
</thead>
</table>
|   | ENTER THE AGE OVER 90 DAYS
ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.

<table>
<thead>
<tr>
<th></th>
<th>20 60000 20000 40000 50000</th>
</tr>
</thead>
</table>
|   | ENTER THE AGE
<table>
<thead>
<tr>
<th>AGE IN DAYS</th>
<th>PERCENT</th>
<th>AMOUNT OF BAD DEBT ALLOWANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BETWEEN 0 AND 30 DAYS</td>
<td>1</td>
<td>3,500.00 4,000.00 5,000.00 4,000.00</td>
</tr>
<tr>
<td>BETWEEN 31 AND 60 DAYS</td>
<td>3</td>
<td>4,500.00 6,300.00 6,600.00 6,000.00</td>
</tr>
<tr>
<td>BETWEEN 61 AND 90 DAYS</td>
<td>10</td>
<td>4,000.00 7,000.00 14,000.00 15,000.00</td>
</tr>
<tr>
<td>OVER 90 DAYS</td>
<td>20</td>
<td>12,000.00 4,000.00 8,000.00 10,000.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>24,000.00 21,300.00 33,600.00 35,000.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AGEING OF ACCOUNTS</th>
<th>ALLOWANCE ACCOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>---------------------</td>
<td>-------</td>
</tr>
<tr>
<td>BALANCE: BEG.</td>
<td>0</td>
</tr>
<tr>
<td>AMOUNT ADDED</td>
<td>40,000</td>
</tr>
<tr>
<td>TOTAL AVAILABLE</td>
<td>40,000</td>
</tr>
<tr>
<td>LESS: BAD DEBTS</td>
<td>16,000</td>
</tr>
<tr>
<td>BALANCE: END</td>
<td>24,000</td>
</tr>
</tbody>
</table>

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

CREDITRISK


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

<table>
<thead>
<tr>
<th>Credit Risk Factor</th>
<th>Credit Risk Group</th>
<th>Potential Number of Persons</th>
<th>Average Sales Per Person (Limit)</th>
<th>Total Potential Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A</td>
<td>1000</td>
<td>200</td>
<td>200000</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>1500</td>
<td>600</td>
<td>900000</td>
</tr>
<tr>
<td>12</td>
<td>C</td>
<td>2000</td>
<td>500</td>
<td>1000000</td>
</tr>
<tr>
<td>17</td>
<td>D</td>
<td>2500</td>
<td>400</td>
<td>1000000</td>
</tr>
<tr>
<td>21</td>
<td>E</td>
<td>2000</td>
<td>300</td>
<td>600000</td>
</tr>
<tr>
<td>37</td>
<td>F</td>
<td>1500</td>
<td>200</td>
<td>300000</td>
</tr>
<tr>
<td>75</td>
<td>G</td>
<td>1000</td>
<td>100</td>
<td>100000</td>
</tr>
</tbody>
</table>

Accept the groups A, B, C, D, and E
### PRO-FORMA INCOME STATEMENTS ON A MARGINAL BASIS

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES</td>
<td>200,000.00</td>
<td>900,000.00</td>
<td>1,000,000.00</td>
<td>1,000,000.00</td>
<td>600,000.00</td>
<td>3,700,000.00</td>
</tr>
<tr>
<td>VARIABLE COSTS</td>
<td>120,000.00</td>
<td>594,000.00</td>
<td>720,000.00</td>
<td>770,000.00</td>
<td>486,000.00</td>
<td>2,690,000.00</td>
</tr>
<tr>
<td>MARG. INCOME</td>
<td>80,000.00</td>
<td>306,000.00</td>
<td>280,000.00</td>
<td>230,000.00</td>
<td>114,000.00</td>
<td>1,010,000.00</td>
</tr>
<tr>
<td>FIXED COSTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>600,000.00</td>
</tr>
<tr>
<td>PROFIT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>410,000.00</td>
</tr>
</tbody>
</table>

### PRO-FORMA INCOME STATEMENT ON A CUMULATIVE BASIS

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES</td>
<td>200,000.00</td>
<td>1,100,000.00</td>
<td>2,100,000.00</td>
<td>3,100,000.00</td>
<td>3,700,000.00</td>
<td></td>
</tr>
<tr>
<td>VARIABLE COSTS</td>
<td>120,000.00</td>
<td>714,000.00</td>
<td>1,434,000.00</td>
<td>2,204,000.00</td>
<td>2,690,000.00</td>
<td></td>
</tr>
<tr>
<td>MARG. INCOME</td>
<td>80,000.00</td>
<td>386,000.00</td>
<td>666,000.00</td>
<td>896,000.00</td>
<td>1,010,000.00</td>
<td></td>
</tr>
<tr>
<td>FIXED COSTS</td>
<td>600,000.00</td>
<td>600,000.00</td>
<td>600,000.00</td>
<td>600,000.00</td>
<td>600,000.00</td>
<td></td>
</tr>
<tr>
<td>PROFIT</td>
<td>(520,000.00)</td>
<td>(214,000.00)</td>
<td>66,000.00</td>
<td>296,000.00</td>
<td>410,000.00</td>
<td></td>
</tr>
</tbody>
</table>

DO YOU HAVE MORE DATA?
No
D. 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
-&gt; 24 6
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 7
-&gt; 3600 0 60 33 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
-&gt; 16 6
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 8
-&gt; 1782 4 84 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
-&gt; 38 5
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 9
-&gt; 3600 6.5 90 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
-&gt; 24 4
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 10
-&gt; 5400 5 48 0 0
ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE
-&gt; 30 6
ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. 11
-&gt; 1810
| NOTE NO. | FACE VALUE | INT. RATE | TERM (DAYS) | INT. AMT. | MAT. VALUE | DISC. DISC. DISC. FACTORING PROCEEDS |
|----------|------------|-----------|-------------|-----------|------------|-----------------------------------|---------------------------------|
|          |            |           |             |           |            | NO. VALUE RATE (DAYS) PERIOD RATE AMOUNT 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        | 1,600      | 7         | 60          | 33.00     | 1,633.00   | 16 6 9.69 1,625.31 |
| 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

\[ V_{DFAC}[\cdot] V \]

\[ V_{DFAC;ACR;AVACR;N;NCS;PRD;BD;BB} \]

[1] START: 'ENTER THE PERIODS (E.G., 67 68 ETC..)'
[2] \[ N+pPRD;0 \]
[3] 'ENTER THE ACTUAL BAD DEBTS'
[4] \[ BD+Np0 \]
[5] 'ENTER THE BEGINNING BALANCE IN ALLOWANCE FOR DOUBTFUL ACCOUNTS.'
[6] \[ BB+1p0 \]
[7] 'ENTER THE METHOD OF VALUATION'
[8] \[ BACK:'flliEDIT SALES, LVERAGE BALANCE IN RECEIVABLES OR dQING RECEIVABLES' \]
[9] \[ ('RVC'=1)2t(!J)/CREDIT,AVERAGE,AGING \]
[10] CREDIT:METHOD1
[12] AVERAGE:METHOD2
[13] \[ ->OTHERMETHOD \]
[14] AGING:METHOD3
[15] \[ OTHERMETHOD: ' \]

[16] 'DO YOU WANT TO TRY OTHER METHOD?'
[17] \[ ('Y'=1)0/BACK \]
[18] 'DO YOU HAVE MORE TRANSACTIONS?'
[19] \[ ('Y'=1)0/START \]

\[ V \]

\[ V_{METHOD1}[\cdot] V \]

\[ V_{METHOD1;DF;NCS;AA;BBL;EB;TA} \]

[1] 'ENTER THE NET CREDIT SALES (TOTAL SALES LESS RETURNS)'
[2] \[ NCS=Np0 \]
[3] 'ENTER THE PERCENT OF CREDIT SALES THAT IS DOUBTFUL'
[4] \[ DF=0 \]
[5] \[ AA=NCS*DF*100 \]
[6] \[ BBL=Np0 \]
[8] \[ I=0 \]
[10] \[ (I=N)/OUT \]
[11] \[ I=I+1 \]
[12] \[ ->LOOP1 \]
[13] \[ OUT:EB=(TA+BBL+AA)-BD \]
[14] ']

[15] (25+N*12)p'-'
[16] 'PERCENTAGE OF CREDIT ;((N*12)-18)p' '; ALLOWANCE ACCOUNT'
[17] '! SALES METHOD, X9,10f12' \[ \Delta PMT(1,N)pPRD \]
[18] OUTPUT
`\textbf{METHOD2[]}\textbf{V}

\textbf{METHOD2[]} = ADF; ACR; AVACR; AA; TA; EB; BBL

[1] 'ENTER THE ACCOUNTS RECEIVABLE FOR ' ; (PRD[1] - 1) ; ' THRU ' ; PRD[\text{pPRD}] 
[2] AVACR = \((N+AHR) + (1 + (ACR + (N+1)pP)) \div 2
[3] 'ENTER THE PERCENTAGE OF A/R THAT IS DOUBTFUL
[4] OUT: AA + (TA + EB + BD) - (BBL + BB, (N-1) + EB + AVACR \times (ADF + 1) \div 100))
[5] '

[6] \((25 + N \times 12) \text{p}'
[7] 'PERCENTAGE OF AVERAGE ' ; (\((N \times 12) - 18) \div 2 \text{p}' 'ALLOWANCE ACCOUNT'
[8] 'BALANCE IN ACCOUNTS ' ; (N \times 12) \text{p}'
[9] 'RECEIVABLE METHOD ' ; \text{1012} \text{pPRD}
[10] OUTPUT

\textbf{METHOD3[]}\textbf{V}

\textbf{METHOD3[]} = AGE; ASC; AX; Y; AG; AGSCH; DAYS

[1] AGE = AGSCH + 10
[3] 'WHEN YOU ARE THRU ENTERING HIT THE CARRIAGE RETURN'
[5] 'INSTEAD OF "2 \% , $2,000 3,000 4,000 ETC.,'''
[7] AG = 0
[8] \text{OUT} \times 10 = pAG
[10] ST: 'ENTER THE PERCENT AND AMOUNT CORRESPONDING TO THE ABOVE.'
[11] ASC = 0
[12] \text{ASC} = (pASC) \times (N+1) / \text{FORMAT}
[13] AGE = AGE + ASC
[14] AX = ((pAGE) \times (1 + N)) \times (1 + N) / \text{PAGE}
[15] \text{BEGIN}
[16] OUT: '

[17] BB = ((pY), ((pAX)[1]) \times AX[1] + ((pAX)[2])) \times 100
[18] EB = + / \text{BB}
[19] BAL = 0
[21] DAYS = ((pAGSCH + 25) \times 25) \times \text{AGSCH}
[22] \text{BEGIN}
[23] 'AGE IN DAYS PERCENT'; (\((N \times 12) - 18) \div 2 \text{p}' 'AMOUNT OF BAD DEBT A LLOWANCE'
[24] \text{BEGIN}
[25] 'INPUT FORMAT: 2 2000 3000 4000 ETC.,'
4-16

[26] $\alpha$T

[27] OUT: 'AGE IN DAYS PERCENT', 'AMOUNT OF BAD DEBT ALLOWANCE'

[28] Q1: ('X36,10I12' $\Delta$FMT((1,N)pPRD)); '-------------PERIOD'

[29] '25A1,X2,I4,X5,10CF12.2' $\Delta$FMT(DAYS;AX[1];BBD)

[30] '

[31] 'TOTAL, X31,10CF12.2' $\Delta$FMT(1,N)pEB

[32] '

[33] AA+(TA+EB+BD)-BBL+BB. (N-1)+EB

[34] (25+Nx12)p'-'

[35] 'AGING OF ACCOUNTS'; (((Nx12)-18)+2)p' '; 'ALLOWANCE ACCOUNT'

[36] 'RECEIVABLE METHOD, X8,10I12' $\Delta$FMT(1,N)pPRD

[37] OUTPUT

\[V\]

\[V\] OUTPUT[[]]V

\[V\] OUTPUT

[1] (25+Nx12)p'-'

[2] 'BALANCE: BEG, X12,10CI12' $\Delta$FMT(1,N)pBBL

[3] 'AMOUNT ADDED, X13,10CI12' $\Delta$FMT(1,N)pAA

[4] 'TOTAL AVAILABLE, X10,10CI12' $\Delta$FMT(1,N)pTA

[5] 'LESS: BAD DEBT, X10,10CI12' $\Delta$FMT(1,N)pBD

[6] 'BALANCE: END, X13,10CI12' $\Delta$FMT(1,N)pEB

[7] (25+Nx12)p'-'
C. CREDIT RISK

4-17

VCREDITRISK[[]]

VCREDITRISK;CO;GRP;FACTOR;GP;VCR;FC;MCM;I;TVR;SL;VC;MI;NGP;NGP;Z;FC;PR;I;FMAT
[1] CO+GRP+FACTOR+10
[6] GP
[7] +('&''=GP)/OUT
[8] GRP+GRP,15pGP,15p'
[10] FACTORS+,
[12] FMAT+(((pFACTOR)*3),3)pFACTOR+FACTOR,FACTORS
[13] +BEGIN
[14] OUT: 'ENTER THE BASIC VARIABLE COST RATE (AS A PERCENT)'
[15] VCR+lpD+100
[16] 'ENTER FIXED COSTS'
[17] FC+lp0
[18] 'MINIMUM CONTRIBUTION TO MARGIN'
[19] MCM+lpD+100
[20] I+1
[21] STR+:((1-MCM)=((TVR+(FMAT[1]+100)+VCR)[I])/COUNT
[22] STRT+:((I=pFMAT[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] OUT: '
[32] MI+SL+VC+((SL+((FMAT[1])[CO])*(FMAT[2])[CO])xTVR[CO])
[33] NGP+((pGRP)*15,15)pGRP
[34] NGP,NGP[CO,]
[35] Z+(5,pCO)pO
[36] 'DO YOU WANT THE SUMMARY OF DATA?'
[37] +('Y'=14W)/SUMMARY
[38] OUTPUT: '

[40] '

[41] FC+((pCO)pO),FC
PRO-FORMA INCOME STATEMENTS ON A MARGINAL BASIS

T1: \((28 + 16 \times pCO) - 46\) + 2

PRO-FORMA INCOME STATEMENTS ON A CUMULATIVE BASIS

T2: \((30 + 16 \times pCO) - 46\) + 2

GROUP

23p 'NGP TOTAL'

VARIABLE COSTS, X1, 10CF15.2' ΔFMT(1, pCO)pSL;+/SL)

FIXED COSTS, X4, 10BCF15.2' ΔFMT(1, pFC)pFC

TOTAL

PROFIT, X9, 10BCF15.2' ΔFMT(1, pPR)pPR

TRB:

OUTPUT2: X[1], SL[1], VC[1], MI[1], FC, 0

X[5,] = X[3,] - X[4,]
Do you have more data?

Summary:

Properties of our assumed credit risk groups

<table>
<thead>
<tr>
<th>Credit Risk Group</th>
<th>Number of Persons (Limit)</th>
<th>Average Sales</th>
<th>Potential Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>15, X5, 15A1, X5, I10, X10, I6, X5, I10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Output
D. NOTESDISCOUNT

\[\text{NOTESDISCOUNT}()\]

\[\text{NOTESDISCOUNT}(:A;I;K;M;MAT;XX;XY;Z)\]

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. \(M\) = 10
3. \(X\) = 9p0
4. 'DO YOU KNOW HOW TO USE THIS PROGRAM?'
5. \(\rightarrow(\text{Y}'=1*0)/\text{START}\)
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. \(Y=1p1\)
15. \(I=1\)
16. \(QQ: 'ENTER THE DATA (THE FIVE VARIABLES IN THE ABOVE ORDER) FOR NOTE NO. ' ;I
17. \(Z=X[1:5]+5p0\)
18. \(XY+X[2]+100\)
19. \(\rightarrow(X[1]=10000000000)/\text{END}\)
20. \(K=((Z=0)/(Z=0))\times pZ)\)
21. 'ENTER THE DISCOUNT PERIOD AND DISCOUNT RATE'
22. \(X[6]=7\)-2pl
23. \(XX+X[7]+100\)
24. \(\rightarrow(AA=-K)/A1,A2,A3,A4,A5,A6,A7,A8,ERROR,ERROR\)
25. 'ERROR: 'WRONG ENTRY...REENTER'
26. \(\rightarrow QQ\)
28. \(\rightarrow NQ\)
29. \(A2:X[3]+(Y\times X[4])+(X[1]\times XY)\)
31. \(\rightarrow NQ\)
33. \(\rightarrow NQ\)
34. \(A4:X[5]+X[1:4]\)
35. \(X[2]+((Y\times X[4])+(X[1:3]))\times 100\)
36. \(\rightarrow NQ\)
38. \(\rightarrow NQ\)
40. \(\rightarrow NQ\)
4-21


\[ M = M, X \]

\[ I = I + 1 \]

\[ \rightarrow QQ \]

\[ END: \text{MAT} + (((pM \times 9), 9)pM) \]

\[ '\]

\[ ' \]

\[ ' \]

\[ 'I_2, X_4, C_16, I_6, I_12, 2 CF_{12.2}, I_5, I_8, 2 CF_{14.2}, \Delta F_{MT(1(I-1);MAT[13];MAT[45];MAT[67];MAT[89])} \]

\[ ' \]
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

A. INVENTORY
   B. INVENTPRICE
   C. RETAIL
   D. EOQ

Exhibit 5-2
INVENTORY FUNCTIONS & VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVENTPRICE</td>
<td>-</td>
<td>TIL</td>
</tr>
<tr>
<td>RETAIL</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>EOQ</td>
<td>-</td>
<td>TIE</td>
</tr>
</tbody>
</table>
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.
5. Net sales.
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:

\[ \text{EOQ} = \sqrt{ \frac{2 \times C \times D}{i} } \]

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

<table>
<thead>
<tr>
<th>PERIOD</th>
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<th>2</th>
<th>3</th>
<th>4</th>
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<tr>
<td>SALES</td>
<td>120</td>
<td>250</td>
<td>191</td>
<td>303</td>
<td>863</td>
</tr>
<tr>
<td>COST OF SALES</td>
<td>81</td>
<td>163</td>
<td>128</td>
<td>199</td>
<td>571</td>
</tr>
<tr>
<td>GROSS PROFIT</td>
<td>39</td>
<td>87</td>
<td>63</td>
<td>104</td>
<td>292</td>
</tr>
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<td>INVENTORY (UNITS)</td>
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<td>5</td>
<td>15</td>
<td>40</td>
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<td>INVENTORY (VALUE)</td>
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<td>40</td>
<td>20</td>
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<td>162</td>
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ANOTHER METHOD? (YES OR NO)
YES
ENTER INVENTORY METHOD - **LIFO, FIFO, OR AVG**

**FIFO**

<table>
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<tr>
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<td>100</td>
<td>290</td>
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**ANOTHER METHOD? (YES OR NO)**

YES

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

**AVG**

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<thead>
<tr>
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<td>39</td>
<td>87</td>
<td>63</td>
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<td>291</td>
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<td>41</td>
<td>21</td>
<td>60</td>
<td>163</td>
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</table>

**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

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

ADD:  PURCHASES (NET)  194500
      ADDITIONAL MARKUPS  12000
      MARKDOWN CANCELLATIONS  7000

       __________
       213500

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

       __________
       207500

ENDING INVENTORY

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

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

ADD:  PURCHASES (NET)  194500
      ADDITIONAL MARKUPS  12000
      MARKDOWN CANCELLATIONS  7000

       __________
       213500

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

       __________
       207500

ENDING INVENTORY

ENDING INVENTORY AT COST = 34636.66

REPEAT WITH A DIFFERENT INVENTORY METHOD? (YES OR NO)

NO
D. EOQ

**EOQ**

ENTRER ANNUAL DEMAND (UNITS)

☐: 1000

ENTRER ORDERING COST (IN DOLLARS)

☐: 12.50

ENTRER 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

\[ \text{VINVENTPRICE}([\cdot]) \]

\[ \text{V} \text{INVENTPRICE} = P; C; S; SP; X1; X2; A; I; T; R; CG; CI; T1; A1; A2; INV; U; V; IV; VS; REP \]

[1] \( R \leftarrow 1 \)
[2] \( \text{RE8} \leftarrow (R = 4) / P1, MT, P2, OUT \)
[3] \( P1 \leftarrow X1 + 1 + IP1 \) 'ENTER NUMBER OF SALES PERIODS', REP + CR, '[]', 'LE, 3p' 
[4] \( X2 + 1 + IP1 \) 'ENTER MAXIMUM NUMBER OF PURCHASES (NOT UNITS) IN ONE PERIOD', D', REP
[5] \( C + P + (X1, X2) P I \leftarrow 0 \)
[6] \( S + SP + X1 P I \leftarrow 0 \)
[7] 'ENTER UNIT SALES FOR PERIODS 1 TO '; X1
[8] \( S + X1 + IP1 \) REP
[9] 'ENTER CORRESPONDING SALES PRICES'
[10] \( SP + X1 + \)
IN + I + I + 1 \)
[12] 'ENTER QUANTITIES PURCHASED IN PERIOD '; I
[14] \( P[I] + A, (X2 - pA) P I \leftarrow 0 \)
[15] 'ENTER CORRESPONDING UNIT PRICES'
[16] \( A + , [\cdot] \)
[17] \( C[I] + A, (X2 - pA) P I \leftarrow 0 \)
[18] \( + (I < X1) / IN \)
[19] \( VS + S + SP \)
[20] \( R \leftarrow 2 \)
[21] \( MT + INV + 2 \ 1 \ P I \leftarrow 0 \)
[22] \( R \leftarrow 3 \)
[23] \( P2 \leftarrow IV + CG + CI + X1 P I + U + V \leftarrow 0 \)
[24] 'ENTER INVENTORY METHOD - LIFO, FIFO, OR AVG'
[25] \( + ('LFA' = A + 1 [\cdot]) / NA, NA, AV \)
[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] \( IT : R + 1 + ((pINV[1;]) - 1) \times A = 'L' \)
[35] \( T1 + INV[1;] R - T \)
[36] \( CG[I] + CG[I] + INV[2;] R + T + T1 \times T T1 < 0 \)
[37] \( INV[1;] R - T1 \)
[38] \( INV + (INV[1;]) > 0) / INV \)
[39] \( IV[I] + (/INV) \)
[40] \( + (T1 \geq 0) / INCR \)
[41] \( T + - T1 \)
[42] \( + MT \)
[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] \( CG[I] + S[I] \times V + U \)
[49] \( CI[I] + U + U + S[I] \)
[50] \( + (U < 0) / SO \)
5-10

[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+(I-X1),[1] VS,[1] CG,[1](VS-CG),[1] CI,[0.5] IV
[58] 2CR
[59] TTL,('1018' ΔFMT(T)), TOTAL,[1] 'I8' ΔFMT(1+/T)
[60] CR
[61] Q:'ANOTHER METHOD? (YES OR NO)'
[62] →('YN'=1+T)/MT,0
[63] →Q

TTL
PERIOD
SALES
COST OF SALES
GROSS PROFIT
INVENTORY (UNITS)
INVENTORY (VALUE)
C. RETAIL

```
VRetail[]
V Retail; B; P; U; UC; S; DC; M; R; BC; PC; A; L; EC; E
E+1
R=+(R=\13)/P1, Q, OUT
P1:=BC+0
'DENTER THE FOLLOWING INFORMATION AT RETAIL'
BEGINNING INVENTORY'
B+1+[]
'PURCHASES (NET)'
P+1+[]
'ADDITIONAL MARKUPS'
U+1+[]
'MARKUP CANCELLATIONS'
UC+1+[]
'SALES (NET)'
S+1+[]
'MARKDOWNS'
D+1+[]
'MARKDOWN CANCELLATIONS'
DC+1+[]
R+2
Q: 'ENTER METHOD - LOWER OF COST OR MARKET; REPLACEMENT COST; LIFO; \1 annihilated
FO'
+(1*(+'CRLF'=M=1+[]))/Q
'ENTER COST-PRICE RATIO (AS A PERCENT) OR ZERO TO CALCULATE IT'
+(0<R+(1+[])*100)/OUT
'ENTER PURCHASES (NET) AT COST'
PC+1+[]
+(M='P')/LFR
'ENTER BEGINNING INVENTORY AT COST'
BC+1+[]
R+=(BC+PC)+B+P+(M='C')xU-UC
RO
LFR:=R+PC+P+u+DC-UC+D
RO: 'COST-PRICE RATIO IS ';2 RND R*100;' PERCENT'
R+3
OUT: E+B+(A+P+DC)-(L+S+UC+D)
EC+((((E>B)xBC+RxE-B)+(E>B)xExBC+B)xM='L')+RxE*M='L'
E
'BEGINNING INVENTORY
ADD: PURCHASES (NET)'
ADDITIONAL MARKUPS
MARKDOWN CANCELLATIONS

LESS: SALES (NET)
MARKUP CANCELLATIONS
MARKDOWNS

ENDING INVENTORY
ENDING INVENTORY AT COST = ';2 RND EC
EQ: 'REPEAT WITH A DIFFERENT INVENTORY METHOD? (YES OR NO)'
+(\1'Y\2'N'=1+[]))/Q, O
EQ
```


D. EOQ

5-12

\*EOQ[]\*V
\* EOQ = D; I; P; T; F; Q; J
[1] \* R+1
[2] \* REQ = (R = 3 ) / P1, Q1, P2
[4] \* D+1 [R]
[5] \* 'ENTER ORDERING COST (IN DOLLARS)'
[6] \* C+1 [R]
[7] \* 'ENTER CARRYING COST OF ONE UNIT FOR ONE YEAR (IN DOLLARS)'
[8] \* I+1 [R]
[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] \* P+(1+0)*100
[13] \* ->((P>0.95), P<0) / Q1, 0
[14] \* 'SENSITIVITY ANALYSIS ON DEMAND, ORDERING COST, OR CARRYING COST?'
[15] \* T+, ('DOC'=F+1+0)/TTE
[16] \* R+3
[17] \* P2:J+1, Q+1
[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
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. COMPOSITE DPR
   F. DPRSWITCH
### Exhibit 6-2

**DEPRECIATION FUNCTIONS & VARIABLES**

<table>
<thead>
<tr>
<th>Major Function</th>
<th>Supporting Functions</th>
<th>Supporting Variables</th>
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<tbody>
<tr>
<td>DEPRECIATION</td>
<td>DPR, DPROUT</td>
<td>-</td>
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<tr>
<td>GROUPLIFE</td>
<td>-</td>
<td>-</td>
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<td>GROUPDPR</td>
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<td>ATRANS, DPRC, DPROUT</td>
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<tr>
<td>DPRSWITCH</td>
<td>DPR, DPROUT</td>
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</table>

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.
15000

2500

8

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

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DEPRECIATE

ENTER ASSET COST
10000

ENTER ASSET SALVAGE VALUE
1000

ENTER ASSET LIFE
10

ENTER METHOD OF DEPRECIATION - SL, DR, IR, SYD
SYD

COMPLETE DEPRECIATION SCHEDULE? (YES OR NO)
YES

DEPRECIATION SCHEDULE

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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

0: 30 4
0: 30 5
0: 10 6
0: 10 7
0: 10 8
0: 10 9
0: 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 or 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

Enter depreciation rate (as a percent)
Enter zero if you want to compute it
- 20
SL or Accelerated Depreciation

DEPRECIATION SCHEDULE

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MORE GROUP DEPRECIATION? (YES OR NO)

NO
GROUPDPR

ASSET PURCHASE IN YEAR ZERO (TOTAL COST)

$100,000

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 10,000
$4 0 20,000
$5 20,000 40,000 10,000
$6 0 20,000
$7 0 10,000
$8 0 2000
$9 0 4000
$10 0 8000
$11 0 4000
$12 0 2000

ENTER DEPRECIATION RATE (AS A PERCENT)
ENTER ZERO IF YOU WANT TO COMPUTE IT

$0

ENTER GROUP LIFE

$5.7

ENTER DEPRECIATION METHOD - SL, RR, SYD
DB
PERCENT OF STRAIGHT LINE (100 ≤ M ≤ 200)

$150
**DEPRECIATION SCHEDULE**

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

**NO**
E. COMPOSITEDPR

ENTER DEPRECIATION RATE (AS A PERCENT)
ENTER ZERO IF YOU WANT TO COMPUTE IT

\[ 0 \]\n
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

\[ 3 \ 0 \ 10000 \]
\[ 4 \ 0 \ 15000 \]
\[ 10 \ 0 \ 25000 \]
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**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, LR, 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

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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

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ENTER ASSET COST
☐: 10000
ENTER ASSET SALVAGE VALUE
☐: 1500
ENTER ASSET LIFE
☐: 10
FOR INITIAL PERIOD - -
ENTER METHOD OF DEPRECIATION - SL, DB, LR, SYD
DB
PERCENT OF STRAIGHT LINE \(100 \leq M \leq 200\)
☐: 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

```plaintext
\texttt{DEPRECIATE[n]}\n\texttt{DEPRECIATE[C;D;L;S;DS;I]}\n

```plaintext
\texttt{DPROUT[n]}\n\texttt{DPROUT D;H;I}\n
**ENTER METHOD OF DEPRECIATION - SL, DR, LR, SYD**

1. \( Q1 \) = 'ENTER METHOD OF DEPRECIATION - SL, DR, LR, SYD'
2. \( SL: BV + 2 \times RND \times (C - S) \times (1 - L) + L \)
3. \( DB: BV + 2 \times RND \times (C - S) \times (1 - L) + L \)
4. \( DD: 'PERCENT OF STRAIGHT LINE (100 \leq M \leq 200)' \)
5. \( M = \frac{(1 + R - 1)}{100} \)
7. \( K + 1 \)
8. \( RE: K + K + 1 \)
10. \( (K < L) / RE \)
11. \( OUT: DP + (C, 0, C, 0, 0, 0, C), [1] 0, 0, C, 0, D, AD, [1.5] BV \)
C. GROUPLIFE

\[ \text{GROUPLIFE[]} \]
\[ \text{GROUPLIFE}: A; E; F; L \]
[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] \( A+1 \) \( 2 \) \( P=0 \)
[4] \( IN:E+2+[] \)
[5] \( +(E[1]=0)/EX \)
[7] \( +IN \)
[8] \( EX:L+(/\times/A)^+//A[;1] \)
[9] 'GROUPLIFE IS ';2 RND L;' YEARS'

D. GROUPDPR

\[ \text{GROUPDPR[]} \]
\[ \text{GROUPDPR}: A; B; R \]
[1] \( R+1 \)
[2] \( RES:\rightarrow(R=5)/P1,P2,P3,NC,P4 \)
[3] \( P1:A+ATRANS \)
[4] \( R+2 \)
[5] \( P2:R+FLAGRATE \)
[6] \( R+3 \)
[7] \( +(0\leq R)/NC \)
[8] \( P3:R+GROUPRATE \)
[9] \( R+4 \)
[10] \( NC:B+DPRC(R,0),[1] A \)
[11] \( R+5 \)
[12] \( P4:DPROUT((1+P)\times-1),B[; 1 2 4 5 6 7 8] \)
[13] 'MORE GROUP DEPRECIATION? - (YES OR NO)'
[14] \( +('Y'=1+[])/1 \)

E. COMPOSITEDPR

\[ \text{COMPOSITEDPR[]} \]
\[ \text{COMPOSITEDPR}: A; B; R \]
[1] \( R+1 \)
[2] \( RES:\rightarrow(R=5)/P1,P2,NC,P3,P4 \)
[3] \( P1:R+FLAGRATE \)
[4] \( R+2 \)
[5] \( +(0\leq R)/NC \)
[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] \( P4:DPROUT((1+P)\times-1),B[; 1 2 4 5 6 7 8] \)
[13] 'MORE COMPOSITE DEPRECIATION? - (YES OR NO)'
[14] \( +('Y'=1+[])/1 \)
F. DPRSWITCH

\[ \text{DPRSWITCH}[\text{C}; \text{S}; \text{L}; \text{D}; \text{S}; \text{L}; \text{K}; \text{N}; \text{SD}] \]

1. \( \text{R}+1 \)
2. \( \text{P}1: \text{C}+1 \text{ INC 'ENTER ASSET COST' '} \)
3. \( \text{S}+1 \text{ INC 'ENTER ASSET SALVAGE VALUE'} \)
4. \( \text{L}+1 \text{ '/IPI 'ENTER ASSET LIFE', CH: CH: 'L,' DEP, 3p' '} \)
5. \( \text{P1: 'FOR INITIAL PERIOD - -' '} \)
6. \( \text{D}+(\text{DPR} C, \text{S}, \text{L})[; 5 6 7] \)
7. \( \text{R}+2 \)
8. \( \text{P1: 'SWITCH TO SL OR SD?' '} \)
9. \( \text{R}+3 \)
10. \( \text{R}+4 \)

\[ \text{DPRSWITCH}[\text{C}; \text{S}; \text{L}; \text{D}; \text{S}; \text{L}; \text{K}; \text{N}; \text{SD}] \]

\[ \text{FLGRATE}[\text{C}; \text{E}; \text{F}] \]

1. \( \text{Q1: 'ENTER DEPRECIATION RATE (AS A PERCENT)' '} \)
2. \( \text{E}+(\text{E}+100) \)
3. \( \text{Q2: 'SL OR ACCELERATED DEPRECIATION' '} \)
4. \( \text{Q2: 'STANDARD OR ACCELERATED DEPRECIATION' '} \)
5. \( \text{FR}+(\text{F}+100) \)
6. \( \text{CA: FR}+1 \)

\[ \text{FLGRATE}[\text{C}; \text{E}; \text{F}] \]
V GROUPRATE[0] V
V GR=GROU RATE;L;R;M;F
[1] F+0
[2] 'ENTER GROUP LIFE'
[3] L+1 I
[5] \( 'LBY'=1+2\times L)/(SL, MSL, SYD \)
[6] \( +C3 \)
[7] SL: R+1+L
[8] F+1
[9] \( \rightarrow \) OUT
[10] MSL: 'PERCENT OF STRAIGHT LINE (100\leq N \leq 200)'
[11] M\times (1+1)/100
[12] \( (M<1), M>2)/M S L, M S L
[13] R=M S L
[14] \( \rightarrow \) OUT
[15] SYD: R+2+L+1
[16] 'DEPRECIATION RATE IS '; 100 \times 4 RND R
[17] \( \rightarrow \) OUT: GR+R, R
V
V AT RANS[0] V
V TM=ATRANS; E; A; S; K; A; AM; PO
[1] R: 'ASSET PURCHASE IN YEAR ZERO (TOTAL COST)'
[2] \( \rightarrow \) PO+1[]
[3] A+ 1 \times 0
[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] \( \rightarrow \) (E[1]=0)/CK
[12] \( \rightarrow \) IN
[13] CK: \( \rightarrow ((PO++/A[;2])\div A[;3])/ER \)
[14] A+ 1 \times A
[15] \( AM=((/A[;1]), 3)\times 0 \)
[16] S+1\times p A
[18] K+K+1
[19] \( \rightarrow (K \leq S) / R \)
[20] TM\times (P O, 0, 0),[1] AM
[21] \( \rightarrow 0 \)
[22] ER: 'ADDITIONS MUST EQUAL RETIREMENTS - RE ENTER DATA'
[23] \( \rightarrow R \)
V
VCOMPRATE[[]] V
V CR+COMPRATE;K;E;C;D;F;M
[1] F+K+1+D+O
[2] C+ 1 3 P0
[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+[]
[8] C+C,[1] E
[9] Q1:'DEPRECIATION METHOD FOR ASSET ';K;' - SL, DR, IR, SYD'
[10] K+K+1
[12] Q1
[13] SL:D+D+(-/E[1 2])x3
[14] IN
[15] MSL:'PERCENT OF STRAIGHT LINE (100≤M≤200)'
[16] N+4[1]x100
[17] F+0
[18] +((M<1),M>2)/MSL,MSL
[20] IN
[22] F+0
[23] IN
[25] F+0
[26] IN
[27] E1:C+ 1 0 +C
[28] 'COMPOSITE RATE IS ';100x4 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

A. TIMEVALUE

B. SINGLE

C. LEVEL

D. PRESENTVALUE

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

Exhibit 7-2
TIMEVALUE FUNCTIONS & VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SINGLE</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LEVEL</td>
<td>-</td>
<td>III</td>
</tr>
<tr>
<td>PRESENTVALUE</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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 compounded 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)
0: 102.75 284.36 400 310 600 210.75 200.15 1250
INTEREST RATE - AS A PERCENT
0: 8.75
PRESENT VALUE IS: 2326.89
B. SINGLE

\[ \text{SINGLE}^{\square} \]

\[ \text{SINGLE}: A; IN; B; C \]

[1] \( R+1 \)

[2] \( \text{ESC}: \) 'ENTER PRESENT VALUE, NUMBER OF YEARS, ANNUAL INTEREST RATE,'

[3] AND FUTURE VALUE -- SUBSTITUTE '?' FOR THE ONE UNKNOWN VALUE'

[4] \( F \times 12^{+}/ 4 \ 3 \ = (pB) +/B + A + V \ + A \ K \ I \)

[5] \( \rightarrow 2 \times 1^{+} \ ? = (\Delta M \ A) [(B \ 0); 1] \)

[6] \( \rightarrow F \times 1^{+} C+1 \ \text{INC} \ ' \text{NUMBER OF COMPOUNDING PERIODS PER YEAR}' \)

[7] \( IN + B / (\Delta F \ A) \times 1, C, (0.01 + C), 1 \)

[8] \( \rightarrow (\sim B) / P, N, R, F \)

[9] \( P: \) 'PRESENT VALUE IS ' \( 2 \ \text{RND IN}[3] \times (1 + \text{IN}[2]) \times -\text{IN}[1] \)

[10] \( \rightarrow 0 \)

[11] \( N: \rightarrow E \times ((0.2 + / \text{IN}[3 \ 1]) \times \text{IN}[2]), -1 \)

[12] \( ' \text{NUMBER OF YEARS IS '}; 3 \ \text{RND}((\sim / \text{IN}[3 \ 1]) \times 1 + \text{IN}[2]), -1 \)

[13] \( \rightarrow 0 \)

[14] \( R: \) 'ANNUAL RATE IS ' \( 3 \ \text{RND} C / 100 \times ((/ \text{IN}[3 \ 1]) \times 1 + \text{IN}[2]) - 1; ' \) PERCENT'

[15] \( \rightarrow 0 \)

[16] \( P: \) 'FUTURE VALUE IS ' \( 2 \ \text{RND} \text{IN}[1] \times (1 + \text{IN}[3]) \times \text{IN}[2] \)

[17] \( \rightarrow 0 \)

[18] \( FE: \) 'INPUT FORMAT ERROR....'

[19] \( \rightarrow 1 \)

[20] \( IE: \) 'INPUT VALIDITY ERROR....'

[21] \( \rightarrow 1 \)

\[ \]
C. LEVEL

\[ \text{LEVEL}[0] \]
\[ \text{LEVEL;A;B;C;IN;T;Z} \]

[1] \( R = 1 \)

[3] 'AND FUTURE VALUE -- SUBSTITUTE "?" FOR THE TWO UNKNOWN VALUES'
[4] \( \rightarrow FC \times 2 + / \) \( 5 \ 3 = (pB), + / B + \text{AVI} + \text{AKI} '' \)
[5] \( \rightarrow 2 \times 1 + ') = (\Delta M I \ A) ([B] + 0) ; 1 \)
[6] \( \rightarrow FC \times 1 + C + 1 + \text{IFI} ' \) 'NUMBER OF INSTALLMENTS PER YEAR', GR
[7] T + AYIN 'ANNUITY IN ARREARS? YES OR NO:'
[8] \( \text{IN} + (\text{IFI} A) \times 1, C, 0.01 + C, 1, 1 \)
[9] \( \rightarrow ((2B)) = 28 \ 22 \ 19 \ 21 \ 26 \ 25 \ 14 \ 11 \ 13 \ 7) / D, E, F, G, H, I, J, K, L, M \)
[10] \( D: \text{IN}[4] + \text{IN}[1] + ((1 - (1 + \text{IN}[3]) \times - \text{IN}[2] + T + \text{IN}[3]) + T \)
[11] \( \rightarrow \text{PV} \)
[12] \( E: \text{IN}[2] + T - (\text{IN}[1] - (1 - \text{IN}[3]) \times - \text{IN}[2] + T) \times \text{IN}[3] \)
[13] \( \rightarrow \text{PV} \)
[14] \( F: \text{IN}[2] + (\text{IN}[1]) \times \text{IN}[3] \times - \text{IN}[1] = (\text{IN}[4]) \times - \text{IN}[2] + T \times \text{IN}[5] \)
[15] \( \rightarrow \text{OUT} \)
[16] \( G: \text{IN}[2] + (\text{IN}[1]) + \text{IN}[3] \)
[17] \( \rightarrow \text{AC} \)
[18] \( H: \text{IN}[3] + 1 + \text{IN}[2] \times \text{YLD}(\Phi); (\text{IN}[2] + \text{IN}[4]), [0.5] \times \text{IN}[1], (\text{IN}[2]) \times \Phi \)
[19] \( \rightarrow \text{PV} \)
[20] \( I: \text{IN}[3] + (\text{IN}[1]) + \text{IN}[2] - 1 \)
[21] \( \rightarrow \text{AC} \)
[22] \( J: \text{IN}[5] + \text{IN}[4] \times - T + ((1 + \text{IN}[3]) \times \text{IN}[2] + T) - 1 + \text{IN}[3] \)
[23] \( \rightarrow \text{PV} \)
[24] \( K: \text{IN}[3] + -1 + (\text{IN}[2]) \times \text{YLD}((\text{IN}[2]) + \text{IN}[4]), [0.5] \times \text{IN}[5], (\text{IN}[2]) + \text{IN}[4] \)
[25] \( \rightarrow \text{PV} \)
[26] \( L: \text{IN}[4] + \text{IN}[5] \times - T + ((1 + \text{IN}[3]) \times \text{IN}[2] + T) - 1 + \text{IN}[3] \)
[27] \( \rightarrow \text{PV} \)
[28] \( M: \text{IN}[2] + - T + (\text{IN}[3] \times - T + \text{IN}[5] + \text{IN}[4]) + \text{IN}[3] \)
[29] \( \rightarrow \text{PV} \)
[30] \( N: \text{IN}[1] + \text{IN}[5] \times (1 + \text{IN}[3]) + \text{IN}[2] \)
[31] \( \rightarrow \text{OUT} \)
[32] \( \rightarrow \text{OUT} \)
[33] \( \rightarrow \text{OUT} \)
[34] \( \rightarrow \text{OUT} \)
[35] \( \rightarrow \text{OUT} \)
[36] \( \rightarrow \text{OUT} \)
[37] \( \rightarrow \text{OUT} \)
[38] \( \rightarrow \text{OUT} \)

\[ \text{FE: 'INPUT FORMAT ERROR...'} \]

\[ \rightarrow 1 \]
D. PRESENTVALUE

\[ \text{PRESENTVALUE}[\text{V}] \]
\[ \text{PRESENTVALUE};\text{N};\text{B};\text{R} \]

[1] \text{R} = 1

[2] \text{X} = 1 \times 1 \times \text{R}, \text{N} = \text{IP} \quad \text{NUMBER OF PERIODS:}_1, \text{E} = \text{R} \quad \text{INC} \quad \text{AMOUNTS TO BE PRESENT VALUED (ONE AMOUNT FOR EACH PERIOD)} \]

[3] \text{B} + \text{N} \quad \text{INC} \quad \text{INTEREST RATE - AS A PERCENT} \]

[4] \text{R} = 0.01 \times 1 \quad \text{INC} \quad \text{INTEREST RATE - AS A PERCENT} \]

[5] \quad \text{PRESENT VALUE IS:}_2 \quad \text{RND+/B*(1+R)*N)--1
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

A. INVESTMENT
B. BOND
C. BONDPV
D. RINV
E. SINKINGFUND
F. AMORTIZE
G. REALESTATE
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 annual 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:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>RETURN</td>
<td>$50</td>
<td>$60</td>
<td>$70</td>
<td>$80</td>
<td>$1245</td>
</tr>
</tbody>
</table>

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:

   \[ \text{Periodic Payment} - \text{Balance} = \text{Periodic Interest} \]

   The difference between periodic balances is equal to the principal 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. REAL ESTATE

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.
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 - \( S/L \) OR \( C/L \)**

- CI

**ANNUAL TOTALS OR COMPLETE A**

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**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

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C. **BOND PV**

**BOND PV**

**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. Sinking Fund

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F. AMORTIZE

AMORTIZE

AMOUNT TO BE AMORTIZED
$100,000

INTEREST RATE (AS A PERCENT)
8.5%

LENGTH OF LOAN (YEARS)
15 years

NUMBER OF LOAN PAYMENTS PER YEAR
12

ANNUAL PAYMENT IS $11,816.87
PERIODIC PAYMENT IS $984.74

ANNUAL AMORTIZATION SCHEDULE? - (YES OR NO)
YES

AMORTIZATION SCHEDULE

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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
EBDPT - (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, DR, IR, XD
SL
ANNUAL PAYMENT IS 9740.36
PERIODIC PAYMENT IS 728.36
ANNUAL AMORTIZATION SCHEDULE? - (YES OR NO)
YES
# Amortization Schedule

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**Complete Schedule of Amortization Balances?** (Yes or No) **No**

**Depreciation Schedule?** (Yes or No) **Yes**

# Depreciation Schedule

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

Yes
### PRO FORMA YIELD ON SALE OF INVESTMENT

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B. BOND

\[ vBOND[]v \\
\]

\[ vBOND;A;B;C;D;AA;P;Q;R;K;I;S \]

[1] \( R+1 \)
[2] \( R:\to(R=\wedge)/P_1,P_2,Q_2,OUT \)
[3] \( P_1:=BONDIN \)
[4] \( A+\cdot A_0.01\cdot A[1]\times 1 \:\text{INC} \: '\text{BOND PRICE (E.G. 104.375)}' \)
[5] \( \text{((=/A[[5]])/'} \text{FACE VALUE EQUALS PRICE - RE ENTER DATA')/1} \)
[6] \( \to(=/A[[5]])/1 \)
[7] \( Q+:((>/A[[5]])/'} \text{DISC ACCUM'}),((</A[[5]])/'} \text{PREM AMORT'})) \)
[8] \( S+\to \text{PAYMENT'} \)
[9] \( AA+:((/>A[[1,2]])+A[3]) \)
[11] \( R+2 \)
[12] \( P_2:=R+(P:\text{YLD}(0,(1+P_{PA}),A[1]+AA),(0.5)\cdot A[5],Pp0)-1 \)
[13] \( '\text{BOND YIELD IS } ';2\text{ RND } R\times A[3]\times 100; ' \text{ PERCENT'} \)
[14] \( R+3 \)
[15] \( Q+2:':\text{DO YOU WANT SCHEDULE OF } ^{,}Q \)
[16] \( \to('YN'=1+\wedge)/Q1,0 \)
[17] \( Q+2 \)
[18] \( Q1:=Q', ' \text{ METHOD - SL OR CI'} \)
[19] \( \to('SC'=1+\wedge)/SL,CI \)
[20] \( Q+1 \)
[22] \( K+\cdot A[3,4] \)
[23] \( C+0,Pp-AA-B \)
[24] \( D+\cdot A[5],A[5]-(1\times P)\times B \)
[25] \( B+0,Pp-B \)
[26] \( AA+0,PpAA \)
[27] \( OUT \)
[28] \( CI:=K+1 \)
[29] \( SCH:=B+C+Pp0 \)
[31] \( RE1:=K+K+1 \)
[33] \( \to(K\times P)/RE1 \)
[34] \( B+:B,D[P]-A[1] \)
[36] \( C+C,R\times D[P-1] \)
[37] \( AA+0,PpAA \)
[38] \( OUT:=R+4 \)
[39] \( \to(A[3]=1)/OUT1 \)
[40] \( '\text{ANNUAL TOTALS OR COMPLETE'} \)
[41] \( \to('AC'=1+\wedge)/AN,OUT1 \)
[42] \( OUT \)
[44] \( D+D[1\times A[3]+(0,1A[4])]) \)
[45] \( K+0 \)
[46] \( G+: ' \text{ YEAR'} \)
[47] \( RE:=K+K+1 \)
[48] \( I+:((>A[3])-1)+2\times K \)
[50] \( C[K+1]=+C[I] \)
\[ \text{BONDIN} \]

\[ \text{BONDIN[]} \]

\[ \text{BONDIN;A1,A2,A3,A4;REP} \]

\[ \text{RE}+1 \text{INC 'BOND FACE VALUE'} \]

\[ \text{A2}+0.01 \times 1 \text{INC 'BOND ANNUAL INTEREST RATE - (AS A PERCENT)'} \]

\[ \text{A3}+1 \text{IPI 'NUMBER OF INTEREST PAYMENTS PER YEAR', REP} \]

\[ \text{A4}+1 \text{IPI 'BOND LIFE - (YEARS) ', REP} \]

\[ \text{BINV}+\text{A1,A2,A3,A4} \]

\[ \text{C, BONDPV} \]

\[ \text{BONDPV[]} \]

\[ \text{BONDPV;A;PV} \]

\[ \text{A}+\text{BONDIN} \]

\[ \text{A}+\text{A}, 0.01 \times 1 \text{INC 'MARKET INTEREST RATE - (AS A PERCENT)'} \]

\[ \text{PV}+((x/A[1,2])^{I}+A[3]) \times (1/(1+A[3])^{I}) / A[3]^{I} \]

\[ \text{PV}+2 \text{RND PV}+\text{A}^{I}((1+A[3])^{I}+A[3])^{I} / A[3]^{I} \]

\[ \text{PV}+2 \text{RND PV}+\text{A}^{I}((1+A[3])^{I}+A[3])^{I} / A[3]^{I} \]

\[ \text{YLD[]} \]

\[ \text{Y}+\text{A}\text{YLD X;R;D} \]

\[ \text{R}+((x+x) / A[1,2])^{I} / A[1,2] \]

\[ \text{RE}+((x+x) / x)^{I} A[1,2]^{I} + A[1,2]^{I} \]

\[ \text{R}+((x+x) / A[1,2])^{I} A[1,2]^{I} \]

\[ \text{RE}+((x+x) / A[1,2])^{I} A[1,2]^{I} \]

\[ \text{Y}+\text{R} \]
D. RINV

\[ \text{\texttt{RINV}}([]) \text{\texttt{V}} \]

\[ \text{\texttt{RINV}; IV; IP; RT; RP; D; N; R; REP} \]

[1] \text{REP+}; 'ER'; 'LE'; '3p' ']

[2] \text{Q1: 'ENTER INVESTMENT AMOUNTS'}

[3] \text{IV+; []}

[4] \text{IP+; IP; 'ENTER PERIOD WHEN EACH INVESTMENT IS MADE', REP}

[5] \rightarrow \text{ER1; x1(pIV)*pIP}

[6] \text{Q2: 'ENTER RETURN AMOUNTS'}

[7] \text{RT+; []}

[8] \text{N+; /IP, RP+; IP; 'ENTER PERIOD WHEN EACH RETURN IS RECEIVED', REP}

[9] \rightarrow \text{ER2; x1(pRT)*pRP}

[10] \text{R+; (+/RT)*+IV)*1:N}

[11] \rightarrow \text{RE; D+; (+/RT*R*RP)+/IV*R*-IP}

[12] \text{R+R*D*1:N}

[13] \rightarrow \text{OUT; 'YIELD IS '; 2 RND 100xR-1; ' PERCENT'}

[14] \rightarrow \text{Q0}

[15] \text{ER1: 'NUMBER OF PERIODS NOT EQUAL TO NUMBER OF INVESTMENTS'}

[16] \rightarrow \text{Q1}

[17] \text{ER2: 'NUMBER OF PERIODS NOT EQUAL TO NUMBER OF RETURNS'}

[18] \rightarrow \text{Q2} \]
E. SINKINGFUND

\[ V SINKINGFUND (\[\]) \]
\[ V SINKINGFUND; A; F; R; N; Y; T; I; K; REP \]
\[ \text{REP} = \text{CHR}, 'O': \text{E}, '3p': ' \]
\[ \text{R} = 1 \]
\[ \text{RES:}=\text{(R=1)} / P1, P2, PER1 \]
\[ \text{P1} = \text{F} + 1 \text{ INC 'FUTURE AMOUNT'} \]
\[ \text{R} = 0.01 \times 1 \text{ INC 'INTEREST RATE (AS A PERCENT') } \]
\[ \text{Y} + I, \text{PER1 'NUMBER OF YEARS', REP} \]
\[ \text{N} + 1 \text{ PER1 'NUMBER OF PERIODS PER YEAR', REP} \]
\[ \text{R} = 2 \]
\[ \text{P2} = A \times \text{SPD}_A, (R+N), Y \times N \]
\[ \text{T} = \text{ ' YEAR'} \]
\[ \text{Q:}=\text{(N=1) / PER1} \]
\[ \text{Q:}=\text{('PERIOD OR ANNUAL TOTALS?') } \]
\[ \text{Q:}=\text{('PA'=1 or 2) / PER, ANN} \]
\[ \text{Q:}=\text{'} \]
\[ \text{ANN} = I + 1 \]
\[ \text{RE:}=\text{K+(i)(N)+N\times I-1} \]
\[ \text{A}[I; 1, 2] = A[K; 1, 2] \]
\[ I = I + 1 \]
\[ \text{Q:}=\text{('Y'=I or Y) / RE} \]
\[ \text{A}[Y; 3] = A[(N\times I); 3] \]
\[ A[Y; 3] = A + \text{PER1} \]
\[ \text{PER:}=\text{T = ' PERIOD'} \]
\[ \text{PER1} = R + 3 \]
\[ \text{Q:}=\text{'} \]
\[ \text{CONTRIBUTION INTEREST BALANCE'} \]
\[ \text{I6.3F14.2'} \text{ ΔFMT}((\text{1+pA}), A) \]

\[ V SFD[\[\] \]
\[ V VSF+SPD X; AD; D; I; J \]
\[ D = X[1] \times X[2]:((1+X[2]) \times X[3]) - 1 \]
\[ J + 1 \]
\[ AD + D = I + 0 \]
\[ \text{RE:}=\text{I+1, AD[J] \times X[2]} \]
\[ AD = AD, AD[J] + D + I[J+1] \]
\[ J = J + 1 \]
\[ \text{Q:}=\text{('J<X[3]') / RE} \]
\[ \text{VSP+D, I, [1.5] AD} \]
\[ V \]
F. AMORTIZE

\[ \text{AMORTIZE}[\square] \]
\[ \text{AMORTIZE}; P; R; Y; NP; A; REP \]
\[ \text{REP} + \text{EX} \]
\[ \text{REP} + \text{P} \]
\[ \text{INC} \] 'AMOUNT TO BE AMORTIZED'
\[ R + 0.01 \times 1 \] INC 'INTEREST RATE (AS A PERCENT)' \\
\[ Y + 1 + I P I \] 'LENGTH OF LOAN (YEARS)', REP
\[ NP + 1 + I P I \] 'NUMBER OF LOAN PAYMENTS PER YEAR', REP
\[ A + ARTZ P; R; Y; N P \]

\[ \text{ARTZ}[\square] \]
\[ \text{ARTZ}; X; MP; BAL; Y; M; I; P; PB; MR \]
\[ MR + X[2]; X[4] \]
\[ MP + (x / X[1]; 4] \times (1 - (1 + MR) \times X[3] + 4]); MR \]
\[ \text{'ANNUAL PAYMENT IS '}; 2 \text{ RND MP} \]
\[ \text{'PERIODIC PAYMENT IS '}; 2 \text{ RND MP} \times X[4] \]
\[ BAL + X[3]; 4) + 0 \]
\[ P + I + X[3] + 0 \]
\[ PB + X[1] \]
\[ Y + 1 \]
\[ I Y + M + 1 \]
\[ I M + I [Y] + I [Y] + PB \times MR \]
\[ BAL + Y; M + PB + PB - ((MP + X[4]); 1 - (PB + MR)) \]
\[ N + M + 1 \]
\[ Y + Y + 1 \]
\[ (Y + X[3]) \times I Y \]
\[ I M; X[3]; X[4] = 0 \]
\[ Q1: \text{'ANNUAL AMORTIZATION SCHEDULE? - (YES OR NO)'} \]
\[ Q2: \text{'COMPLETE SCHEDULE OF AMORTIZATION BALANCES? - (YES OR NO)'} \]
\[ A: \text{COMPLETE SCHEDULE OF BALANCES'} \]
\[ B: P + MP - I \]
\[ EX: \text{AMORTIZATION SCHEDULE'} \]

\[ \text{'YEAR INTEREST PRINCIPAL BALANCE'} \]
\[ 'I3,3M' ('\text{YN}') \text{Q} \text{M} I14' \text{DMT}((X[3]), I, P, [1.5] BAL[; X[4]]) \]
\[ Q2 \]
\[ EX: \text{AMORTIZATION SCHEDULE'} \]

\[ 8-20 \]
G. REAL ESTATE

[2] R+1
[3] RES:=(R=8)/P1,P2,P3,P4,PQ,RE1,P3,P4
[4] P1:PL+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+LP/P:100
[8] YD+IIP 'DEPRECIATION PERIOD (YEARS)',REP
[9] YA+IIP 'AMORTIZATION PERIOD (YEARS)',REP
[10] YI+IIP 'INVESTMENT PERIOD (YEARS)',REP
[11] CT+0.01x1 INC 'CAPITAL GAINS TAX RATE (AS A PERCENT)'
[12] RC+0.01x1 INC 'PERCENT RECAPTURE'
[13] ET+YIP(1,YI) INC 'EBDFT - (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)'
[14] TR+0.01x1 INC 'TAX RATE - (AS A PERCENT)'
[15] AP+0.01x1 INC 'ANNUAL PROPERTY APPRECIATION RATE - (AS A PERCENT)'
[16] D+1 INC 'DOWN PAYMENT'
[17] IR+0.01x1 INC 'INTEREST RATE - (AS A PERCENT)'
[18] R+2
[19] NP+IIP 'NUMBER OF LOAN PAYMENTS PER YEAR',REP
[20] P2:DP+ 0 (DPR P,L,YD)[; 5 6 7]
[21] R+3
[22] P3:A+ARTZ(P-D),IR,YA,NP
[23] R+4
[24] DQ: 'DEPRECIATION SCHEDULE? (YES OR NO)'
[25] YN'=1+5)/DSC,BY
[26] DQ
[27] DSC:30,CR',10p', 'DEPRECIATION SCHEDULE',CR
[28] 'YEAR DEPRECIATION ACCUM DEPR BOOK VALUE'
[29] 'N:3113' APMT((1+tDP);DP)
[30] BY:=(YD=YI)/PF1
[31] DP+DP,[11][YI-YD),3p0,DP[YD; 2 3]
[32] PF1:DP+(YI,3)DP
[33] \((YA+YI)/PFO
[34] A+A,[1][(YI-YA),4p0,0,A[YA 3 4]
[35] PFO:A+(YI,4)+A
[36] S+PX(1+AP)*Yi+YI
[38] CA+(DP[1]-A[1]; 3)+EA+EB-TX
[39] RTN+CAx100+D
[40] R+5
[41] P4:30,CR'),23p', 'INTEGRATED STATEMENT OF EARNINGS AND CASH FLOW',CR
[42] 'YEAR EBDFT (INTEREST) (DEPREC) EBT (TAX) EAT
DEPREC (PRIN) CAT RETURN'
[43] 'N:SM((MN)NW (1410,NN(MN)NW) IF P10.2' APMT(YI;ET;A[1];DP[11];
EB;TX;EA;DP[1];A[1];3)+CA;RTN)
[44] \(4p', '90p(3p', '7p')' -
[45] 'TOTALS'
DP[11];(+A[1];3);(+CA)
PQ: 'DO YOU WANT A STATEMENT OF PRO FORMA YIELD ASSUMING SALE EACH YEAR? (YES OR NO)'  

IF ('YN' = 'Y') \ THEN 0  
PQ  
PF: CG + S + DP[,2] - P  
CG + RC + CG - S + ((P - L) \times YI) \times YI - P  
CGAT + (CG \times 1 - CT) + (CGD \times CT) - CGD \times TR  
C + S + CGAT - A[;4] + CGD  
CNS + CA[1]  
X + 1  
BK: CNS + CNS \times X + CA[1]  
K + X + 1  
(K < YI) / BK  
PFAT + C + CNS  
Y + 1  
X + 1  
5  
RE1: R + K \times YLD(0, CA[;K-1], CA[K] + C[K]), [0.5] \times Kp0  
R + Y, (R - 1) \times 100  
R + X + 1  
(K < YI) / RE1  
5  
P5: (3 \times CR), (26p', ')  
'PRO FORMA YIELD ON SALE OF INVESTMENT'  
'YEAR CUMULATIVE CUMULATIVE CAPITAL CAP. GAIN TAX BASIS  
CASH FLOW CUMULATIVE TOTAL CASH YIELD'  
'O N SALE DEPREC APPREC GAIN AFTER TAX LESS LOAN  
FLOW A.T.'  
'I3.8M(\times N)IQN \times I12, MN(\times N)IQN \times F15.2' \times FMT(\times IY; DP[,2]; (S - P); CG;  
CGAT; TB; C; CNS; CFAT; Y)
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
**Financial Functions and Variables**

<table>
<thead>
<tr>
<th>Major Functions</th>
<th>Supporting Functions</th>
<th>Supporting Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIQ</td>
<td>PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>PROF</td>
<td>PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>EARN</td>
<td>PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>CRED</td>
<td>PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>INV</td>
<td>PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>DEBT</td>
<td>PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>STAN</td>
<td>PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>NORM</td>
<td>NOSTMT, NOBSHEET, PLOT, VS</td>
<td>-</td>
</tr>
<tr>
<td>BETA</td>
<td>BETAFACTOR, BETAFORMULA</td>
<td>-</td>
</tr>
</tbody>
</table>

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").


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.
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

<table>
<thead>
<tr>
<th>MAJOR FUNCTION</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FINANAL2</td>
<td>LIQ, PROF, CRED, EARN</td>
<td>MAT, AVDAYS, YRS</td>
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</tbody>
</table>
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..)?
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
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<th>AMOUNT</th>
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DO YOU WANT TO CHANGE ANY DATA? **YES**

PLEASE TYPE THE CHANGED DATA.(A ZERO SIGNALS THE END)

```
7 1969 227
WRONG ENTRY...REENTER
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7 1961 227
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0
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DO YOU WANT TO SEE YOUR DATA? **YES**

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DO YOU WANT TO CHANGE ANY DATA? **NO**
LIQUIDITY RATIOS.

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<td>1.816</td>
</tr>
<tr>
<td>CASH TO TOTAL ASSETS</td>
<td>0.035</td>
<td>0.033</td>
<td>0.032</td>
<td>0.036</td>
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<tr>
<td>CASH TO SALES</td>
<td>0.047</td>
<td>0.049</td>
<td>0.044</td>
<td>0.046</td>
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</tbody>
</table>

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.

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.
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

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**

<table>
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<tr>
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<tr>
<td></td>
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<td>195000.00</td>
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<td>2</td>
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<td>120000.00</td>
</tr>
<tr>
<td>3</td>
<td>COM. ST. EQ.</td>
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<td>0.75</td>
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<td></td>
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DO YOU WANT TO CHANGE ANY DATA? **YES**

PLEASE TYPE THE CHANGED DATA. (A ZERO SIGNALS THE END)

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

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

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DO YOU WANT TO CHANGE ANY DATA? **NO**.
PROFITABILITY RATIOS.

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<tr>
<th>YEAR</th>
<th>1970</th>
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<tr>
<td>EARNING PER SHARE</td>
<td>2.080</td>
<td>2.458</td>
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<td>PRO-FORMA E.P.S.</td>
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<td>PRICE-EARNING RATIO</td>
<td>12.019</td>
<td>13.017</td>
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<td>YIELD</td>
<td>0.032</td>
<td>0.023</td>
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<td>BOOK VALUE PER SHARE</td>
<td>25.000</td>
<td>26.667</td>
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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

PERIODS(E.G., 69 70 ETC.,)?
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
<table>
<thead>
<tr>
<th>NO.</th>
<th>ACCOUNT</th>
<th>AMOUNT</th>
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<tbody>
<tr>
<td>1.</td>
<td>NET SALES</td>
<td>781.40</td>
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<td></td>
<td></td>
<td>817.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>890.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>926.20</td>
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<tr>
<td>2.</td>
<td>GROSS PROFIT</td>
<td>318.20</td>
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<td>304.90</td>
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<td>318.10</td>
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<td>64.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>69.20</td>
</tr>
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<td></td>
<td>72.90</td>
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DO YOU WANT TO CHANGE ANY DATA? YES
PLEASE TYPE THE CHANGED DATA. (A ZERO SIGNALS THE END)

3 1961 59.2

DO YOU WANT TO SEE YOUR DATA? NO

EARNING POWER RATIOS.

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<th></th>
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<tbody>
<tr>
<td>EARNING POWER</td>
<td>0.866</td>
<td>0.786</td>
<td>0.844</td>
<td>0.906</td>
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<td>GROSS EARNING POWER</td>
<td>0.353</td>
<td>0.293</td>
<td>0.302</td>
<td>0.335</td>
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<tr>
<td>NET EARNING POWER</td>
<td>0.091</td>
<td>0.062</td>
<td>0.056</td>
<td>0.071</td>
</tr>
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</table>

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.
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

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

<table>
<thead>
<tr>
<th>NO.</th>
<th>ACCOUNT</th>
<th>AMOUNT</th>
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<tr>
<td>1.</td>
<td>TOTAL SALES</td>
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<tr>
<td>2.</td>
<td>BEGINNING A/R</td>
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<td>3.</td>
<td>ENDING A/R</td>
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DO YOU WISH TO CHANGE ANY DATA? NO

CREDIT MGMT. RATIOS

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<th>YEAR</th>
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<th>1962</th>
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<td>COLLECTION PERIOD</td>
<td>19.333</td>
<td>19.800</td>
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<td>RECEIVABLES TO SALES</td>
<td>0.054</td>
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<tr>
<td>AVERAGE SALES/DAY</td>
<td>7500.000</td>
<td>8333.333</td>
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DO YOU WANT A PLOT OF ANY OF THESE? NO
DO YOU WANT 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(REDUCTING) 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
4. NO. OF DAYS IN THE PERIOD?
[]: 360
5. TOTAL ASSETS?
[]: 2800000
DO YOU WANT TO SEE YOUR DATA? NO

INVENTORY MGMT. RATIOS

<table>
<thead>
<tr>
<th>YEAR</th>
<th>1971</th>
<th>1972</th>
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<tr>
<td></td>
<td></td>
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<tr>
<td>INVENTORY TURNOVER</td>
<td>3.975</td>
<td>5.371</td>
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<tr>
<td>INVENTORY HOLDING PERIOD</td>
<td>90.566</td>
<td>67.021</td>
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<td>INVENTORY TO TOTAL ASSETS</td>
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<td>0.125</td>
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<tr>
<td>AVERAGE INVENTORY</td>
<td>400000.00</td>
<td>350000.00</td>
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</table>

DO YOU WANT A PLOT OF ANY OF THESE? 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

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<th>NO.</th>
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<th>AMOUNT</th>
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<tr>
<td>1.</td>
<td>TOTAL C.L.</td>
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<td>2.</td>
<td>LONG TERM DEBT</td>
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<td>3.</td>
<td>TOTAL O.E.</td>
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DO YOU WISH TO CHANGE ANY DATA? NO.

DEBT MGMT. RATIOS

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<td>DEBT TO EQUITY</td>
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<td>LONG TERM DEBT TO EQUITY</td>
<td>2.645</td>
<td>2.571</td>
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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

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.,)?
□:
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

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. SALES</td>
<td>781.40</td>
<td>817.50</td>
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<td>926.20</td>
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<tr>
<td>2. COST OF SALES</td>
<td>463.20</td>
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<td>4. DEPRECIATION</td>
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<td>89.80</td>
<td>103.20</td>
<td>99.60</td>
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<tr>
<td>5. OTHER ITEMS</td>
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<td>-6.80</td>
<td>-3.50</td>
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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

DO YOU WANT TO SEE YOUR DATA? YES

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<td>583.90</td>
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<tr>
<td>3. EXPENSES</td>
<td>91.70</td>
<td>114.10</td>
<td>115.80</td>
<td>117.60</td>
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<tr>
<td>4. DEPRECIATION</td>
<td>78.40</td>
<td>89.80</td>
<td>103.20</td>
<td>99.60</td>
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<tr>
<td>5. OTHER ITEMS</td>
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<td>-6.80</td>
<td>-3.50</td>
<td>-5.60</td>
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DO YOU WANT TO CHANGE ANY DATA? NO_
### INCOME STATEMENT

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<td>100.0</td>
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<td>0.4</td>
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<td>4.9</td>
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<td>7.8</td>
<td>6.7</td>
<td>7.8</td>
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**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? No
PLEASE ANSWER YES OR NO: No

---

**BALANCE SHEET**

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<td>3.8</td>
<td>3.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Receivables</td>
<td>13.6</td>
<td>13.5</td>
<td>15.1</td>
<td>14.5</td>
</tr>
<tr>
<td>Inventories</td>
<td>17.3</td>
<td>16.5</td>
<td>15.4</td>
<td>16.1</td>
</tr>
<tr>
<td><strong>CURRENT ASSETS</strong></td>
<td>35.0</td>
<td>33.8</td>
<td>34.1</td>
<td>34.8</td>
</tr>
<tr>
<td>Investments</td>
<td>1.9</td>
<td>5.5</td>
<td>6.3</td>
<td>7.4</td>
</tr>
<tr>
<td>Deferred Charges</td>
<td>0.6</td>
<td>0.8</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Plant and Equip. (Net)</td>
<td>62.1</td>
<td>59.6</td>
<td>58.3</td>
<td>56.6</td>
</tr>
<tr>
<td>Intangibles</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>EQUITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Liabilities</td>
<td>17.7</td>
<td>23.4</td>
<td>21.5</td>
<td>19.2</td>
</tr>
<tr>
<td>Long-Term Debt</td>
<td>17.3</td>
<td>14.0</td>
<td>13.9</td>
<td>12.4</td>
</tr>
<tr>
<td><strong>TOTAL DEBT</strong></td>
<td>35.0</td>
<td>37.4</td>
<td>35.5</td>
<td>31.6</td>
</tr>
<tr>
<td>Owners' Equity</td>
<td>65.0</td>
<td>62.6</td>
<td>64.5</td>
<td>68.4</td>
</tr>
</tbody>
</table>

---

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

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)
THERE 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
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cash</td>
<td>36</td>
<td>45</td>
<td>36</td>
<td>26</td>
</tr>
<tr>
<td>2. Marketable Securities</td>
<td>64</td>
<td>67</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>3. Accounts Receivable Beginning</td>
<td>142</td>
<td>162</td>
<td>152</td>
<td>142</td>
</tr>
<tr>
<td>4. Accounts Receivable Ending</td>
<td>162</td>
<td>152</td>
<td>142</td>
<td>135</td>
</tr>
<tr>
<td>5. Inventory Beginning</td>
<td>156</td>
<td>172</td>
<td>162</td>
<td>172</td>
</tr>
</tbody>
</table>
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*
## Financial Statements

<table>
<thead>
<tr>
<th>No.</th>
<th>Account</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CASH</td>
<td>36.00 45.00 36.00 26.00</td>
</tr>
<tr>
<td>2</td>
<td>Marketable Securities</td>
<td>64.00 67.00 65.00 65.00</td>
</tr>
<tr>
<td>3</td>
<td>Accounts Receivable Beginning</td>
<td>142.00 162.00 152.00 142.00</td>
</tr>
<tr>
<td>4</td>
<td>Accounts Receivable Ending</td>
<td>162.00 152.00 142.00 135.00</td>
</tr>
<tr>
<td>5</td>
<td>Inventory Beginning</td>
<td>156.00 172.00 162.00 172.00</td>
</tr>
<tr>
<td>6</td>
<td>Inventory Ending</td>
<td>172.00 162.00 172.00 165.00</td>
</tr>
<tr>
<td>7</td>
<td>Prepaid Expenses</td>
<td>0.00 0.00 0.00 0.00</td>
</tr>
<tr>
<td>8</td>
<td>Land, Bldgs, Plant etc.</td>
<td>577.00 677.00 681.00 654.00</td>
</tr>
<tr>
<td>9</td>
<td>Intangible Assets (Less Amortn.)</td>
<td>4.00 3.00 3.00 2.00</td>
</tr>
<tr>
<td>10</td>
<td>Investments</td>
<td>5.00 8.00 11.00 10.00</td>
</tr>
<tr>
<td>11</td>
<td>Current Liabilities</td>
<td>160.00 143.00 127.00 196.00</td>
</tr>
<tr>
<td>12</td>
<td>Deferred Charges</td>
<td>0.00 0.00 0.00 0.00</td>
</tr>
<tr>
<td>13</td>
<td>Long-Term Debt</td>
<td>120.00 200.00 125.00 100.00</td>
</tr>
<tr>
<td>14</td>
<td>Total Owners' Equity</td>
<td>320.00 310.00 335.00 357.00</td>
</tr>
<tr>
<td>15</td>
<td>Total Sales</td>
<td>1200.00 1350.00 1465.00 1753.00</td>
</tr>
<tr>
<td>16</td>
<td>Cost of Sales</td>
<td>375.00 389.00 465.00 486.00</td>
</tr>
<tr>
<td>17</td>
<td>G and A and Selling Expenses</td>
<td>120.00 120.00 120.00 120.00</td>
</tr>
<tr>
<td>18</td>
<td>Depreciation</td>
<td>120.00 120.00 120.00 120.00</td>
</tr>
<tr>
<td>19</td>
<td>Other Items</td>
<td>53.00 53.00 53.00 53.00</td>
</tr>
<tr>
<td>20</td>
<td>Income Tax</td>
<td>475.00 475.00 475.00 475.00</td>
</tr>
<tr>
<td>21</td>
<td>Number of Common Shares O/S</td>
<td>10.00 10.00 10.00 10.00</td>
</tr>
<tr>
<td>22</td>
<td>Common Stock Equivalents</td>
<td>0.00 0.00 0.00 0.00</td>
</tr>
<tr>
<td>23</td>
<td>Dividend Per Share Declared</td>
<td>0.65 0.75 0.80 0.93</td>
</tr>
<tr>
<td>24</td>
<td>Market Price Per Share</td>
<td>25.00 32.00 28.00 42.00</td>
</tr>
</tbody>
</table>

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

LIQUIDITY, PROFITABILITY, 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

<table>
<thead>
<tr>
<th>YEAR</th>
<th>69</th>
<th>70</th>
<th>71</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUICK RATIO(S)</td>
<td>0.63</td>
<td>0.78</td>
<td>0.80</td>
<td>0.46</td>
</tr>
<tr>
<td>CURRENT RATIO(S)</td>
<td>2.71</td>
<td>2.98</td>
<td>3.27</td>
<td>1.99</td>
</tr>
<tr>
<td>CASH TO TOTAL ASSETS</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>CASH TO SALES</td>
<td>0.03</td>
<td>0.03</td>
<td>0.02</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**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.
<table>
<thead>
<tr>
<th>YEAR</th>
<th>Profitability Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARN. PER SHARE</td>
<td>5.70</td>
</tr>
<tr>
<td>PRO-FORMA E.P.S.</td>
<td>5.70</td>
</tr>
<tr>
<td>PRICE-EARNING RATIO</td>
<td>4.39</td>
</tr>
<tr>
<td>YIELD</td>
<td>0.03</td>
</tr>
<tr>
<td>BOOK VALUE PER SHARE</td>
<td>32.00</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>YEAR</th>
<th>69</th>
<th>70</th>
<th>71</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARNING POWER</td>
<td>1.18</td>
<td>1.21</td>
<td>1.32</td>
<td>1.66</td>
</tr>
<tr>
<td>GROSS EARNING POWER</td>
<td>0.81</td>
<td>0.86</td>
<td>0.90</td>
<td>1.20</td>
</tr>
<tr>
<td>NET EARNING POWER</td>
<td>0.06</td>
<td>0.17</td>
<td>0.21</td>
<td>0.47</td>
</tr>
</tbody>
</table>

**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**

![Graph showing the trend of net earning power from 1969 to 1972](image)

**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

<table>
<thead>
<tr>
<th></th>
<th>YEAR</th>
<th>69</th>
<th>70</th>
<th>71</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COLLECTION PERIOD</strong></td>
<td></td>
<td>91.20</td>
<td>83.73</td>
<td>72.25</td>
<td>56.89</td>
</tr>
<tr>
<td><strong>RECEIVABLES TO SALES</strong></td>
<td></td>
<td>0.13</td>
<td>0.12</td>
<td>0.10</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>AVERAGE SALES PER DAY</strong></td>
<td></td>
<td>3.33</td>
<td>3.75</td>
<td>4.07</td>
<td>4.87</td>
</tr>
</tbody>
</table>

Do you want a plot of any of these? Yes.

Collection period or receivables to sales?

Type the underlined letters for the plot.
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 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(REDUCEING) 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

<table>
<thead>
<tr>
<th>YEAR</th>
<th>69</th>
<th>70</th>
<th>71</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVENTORY TURNOVER</td>
<td>2.29</td>
<td>2.33</td>
<td>2.78</td>
<td>2.88</td>
</tr>
<tr>
<td>INVENTORY HOLDING PERIOD</td>
<td>157.44</td>
<td>154.55</td>
<td>129.29</td>
<td>124.81</td>
</tr>
<tr>
<td>INVENTORY TO TOTAL ASSETS</td>
<td>0.16</td>
<td>0.15</td>
<td>0.15</td>
<td>0.16</td>
</tr>
<tr>
<td>AVERAGE INVENTORY</td>
<td>164.00</td>
<td>167.00</td>
<td>167.00</td>
<td>168.50</td>
</tr>
</tbody>
</table>

DO YOU WANT A PLOT OF ANY OF THESE? YES

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

<table>
<thead>
<tr>
<th>YEAR</th>
<th>69</th>
<th>70</th>
<th>71</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEBT TO EQUITY</td>
<td>0.88</td>
<td>1.11</td>
<td>0.75</td>
<td>0.83</td>
</tr>
<tr>
<td>LONG TERM DEBT TO EQUITY</td>
<td>0.38</td>
<td>0.65</td>
<td>0.37</td>
<td>0.28</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Year</th>
<th>69</th>
<th>70</th>
<th>71</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash and Equivalents</td>
<td>9.8</td>
<td>10.1</td>
<td>9.1</td>
<td>8.6</td>
</tr>
<tr>
<td>Receivables</td>
<td>15.9</td>
<td>13.6</td>
<td>12.8</td>
<td>12.8</td>
</tr>
<tr>
<td>Inventories</td>
<td>16.9</td>
<td>14.5</td>
<td>15.5</td>
<td>15.6</td>
</tr>
<tr>
<td><strong>Current Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>42.5</td>
<td>38.2</td>
<td>37.4</td>
<td>37.0</td>
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<tr>
<td>Investments</td>
<td>0.5</td>
<td>0.7</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>Deferred Charges</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Land, Buildings, Etc., (Net)</td>
<td>56.6</td>
<td>60.8</td>
<td>61.4</td>
<td>61.9</td>
</tr>
<tr>
<td>Intangibles</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Equities</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Current Liabilities</td>
<td>15.7</td>
<td>12.8</td>
<td>11.4</td>
<td>18.5</td>
</tr>
<tr>
<td>Long-Term Debt</td>
<td>11.8</td>
<td>18.0</td>
<td>11.3</td>
<td>9.5</td>
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<tr>
<td><strong>Total Debt</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>27.5</td>
<td>30.8</td>
<td>22.7</td>
<td>28.0</td>
</tr>
<tr>
<td>Owners' Equity</td>
<td>72.5</td>
<td>69.2</td>
<td>77.3</td>
<td>72.0</td>
</tr>
</tbody>
</table>

---

DO YOU WANT THE OTHER STATEMENT? YES
### INCOME STATEMENT

<table>
<thead>
<tr>
<th>YEAR</th>
<th>69</th>
<th>70</th>
<th>71</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>COST OF SALES</td>
<td>31.3</td>
<td>28.8</td>
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<td>SELLING AND ADMN.</td>
<td>10.0</td>
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<td>OPERATING EXP.</td>
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<td>NET OPER. INCOME</td>
<td>48.8</td>
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<td>OTHER ITEMS</td>
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<td>NET INCOME</td>
<td>44.0</td>
<td>39.1</td>
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**DO YOU WANT THE OTHER STATEMENT? NO.**

**DO YOU WANT TO TRY OTHER RATIOS? NO.**
DO YOU KNOW THE VARIOUS RATIOS YOU CAN ANALYZE?

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

SPECIFDSNB = (1 + T))/LR, PROF, INTE, CRED, INV, DEBT, STR, NORM, BET

LR: LIQ
PRO: PROF
CRED: CRED
DEBT: DEBT
INVE: INV
INTE: EARN
STR: STAN
NORM: NORM
BET: BETA

DO YOU WANT THE OTHER RATIOS?
### B. LIQ

\[ \text{\(\text{LIQ} = A_1 + A_2 + A_3 + A_4 + M; N_1 + M; YRS\)} \]

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\[ \Delta \text{FMT}(1, N_1) \text{pYRS} \]

\[ \Delta \text{FMT}(1, N_1) \text{pA1} + \#\text{MAT}[1 : 2] \] * \#\text{MAT}[7 ; ]

\[ \Delta \text{FMT}(1, N_1) \text{pA2} + \#\text{MAT}[1 : 4] \] * \#\text{MAT}[7 ; ]

\[ \Delta \text{FMT}(1, N_1) \text{pA3} + \#\text{MAT}[1 ; 5] \]

\[ \Delta \text{FMT}(1, N_1) \text{pA4} + \#\text{MAT}[1 ; 6] \]

**CH: CHANGE YRS**

**STP1:** 'TYPE THE UNDERLINED LETTERS FOR WHICH YOU WANT THE PLOT.'

**STP200:** 'CURRENT RATIO, QUICK RATIO, CASH TO TOTAL ASSETS, CASH TO SALES.'

\[ \Delta \text{FMT}(M_1; \text{MAT}) \]

\[ \#(\text{AyN} '\text{DO YOU WANT A PLOT OF ANY OF THESE?}')]/\text{STP1} \]

\[ \#(\text{AyN} '\text{DO YOU WANT TO CHANGE ANY DATA?}')]/\text{CHA} \]

\[ '\text{CQAS'} = 1 + \#(\text{AyN} '\text{DO YOU WANT TO CHANGE ANY DATA?}')]/\text{SP2}/\text{S2, S3, S4, S5} \]

\[ '\text{AyN} '\text{DO YOU WANT TO SEE YOUR DATA?}' /\text{S1} \]

\[ '\text{AyN} '\text{DO YOU WISH TO CHANGE ANY DATA?}' /\text{CH} \]

\[ '\text{AyN} '\text{DO YOU WANT TO SEE ANY DATA?}' /\text{SP1} \]

\[ '\text{AyN} '\text{DO YOU WANT TO CHANGE ANY DATA?}' /\text{S1} \]

\[ '\text{AyN} '\text{DO YOU WANT TO SEE ANY DATA?}' /\text{S1} \]

\[ '\text{AyN} '\text{DO YOU WANT TO CHANGE ANY DATA?}' /\text{S1} \]

\[ '\text{AyN} '\text{DO YOU WANT TO SEE ANY DATA?}' /\text{S1} \]

\[ '\text{AyN} '\text{DO YOU WANT TO CHANGE ANY DATA?}' /\text{S1} \]
[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

C. PROF

VPROP[[]]V

V PROF;M;M1;MAT;N4;A1;A2;A3;A4;YRS
[4] START:'PERIODS(E.G., 69 70 ETC.,)?'
[5] MAT+(6,N4+YRS+1,0)0
[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
[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:1pCR
[20] (((4+10×N4)×2)' '); 'PROFITABILITY RATIOS.'
[21] ' '
[22] 'EYEAR ME17,10110' DFMT(1,N4)0YRS
[23] ' '
[24] 'EARNING PER SHARE ME8,10F10.3' DFMT(1,N4)0A1+×MAT[1; 2;]
[25] 'EPRO-FORMA E.P.S.ME9,10F10.3' DFMT(1,N4)0A0+MAT[1;]××MAT[ 2 3 ;]
D. EARN

\[ EARN[] \]

\[ EARN; A_1; A_2; A_3; N_1; YRS \]

\[ M = '1. NET SALES' \]
\[ '2. CROSS PROFIT' \]
\[ '3. NET INCOME' \]

\[ M_1 = 15 \]
\[ M_2 = 10 \]
\[ M_3 = 30 \]
\[ M_4 = 30 \]
\[ M_5 = 30 \]

\[ \text{START: 'PERIODS(E.G., 69 70 ETC.),'?} \]

\[ \text{MAT} + [(4 + 10 \times N_1) \times (YRS + 1)p_0] \]

\[ \text{MAT}(1,[1]) + (1, N_1) \text{ INC '1. NET SALES'?} \]
\[ \text{MAT}(2,[1]) + (1, N_1) \text{ INC '2. CROSS PROFIT'?} \]
\[ \text{MAT}(3,[1]) + (1, N_1) \text{ INC '3. NET INCOME AFTER TAX'?} \]
\[ \text{MAT}(4,[1]) + (1, N_1) \text{ INC '4. TOTAL ASSETS'?} \]

\[ \text{SEE: + (AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1} \]

\[ \text{COMPUTE: pCR} \]

\[ (((4 + 10 \times N_1) \times 2)p') ' EARNING POWER RATIOS.' \]
E. CRED

\[ V \text{CRED}\] \[ V \]

\[ V \text{CRED;}\text{YRS;}N_1;\text{MAT;}M_1;\text{ASD;}\text{AVDAYS;}A_1;A_2;X_1;X_2;X_3;\text{ACR;}\text{INTEREST} \]

1. TOTAL SALES 2. BEGINNING A/R 3. ENDING A/R

M+1 M1 3 16 pM

\[ \text{START: 'PERIODS (E.G., 69 70 ETC.,)?'} \]

\[ \text{MAT+}(3, N_1+\text{N1\text{pYRS+};})\text{p0} \]

\[ \text{AVDAYS+1 INC 'AVERAGE NO. OF DAYS IN THE PERIOD?'} \]

\[ \text{MAT}[1;]+(1, N_1) \text{ INC '1. TOTAL SALES?'} \]

\[ \text{MAT}[2;]+(1, N_1) \text{ INC '2. A/R AT THE BEGINNING OF EACH PERIOD?'} \]

\[ \text{MAT}[3;]+(1, N_1) \text{ INC '3. A/R AT THE END OF EACH PERIOD?'} \]

\[ \text{SEE: 'DO YOU WANT TO SEE YOUR DATA?'}\] /S1

\[ \text{COMPUTE: 'pCR} \]
((6+10*N1)/2) P 'CREDIT MGMT. RATIOS'

'1
'TYPE YEAR FOR 11,101-0' DFMT(1,N1) p YRS

'6
'TYPE COLLECTION PERIOD FOR 8,10F10.3' DFMT(1,N1) P A1+(AVDAYS×MAT[2 3 ;])×2×MAT[1 ;]

'9
'TYPE RECEIVABLES TO SALES FOR 5,10F10.3' DFMT(1,N1) p A2+(+ MAT[2 3 ;])×2×MAT[1 ;]

'2
'TYPE AVERAGE SALES/DAY FOR 8,10F10.3' DFMT(1,N1) p MAT[1 ;]×AVDAYS

'3

+(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1

CHANGE:=(~(AYN 'DO YOU WISH TO CHANGE ANY DATA?'))/CHI

'4
'CHANGE YRS

'STP1:'TYPE THE UNDERLINED LETTERS FOR THE PLOT.'

'STP2:'COLLECTION PERIOD, RECEIVABLES TO SALES.'

'STP2=(CR'=(1+T))/S2,S3

'7
'STP2

'NO. ACCOUNT AMOUNT'

'8
'16A1,X2,10F11.2' DFMT(N1;MAT)

'9
'1p28

CH:=(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHI

'10
'COMPUTE

'S3: 30 40 PLOT A1 VS YRS

'STP2: PLOT A2 VS YRS

'MOREPLOT:=(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1

'13
'CH:='DO YOU WANT TO SEE THE SAVINGS BY CHANGING'

'14
'CH:=(AYN 'COLLECTION PERIOD FOR TWO PERIODS?')/0

'15
'CH:='PLEASE TYPE THE AVERAGE COLLECTION PERIOD FOR TWO PERIODS.'

'16
'X3×(X1×(-/ACR))×(X2×AVDAYS×(+/ACR)×2)

'17
'INTEREST+0.01×X1 INC 'WHAT IS THE AVERAGE SALES PER DAY FOR THE SECOND YEAR R?'

'18
'INTEREST+0.01×X1 INC 'WHAT IS THE INTEREST RATE?'

'19
'THE COST(SAVINGS) OF EXTENDING(REDUCTING) THE CREDIT BY ';X1;' DAYS'

'20
'FN+(ASD×((1+IR1)×X3)-1))×IR1-

INTEREST×AVDAYS)-FN1×ASD×X3

'21
+(AYN 'DO YOU WANT TO TRY AGAIN?')/CHI
F. INV

\[\text{INV}[[]]v\]

\[\text{INV}: A1; A2; A3; AVIN; MAT; M; M1; AHP; INT; IRI1; TDAYS; AVH; FN; FN1; DX\]

1. BEGINNING INV. 2. ENDING INV. 3. C.G.S.

\[M1 = 4 \times 17 \times \text{M}, '4, TOTAL ASSETS', '\]

3. START: 'PERIODS(E.G., 69 70 ETC.,)?'

\[\text{MAT} = (4, M1 \times \text{pYRS} +, 0)\]

1. INVENTORY AT THE BEGINNING OF EACH PERIOD?

\[\text{MAT}[1:] = (1, N1) \text{INC}

2. INVENTORY AT THE END OF EACH PERIOD?

\[\text{MAT}[2:] = (1, N1) \text{INC}

3. COST OF GOODS SOLD?

\[\text{MAT}[3:] = (1, N1) \text{INC}

4. NO. OF DAYS IN THE PERIOD?

\[\text{TDAYS} = 1 \text{INC } \text{N1}\]

5. TOTAL ASSETS?

\[\text{MAT}[4:] = (1, N1) \text{INC}

SEE: +(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1

COMPUTE: 'pQR

(((8 \times 12 \times N1) \times 2) \times '). 'INVENTORY MGMT. RATIOS'

'I YEAR

T \times 16, 10i12' \text{DFMT}(1, N1)pYRS

'T INVENTORY TURNOVER', X12, 10F12.3' \text{DFMT}(1, N1)pA1+MAT[3] \times \text{AVIN}

'T INVENTORY HOLDING PERIOD', X6, 10F12.3' \text{DFMT}(1, N1)pA2+(TDAYS \times \text{AVIN})+MAT[3];

'T INVENTORY TO TOTAL ASSETS', X5, 10F12.3' \text{DFMT}(1, N1)pA3+AVIN+MAT[4];

'T AVERAGE INVENTORY', X13, 10F12.3' \text{DFMT}(1, N1)pAVIN

'I, pQR

+(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1

CHG: 'CHG YRS

SEE

STP1: 'TYPE THE UNDERLINED LETTERS FOR THE PLOT.'

STP2: 'INVENTORY TURNOVER, HOLDING PERIOD, TO TOTAL ASSETS.'

+(THA' = (14T)))/S2, S3, S4

STP1

S1, pQR

'NO. ACCOUNT AMOUNT'

'17A1, X2, 10F11.2' \text{DFMT}(M1; MAT)

'S2: 30 40 PLOT A1 VS YRS

'S3: 30 40 PLOT A2 VS YRS

'S4: 30 40 PLOT A3 VS YRS

'MOREPLOT + (AYN 'DO YOU WANT OTHER PLOTS?')/STP1

CH: 'CH: 'CH: 'DO YOU WANT TO SEE THE SAVINGS BY CHANGING' 'THE HOLDING PERIOD FOR TWO PERIODS?'

+(AYN 'THE HOLDING PERIOD FOR TWO PERIODS?')/0

CHN: 'AHP+2 INC 'PLEASE TYPE THE INVENTORY HOLDING PERIOD FOR TWO PERIODS.'

+(AYN 'DO YOU WANT TO SEE THE SAVINGS BY CHANGING' THE HOLDING PERIOD FOR TWO PERIODS?)

+(CHN: AHP+2 INC 'PLEASE TYPE THE INVENTORY HOLDING PERIOD FOR TWO PERIODS.'

+(AYN 'DO YOU WANT THE INTEREST RATE(I.E., CARRYING'
INT*0.01*x1 INC 'COSTS EXPRESSED AS A PERCENTAGE OF C.G.S. '  
INT*INT+TDAIS  
FN1=(FN*(AIN*((1+IR1)*N1+(((-#AHP)*)((+/AHP)2)))-(AIN*  
1 INC 'AVERAGE INVENTORY FOR THE SECOND PERIOD. '  
DX+((1)*AHP[1]-AHP[2])  
' THE SAVINGS IN (COST OF) REDUCING (EXTENDING) THE INVENTORY'  
' THE HOLDING PERIOD BY F4.1, W DAYS IS... F4.1 F10.2 '  
→(AYN 'DO YOU WANT TO TRY AGAIN? ')/CHN  
G. DEBT  

VDEBT[0][0]  
V DEBT[1];A1;A2;M;M1;N1;MAT;YRS  
M''1. TOTAL C.L. 2. LONG TERM DEBT 3. TOTAL O.E. '  
M1+3 17 pM  
' START: 'PERIODS (E.G., 69 70 ETC., )?'  
MAT+(3,N1+YRS+,[]p0)  
MAT[1;]+(1,N1) INC '1. TOTAL CURRENT LIABILITIES?'  
MAT[2;]+(1,N1) INC '2. LONG TERM DEBT?'  
MAT[3;]+(1,N1) INC '3. TOTAL OWNERS' EQUITY (PAID-IN CAPITAL P  
LUS R.E.).'  
SEE:→(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1  
COMPUTE:1pCR  
(12+10*N1+2)*1'; 'DEBT MGMT. RATIOS'  
' '  
' '  
' '  
' (12+10*N1+2)*1'; 'DEBT TO EQUITY, X15,10F10.3'  
' '  
' '  
' (12+10*N1+2)*1'; 'LONG TERM DEBT TO EQUITY, X5,10F10.3'  
' '  
' '  
→(AYN 'DO YOU NEED A PLOT OF ANY OF THESE? ')/STP1  
CH1:→(AYN 'DO YOU WISH TO CHANGE ANY DATA?' )/O  
CHA:CHANGE YRS  
' '  
STP1:'TYPE THE UNDERLINED LETTERS FOR THE PLOT.'  
STP2:'DEBT TO EQUITY, LTD TO EQUITY.'  
' '  
STP1  
S1:10CR  
'NO. ACCOUNT AMOUNT'  
' '  
' '  
CHA:→(AYN 'DO YOU WISH TO CHANGE ANY DATA?' )/CHA
\[ \text{COMPUTE} \]
\[ S2: 30 40 \text{ PLOT A1 VS YRS} \]
\[ \text{MOREPLOT} \]
\[ S3: 30 40 \text{ PLOT A2 VS YRS} \]
\[ \text{MOREPLOT:(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1} \]
\[ \text{CH1} \]

**H. STAN**

\[ \text{VSTAN[]} \]

\[ \text{V STAN[[]]} \]

\[ \text{RATIO: 'PLEASE TYPE THE RATIO YOU WISH TO EXAMINE. (CURRENT ETC..)' } \]
\[ RX+R \]
\[ R-->'PLEASE ENTER 'RX;' RATIOS AS A VECTOR.' \]
\[ R+R \]
\[ N+1 \text{ INC 'PLEASE TYPE THE NUMBER OF UNITS FOR THE MOVING AVERAGE.' } \]
\[ MVAV1+R \text{ EMA(N, }pR) \]
\[ MVAV+(1,}pMVAV1)pMVAV1 \]
\[ RS+R[\Delta R] \]
\[ RMEAN+((/+R)÷(R1+pR) \]
\[>((2|R1|=1)/ODD1 \]
\[ EVEN1:RMEDIAN+0.5×+/RS[(0.5×0 1 +R1] \]
\[ R2+RS[(R1+R2)],RMEDIAN, RMEDIAN, RS[(R1+R2)+1(R1+R2)] \]
\[ R3+(pR2)+2 \]
\[ ((2|R3|=1)/ODD2 \]
\[ EVEN2: IUP+(R2(R3+2)+R2[(R3+2)+1])÷2 \]
\[ IDN+(R2(R3+(R3+2))+R2[(R3+1+(R3+2))]÷2 \]
\[ IQA+(IUP+IDN)+2 \]
\[ ODD1:RMEDIAN+0.5×+/RS[(0.5×0 1 +R1] \]
\[ R2+RS[(R1-1(R2)],RMEDIAN, RMEDIAN, RS[(R1+1(R2)+(R1+1)] \]
\[ R3+(pR2)+2 \]
\[ ((2|R3|=1)/ODD2 \]
\[ EVEN2 \]
\[ ODD2: IUP+R2[((R3-1)+2)+1] \]
\[ IDN+R2(R3+1((R3-1)+2)) \]
\[ IQA+(IUP+IDN)+2 \]
\[ OUT: \]

\[ \text{'T MEAN IS, X23, F10.3' AFMT(RMEAN) \]
\[ \text{'T MEDIAN IS, X23, F10.3' AFMT(RMEDIAN) \]
INTERQUARTILE AVERAGE IS, X6, F10.3' DFMT(IQA)

MOVING AVERAGE IS, X13, 20 F10.3' DFMT(MVAV)

' DO YOU WANT TO TRY OTHER RATIOS? ' / RATIO

I. NORM

NORM[[]]V

' DO YOU WANT THE INCOME STATEMENT OR BALANCE SHEET?'
REPEAT: 'TYPE THE UNDERLINED WORD.'
' I ' =1*V / NOX, REPEAT

NOBSHEET

QN: ' DO YOU WANT THE OTHER STATEMENT? ' / REPEAT

0

NOX: NOSTMT

QN

NOSTMT[[]]V

' DO YOU WANT THE OTHER STATEMENT? ' / REPEAT

M+N1; MAT; N3; YRS; CSL; GAS; DEPR; OTHER; INCTAX; NOPI
M=' 1. SALES  2. COST OF SALES  3. EXPENSES '
M=M,' 4. DEPRECIATION  5. OTHER ITEMS  6. INCOME TAX '
M1+(6,(pM)+6)pM

START: ' PERIODS (E.G., 69 70 ETC..)?'
MAT=(+6, N3+pYRS+, [0])p0

MAT[1;]+(1,N3) INC ' 1. SALES?'

MAT[2;]+(1,N3) INC ' 2. COST OF SALES?'

MAT[3;]+(1,N3) INC ' 3. G AND A AND SELLING EXPENSES?'

MAT[4;]+(1,N3) INC ' 4. DEPRECIATION?'

MAT[5;]+(1,N3) INC ' 5. OTHER ITEMS?'

MAT[6;]+(1,N3) INC ' 6. INCOME TAX?'

SEE: ' DO YOU WANT TO SEE YOUR DATA? '/ S1

CMPT: 1pCR

(' ((6+10×N3)+2) p' ' '); INCOME STATEMENT'

' ' 

(22+10×N3)p' ' 

' YEAR X, X15, 10 I10' DFMT(1, N3)pYRS

(22+10×N3)p' ' 

' SALES X, X17, 10 F10.1' DFMT(1, N3)p100

' COST OF SALES X, X9, 10 F10.1' DFMT(1, N3)p CSL+100×4#MAT[ 2 1 ;]

(22+10×N3)p' ' 

' GROSS PROFIT X, X10, 10 F10.1' DFMT(1, N3)p100-CSL

(22+10×N3)p' ' 

' SELLING AND ADMIN. X, X5, 10 F10.1' DFMT(1, N3)p GAS+100×4#MAT[ 3 1 ;]
[26] 'DEPRECIATION',X10,10F10.1' DFMT(1,N3)pDEPR+100+#MAT[41]
[27] (22+10xN3)p'-'
[28] 'OPERATING EXP.',X8,10F10.1' DFMT(1,N3)pGAS+DEPR
[29] (22+10xN3)p'-'
[30] 'NET OPER. INCOME',X6,10F10.1' DFMT(1,N3)pNOPI-(100-CSL)-(GAS+
DEPR)
[31] (22+10xN3)p'-'
[32] 'OTHER ITEMS',X11,10F10.1' DFMT(1,N3)pOTHER+100xN3pMAT[51]
[33] 'INCOME TAX',X12,10F10.1' DFMT(1,N3)pINCTAX+100xN3pMAT[61]
[34] (22+10xN3)p'-'
[35] 'NET INCOME',X12,10F10.1' DFMT(1,N3)pNOPI-(OTHER+INCTAX)
[36] (22+10xN3)p'-'
[37] 1pQR
[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] S1:1pQR
[44] 'YEARS',X16,10I10' DFMT(1,N3)pYRS
[45] ' '
[46] '1M>A1,X5,10F10.2' DFMT(M1;MAT)
[47] 1pQR
[48] ->(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHA
[49] ->CMFT

\n
V\nNOBSHEET[[]]V
\n\nV\nNOBSHEET:M;M1;MAT;YRS;N2;T
[5] ' '
[6] START:'PERIODS(E.G., 69 TO ETC..)?'
[7] MAT+(9,N2+pYRS+,[])p0
[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?'
SEE:+(AYN 'DO YOU WANT TO SEE YOUR DATA?')/S1
CMPT:10CR
((14+10*N2)*2)P1"BALANCE SHEET"
"'
(27+10*N2)P1"*
"YEAR',X23,10I10' ΔFMT(1,N2)P1YRS
(27+10*N2)P1"-
"ASSETS"
"CASH AND EQUIVALENTS',X7,10F10.1' ΔFMT(1,N2)P1MAT[1;]XT
"RECEIVABLES',X16,10F10.1' ΔFMT(1,N2)P1MAT[2;]XT
"INVENTORIES',X16,10F10.1' ΔFMT(1,N2)P1MAT[3;]XT
"CURRENT ASSETS',X13,10F10.1' ΔFMT(1,N2)P1MAT[4;]XT
"INVESTMENTS',X16,10F10.1' ΔFMT(1,N2)P1MAT[5;]XT
"PLANT AND EQUIP. (NET)',X5,10F10.1' ΔFMT(1,N2)P1MAT[6;]XT
"INTANGIBLES',X16,10F10.1' ΔFMT(1,N2)P1MAT[7;]XT
"CURRENT LIABILITIES',X8,10F10.1' ΔFMT(1,N2)P1MAT[8;]XT
"LONG-TERM DEBT',X13,10F10.1' ΔFMT(1,N2)P1MAT[9;]XT
"TOTAL DEBT',X17,10F10.1' ΔFMT(1,N2)P1MAT[8 9 ;]
"OWNERS' EQUITY',X13,10F10.1' ΔFMT(1,N2)P1MAT[8 9 ;]
(27+10*N2)P1"*
1PGR
CHN:+(AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHA
+(AYN 'DO YOU WANT TO TRY FOR OTHER PERIODS?')/START
+O
CHA:CHANGE YRS
+SEE
S1:1PGR
"YEAR',X18,10I10' ΔFMT(1,N2)PYRS
"'
'18A1,X4,10F10.2' ΔFMT(M1;MAT)
1PGR
+(AYN 'DO YOU WANT TO CHANGE ANY DATA?')/CHA
VCHANGE[++]V

V R+CHANGE YRS

[1] N=(pMAT)[2]
[3] NEW:+=(1pNN=0)=0)/O
[4] +=((pNN)=(1+N))/LX1
[5] +=((pNN)=3)/LX2
[9] →NEW
[10] LX1:=(pNN=1)=:(pMAT[1])/LX2
[12] →NEW
[13] LX2:'WRONG ENTRY....REENTER'
[14] →NEW

"
\( \text{FINANAL2(\[]\[]\text{\])} \)

\( \text{FINANAL2:AVDAYS;M;MAT;MATRIX;MM;N;Y;YRS} \)

[1] 'ENTER THE PERIODS (E.G., 69 70 ETC.)'
[2] \( N+pYRS+,() \)
[3] \( \text{MAT}+(27,N)p0 \)
[4] \( +(N>1)/\text{STEP} \)
[5] \( Y+pYRS \)
[6] \( \text{MAT}+ 26 1 p0 \)
[7] \( \rightarrow\text{NSTEP} \)
[8] \( \text{STEP:Y+}(1,N)pYRS \)
[9] \( \text{NSTEP}:\text{AVDAYS}+1 \) INC 'AVERAGE NUMBER OF DAYS IN THE PERIOD.'
[10] \( \text{MAT}[1;]+(1,N) \) INC '1. CASH.'
[11] \( \text{MAT}[2;]+(1,N) \) INC '2. MARKETABLE SECURITIES.'
[12] \( \text{MAT}[3;]+(1,N) \) INC '3. ACCOUNTS RECEIVABLE BEGINNING.'
[13] \( \text{MAT}[4;]+(1,N) \) INC '4. ACCOUNTS RECEIVABLE ENDING.'
[14] \( \text{MAT}[5;]+(1,N) \) INC '5. INVENTORY BEGINNING.'
[15] \( \text{MAT}[6;]+(1,N) \) INC '6. INVENTORY ENDING.'
[16] \( \text{MAT}[7;]+(1,N) \) INC '7. PREPAID EXPENSES.'
[17] \( \text{MAT}[8;]+(1,N) \) INC '8. LAND, BLDGS, PLANT AND EQUIPMENT(LESS ACC DEPRN.).'
[18] \( \text{MAT}[9;]+(1,N) \) INC '9. INTANGIBLE ASSES. (LESS AMORTIZATION, IF ANY).'</n
[19] \( \text{MAT}[10;]+(1,N) \) INC '10. INVESTMENTS.'</n
[20] \( \text{MAT}[11;]+(1,N) \) INC '11. CURRENT LIABILITIES (N/P, A/P, DIV./P A CCURRED INT. ETC.).'</n
[21] \( \text{MAT}[12;]+(1,N) \) INC '12. DEFERRED CHARGES.'
[22] \( \text{MAT}[13;]+(1,N) \) INC '13. LONG-TERM DEBT.'
[23] \( \text{MAT}[14;]+(1,N) \) INC '14. TOTAL OWNERS' EQUITY.'
[24] \( \text{MAT}[15;]+(1,N) \) INC '15. TOTAL SALES.'
[25] \( \text{MAT}[16;]+(1,N) \) INC '16. COST OF SALES.'
[26] \( \text{MAT}[17;]+(1,N) \) INC '17. G AND A AND SELLING EXPENSES.'
[27] \( \text{MAT}[18;]+(1,N) \) INC '18. DEPRECIATION EXPENSES.'
[28] \( \text{MAT}[19;]+(1,N) \) INC '19. OTHER ITEMS, IF ANY.'</n
[29] \( \text{MAT}[20;]+(1,N) \) INC '20. INCOME TAX.'</n
[30] \( \text{LAST}:\text{MAT}[21;]+(1,N) \) INC '21. NUMBER OF COMMON SHARES OUTSTANDING.'</n
[31] \( \rightarrow((\times/\text{MAT}[21;])\ast0)/\text{NEXT} \)
[32] 'YOU CANNOT HAVE ZERO COMMON SHARES....REENTER.'</n
[33] \( \rightarrow\text{LAST} \)
[34] \( \text{NEXT}:\text{MAT}[22;]+(1,N) \) INC '22. COMMON STOCK EQUIVALENTS.'
MAT[23;]+(1,N) INC '23. DIVIDEND PER SHARE DECLARED.'
LAST1:MAT[24;]+(1,N) INC '24. MARKET PRICE PER SHARE.'

'YOU CANNOT HAVE ZERO MARKET PRICE PER SHARE....REENTER.'

NEXT1:MAT[25;]+-MAT[15 16 ;]
MAT[26;]+(-MAT[15 16 ;])-(+MAT[16+14;])

SEE:=(~(AYN 'DO YOU WANT TO SEE YOUR DATA?'))/RATIO
SEEDATA:S1
PD:=(~(AYN 'DO YOU WANT TO CHANGE ANY DATA?'))/RATIO
CHANGE:'PLEASE ENTER THE CHANGED DATA.(A ZERO SIGNALS THE END)'
NEW:NN+,(D)

RATIO: 'LIQUIDITY, PROFITABILITY, EARNING POWER'
' CREDIT MGMT., INVENTORY MGMT. AND DEBT MGMT.'
'STANDARD RATIOS, NORMALIZED STATEMENTS AND BETA ANALYSIS.'
SS1: 'TYPE ANY OF THE UNDERLINED LETTERS FOR THE RATIOS.'

LR:LIQ MATRIX+MAT[1 2 4 6 7 8 9 10 15 11 ;]
PT:PROCR

PRO:PROF MATRIX+MAT[26 21 22 23 24 14 ;]

EAR:EARN MATRIX+MAT[25 26 ;],[1]+MAT[1 2 4 6 7 8 9 10 ;]

CRE:CRED MATRIX+MAT[15 3 4 ;]
<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>1.</td>
<td>CASH</td>
</tr>
<tr>
<td>2.</td>
<td>MARKETABLE SECURITIES</td>
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<td>3.</td>
<td>ACCOUNTS RECEIVABLE BEGINNING</td>
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<td>4.</td>
<td>ACCOUNTS RECEIVABLE ENDING</td>
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<td>5.</td>
<td>INVENTORY BEGINNING</td>
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<td>6.</td>
<td>INVENTORY ENDING</td>
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<td>7.</td>
<td>PREPAID EXPENSES</td>
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<td>8.</td>
<td>LAND, BLDGS, PLANT ETC.</td>
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<td>9.</td>
<td>INTANGIBLE ASSETS (LESS AMORTN.)</td>
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<td>10.</td>
<td>INVESTMENTS</td>
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<td>11.</td>
<td>CURRENT LIABILITIES</td>
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<td>14.</td>
<td>TOTAL OWNERS' EQUITY</td>
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<tr>
<td>15.</td>
<td>TOTAL SALES</td>
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<tr>
<td>16.</td>
<td>COST OF SALES</td>
</tr>
<tr>
<td>17.</td>
<td>G AND A AND SELLING EXPENSES</td>
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<td>18.</td>
<td>DEPRECIATION</td>
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<tr>
<td>19.</td>
<td>OTHER ITEMS</td>
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<tr>
<td>20.</td>
<td>INCOME TAX</td>
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<tr>
<td>21.</td>
<td>NUMBER OF COMMON SHARES O/S</td>
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<tr>
<td>22.</td>
<td>COMMON STOCK EQUIVALENTS</td>
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<tr>
<td>23.</td>
<td>DIVIDEND PER SHARE DECLARED</td>
</tr>
<tr>
<td>24.</td>
<td>MARKET PRICE PER SHARE</td>
</tr>
<tr>
<td>25.</td>
<td>35 35 pM</td>
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</tbody>
</table>

'NO. ACCOUNT':(4xN+1)P', 'AMOUNT', '35A1,X2,10F8.2' ΔFMT(MM;MAT[124;])
\[ V \text{ LIQ} \{\} \] \[ V \text{ R1+LIQ MAT;A40;A50;A60;A70} \]

1

[2] \[((8+10*YRS)*2)\text{p' '}); 'LIQUIDITY RATIOS', (16\text{pBS})_{16\text{p' '}}' \]

3

[4] \text{ 'YEAR } X_{16,10I10'} \text{ AFMT(Y) } \]

5

[6] \text{ 'QUICK RATIO(S),X11,10F10.2' AFMT(1,N)_{pA40+\left(+\text{MAT[12;]}\right)^{\text{MAT[10;]}}} \]

7

[8] \text{ 'CURRENT RATIO(S),X9,10F10.2' AFMT(1,N)_{pA50+\left(+\text{MAT[15;]}\right)^{\text{MAT[10;]}}} \]

9

[10] \text{ 'CASH TO TOTAL ASSETS, X5,10F10.2' AFMT(1,N)_{pA60+\text{MAT[1;]^{\text{MAT[10;]}}} \]

11

[13] \text{ STP1: 'CURRENT RATIO, QUICK RATIO, CASH TO TOTAL ASSETS, CASH TO SALES' \]

14

[16] \text{ STP2: 'TYPE THE UNDERLINED LETTERS FOR THE PLOT' \]

17

[19] \text{ S1: 30 40 PLOT A50 VS YRS \]

20

[22] \text{ S3: 30 40 PLOT A60 VS YRS \]

23

[26] \text{ S4: 30 40 PLOT A70 VS YRS \]

27

[29] \text{ MOREPLOT; ' \]

30

[32] \text{ PP: +(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP2 \]

33
\[ \text{VPROF[]} \]
\[ \text{V} R2\text{+PROF MAT;} A80; A90; A100; A110; A120 \]

[1]''

[2]\[((4+10\times \text{YRS})+2)\]'';'PROFITABILITY RATIOS', (20pBS), 20p'_'

[3]''

[4]'\text{YEAR} [x57, 10, 10]' \text{\textasciicircum 2FMT}(y)

[5]''

[6]'\text{EARNING PER SHARE}[x8, 10, 10.2]' \text{\textasciicircum 2FMT}(1, N)pA90+\#MAT[1 2;]

[7]'\text{PRO-FORMA E.P.S.}[x9, 10, 10.2]' \text{\textasciicircum 2FMT}(1, N)pA80+\#MAT[1 2;]

[8]'\text{PRICE-EARNING RATIO}[x5, 10, 10.2]' \text{\textasciicircum 2FMT}(1, N)pA100+\#MAT[5 2;] \text{\#MAT}[1 1;

[9]'\text{YIELD}[x20, 10, 10.2]' \text{\textasciicircum 2FMT}(1, N)pA110+\#MAT[4 5 ;]

[10]'\text{BOOK VALUE PER SHARE}[x5, 10, 10.2]' \text{\textasciicircum 2FMT}(1, N)pA120+\#MAT[1 2;]

[11]''

[12]\text{PP:}\rightarrow\text{(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1}

[13]''

[14]\text{STP1: 'EPS, PE RATIO, YIELD, PRO-FORMA E.P.S. OR BOOK VALUE/SH.'}

[15]\text{STP2: 'TYPE THE UNDERLINED LETTERS FOR THE PLOT'}

[16]\rightarrow\text{('EPYFB'=1\#)/S1, S2, S3, S4, S5}

[17]''

[18]\text{S1: 30 40 PLOT A90 VS YRS}

[19]''

[20]\text{S2: 30 40 PLOT A100 VS YRS}

[21]''

[22]\text{S3: 30 40 PLOT A110 VS YRS}

[23]''

[24]\text{S4: 30 40 PLOT A80 VS YRS}

[25]''

[26]\text{S5: 30 40 PLOT A120 VS YRS}

[27]\text{MOREPLOT: '}

[28]\text{PD:}\rightarrow\text{(AYN 'DO YOU WANT ANY OTHER PLOT?')/STP2}
VEARN[]

\[ V R3+EARN\ MAT;A130;A140;A150 \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ \text{EARNING POWER RATIOS',}(20pBS),20p'_' \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{YEAR}\ X18,10I10' \Delta FMT(Y) \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{EARNING POWER}',X12,10F10.2' \Delta FMT(1,N)pA130+;#MAT[1 4 ;] \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{GROSS EARNING POWER}',X6,10F10.2' \Delta FMT(1,N)pA140+;#MAT[2 4 ;] \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{NET EARNING POWER}',X8,10F10.2' \Delta FMT(1,N)pA150+;#MAT[3 4 ;] \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{GROSS EARNING POWER',X21,10I10' \Delta FMT(Y) \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{CREDIT MGMT. RATIOS',}(19pBS),19p'_' \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{YEAR}',X21,10I10' \Delta FMT(Y) \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{DO YOU WANT A PLOT OF ANY OF THESE?')/STP1 \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{TYPE THE UNDERLINED LETTERS FOR THE PLOT'} \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{DO YOU WANT ANY OTHER PLOT?')/STP2 \]

[1] ' ' 
[2] ' ' 
[3] ' ' 
[4] ' ' 

\[ ' \text{CREDIT MAT;A10;A20;A30} \]
9-60

[5] ' 

[6] 'COLLECTION PERIOD',X8,10F10.2' ΔFMT(1,N)pA20+((+#MAT[2 3 ;])xAVDAYS)+MAT[1;]

[7] 'RECEIVABLES TO SALES',X5,10F10.2' ΔFMT(1,N)pA30+((+#MAT[2 3 ;])+2xMAT[1;]

[8] 'AVERAGE SALES PER DAY',X4,10F10.2' ΔFMT(1,N)pA10+MAT[1;]+AVDAYS

[9] ' 

[10] PP:+(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')/STP1


[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+x2X1

[28] ASD+1 INC 'WHAT IS THE AVERAGE SALES PER DAY FOR THE SECOND YEAR?'

[29] INTEREST+0.01x1 INC 'WHAT IS THE INTEREST RATE?'

[30] IR1+INTERESTxAVDAYS

[31] FN+(ASD×((1+IR1)×X3)-1)+IR1

[32] FN1+ASD×X3

[33] 'THE COST(SAVINGS) OF EXTENDING(REDUCING) THE CREDIT BY ';X1;' DAYS'

[34] 'IS $';2 RND(FN-FN1)

[35] ' 

[36] PC:+(AYN 'DO YOU WANT TRY AGAIN?')/CHI
9-61

```
VINV[]V

V R4+INV MAT;A170;A180;A190

[1]

[2] (((8+10xPYS)+2)p ') INVENTORY MGMT. RATIOS', (22pBS),
22p'-

[3] ' -

[4] 'YEAR', X26,10I10' $FMT(Y)

[5] ' -

[6] 'INVENTORY TURNOVER', X12,10F10.2' $FMT(1,N)pA170+MAT[
3]+A+(+MAT[12]);]2

[7] 'INVENTORY HOLDING PERIOD', X6,10F10.2' $FMT(1,N)pA190+AVDAYSxA
+MAT[3];

[8] 'INVENTORY TO TOTAL ASSETS', X5,10F10.2' $FMT(1,N)pA190+A+MAT[
4];

[9] 'AVERAGE INVENTORY', X13,10F10.2' $FMT(1,N)pA

[10] ' -

[11] PC: (~(AYN 'DO YOU WANT A PLOT OF ANY OF THESE?'))/CHI
[12] STP1: 'INVENTORY TURNOVER, HOLDING PERIOD, TO TOTAL ASSETS'

[14] ->('THA'=1+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?'))/O
[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+0.01x1 INC 'EXPRESSED AS A PERCENTAGE OF C.G.S."

[28] IR1+INT+AVDAYS
[29] FN1=(FN+((A1Nx((1+IR1)*)-((-AHP))x(AVADAYS+((/+AHP))
2)))x)-AIN+1 INC 'AVERAGE INVENTORY FOR THE SEOND PERIOD.'
[30] DX+I(AHP[1]-AHP[2])
[31] ' -

THE SAVINGS(COST OF) IN REDUCING(EXTENDING) THE'

[32] 'HOLDING PERIOD BY ',D;S' DAYS IS $';2 RND FN1

[33] ' -

[34] ~(AYN 'DO YOU WANT TO TRY AGAIN?'))/CHA
```
\[ V \text{DEBT}[\text{[]}] V \]

\[ V R5 + \text{DEBT MAT;A200;A210} \]

[1] '

[2] \((12 + 10 \times \text{YRS}) + 2\)' \text{DEBT MGMT. RATIOS', (17pBS), 17p'_'}

[3] '

[4] 'YEAR [X22,1010] \text{DFMT}(Y)'

[5] '

[6] 'DEBT TO EQUITY',X15,10F10.2' \text{DFMT}(1,N)pA20+(+#MAT[1]

[7] 'LONG TERM DEBT TO EQUITY',X5,10F10.2' \text{DFMT}(1,N)pA210+:#MAT[

[8] '

[9] PC:+(\text{AYN 'DO YOU WANT A PLOT OF ANY OF THESE?')))/0

[10] STP1:'DEBT TO EQUITY OR LTD TO EQUITY'


[12] +('DL'=1+)\text{/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:+(\text{AYN 'DO YOU WANT ANY OTHER PLOT?')/STP1

\[ V \]
\texttt{\textbackslash{}VNORM[\text{}]}\texttt{\textbackslash{}V}

\begin{verbatim}
  NORM
  [1] 'DO YOU WANT THE \textit{INCOME STATEMENT} OR \textit{BALANCE SHEET}?'
  [3] -> ('I' =+I)/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[14,16 ;]
  [7] ->QN

  \texttt{\textbackslash{}VNORM1[\text{}]}\texttt{\textbackslash{}V}

  R7=+NORM1 MAT;TA
  [1] T+100+TA++#MAT[\text{}17 ;]
  [2] ';
  [3] (((14+10N)+2)p' ');'BALANCE SHEET',(13pBS),13p'_'
  [4] (27+10N)p'*'
  [5] 'YEAR',X23,10101' APMT Y
  [6] (27+10N)p'-'
  [7] 'ASSETS',(6pBS),'________'
  [8] 'CASH AND EQUIVALENTS',X7,10F10.1' APMT(1,N)pMAT[1;]xT
  [9] 'RECEIVABLES',X16,10F10.1' APMT(1,N)pMAT[2;]xT
  [10] 'INVENTORIES',X16,10F10.1' APMT(1,N)pMAT[3;]xT
  [12] 'CURRENT ASSETS',X13,10F10.1' APMT(1,N)pT'x#MAT[\text{}13 ;]
  [13] (27+10N)p'-'
  [14] 'INVESTMENTS',X16,10F10.1' APMT(1,N)pMAT[4;]xT
  [15] 'DEFERRED CHARGES',X11,10F10.1' APMT(1,N)pMAT[5;]xT
  [16] 'LAND, BUILDINGS, ETC.(NET)',X1010.1' APMT(1,N)pMAT[6 ;]xT
  [17] 'INTANGIBLES',X16,10F10.1' APMT(1,N)pMAT[7;]xT
  [18] (27+10N)p'-'
  [19] 'TOTAL',X22,10F10.1' APMT(1,N)p100
  [20] (27+10N)p'_'
  [21] 'EQUITIES',(8pBS),'________'
  [22] 'CURRENT LIABILITIES',X8,10F10.1' APMT(1,N)pMAT[8;]xT
  [23] 'LONG-TERM DEBT',X13,10F10.1' APMT(1,N)pMAT[9;]xT
  [24] (27+10N)p'-'
  [25] 'TOTAL DEBT',X17,10F10.1' APMT(1,N)pT x+#MAT[8 9 ;]
  [26] (27+10N)p'-'
  [27] 'OWNERS'' EQUITY',X13,10F10.1' APMT(1,N)p100 Tx+#MAT[8 9 ;]
  [28] (27+10N)p'**'
\end{verbatim}
\`V NORM2\[\[\]V
\`v R6+NORM2 MAT;CSL;DEPR;NOPI;OTHER;INCTAX
\[1\]	'
\[2\] ((6+10xN)*2)p' '); 'INCOME STATEMENT'
\[3\] '
\[4\] (22+10xN)p' '*'
\[5\] 'YEAR \[y\],X15,10I10' AFMT(Y)
\[6\] (22+10xN)p' '-'
\[7\] 'SALES\[s\],X17,10F10.1' AFMT(1,N)p100
\[8\] 'COST OF SALES\[c\],X9,10F10.1' AFMT(1,N)pCSL+100\*#MAT[2 1 ;]
\[9\] (22+10xN)p' '-'
\[10\] 'GROSS PROFIT\[g\],X10,10F10.1' AFMT(1,N)p100-CSL
\[11\] (22+10xN)p' '-'
\[12\] 'SELLING AND ADMN.\[s\],X5,10F10.1' AFMT(1,N)pGAS+100\*#MAT[3 1 ;]
\[13\] 'DEPRECIATION\[d\],X10,10F10.1' AFMT(1,N)pDEPR+100\*#MAT[4 1 ;]
\[14\] (22+10xN)p' '-'
\[15\] 'OPERATING EXP.\[e\],X8,10F10.1' AFMT(1,N)pGAS+DEPR
\[16\] (22+10xN)p' '-'
\[17\] 'NET OPER. INCOME\[i\],X6,10F10.1' AFMT(1,N)pNOPI+(100-CSL)-(GAS+DEPR)
\[18\] (22+10xN)p' '-'
\[19\] 'OTHER ITEMS\[o\],X11,10F10.1' AFMT(1,N)pOTHER+100\*#MAT[5 1 ;]
\[20\] 'INCOME TAX\[t\],X12,10F10.1' AFMT(1,N)pINCTAX+100\*#MAT[6 1 ;]
\[21\] (22+10xN)p' '-'
\[22\] 'NET INCOME\[n\],X12,10F10.1' AFMT(1,N)pOTHER+INCTAX
\[23\] (22+10xN)p' '*'
\[24\] ','
\v
\( \text{VNORM[0]} \)

\( \text{V NORM} \)

[1] 'DO YOU WANT THE INCOME STATEMENT OR BALANCE SHEET?'


[3] \( \rightarrow (\text{I} \to =1+\text{T})/\text{NOX}. \text{REPEAT} \)

[4] \( \text{NOSHEET} \)

[5] \( \text{QN}: \rightarrow (\text{AYN ‘DO YOU WANT THE OTHER STATEMENT?’}))/\text{REPEAT} \)

[6] \( \rightarrow 0 \)

[7] \( \text{NOX: NOSTMT} \)

[8] \( \rightarrow \text{QN} \)

\( \text{J. BETA} \)

\( \text{V BETA[0]} \)

\( \text{V BETA} \)

[1] \( \text{BETAFACTOR} \)

[2] \( \text{PRE}: \rightarrow (\sim (\text{AYN ‘DO YOU WANT THE FORMULA METHOD?’}))/0 \)

[3] \( \text{BETAFORMULA} \)

\( \text{V STAN[0]} \)

\( \text{V STAN} \)

[1] \( \text{RATIO: ‘PLEASE TYPE THE RATIO YOU WISH TO EXAMINE. (CURRENT ETC..)} \)

[2] \( \text{RX}+\text{M} \)

[3] \( \text{R}+‘\text{PLEASE ENTER ‘;} \text{RX}; \text{‘ RATIOS AS A VECTOR.’} \)

[4] \( \text{R}+\text{O} \)

[5] \( \text{N}+1 \text{ INC ‘PLEASE TYPE THE NUMBER OF UNITS FOR THE MOVING AVERAGE .} \)

[6] \( \text{MVAV}1+\text{R} \text{ ENA}(\text{N}, \text{pR}) \)

[7] \( \text{MVAV}+(1, \text{pMVAV}1) \odot \text{MVAV}1 \)

[8] \( \text{RS}+\text{R} \odot \text{AR} \)

[9] \( \text{RMEAN}+(\text{+/R}) \odot (\text{R}+\text{pR}) \)

[10] \( \rightarrow ((\text{2} \odot \text{R}1)=1)/\text{ODD}1 \)

[11] \( \text{EVEN}1: \text{RMEDIAN}+0.5 \odot /\text{RS}[(0.5 \odot 0 \odot 1+\text{R}1] \)

[12] \( \text{R}1+\text{RS}[(\text{R}1+2)], \text{RMEDIAN}, \text{RMEDIAN}, \text{RS}[(\text{R}1+2):\odot (\text{R}1+2)] \)

[13] \( \text{R}3+(\text{pR}2)+2 \)

[14] \( \rightarrow ((\text{2} \odot \text{R}3)=1)/\text{ODD}2 \)

[15] \( \text{EVEN}2: \text{IUP}+(\text{R}2[\text{R}3:2]+\text{R}2[(\text{R}3:2)+1]) \odot 2 \)
IDN+(R2[(R3+(R3±2)))+R2[(R3+1+(R3±2))]+2
IQA+(IUP+IDN)*2
→OUT
ODD1:RMEAN*0.5x/RS[(0.5x 0 1 +R1]
R2+RS[(R1-1)*2],RMEAN,RMEAN,RS[(R1+1)*2]+((R1-1)*2)]
R3+(ρR2)+2
→EVEN2
ODD2:IUP+R2[(R3-1)*2]*1
IDN+R2[(R3+1+((R3-1)*2)]
IQA+(IUP+IDN)*2
OUT:

...-MEAN IS X23,F10.3' ΔFMT(RMEAN)
...-MEDIAN IS X21,F10.3' ΔFMT(RMEDIAN)
...-INTERQUARTILE AVERAGE IS X6,F10.3' ΔFMT(IQA)
...-MOVING AVERAGE IS X13,20F10.3' ΔFMT(MVAV)

BETAFORMULA[[]]

BETAFORMULA

attachment:RATIOS.READ.ME

'HELP TYPE HELP. OTHERWISE HIT THE CARRIAGE RETURN.'

RTN+4pINP 4

OUTPUT:'αFACTOR IS X14,F10.2' ΔFMT(AF)

'EXPECTED RTN. ON STK. IS X5,F10.2' ΔFMT(ERJ)
\( \text{RETURN ON MARKET} \)
\( \text{STOCK PRICE HIGH} \)
\( \text{STOCK PRICE LOW} \)
\( \text{DIV. PER SHARE} \)

\( \text{INSTR:} '1. \text{THE NUMBER OF PERIODS SHOULD ALWAYS BE MORE THAN 5.'} \)
\( '2. \text{THE RETURN ON MARKET, STOCK-PRICE HIGH, STOCK-PRICE'} \)
\( '\text{LOW AND THE DIVIDENDS PER SHARE CAN BE FOUND IN THE'} \)
\( '\text{STANDARD AND POOR'S ANALYSTS HANDBOOK.'} \)
\( '\text{TO AVOID ERRORS IT IS ADVISABLE THAT THE DIVIDEND PER'} \)
\( '\text{SHARE BE ENTERED AS A DECIMAL. E.G., 2.000001 INSTEAD OF 2} \)

\( \text{START: 'PERIODS (E.G., 69 70 ETC., OR 1 2 3 ETC.,) ?'} \)
\( \text{STOP: 'PLEASE TYPE 1. THE RETURN ON MARKET FOR THE YEARS'} \)
\( '\text{THRU '}, N[2]) \)
\( '\text{INC '}, (N[1] - 1) \)
\( '\text{INC '}, (1, N[1]) \)
\( '\text{INC '}, (3, N[1]) \)
\( '\text{INC '}, (4, N[1]) \)
\( '\text{INC '}, (5, N[1]) \)

\( \text{RETURN} \)
[35] CHG: + (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: 'M/YEAR', X16, 10I13' \Delta FMT(NN+(1, N1)pN)
[41] '19A1, X4, 10F10.3' \Delta FMT(M1; MAT)
[42] 1pQR
[43] + (AYN 'DO YOU WISH TO CHANGE ANY DATA?')/CHG
[44] + CMPT

\[ V \]

\[ V \] RETURN[\[]\[V \]

\[ V \] RETURN X; P; R
[1] P\rightarrow (X[1; 1]+X[; 2])\times 2
[4] \text{CALC } N

\[ V \]

\[ V \] CALC[\[]\[V \]

\[ V \] CALC N; R; D
[1] R\rightarrow RM SR RJ[1+(pRJ)-1]
[2] D\rightarrow (1\cdot RJ) SR DPS
[3] ARJ\rightarrow R[3; 1], R[4; 1], R[5; 1], DJ[3; 1], DJ[4; 1], RJ[pRJ]
\[ \nabla SR[\{} \\nabla T \times SR \ Y ; MX ; SX ; MY ; SY ; B1 ; B0 ; RSQ ; TV ; SE ; A ; B \[1] \ SX += ((A++(X-MX+(+/X)\div N)\ast 2)\div (N+(pX))-1)\ast 0.5 \[2] \ SY += ((B++(Y-MY+(+/Y)\div N)\ast 2)\div (N-1)\ast 0.5 \[3] \ B0 + MY-MX*B1 + (+/(X-MX)\times(Y-MY)) + A \[4] \ SE +=((B\times 1-RSQ+(R+B1\times SX\times SY)\ast 2)\div N-2)\ast 0.5 \[5] \ TV + B1*SB1+(SY\times SX)\times((N-2)\ast(1-RSQ))\ast 0.5 \[6] \ T + (5 3)\rho MX, SX, 0, MY, SY, 0, B0, 0 0, B1, SB1, TV, SE, R, RSQ \nabla \\nabla EMA[\{} \nabla R + IN, EMA, IZ \[1] \ K1 + IZ[1] - 1 \[2] \ INT +=((K1)\rho IN[1]), IN, (K1+1)\rho IN[1] \[3] \ N - 0 \[4] \ INT2 + 1 0 \[5] \ T1 : INT2 + INT2, (+/INT[N+1IZ[1]]) + K1 + 1 \[6] \ + ((\rho IN)\ast N+1) / T1 \[7] \ R + K1 + INT2 \nabla \]
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

A. PRICEINDEX
B. INDEX
C. PUR
D. PVI
E. MVI
F. ADJUST
### Exhibit 10-2
PRICEINDEX FUNCTIONS & VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDEX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PUR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVI</td>
<td>YLD</td>
<td></td>
</tr>
<tr>
<td>ADJUST</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. INDEX**

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

- **Laspeyres**
  \[
  \text{Laspeyres} = \frac{\sum (p_nq_o)}{\sum (p_{oq_o})}
  \]

- **Paasche**
  \[
  \text{Paasche} = \frac{\sum (p_nq_n)}{\sum (p_{oq_n})}
  \]

- **Fisher**
  \[
  \text{Fisher} = \sqrt{\frac{\sum (p_nq_o)}{\sum (p_{oq_o})} \times \frac{\sum (p_nq_n)}{\sum (p_{oq_n})}}
  \]

- **Fixed-Weight**
  \[
  \text{Fixed-Weight} = \frac{\sum (p_nq_a)}{\sum (p_{oq_a})}
  \]

**where:**

- \(p\) = the price of a commodity or service
- \(q\) = the quantity of that commodity or service.
- \(p_{oq_o}\) = the price or quantity of a commodity or service in the base period.
- \(p_nq_n\) = the price or quantity of a commodity or service in a period other than the base period.
- \(p_aq_a\) = the price or quantity of a commodity or service in some arbitrary period.
- \(\Sigma\) = 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.

<table>
<thead>
<tr>
<th></th>
<th>1960 (Base)</th>
<th></th>
<th>1970</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Quantity</td>
<td>Price/(lb)</td>
</tr>
<tr>
<td></td>
<td>($q_a$)</td>
<td>($q_o$)</td>
<td>($p_o$)</td>
</tr>
<tr>
<td>Meat----------</td>
<td>40</td>
<td>100</td>
<td>$1.00</td>
</tr>
<tr>
<td>Potatoes------</td>
<td>160</td>
<td>200</td>
<td>$.06</td>
</tr>
</tbody>
</table>

**FORMULA**

- **Laspeyres**
  \[
  \frac{(M \times 1.50 \times 100) + (P \times .12 \times 200)}{(M \times 1.00 \times 100) + (P \times .06 \times 200)} \times 100 = 155.4
  \]

- **Paasche**
  \[
  \frac{(M \times 1.50 \times 100) + (P \times .12 \times 300)}{(M \times 1.00 \times 200) + (P \times .06 \times 300)} \times 100 = 154.1
  \]

- **Fisher**
  \[
  \sqrt{\frac{174}{112} \times \frac{336}{218}} = 1.5474 \times 100 = 154.7
  \]

- **Fixed-Weight**
  \[
  \frac{(M \times 1.50 \times 40) + (P \times .12 \times 160)}{(M \times 1.00 \times 40) + (P \times .06 \times 160)} \times 100 = 159.7
  \]

**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.

<table>
<thead>
<tr>
<th>Periods:</th>
<th>1940</th>
<th>1950</th>
<th>1960</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indices:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price:</td>
<td>34.70</td>
<td>90</td>
<td>233.44</td>
</tr>
<tr>
<td>Money:</td>
<td>259.37</td>
<td>100</td>
<td>38.55</td>
</tr>
</tbody>
</table>

Rate of Depreciation $\rightarrow 10\% \rightarrow 10\% \rightarrow$

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

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted</th>
<th>Multiplier</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$500,000</td>
<td>110/108</td>
<td>$509,260</td>
</tr>
<tr>
<td>Cost of goods sold:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beginning inventory</td>
<td>100,000</td>
<td>110/100</td>
<td>110,000</td>
</tr>
<tr>
<td>Purchases</td>
<td>300,000</td>
<td>110/108</td>
<td>305,560</td>
</tr>
<tr>
<td>Available</td>
<td>400,000</td>
<td>110/108</td>
<td></td>
</tr>
<tr>
<td>Ending inventory</td>
<td>150,000</td>
<td>110/108</td>
<td>152,780</td>
</tr>
<tr>
<td>Cost of goods sold</td>
<td>250,000</td>
<td></td>
<td>262,780</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross profit</td>
<td>250,000</td>
<td></td>
<td>246,480</td>
</tr>
<tr>
<td>Expenses:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selling</td>
<td>120,000</td>
<td>110/108</td>
<td>122,220</td>
</tr>
<tr>
<td>Administrative</td>
<td>95,000</td>
<td>110/108</td>
<td>96,760</td>
</tr>
<tr>
<td>Depreciation</td>
<td>5,000</td>
<td>110/100</td>
<td>5,500</td>
</tr>
<tr>
<td></td>
<td>220,000</td>
<td></td>
<td>224,480</td>
</tr>
<tr>
<td>Net income before tax</td>
<td>$ 30,000</td>
<td></td>
<td>$ 22,000</td>
</tr>
<tr>
<td>Income tax</td>
<td>15,000</td>
<td></td>
<td>15,000</td>
</tr>
<tr>
<td>Net income after tax</td>
<td>$ 15,000</td>
<td></td>
<td>$ 7,000</td>
</tr>
</tbody>
</table>
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
10-8

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
□: 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
ENTER DEPRECIATION RATE (AS A PERCENT) BETWEEN EACH PERIOD
IF IT REMAINS CONSTANT, ENTER SINGLE PERCENT
□: 10 9 7 6 8

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 1936 1950 1973

**ENTER DEPRECIATION RATE (AS A PERCENT) BETWEEN EACH PERIOD**
- If it remains constant, enter single percent

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>1920</th>
<th>1930</th>
<th>1932</th>
<th>1936</th>
<th>1950</th>
<th>1973</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRICE INDEX</td>
<td>101.10</td>
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<td>75.52</td>
<td>85.00</td>
<td>147.19</td>
<td>562.24</td>
</tr>
<tr>
<td>MONEY INDEX</td>
<td>37.83</td>
<td>56.91</td>
<td>50.65</td>
<td>45.00</td>
<td>25.99</td>
<td>6.80</td>
</tr>
</tbody>
</table>
D. PVI

**PVI**
Enter first year (e.g. 1959)  
\[ \text{1950} \]
Enter final year (e.g. 1969)  
\[ \text{1965} \]
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)  
\[ \text{1950} \]
Enter final year (e.g. 1969)  
\[ \text{1965} \]
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
口: 130
ENTER DENOMINATOR INDEX
口: 79.1
CONVERSION FACTOR IS 1.643489254
ENTER DATA FOR ADJUSTMENT (ZERO WILL TERMINATE)
□: 24897 34806 42312
40917.95 57203.29 69539.32
口: 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
口: 0
NEW DENOMINATOR INDEX? (YES OR NO)
NO
B. INDEX

\[ \text{INDEX[\_]} \]
\[ \text{INDEX;} QO; PO; QN; PN; IX; I; QA \]
[1] BA: 'ENTER QUANTITIES FOR BASE PERIOD'
[2] QO+, \[\]
[3] PO+, (\(pQO\)) INC 'ENTER CORRESPONDING PRICES FOR BASE PERIOD'
[4] CU: 'ENTER QUANTITIES FOR CURRENT PERIOD'
[5] QN+, \[\]
[6] PN+, (\(pQN\)) INC 'ENTER CORRESPONDING PRICES FOR CURRENT PERIOD'
[7] N1: =((\(pQO\))=\(pQN\))/N2
[8] 'INCORRECT NUMBER OF ENTRIES FOR CURRENT PERIOD'
[9] \rightarrow\  CU
[10] N2: 'ENTER CHOICE OF FORMULA: 'LASPEYRES'', 'PAASCHE'', 'FISHER''.

[11] (30p', ') 'OR 'FIXED-WEIGHT'.', CH
[12] IX+5pP
[13] \rightarrow(IX='LQXHC')/AA,N2,DD,CC,BB
[14] \rightarrow N2
[15] AA:I+((+/PN\times QO)/+/PO\times QO
[16] \rightarrow\  OUT
[17] BB:I+((+/PN\times QN)/+/PO\times QN
[18] \rightarrow\  OUT
[19] CC:I+((+/PN\times QO)/+/PN\times QN)*+/PO\times QO)*+/PO\times QN)*
0.5
[20] \rightarrow\  OUT
[21] DD:QA+, (\(pQO\)) INC 'ENTER QUANTITIES FOR FIXED PERIOD'
[22] N3: I+((+/PN\times QA)/+/PO\times QA
[23] OUT: 'INDEX FOR CURRENT YEAR (BASE=100) IS '; 1 RND 100xI
[24] Q: 'ANOTHER FORMULA? (YES OR NO)'
[25] IX+1pP
[26] \rightarrow((Y'=IX), ('N'=IX), 1)/N2, 0, Q
C. PUR

\[ \text{PUR][]} \]
\[ \text{PUR;P;PM;Y;DR;I;L;M;PI;MI;D;REP;A} \]
\[ [1] \text{P}+1tIPI \ 'ENTER PIVOTAL PERIOD (E.G. 1950)' ,REP+CR. '[]: ,LE. 3p' \]
\[ [2] \ 'ENTER PRICE INDEX FOLLOWED BY MONEY INDEX FOR ' ;P \]
\[ [3] \text{PM}+\text{INP} 2 \]
\[ [4] \text{E:} \ 'ENTER YEARS INDEX INFORMATION IS DESIRED - EXCLUDING ' ;P \]
\[ [5] \text{+E} \times 1+I+/P=Y,10 \times D+B \times Y+Y[AY+P, IPI RE]\]
\[ [6] \ 'ENTER DEPRECIATION RATE (AS A PERCENT) BETWEEN EACH PERIOD' \]
\[ [7] \ 'IF IT REMAINS CONSTANT, ENTER SINGLE PERCENT' \]
\[ [8] \ (8p'; ') ;Y \]
\[ [9] \text{DR}+1+(L0INP(1,L-1)) \times 100 \]
\[ [10] \text{M}+L0I+1 \]
\[ [11] \text{RE:} \text{M}[I+1]+\text{M}[I] \times \text{DR}[I] \times \text{Y}[I+1]-\text{Y}[I] \]
\[ [12] \text{I}+I+1 \]
\[ [13] \rightarrow (I<\text{L}) \text{/ RE} \]
\[ [14] \text{M}+M[\text{Y}, \text{P}] \]
\[ [15] \text{PI}+M \times \text{PM}[1] \]
\[ [16] \text{MI}+\text{PM}[2] \times \text{M} \]
\[ [17] \text{A} \times 'I8, 2F8.2' \text{ AFMT(}Y; \text{PI;} \text{MI}) \]
\[ [18] \text{Y} \times 6 8 + A \]
\[ [19] \text{PI}+ 6 8 \times 0 8 + A \]
\[ [20] \text{MI}+ 0 16 + A \]
\[ [21] 2pCR \]
\[ [22] \ 'PERIOD' ;DpY \]
\[ [23] \ 'PRICE INDEX' ;DpPI \]
\[ [24] \ 'MONEY INDEX' ;DpMI \]
\]

D. PVI

\[ \text{PVI][]} \]
\[ \text{PVI;Y1;V1;Y2;V2;R;F;P;REP} \]
\[ [1] \text{Y1}+1tIPI \ 'ENTER FIRST YEAR (E.G. 1959)' ,REP+CR. '[]: ,LE. 3p' \]
\[ [2] \text{Y2}+1tIPI \ 'ENTER FINAL YEAR (E.G. 1969)' ,REP \]
\[ [3] \ 'ENTER INDEX OF MONEY VALUE FOR ' ;Y1 \]
\[ [4] \text{V1}+\text{INP} 1 \]
\[ [5] \ 'ENTER INDEX OF MONEY VALUE FOR ' ;Y2 \]
\[ [6] \text{V2}+\text{INP} 1 \]
\[ [7] \ 'ENTER PRICE INDEX FOR ' ;Y1;' (E.G. 100)' \]
\[ [8] \text{P}+\text{INP} 1 \]
\[ [9] \text{R}+1-(\text{V2}+\text{V1}) \times 1+:\text{Y2}-\text{Y1} \]
\[ [10] \text{F}+(\text{P}+\text{R}) \times ((1+\text{R}) \times \text{Y2}-\text{Y1})-1 \]
\[ [11] \ 'THE ANNUAL DEPRECIATION RATE FROM ' ;Y1;' TO ' ;Y2;' IS ' ;2 RND 100 \times ' PERCENT' \]
\[ [12] \ 'THE PRICE INDEX FOR ' ;Y2;' IS ' ;1 RND F \]
E. MVI

\[ \text{MVI}[\square] \\]
\[ \text{MVI}; \text{Y1}; \text{Y2}; \text{P1}; \text{P2}; \text{R}; \text{V1}; \text{V2}; \text{REP}; \text{H} \]
[1] \( \text{Y1}+1+\text{IP} \) 'ENTER FIRST YEAR (E.G. 1959)', \text{REP+CR}, '0', 'LE', '3p' '
[2] \( \text{Y2}+1+\text{IP} \) 'ENTER FINAL YEAR (E.G. 1969)', \text{REP}
[3] 'ENTER PRICE INDEX FOR '; \text{Y1}
[4] \( \text{P1}+\text{INP} \)
[5] 'ENTER PRICE INDEX FOR '; \text{Y2}
[6] \( \text{P2}+\text{INP} \)
[7] 'ENTER MONEY VALUE INDEX FOR '; \text{Y1}
[8] \( \text{V1}+\square \)
[9] \( \text{R}+\text{N} \cdot \text{YLD}(2, \text{N}+1) \cdot \text{P} \cdot (\text{N}+1) \cdot \text{P} \cdot 1 \cdot \text{P} \cdot 1 \)
[10] \( \text{V2}+\text{V1} \times (1-\text{R}) \times \text{Y2} \times \text{Y1} \)
[11] 'THE MONEY VALUE INDEX FOR '; \text{Y2} ' IS '; \text{RND V2}
[12] 'THE ANNUAL RATE OF DEPRECIATION IS '; \text{RND R} \times 100; ' PERCENT'

\[ \text{F. ADJUST} \]

\[ \text{ADJUST}[\square] \\]
\[ \text{ADJUST}; \text{N}; \text{C}; \text{E} \]
[1] \( \text{N}+1 \text{ INC} \) 'ENTER NUMERATOR INDEX'
[2] \( \text{N}+1 \text{ INC} \) 'ENTER DENOMINATOR INDEX'
[3] 'CONVERSION FACTOR IS '; \text{C}
[4] 'ENTER DATA FOR ADJUSTMENT (ZERO WILL TERMINATE)'
[5] \( \text{A}+\square \)
[6] \( \text{R}+\text{E}+\text{C} \)
[7] \( \text{R}+\text{E}+\text{C} \)
[8] \( \text{R}+\text{E}+\text{C} \)
[9] \( \text{NDQ} \) 'NEW DENOMINATOR INDEX? (YES OR NO)'
[10] \( \text{Y}+\square \)

\[ \text{YLD}[\square] \\]
\[ \text{Y}+\text{A} \text{ YLD X}; \text{R}; \text{D} \]
[1] \( \text{R}+(\text{S}+\text{X})+\text{A} \)
[2] \( \text{R}+(\text{S}+\text{X})+\text{R}+\text{D} \times (2+A+1) \times \text{P} \times (\text{A}+1)-1 \)
[3] \( \text{R}+\text{R}+\text{D}+\text{A} \)
[4] \( \text{R} \times 1 \times (\text{D}-1) \times 1 \times 5 \times 10^{-5} \)
[5] \( \text{Y}+\text{R} \)
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

A. CAPBUDGET
B. BUDGET1
C. BUDGET2
D. UTILITY

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

Exhibit 11-2
CAPBUDGET FUNCTIONS & VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUDGET1</td>
<td>DPR, YLD</td>
<td>-</td>
</tr>
<tr>
<td>BUDGET2</td>
<td>DPR, YLD</td>
<td>-</td>
</tr>
<tr>
<td>UTILITY</td>
<td>INTP</td>
<td>-</td>
</tr>
</tbody>
</table>
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:

<table>
<thead>
<tr>
<th>Investment</th>
<th>Expected Life</th>
<th>Initial Cost</th>
<th>CAT Benefits</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>$10,000</td>
<td>$3,000</td>
<td>6%</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>$15,000</td>
<td>$4,000</td>
<td>8%</td>
</tr>
</tbody>
</table>

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

\[
PVC(1) = \frac{3,000}{1 - (1.06)^{-30}} = \frac{3,000}{0.06} (13.7648) = 41,294
\]

\[
PVC(2) = \frac{4,000}{1 - (1.08)^{-30}} = \frac{4,000}{0.08} (11.2578) = 45,031
\]

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 the 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 = \( P(A_t) \times A_t = E \)

Utility measure = \( P(A_t) \times U(A_t) = U \)

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. BUDGET

BUDGET

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 - QL, DB, IR, SID, 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

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>EBT</th>
<th>DEPR</th>
<th>EBT</th>
<th>TAX</th>
<th>EAT</th>
<th>DEPR</th>
<th>OPR CAT</th>
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<th>CAT</th>
<th>COST</th>
<th>NET</th>
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<td>700</td>
<td>700</td>
<td>10000</td>
<td>(9300)</td>
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<td>750</td>
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<tr>
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<td>0</td>
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<td>0</td>
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<td>750</td>
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<td>0</td>
<td>0</td>
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<td>750</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>2361</td>
<td>750</td>
</tr>
<tr>
<td>6</td>
<td>2208</td>
<td>(2417)</td>
<td>(725)</td>
<td>(1692)</td>
<td>517</td>
<td>750</td>
<td>(233)</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
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<td>(425)</td>
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<td>14550</td>
<td>14500</td>
<td>50</td>
</tr>
</tbody>
</table>

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. BUDGET 2

**Budget 2**

**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

**Escale Unequal Lives Using Lowest Common Multiple or Perpetuity?**

<table>
<thead>
<tr>
<th>Alternative</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period</strong></td>
<td><strong>Investment</strong></td>
<td><strong>Returns</strong></td>
</tr>
<tr>
<td></td>
<td>10,000</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>15,000</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>3,000</td>
<td>4,000</td>
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<tr>
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</tr>
<tr>
<td>3</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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
樽:  3

NUMBER OF PERIODS (MAXIMUM)
樽:  6

INVESTMENT REQUIRED FOR ALTERNATIVE 1
樽:  10000
LIFE OF INVESTMENT (PERIODS)
樽:  5

RETURNS FOR ALTERNATIVE 1 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
樽:  3000 2000 6000 2000 3000

OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
樽:  6

INVESTMENT REQUIRED FOR ALTERNATIVE 2
樽:  15000
LIFE OF INVESTMENT (PERIODS)
樽:  6

RETURNS FOR ALTERNATIVE 2 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
樽:  2000 6000 4000 8000 2000 3000

OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
樽:  8

INVESTMENT REQUIRED FOR ALTERNATIVE 3
樽:  25000
LIFE OF INVESTMENT (PERIODS)
樽:  6

RETURNS FOR ALTERNATIVE 3 (ENTER SINGLE AMOUNT IF LEVEL ANNUITY)
樽:  6000

OPPORTUNITY COST OF CAPITAL (AS A PERCENT)
樽:  10
UNEQUAL LIVES WILL BE SCALED BY CALCULATING PV OF THE BENEFITS AND PROJECTING PERPETUITIES.

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>INVESTMENT</td>
<td>10,000</td>
<td>15,000</td>
<td>25,000</td>
</tr>
<tr>
<td>RETURNS</td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>3,000</td>
<td>2,000</td>
<td>6,000</td>
</tr>
<tr>
<td>2</td>
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<tr>
<td>6</td>
<td>3,000</td>
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</tr>
<tr>
<td>PERPETUITY</td>
<td>3,198.65</td>
<td>4,175.56</td>
<td>6,000.00</td>
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<tr>
<td>PAYBACK PERIOD</td>
<td>2.83</td>
<td>3.38</td>
<td>4.17</td>
</tr>
<tr>
<td>PRESENT VALUE</td>
<td>53,310.76</td>
<td>52,194.54</td>
<td>60,000.00</td>
</tr>
<tr>
<td>NET PRESENT VALUE</td>
<td>43,310.76</td>
<td>37,194.54</td>
<td>35,000.00</td>
</tr>
<tr>
<td>PROFITABILITY INDEX</td>
<td>5.33</td>
<td>3.48</td>
<td>2.40</td>
</tr>
<tr>
<td>YIELD (PERCENT)</td>
<td>17.88</td>
<td>16.85</td>
<td>11.53</td>
</tr>
</tbody>
</table>
D. UTILITY

UTILITY
ENTER POSSIBLE CASH FLOWS
\[\begin{array}{cccccccccccc}
-400 & -200 & 0 & 75 & 200 & 300 & 500 & 600 & 800 & 1000 & 1600 & 2000 \\
\end{array}\]
ENTER RESPECTIVE UTILITY MEASURES
\[\begin{array}{cccccccccccc}
0 & .4 & .6 & .685 & .75 & .8 & .86 & .88 & .91 & .95 & .98 & 1 \\
\end{array}\]
CASH RETURNS OF POSSIBLE ALTERNATIVES
\[\begin{array}{cccccccccccc}
-400 & 600 & 1600 \\
\end{array}\]
RESPECTIVE PROBABILITIES OF RETURNS
\[\begin{array}{cccccccccccc}
25 & 50 & 25 \\
\end{array}\]
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
\[\begin{array}{cccccccccccc}
-200 & 550 \\
\end{array}\]
RESPECTIVE PROBABILITIES OF RETURNS
\[\begin{array}{cccccccccccc}
50 & 50 \\
\end{array}\]
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

`VBUDGET1[[]]V
V BUDGET1;P;I;E;C;L;DP;TR;CR;R;GP;GS;EBT;CAT;T;CL;CT;GT;GAT;NC;REP;IT;
NP;PV;EAT
[1] P+1;P = 'NUMBER OF PERIODS UNDER CONSIDERATION',REP = CR,'[']';LE
[2] 3p' 'I+1;INC = 'REQUIRED INVESTMENT IN YEAR ZERO'
[3] I+I;P;P = 'REQUIRED INVESTMENT IN SUBSEQUENT YEARS (SINGLE AMOUNT IF LEVEL ANNUITY)'
[4] E+0;P;P = 'EBT FOR EACH YEAR (SINGLE AMOUNT IF LEVEL ANNUITY)'
[5] DQ = ER = (I+I;I)<C+1;INC = 'DEPRECIABLE AMOUNT'
[6] L =+IP = 'DEPRECIATION LIFE',REP
[7] DP/((P+1);3)+(DPR IT,(IT-C));L)[; 5 6 7]
[8] TR = 0.01*INC = 'ORDINARY INCOME TAX RATE (AS A PERCENT)'
[9] CR = 0.01*INC = 'CAPITAL GAINS TAX RATE (AS A PERCENT)'
[10] R = 0.01*INC = 'COST OF CAPITAL (AS A PERCENT)'
[11] GP = 1;INC = 'GAIN (LOSS) ON PURCHASE'
[12] GL = GP,((P-1);P0),((G+1;INC = 'TERMINAL SALE OR TRADE-IN VALUE')-DP[P+1; 3]
[14] CT+'CAT+GL-CT+GL*CR
[15] PV/((NC+CT-I)+(1+R)*0;1;P
[16] (4pCR),('3p');'ANALYSIS OF CAPITAL INVESTMENT',(3pCR);3p'
[17] (2pCR),'PERIOD EBT DEPR EBT'
[18] 'I6,7M((MN)WQ W15' DMT((P+1);1;E;DP[P];1;EBT;T;EAT;DP[P];1;CAT)
[19] (6p'),(105p(5p'),10p'),CR,'TOTALS'',''7M((MN)WQ W15' DMT(+
E+/DP[P];1;+)/EBT+/T+/EAT+/DP[P];1;+)/CAT)
[20] 3pCR
[21] 3pCR
[22] 'PERIOD OPR CAT GAIN B.T. TAX GAIN A.T.
[23] 'I6,7M((MN)WQ W15' DMT((P+1);1;CAT;GL;CT;I;CT-I)
[24] (6p'),(105p(5p'),10p'),CR,'TOTALS'',''7M((MN)WQ W15' DMT(+
CAT+/GL+/GC;+;CAT;+;CL;+;I;+/CT-I)
[25] CR,'PRESENT VALUE IS ';2 RND PV
[26] 'NET PRESENT VALUE IS ';2 RND NP+PV-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

\[ \text{BUDGET2[]} \]

\[ \text{BUDGET2[]} \]

\[ \rightarrow \text{ER3} \times 12 \times N + 1 + \text{IPI} \ (\text{NUMBER OF INVESTMENT ALTERNATIVES'}), \text{REP}_+ \text{CR}, \ [''] \times 3p' \]

\[ \rightarrow \text{P} + 1 + \text{IPI} \ (\text{NUMBER OF PERIODS (MAXIMUM')}, \text{REP} \]

\[ \rightarrow \text{M} = ((N + 1), \text{P}) \times \text{GM} + \text{C} + \text{PB} + \text{PV} + \text{Y} + \text{N} \times \text{SM} + \text{0} \]

\[ \rightarrow \text{CB} + ((N, \text{P}) \times \text{GM}) + \text{I} + \text{F} + \text{1} \]

\[ \rightarrow \text{RE} : \text{I} + \text{I} + \text{1} \]

\[ \rightarrow \text{E} + \text{ER}1 = \text{P} \times \text{GM} = \text{I} + \text{1} + \text{I} + \text{P} = \text{(A} + 1 + 1) \times \text{IPI} \ (\text{LIFE OF INVESTMENT (PERIODS')}, \text{REP}) - 1 \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{ER}1 = \text{I} \times \text{P} \times \text{GM} = \text{I} + \text{1} + \text{I} + \text{P} = \text{(A} + 1 + 1) \times \text{IPI} \ (\text{LIFE OF INVESTMENT (PERIODS')}, \text{REP}) - 1 \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{P} + \text{X} \times \text{P} + \text{GM} = \text{I} + \text{1} + \text{I} + \text{P} = \text{(A} + 1 + 1) \times \text{IPI} \ (\text{LIFE OF INVESTMENT (PERIODS')}, \text{REP}) - 1 \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]

\[ \rightarrow \text{M} = \text{I} + \text{1} + \text{1} + \text{1} + \text{1} + \text{1} \]

\[ \rightarrow \text{E} + \text{E}1 = \text{RETURNS FOR ALTERNATIVE'} ; \text{I} = \text{1} \]
D. UTILITY

\[ \text{UTILITY} \]

\[ \text{UTILITY} ; A ; C ; E ; I ; M ; N ; P ; U ; U P ; Z \]

[1] 'ENTER POSSIBLE CASH FLOWS'
[2] \[ \text{ER1} \times 1 \geq pC \]
[3] \[ \text{UF} = (pC) \text{ INC 'ENTER RESPECTIVE UTILITY MEASURES'} \]
[4] \[ \text{UP} = \text{UF} [\text{AC}] \]
[5] \[ \text{C} + \text{C} [\text{AC}] , [1.5] \text{ UP} \]
[6] \[ \text{ER2} \times 1 (1 + pC) \# \# / (1 + pC) = \text{AC} [2] \]
[7] \[ \text{ALT} ; \text{U} + \text{I} \]
[8] 'CASH RETURNS OF POSSIBLE ALTERNATIVES'
[9] \[ \text{N} = pA \]
[10] \[ \text{P} + \text{P} + / \text{P} + \text{N} \text{ INC 'RESPECTIVE PROBABILITIES OF RETURNS'} \]
[11] \[ \text{I} = 1 \]
[12] \[ \text{RE} : \text{U} = \text{U} , \text{A} [I] \text{ INTP C} \]
[13] \[ \text{RE} = \text{N} \geq \text{I} + 1 \]
[14] \[ \text{CR} : \text{EXPECTED VALUE IS } \# ; 2 \text{ RND E} + / \text{P} \times \text{A} \]
[15] \[ \text{'UTILITY MEASURE IS '} ; \# ; \text{M} + / \text{P} \times \text{U} \]
[16] \[ \text{'POINT OF INDIFFERENCE IS '} ; \# ; 2 \text{ RND E} + \text{M} \text{ INTP C} [2] 1 \]
[17] \[ \text{'RISK DISCOUNT IS '} ; \# ; 2 \text{ RND E} - \text{I} \]
[18] \[ \text{Q} : \text{CR} : \text{ANOTHER ALTERNATIVE SET? (YES OR NO)} \]
[19] \[ \text{Q} = (N' = Z), (I' = Z + 1 \#) , 1 / 0 \text{, ALT, C} \]
[20] \[ \text{ER1} : \text{'MUST BE AT LEAST TWO ALTERNATIVES'} \]
[21] \[ \text{+1} \]
[22] \[ \text{ER2} : \text{'UTILITY FUNCTION INCONSISTENT'} \]
[23] \[ \text{+1} \]

\[ \text{INTP} [\text{H}] \]

\[ \text{IV} = \text{A} \text{ INTP B ; L ; H} \]

[1] \[ \text{B + B} [\text{A} [1] ; 1] \]
[2] \[ \text{+0} \times 0 = \text{IV} + (A \geq B [1 ; 1]) \times A = 1 + 1 + B \]
[3] \[ \text{+0} \times 1 = 1 + 1 + B + 0 \times IV + 1 = 1 + 1 + B \]
[4] \[ \text{IV} + B [L ; 2] + (A - B [L ; 1]) \times (-B[H , L ; 2]) + -B (H + L + 1) , L + / A \geq B [1 ; 1] ; 1 \]

\[ \text{INTP} [\text{H}] \]
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.
As with other programs in this text, use is made of certain supporting functions and variables. Those used in the COSTACCOUNT series are:

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEMIVARCOST</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BREAKEVEN</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CVP</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ALLOCATEOHD</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FULLCOST</td>
<td>-</td>
<td>-</td>
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<tr>
<td>PROCESSCOST1</td>
<td>PCIN</td>
<td>-</td>
</tr>
<tr>
<td>PROCESSCOST2</td>
<td>PCOUT</td>
<td>ITP</td>
</tr>
<tr>
<td>STDCOST</td>
<td>INV</td>
<td>TTV</td>
</tr>
<tr>
<td>MIXVARIANCE</td>
<td>-</td>
<td>TTV</td>
</tr>
</tbody>
</table>

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:

\[ \sum X_i Y_i = a \sum X_i + b \sum X_i^2 \]

\[ \sum Y_i = n \bar{a} + \bar{b} \sum X_i \]

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:

- Sales
  - Variable Cost
  = Marginal Income
  - Fixed Costs
  = Profit

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 preceding 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 actual 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 21.6621403
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

ENTER THE FOLLOWING DATA FROM INITIAL MARGINAL INCOME STATEMENT

SALES
\[ \square: \ 10000 \]

VARIABLE COSTS
\[ \square: \ 6000 \]

FIXED COSTS
\[ \square: \ 3000 \]

SOLVE FOR VOLUME; SELLING PRICE; VARIABLE COST; FIXED COST; OR PROFIT?

\[ \checkmark \]

PERCENT CHANGE IN UNIT SALES PRICE
\[ \square: \ 10 \]

PERCENT CHANGE IN UNIT VARIABLE COST
\[ \square: \ -5 \]

CHANGE IN FIXED COST
\[ \square: \ 1200 \]

CHANGE IN PROFIT (ENTER ZERO IF PROFIT TO BE A PERCENTAGE OF NEW SALES)
\[ \square: \ 0 \]

PROFIT AS A PERCENTAGE OF NEW SALES
\[ \square: \ 13 \]

<table>
<thead>
<tr>
<th></th>
<th>PRESENT</th>
<th>PCT</th>
<th>PROJECTED</th>
<th>PCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES</td>
<td>10000</td>
<td>100.0</td>
<td>11938</td>
<td>100.0</td>
</tr>
<tr>
<td>VARIABLE COSTS</td>
<td>6000</td>
<td>60.0</td>
<td>6186</td>
<td>51.8</td>
</tr>
<tr>
<td>MARGINAL INCOME</td>
<td>4000</td>
<td>40.0</td>
<td>5752</td>
<td>48.2</td>
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<tr>
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<td>30.0</td>
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<tr>
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<td>1000</td>
<td>10.0</td>
<td>1552</td>
<td>13.0</td>
</tr>
</tbody>
</table>

NEW SALES VOLUME IS 108.53 PERCENT OF ORIGINAL SALES

ANOTHER CHANGE FROM SAME INITIAL DATA? (YES OR NO)
\[ \text{YES} \]
SOLVE FOR VOLUME; SELLING PRICE; VARIABLE COST; FIXED COST; OR PROFIT?

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

<table>
<thead>
<tr>
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<th>PCT</th>
<th>Projected</th>
<th>PCT</th>
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</thead>
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<tr>
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<td>10.0</td>
<td>1705</td>
<td>15.0</td>
</tr>
</tbody>
</table>

NEW SALES VOLUME IS 90 PERCENT OF ORIGINAL SALES

ANOTHER CHANGE FROM SAME INITIAL DATA? (YES OR NO)

NO
### E. ALLOCATEOHD

**NUMBER OF COST CENTERS:** 4

**DIRECT MATERIALS COSTS FOR EACH COST CENTER**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8000</td>
<td>12000</td>
<td>15000</td>
<td>20000</td>
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</tr>
</tbody>
</table>

**DIRECT LABOR COSTS FOR EACH COST CENTER**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td></td>
<td>10000</td>
<td>15000</td>
<td>20000</td>
<td>30000</td>
<td></td>
</tr>
</tbody>
</table>

**DIRECT LABOR HOURS FOR EACH COST CENTER**

<table>
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<tr>
<th></th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1000</td>
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**GROSS SALES FOR EACH COST CENTER**

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<th>4</th>
<th>TOTAL</th>
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<tbody>
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<td>42000</td>
<td>55000</td>
<td>75000</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL OVERHEAD TO BE ALLOCATED**

<table>
<thead>
<tr>
<th></th>
<th>55000</th>
</tr>
</thead>
</table>

**METHOD OF OVERHEAD ALLOCATION?** - DIRECT MATERIAL; DIRECT LABOR; PRIME COSTS; DIRECT LABOR HOURS; SALES; CONTRIBUTION TO MARGIN

<table>
<thead>
<tr>
<th>COST CENTER</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
</tr>
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<tr>
<td>PRIME COSTS</td>
<td>18000</td>
<td>27000</td>
<td>35000</td>
<td>50000</td>
<td>130000</td>
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<tr>
<td>OVERHEAD</td>
<td>7333</td>
<td>11000</td>
<td>14667</td>
<td>22000</td>
<td>55000</td>
</tr>
<tr>
<td>TOTAL COSTS</td>
<td>(25333)</td>
<td>(38000)</td>
<td>(49667)</td>
<td>(72000)</td>
<td>(185000)</td>
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<tr>
<td>PROFIT</td>
<td>9667</td>
<td>4000</td>
<td>5333</td>
<td>3000</td>
<td>22000</td>
</tr>
<tr>
<td>PCT OF SALES</td>
<td>27.62</td>
<td>9.52</td>
<td>9.70</td>
<td>4.00</td>
<td>10.63</td>
</tr>
</tbody>
</table>

### ANOTHER ALLOCATION METHOD? (ENTER METHOD OR 'NO')

**H**

<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES</td>
<td>35000</td>
<td>42000</td>
<td>55000</td>
<td>75000</td>
<td>207000</td>
</tr>
<tr>
<td>PRIME COSTS</td>
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<td>27000</td>
<td>35000</td>
<td>50000</td>
<td>130000</td>
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<tr>
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<td>5.49</td>
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<td>10.63</td>
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### ANOTHER ALLOCATION METHOD? (ENTER METHOD OR 'NO')

**C**
### Cost Center Analysis

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<td>SALES</td>
<td>35000</td>
<td>42000</td>
<td>55000</td>
<td>75000</td>
<td>207000</td>
</tr>
<tr>
<td>PRIME COSTS</td>
<td>18000</td>
<td>27000</td>
<td>35000</td>
<td>50000</td>
<td>130000</td>
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<tr>
<td>OVERHEAD</td>
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<td>10714</td>
<td>14286</td>
<td>17857</td>
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<tr>
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<td>(30143)</td>
<td>(37714)</td>
<td>(49286)</td>
<td>(67857)</td>
<td>(185000)</td>
</tr>
<tr>
<td>PROFIT</td>
<td>4857</td>
<td>4286</td>
<td>5714</td>
<td>7143</td>
<td>22000</td>
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<td>PCT OF SALES</td>
<td>13.88</td>
<td>10.20</td>
<td>10.39</td>
<td>9.52</td>
<td>10.63</td>
</tr>
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</table>

**Another Allocation Method? (Enter method or 'No')**

<table>
<thead>
<tr>
<th>COST_CENTER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES</td>
<td>35000</td>
<td>42000</td>
<td>55000</td>
<td>75000</td>
<td>207000</td>
</tr>
<tr>
<td>PRIME COSTS</td>
<td>18000</td>
<td>27000</td>
<td>35000</td>
<td>50000</td>
<td>130000</td>
</tr>
<tr>
<td>OVERHEAD</td>
<td>9300</td>
<td>11159</td>
<td>14614</td>
<td>19928</td>
<td>55000</td>
</tr>
<tr>
<td>TOTAL COSTS</td>
<td>(27300)</td>
<td>(38159)</td>
<td>(49614)</td>
<td>(69928)</td>
<td>(185000)</td>
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<tr>
<td>PROFIT</td>
<td>7700</td>
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<td>5386</td>
<td>5072</td>
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<td>22.00</td>
<td>9.14</td>
<td>9.79</td>
<td>6.76</td>
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</tr>
</tbody>
</table>

**Another Allocation Method? (Enter method or 'No')**

No

**Comparison Summary? (Yes or No)**

Yes

**Profit as a Percent of Sales**

<table>
<thead>
<tr>
<th>COST CENTER</th>
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<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>METHOD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIRECT LABOR COST</td>
<td>27.62</td>
<td>9.52</td>
<td>9.70</td>
<td>4.00</td>
<td>10.63</td>
</tr>
<tr>
<td>DIRECT LABOR HOURS</td>
<td>31.30</td>
<td>5.49</td>
<td>8.89</td>
<td>5.13</td>
<td>10.63</td>
</tr>
<tr>
<td>CONTRIBUTION TO MARGIN</td>
<td>13.88</td>
<td>10.20</td>
<td>10.39</td>
<td>9.52</td>
<td>10.63</td>
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<tr>
<td>SELLING PRICE</td>
<td>22.00</td>
<td>9.14</td>
<td>9.79</td>
<td>6.76</td>
<td>10.63</td>
</tr>
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</table>
FULLCOST

NUMBER OF PRODUCING CENTERS: 3
NUMBER OF SERVICE CENTERS: 3

DIRECT COSTS - PRODUCING CENTERS FOLLOWED BY SERVICE CENTERS

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENTER</td>
<td>10000</td>
<td>8000</td>
<td>7000</td>
<td>5000</td>
<td>6000</td>
<td>9000</td>
<td>45000</td>
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<tr>
<td>ALLOCATE S-1</td>
<td>1483</td>
<td>1236</td>
<td>1013</td>
<td>(7686)</td>
<td>1977</td>
<td>1977</td>
<td></td>
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<tr>
<td>ALLOCATE S-2</td>
<td>3337</td>
<td>2861</td>
<td>1907</td>
<td>1430</td>
<td>(10489)</td>
<td>954</td>
<td></td>
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<tr>
<td>ALLOCATE S-3</td>
<td>3768</td>
<td>2512</td>
<td>1884</td>
<td>1256</td>
<td>2512</td>
<td>(11931)</td>
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<tr>
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<td>11804</td>
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<td>SERVICE</td>
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<td></td>
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<td></td>
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</table>

DO YOU WANT TO CONSIDER REPLACING A SERVICE DEPARTMENT? (YES OR NO)

YES

EXPECTED DIRECT COSTS IN EACH SERVICE DEPARTMENT AFTER CHANGE IS MADE

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<td>9000</td>
<td>5000</td>
<td>10000</td>
<td>9000</td>
<td>45000</td>
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</table>
| POINT OF INDIFFERENCE IS $5000
| ANOTHER REPLACEMENT CONSIDERATION? (YES OR NO)

YES

EXPECTED DIRECT COSTS IN EACH SERVICE DEPARTMENT AFTER CHANGE IS MADE

|        | 4000   | 1000   | 9000   | 4000   | 1000   | 9000   | 6000  |
| POINT OF INDIFFERENCE IS $6000
| ANOTHER REPLACEMENT CONSIDERATION? (YES OR NO)

NO
G. 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

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50</td>
<td>70</td>
<td>90</td>
</tr>
</tbody>
</table>

LABOR

<p>| | | | |</p>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>30</td>
<td>40</td>
</tr>
</tbody>
</table>

OVERHEAD

<p>| | | | |</p>
<table>
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<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

ENTER NUMBER OF UNITS AT EACH STAGE AT THE END OF THE PERIOD

|   | 20  | 20  | 20  | 20  | 20  |

FINISHED GOODS

<table>
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<tr>
<th></th>
<th>UNITS</th>
<th>COST PER</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
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<td>20</td>
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</tr>
<tr>
<td>LABOR</td>
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<td>40000</td>
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<tr>
<td>OVERHEAD</td>
<td>20</td>
<td>500</td>
<td>10000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>20</td>
<td>2600</td>
<td>52000</td>
</tr>
</tbody>
</table>

WORK IN PROCESS

<table>
<thead>
<tr>
<th></th>
<th>EQUIVALENT UNITS</th>
<th>TOTAL</th>
<th>FINISHED</th>
<th>WORK-IN-PROCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>58</td>
<td>7800</td>
<td>2000</td>
<td>5800</td>
</tr>
<tr>
<td>LABOR</td>
<td>32</td>
<td>104000</td>
<td>40000</td>
<td>64000</td>
</tr>
<tr>
<td>OVERHEAD</td>
<td>40</td>
<td>30000</td>
<td>10000</td>
<td>20000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>141800</td>
<td>52000</td>
<td>89800</td>
<td></td>
</tr>
</tbody>
</table>

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  |

<table>
<thead>
<tr>
<th></th>
<th>EQUIVALENT UNITS TO COMPLETE</th>
<th>COST PER</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>22</td>
<td>1000</td>
<td>22000</td>
</tr>
<tr>
<td>LABOR</td>
<td>48</td>
<td>2000</td>
<td>96000</td>
</tr>
<tr>
<td>OVERHEAD</td>
<td>40</td>
<td>500</td>
<td>20000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3500</td>
<td>138000</td>
<td></td>
</tr>
</tbody>
</table>
H. PROCESSCOST2

PROCESSCOST2
ENTER THE FOLLOWING QUANTITY DATA:
BEGINNING W-I-P (UNITS)
- 0 UNITS

UNITS STARTED
- 0 UNITS

UNITS FROM PREVIOUS DEPARTMENT
- 8000 UNITS

UNITS LOST
- 1000 UNITS

UNITS TRANSFERRED TO NEXT DEPARTMENT
- 6000 UNITS

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
UNIT/PREC. DEPT. 8,000
UNITS LOST 1,000
UNITS TRANS./NEXT DEPT. 6,000
ENDING W-I-P 1,000

<table>
<thead>
<tr>
<th>EQUIV. UNITS</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
</table>

2. INPUT FROM PRECEDING DEPARTMENT COSTS
COST/PREC. DEPT. 8,000 10.50 84,000
ADJ. FOR UNITS LOST 1,000 1.50 12.00
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)
BEGINNING W-I-P 0.00
ENDING W-I-P 80.00

DO YOU WISH TO USE THIS DATA AS AN ITERATIVE BASIS? (YES OR NO)
YES
DEPARTMENT OR PERIOD ITERATION?

ENTER THE FOLLOWING QUANTITY DATA:

**UNITS STARTED**

\[
\begin{array}{c}
0
\end{array}
\]

**UNITS FROM PREVIOUS DEPARTMENT**

\[
\begin{array}{c}
14000
\end{array}
\]

**UNITS LOST**

\[
\begin{array}{c}
1000
\end{array}
\]

**UNITS TRANSFERRED TO NEXT DEPARTMENT**

\[
\begin{array}{c}
12000
\end{array}
\]

ENTER UNITS FOLLOWED BY UNIT COST TRANSFERRED FROM PREVIOUS DEPARTMENT

\[
\begin{array}{c}
14000 10.98
\end{array}
\]

ENTER CURRENT PRODUCTION COSTS - MATERIALS, LABOR, OVERHEAD

\[
\begin{array}{c}
60480 94500 71250
\end{array}
\]

ENTER PERCENTAGE COMPLETION BASED ON W-I-P (MATERIAL, LABOR, OVERHEAD)

**ENDING**

\[
\begin{array}{c}
70 50 50
\end{array}
\]
### 1. QUANTITY SCHEDULE

<table>
<thead>
<tr>
<th>BEGINNING W-I-P</th>
<th>1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNITS STARTED</td>
<td></td>
</tr>
<tr>
<td>UNITS/PREC. DEPT.</td>
<td></td>
</tr>
<tr>
<td>UNITS LOST</td>
<td>1,000</td>
</tr>
<tr>
<td>UNITS TRANS./NEXT DEPT.</td>
<td>12,000</td>
</tr>
<tr>
<td>ENDING W-I-P</td>
<td>15,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EQUIV. UNITS</th>
<th>UNIT COST</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2. INPUT FROM PRECEDING DEPARTMENT COSTS

<table>
<thead>
<tr>
<th>COST/PREC. DEPT.</th>
<th>14,000</th>
<th>10.98</th>
<th>153,720</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ. FOR UNITS LOST</td>
<td>(1,000)</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>ADJ. COST/PREC. DEPT.</td>
<td>13,000</td>
<td>11.82</td>
<td>153,720</td>
</tr>
</tbody>
</table>

### 3. BEGINNING W-I-P

<table>
<thead>
<tr>
<th>PRECEDING DEPT.</th>
<th>1,000</th>
<th>12.00</th>
<th>12,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRESENT: MATERIALS</td>
<td>800</td>
<td>5.00</td>
<td>4,000</td>
</tr>
<tr>
<td>LABOR</td>
<td>400</td>
<td>7.00</td>
<td>2,800</td>
</tr>
<tr>
<td>OVERHEAD</td>
<td>500</td>
<td>6.00</td>
<td>3,000</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>21,800</td>
<td></td>
</tr>
</tbody>
</table>

### 4. CURRENT PRODUCTION COSTS

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>12,600</th>
<th>4.80</th>
<th>60,480</th>
</tr>
</thead>
<tbody>
<tr>
<td>LABOR</td>
<td>12,600</td>
<td>7.50</td>
<td>94,500</td>
</tr>
<tr>
<td>OVERHEAD</td>
<td>12,500</td>
<td>5.70</td>
<td>71,250</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>18.00</td>
<td>226,230</td>
</tr>
<tr>
<td>TOTAL W-I-P</td>
<td></td>
<td>29.82</td>
<td>401,750</td>
</tr>
</tbody>
</table>

### 5. TRANSFERRED COST

<table>
<thead>
<tr>
<th>TRANSFERRED/NEXT DEPT.:</th>
<th>1,000</th>
<th>30.11</th>
<th>30,110</th>
</tr>
</thead>
<tbody>
<tr>
<td>FINISH BEGINNING W-I-P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNITS STARTED AND FIN.</td>
<td>11,000</td>
<td>29.82</td>
<td>328,071</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12,000</td>
<td>29.85</td>
<td>358,181</td>
</tr>
</tbody>
</table>

### 6. ENDING W-I-P

<table>
<thead>
<tr>
<th>PRECEDING DEPT.</th>
<th>2,000</th>
<th>11.82</th>
<th>23,649</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRESENT: MATERIALS</td>
<td>1,400</td>
<td>4.80</td>
<td>6,720</td>
</tr>
<tr>
<td>LABOR</td>
<td>1,000</td>
<td>7.50</td>
<td>7,500</td>
</tr>
<tr>
<td>OVERHEAD</td>
<td>1,000</td>
<td>5.70</td>
<td>5,700</td>
</tr>
<tr>
<td>TOTAL W-I-P</td>
<td></td>
<td>43,569</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>401,750</td>
<td></td>
</tr>
</tbody>
</table>

### 7. PERCENTAGE COMPLETION (BASED ON WORK-IN-PROCESS)

<table>
<thead>
<tr>
<th>BEGINNING W-I-P</th>
<th>80.00</th>
<th>40.00</th>
<th>50.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENDING W-I-P</td>
<td>70.00</td>
<td>50.00</td>
<td>50.00</td>
</tr>
</tbody>
</table>
DEPARTMENT OR PERIOD ITERATION?

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**

<table>
<thead>
<tr>
<th>Category</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning W-I-P</td>
<td>1,000</td>
</tr>
<tr>
<td>Units Started</td>
<td></td>
</tr>
<tr>
<td>Units/Previous Dept.</td>
<td>12,000</td>
</tr>
<tr>
<td>Units Lost</td>
<td>1,000</td>
</tr>
<tr>
<td>Units Trans./Next Dept.</td>
<td>10,000</td>
</tr>
<tr>
<td>Ending W-I-P</td>
<td>13,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Units</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **INPUT FROM PRECEDING DEPARTMENT COSTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Units</th>
<th>Cost/Prec. Dept.</th>
<th>Adj. For Units Lost</th>
<th>Adj. Cost/Prec. Dept.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost/Previous Dept.</td>
<td>12,000</td>
<td>29.85</td>
<td>(1,000)</td>
<td>32.56</td>
</tr>
<tr>
<td>Adj. For Units Lost</td>
<td></td>
<td>2.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. Cost/Previous Dept.</td>
<td></td>
<td>358,181</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **BEGINNING W-I-P**

<table>
<thead>
<tr>
<th>Category</th>
<th>Units</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Dept.</td>
<td>1,000</td>
<td>36.00</td>
</tr>
<tr>
<td>Present: Materials</td>
<td>1,000</td>
<td>4.00</td>
</tr>
<tr>
<td>Labor</td>
<td>500</td>
<td>6.00</td>
</tr>
<tr>
<td>Overhead</td>
<td>500</td>
<td>4.00</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>45,000</td>
</tr>
</tbody>
</table>

4. **CURRENT PRODUCTION COSTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Units</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>11,000</td>
<td>4.44</td>
</tr>
<tr>
<td>Labor</td>
<td>10,300</td>
<td>6.00</td>
</tr>
<tr>
<td>Overhead</td>
<td>10,700</td>
<td>4.00</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
<td></td>
<td>47.00</td>
</tr>
<tr>
<td><strong>Total Cumulative Costs</strong></td>
<td></td>
<td>556,621</td>
</tr>
</tbody>
</table>

5. **TRANSFERRED COST**

<table>
<thead>
<tr>
<th>Category</th>
<th>Units</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transferred/Next Dept.: Finish Beginning W-I-P</td>
<td>1,000</td>
<td>50.00</td>
</tr>
<tr>
<td>Units Started and Fin.</td>
<td>9,000</td>
<td>47.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10,000</td>
<td>47.30</td>
</tr>
</tbody>
</table>

6. **ENDING W-I-P**

<table>
<thead>
<tr>
<th>Category</th>
<th>Units</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Dept.</td>
<td>2,000</td>
<td>32.56</td>
</tr>
<tr>
<td>Present: Materials</td>
<td>2,000</td>
<td>4.44</td>
</tr>
<tr>
<td>Labor</td>
<td>800</td>
<td>6.00</td>
</tr>
<tr>
<td>Overhead</td>
<td>1,200</td>
<td>4.00</td>
</tr>
<tr>
<td><strong>Total W-I-P</strong></td>
<td></td>
<td>83,604</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>556,621</td>
</tr>
</tbody>
</table>

7. **PERCENTAGE COMPLETION**

<table>
<thead>
<tr>
<th>Category</th>
<th>Material</th>
<th>Labor</th>
<th>Overhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning W-I-P</td>
<td>100.00</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Ending W-I-P</td>
<td>100.00</td>
<td>40.00</td>
<td>60.00</td>
</tr>
</tbody>
</table>

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

.30

ENTER BEGINNING INVENTORY: UNIT PRICE FOLLOWED BY QUANTITY
ZERO SIGNALS END OF ENTRIES

3.00 20000

3.10 80000

3.20 40000

INVENTORY METHOD - LIFO, FIFO, OR AVERAGE

OVERHEAD ALLOCATED ON THE BASIS OF LABOR HOURS? (YES OR NO)

YES
<table>
<thead>
<tr>
<th>COST ELEMENT</th>
<th>STANDARD AT ACTUAL VOLUME</th>
<th>ACTUAL COST</th>
<th>NET VARIANCE</th>
<th>SUB-VARIANCES TYPE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>$270,000</td>
<td>$371,999</td>
<td>$101,999(U)</td>
<td>QUANTITY</td>
<td>$89,999(U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PRICE</td>
<td>$12,000(U)</td>
</tr>
<tr>
<td>LABOR</td>
<td>$1,080,000</td>
<td>$1,232,500</td>
<td>$152,500(U)</td>
<td>EFFICIENCY</td>
<td>$80,000(U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RATE</td>
<td>$72,500(U)</td>
</tr>
<tr>
<td>FIXED OVERHEAD</td>
<td>$72,000</td>
<td>$85,000</td>
<td>$13,000(U)</td>
<td>BUDGET</td>
<td>$8,000(U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EFFICIENCY</td>
<td>$2,667(F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CONTROLLABLE</td>
<td>$7,667(U)</td>
</tr>
<tr>
<td>VARIABLE OVERHEAD</td>
<td>$540,000</td>
<td>$650,000</td>
<td>$110,000(U)</td>
<td>BUDGET</td>
<td>$0(F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EFFICIENCY</td>
<td>$40,000(U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CONTROLLABLE</td>
<td>$70,000(U)</td>
</tr>
<tr>
<td>TOTAL OVERHEAD</td>
<td>$612,000</td>
<td>$735,000</td>
<td>$123,000(U)</td>
<td>BUDGET</td>
<td>$8,000(U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EFFICIENCY</td>
<td>$37,333(U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CONTROLLABLE</td>
<td>$77,667(U)</td>
</tr>
<tr>
<td>TOTAL COSTS</td>
<td>$1,962,000</td>
<td>$2,339,499</td>
<td>$377,499(U)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
J. MIXVARIANCE

MIXVARIANCE
ENTER STANDARD INPUT QUANTITY FOLLOWED BY STANDARD COST PER UNIT FOR EACH INPUT FACTOR. ZERO WILL SIGNAL END OF INPUT FACTORS.
.snapshot: 50 .20
.snapshot: 75 .40
.snapshot: 75 .80
.snapshot: 0 0
ENTER ACTUAL INPUT QUANTITY FOLLOWED BY ACTUAL COST PER UNIT FOR EACH INPUT FACTOR.
.snapshot: 100000 .27
.snapshot: 120000 .35
.snapshot: 140000 .76
ENTER STANDARD YIELD FOLLOWED BY ACTUAL YIELD (IN UNITS)
.snapshot: 200 340000

PRICE VARIANCE IS $4600 FAVORABLE
MIX VARIANCE IS $0
YIELD VARIANCE IS $10000 UNFAVORABLE
NET VARIANCE IS $5400 UNFAVORABLE
B. SEMIVARCOST

\[ \text{VSEMI} \text{VARCOST}[\text{M;A;X;V}] \]
\[ \text{VSEMI} \text{VARCOST;M;A;X;V} \]

[1] \( M+ 1 2 p0 \)
[2] \( \text{RES: 'ENTER ACTIVITY DATA FOLLOWED BY COST DATA FOR EACH OBSERVATION ( PERIOD)'} \)
[3] \( 'ZERO WILL SIGNAL END OF ENTRIES' \)
[4] \( I:=(0=+/A+IM P 1 2)/C \)
[6] \( +I \)
[7] \( C:M+1 0 \times M \)
[8] \( X+M[,2][1,1.5] M;[1] \)
[9] \( 'FIXED COST IS $';2 RND X[1] \)
[12] \( 'STANDARD ERROR OF THE ESTIMATE Y=A+BX IS ';V* \)
0.5
[13] \( 'VARIANCE IS ';V \)

C. BREAKEVEN

\[ \text{V} \text{BREAKEVEN[[]]} \]
\[ \text{V} \text{BREAKEVEN;F;V;SP;BES;S;MS} \]

[1] \( \text{RES: 'INC 'FIXED COSTS'} \)
[2] \( V+1 \text{ INC 'VARIABLE COST PER UNIT'} \)
[3] \( SP+1 \text{ INC 'SALES PRICE PER UNIT'} \)
[4] \( S+1 \text{ INC 'ACTUAL SALES (IN DOLLARS)'} \)
[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

\[ V_{CVP}[0]V \]

\[ V \quad CVP; V; VC; MI; PC; P; P2; PP2; D; S2; VC2; F; P2; V2; M \]

\[ R=1 \]

\[ RCE:+(R=2)/P1,Q \]

\[ P1:\ 'ENTER THE FOLLOWING DATA FROM INITIAL MARGINAL INCOME STATEMENT' \]

\[ V+1 \quad INC \ 'SALES' \]

\[ M1+V-VxVC+(1 \quad INC \ 'VARIABLE COSTS')xV \]

\[ F+M1-F+1 \quad INC \ 'FIXED COSTS' \]

\[ R=2 \]

\[ Q:\ 'SOLVE FOR VOLUME; SELLING PRICE; VARIABLE COST; FIXED COST; OR PROFIT?' \]

\[ S2+P2+PP2=0 \]

\[ V2+(V2x(M1+1))/Q \]

\[ N1=V2x(D='V') \]

\[ V2x(V2+(1 \quad INC \ 'PERCENT CHANGE IN VOLUME')x100) \]

\[ N2=V3x(D='C') \]

\[ V2x(V2+(1 \quad INC \ 'PERCENT CHANGE IN UNIT SALES PRICE')x100)+1+(D='S')xS2-1 \]

\[ N3=V4x(D='P') \]

\[ V2x(V2+(1 \quad INC \ 'PERCENT CHANGE IN UNIT VARIABLE COST')x100)+1+(D='S')xS2-1 \]

\[ N4=V5x(D='P') \]

\[ 'CHANGE IN PROFIT (ENTER ZERO IF PROFIT TO BE A PERCENTAGE OF NEW SALES)' \]

\[ +P2+P2+P+P2+PP2=0 \]

\[ C1=V2+(P2+P2)xS2+1-VC2+PP2 \]

\[ C2=S2+(P2+P2)xS2+1-VC2+PP2 \]

\[ C3=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C4=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C5=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C6=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C7=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C8=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C9=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C10=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C11=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C12=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C13=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C14=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C15=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C16=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C17=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C18=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C19=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C20=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C21=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C22=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C23=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C24=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C25=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C26=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C27=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C28=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C29=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C30=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C31=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C32=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C33=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C34=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C35=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C36=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C37=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C38=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C39=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ C40=V2+(S2xV2)-P2+P+P2+V2xPP2 \]

\[ Q1:\ 'ANOTHER CHANGE FROM SAME INITIAL DATA? (YES OR NO)' \]

\[ Q1=+(Q1=1)/Q,0 \]
E. ALLOCATEOHD

\begin{verbatim}
\*ALLOCATEOHD[*]
\* ALLOCATEOHD;N;DM;DL;DH;S;M;P;AO;OM;B;O;TC;PP;PS;I;SI;T;FC;CO
[1] FC=+['M][('W)][Q]T
[2] I0,SI+PS+T+10
[3] N+1 INP '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'
[12] RC=(1+/'MLPHSC'=M)/RES
[15] 0.5] S-P
[16] TC+P+AO
[17] OM=(I/N),[1] S,[1] P,[1] AO,[1](-TC),[0.5](S-TC)
[18] CO=((FC,'I12') ΔFMT OM),[1],('B',FC,'F12.2') ΔFMT PP+(100×(S-TC)+S)
[19] 2pCR
[20] TC,CO,' TOTAL',[1](('B',FC,'I12') ΔFMT(1+/OM)),[1](FC,'F12.2
[21] ') ΔFMT 100×(+/S-TC)+/S
[22] PS+PS,PP,100×(+/S-TC)+/S
[23] T=1,M
[24] 2pCR
[25] Q1:'ANOTHER ALLOCATION METHOD? (ENTER METHOD OR 'NO')'
[26] +(('MLPHSC'=M+1))/Q2,6pRC
[27] +(YN'=1+1)/OS,0
[28] +Q2
[29] OS:PS+((pT),N+1)pPS
[30] RE:1+I+1
[31] SI+SI,'MLPHSC';T[I]
[32] +(I<pT)/RE
[33] (2pCR),(20p', 'PROFIT AS A PERCENT OF SALES',2pCR
[34] 'COST CENTER' ,('I10' ΔFMT(1/N)), ' TOTAL'
[35] CR
[36] ' METHOD'
[37] TS[SI;],'I10.2' ΔFMT PS
\end{verbatim}
F. FULLCOST

\[ \text{FULLCOST[][]} \]
\[ \text{FULLCOST}; NP; NS; N; DC; B; I; FSC; OM; AC; PC; RSC; T; OUT \]
[1] \text{RES:NP+i+IPI 'NUMBER OF PRODUCING CENTERS:'}
[2] \text{N+NP+NS+i+IPI 'NUMBER OF SERVICE CENTERS:'}
[3] \text{DC+N INC 'DIRECT COSTS - PRODUCING CENTERS FOLLOWED BY SERVICE CENTERS'}
[4] \text{B+(NS,N)pI+O 'DIRECT COSTS - SERVICE CENTERS' (PRODUCING FIRST) FOR:}
[5] \text{RE:I+I1}
[6] \text{AC+BxFSCO,xNp1}
[7] \text{PC++fDC,[1] AC}
[8] \text{OM+2 1 p(+/PC),+T/FSC}
[9] \text{OUT+T,'BMT(WNN)QQT }\text{NI10' AFMT OM}
[10] \text{OUT[i; (1+pOUT)-5-15] +'TOTAL'
[11] \text{OUT}
[12] \text{Q: 'DO YOU WANT TO CONSIDER REPLACING A SERVICE DEPARTMENT? (YES OR NO )'
[13] \text{RP:+('YN'=1+1)/RP,0}
[14] \text{RND(+/DC[NP+NS])-+/RSC}
[15] \text{Q1: 'ANOTHER REPLACEMENT CONSIDERATION? (YES OR NO)'
[16] \text{Q}

G. PROCESSCOST1

\[ \text{PROCESSCOST1} = \Phi \text{PROCESSCOST1} \]

\[ \text{PROCESSCOST1} \cdot N \cdot F \cdot \text{CPU} \cdot \text{EU} \cdot \text{FT} \cdot \text{CU} \cdot C2 \]

1. \( R + 1 \)
2. \( P1 \cdot \text{PCLN} \)
3. \( R + 2 \)
4. \( P2 : \text{FT} + B[N] \times \text{CPU} + C + \text{EU} \times + / F \times (3, N) \cdot B + N \) INC 'ENTER NUMBER OF UNITS AT EACH STAGE AT THE END OF THE PERIOD'
5. \( (2pCR), \text{'FINISHED GOODS'} \)
6. \( (20p') \), 'UNITS COST PER'
7. \( (18p') \), 'FINISHED FINISHED UNIT TOTAL'
8. \( T, '116' \Delta \text{PMT} (4pB[N] ; \text{CPU} , + / \text{CPU} ; \text{FT} + \text{FT} , + / \text{FT} ) \)
9. \( \text{CR}, \text{'WORK IN PROCESS'} \)
10. \( (18p') \), 'EQUIVALENT TOTAL FINISHED WORK-IN-
11. \( (20p'), \text{'UNITS COSTS GOODS PROCESS'} \)
12. \( T, '116' \Delta \text{PMT} (\text{EU} - B[N] ; C ; \text{FT} ; (C + C , + / C) - \text{FT} ) \)
13. \( (2pCR), \text{'PERCENTAGE COMPLETION BASED ON WORK-IN-PROCESS'} \)
14. \( T[13], 'F8.2' \Delta \text{PMT} 100 \times (\text{EU} - B[N]) + + / B[N-1] \)
15. \( \text{CR}, \text{'ENTER UNIT COSTS TO COMPLETE WORK-IN-PROCESS (MATERIAL, LABOR, O-verhead)'} \)
16. \( C2 + \text{INP} 3 \)
17. \( (2pCR), (17p' ), \text{'EQUIVALENT UNITS COST PER TOTAL'} \)
18. \( (18p'), \text{'TO COMPLETE FINISHED UNIT COST'} \)
19. \( T, 'B116' \Delta \text{PMT} (\text{CU} \times C2 , + / C2 ; (\text{CU} \times C2) , + / C2 \times \text{CU} + (+ / \text{B}) - \text{EU} ) \)

\[ \text{PCLN} = I \]

1. \( T + 49 \text{ 'MATERIALSLABOR OVERHEAD TOTAL'} \)
2. \'ENTER THE NUMBER OF STAGES IN THE PROCESS'
3. \( F + (3,N + 1) + I P I '(\text{THE LAST STAGE IS FINISHED INVENTORY})' \cdot 0 \)
4. \'ENTER THE FOLLOWING COST DATA FOR THIS PERIOD (DEPARTMENT)'
5. \( C + 3 \text{ INC 'MATERIALS, LABOR, OVERHEAD'} \)
6. \'ENTER COST FLOWS FOR EACH PERIOD AS CUMULATIVE PERCENTAGES FOR:'
7. \( I + 1 \)
8. \( F1 : (I = 1 2 3 4) \times T \)
9. \( F[I, IV] + 0.01 \times \text{INP} \times F \)
10. \( + (F[I, IV]) = 1 / F2 \)
11. \'MUST BE CUMULATIVE PERCENTAGES WITH LAST ENTRY = 100'
12. \( + F1 \)
13. \( F2 : + (0 /= (F[I, IV]) \times N) / F3 \)
14. \'MUST BE CUMULATIVE PERCENTAGES!'
H. PROCESSCOST2

\[ \text{PROCESSCOST2}[\text{D};\text{P};\text{Q};\text{I};\text{T};\text{B};\text{C};\text{E};\text{PC};\text{Z};\text{REP}] \]

[1] \( \text{R} = 1 \)
[2] \( E + 6 \; 3 \; \rho C + B + 5 \; 3 \; \rho T + I + 3 \; 3 \; \rho PC + 2 \; 3 \; \rho G + 7 \; D + P + 0 \)
[3] \( \text{RES} \rightarrow (\text{R} = 1) / \text{AGAIN}, P_1, P_2 \)
[4] AGAIN: 'ENTER THE FOLLOWING QUANTITY DATA:

[5] \( \rightarrow S_1 \times P \)
[8] \( \rightarrow S_2 \times P \)
[9] \( Q[3] + 1 \; \text{INC 'UNITS FROM PREVIOUS DEPARTMENT'} \)
[13] \( \rightarrow S_3 \times P \)
[14] \( I[3 \; 3] + \times i[1 \; 1 \; 2] + 2 \; 1 \; 2 \; \text{INC 'ENTER UNITS FOLLOWED BY UNIT COST TRANSFERRED FROM PREVIOUS DEPARTMENT'} \)
[15] \( S_3: S_4 \times P \)
[16] 'ENTER EQUIVALENT UNITS FOLLOWED BY UNIT COST FOR BEGINNING W-I-P:

[17] \( B[1 \; 1 \; 2] + \times 2 \; 1 \; 2 \; \text{INC 'FROM PRECEDING DEPARTMENT'} \)
[18] \( B[2 \; 1 \; 2] + \times 2 \; 1 \; 2 \; \text{INC 'PRESENT MATERIALS'} \)
[19] \( B[3 \; 1 \; 2] + \times 2 \; 1 \; 2 \; \text{INC 'PRESENT LABOR'} \)
[20] \( B[4 \; 1 \; 2] + \times 2 \; 1 \; 2 \; \text{INC 'PRESENT OVERHEAD'} \)
[21] \( B[5 \; 1 \; 3] + \times 2 \; 1 \; 2 \; \text{INC 'PRESENT OVERHEAD'} \)
[22] \( B[6 \; 1 \; 3] + \times 2 \; 1 \; 2 \; \text{INC 'PRESENT OVERHEAD'} \)
[24] 'ENTER PERCENTAGE COMPLETION BASED ON W-I-P (MATERIAL, LABOR, OVERHEAD):

[25] \( \rightarrow S_5 \times P \)
[26] \( PC[1 \; 1] \times 0.01 \times 3 \; 1 \; 3 \; \text{INC 'BEGINNING'} \)
[27] \( S_5: PC[2 \; 1] \times 0.01 \times 3 \; \text{INC 'ENDING'} \)
[28] \( \rightarrow R \times 2 \)
[39] \( 3 \; pCR \)
[40] \( R \times 3 \)
[41] \( P_2: PCOUT \)
[42] \( 3 \; pCR \)
[43] \( Q_1: 'DO YOU WISH TO USE THIS DATA AS AN ITERATIVE BASIS? (YES OR NO)'
\[
\begin{align*}
\textbf{PCOUNT[1]} & \Rightarrow \textbf{PCOUNT[2]} \\
\textbf{PCOUNT[1]} & \Rightarrow \textbf{PCOUNT[2]} \\
\text{F+BCNT)\text{FMNT(MQT M16,PF16.2)} \\
\text{I6+13;},F \text{ FMNT I} \\
\text{I6+13;},F \text{ FMNT B} \\
\text{I7+13;},F \text{ FMNT C} \\
\text{I8+13;},F \text{ FMNT D} \\
\text{I9+13;},F \text{ FMNT E} \\
\text{I10+13;},F \text{ FMNT F} \\
\text{I11+13;},F \text{ FMNT G} \\
\text{I12+13;},F \text{ FMNT H} \\
\text{I13+13;},F \text{ FMNT I} \\
\text{I14+13;},F \text{ FMNT J} \\
\text{I15+13;},F \text{ FMNT K} \\
\text{I16+13;},F \text{ FMNT L} \\
\text{I17+13;},F \text{ FMNT M} \\
\text{I18+13;},F \text{ FMNT N} \\
\text{I19+13;},F \text{ FMNT O} \\
\text{I20+13;},F \text{ FMNT P} \\
\text{I21+13;},F \text{ FMNT Q} \\
\text{I22+13;},F \text{ FMNT R} \\
\text{I23+13;},F \text{ FMNT S} \\
\text{I24+13;},F \text{ FMNT T} \\
\text{I25+13;},F \text{ FMNT U} \\
\text{I26+13;},F \text{ FMNT V} \\
\text{I27+13;},F \text{ FMNT W} \\
\text{I28+13;},F \text{ FMNT X} \\
\text{I29+13;},F \text{ FMNT Y} \\
\text{I30+13;},F \text{ FMNT Z} \\
\end{align*}
\]
I. STDCOST

\[\text{STDCOST}()\]

\[\text{STDCOST}: A; U; H; F_O; V_O; H; R; I; M_T; O_R; P; V_Q; V_P; N_M; V_E; V_R; N_L; O; O_B; S_V; N_V; S_A; B\]

1. Enter 9.3, 1.1.
2. Enter the following information - standard data followed by actual data.
3. +2 INC 'UNITS PRODUCED'
4. +2 INC 'UNITS OF MATERIAL PER UNIT OF OUTPUT'
5. +2 INC 'FIXED OVERHEAD'
6. +2 INC 'VARIABLE OVERHEAD'
7. +2 INC 'LABOR HOURS'
8. +2 INC 'LABOR RATE'
9. + INC 'ENTER STANDARD UNIT MATERIAL COST'
10. 'ENTER BEGINNING INVENTORY: UNIT PRICE FOLLOWED BY QUANTITY'
11. 'ZERO SIGNALS END OF ENTRIES'
12. \( BI: + (I = + / A + 2 + I) / I M \)
13. \( I + I, A \)
14. \( BI \)
15. \( I M: I + (0.5 x p I), 2 \) \( p I \)
16. \( Q: \) 'INVENTORY METHOD - LIFO, FIFO, OR AVERAGE'
17. \( \rightarrow 0 =+/ M T+ 'LIFO' =1+3) / Q \)
18. \( M T+M T / 1 0 -1 \)
19. \( Q 1: 'OVERHEAD ALLOCATED ON THE BASIS OF LABOR HOURS? (YES OR NO)' \)
20. \( + (0 =+/ O B+ 'Y N' =1+3) / Q 1 \)
21. \( + (O B[1] =1) / O L \)
22. \( Q 2: 'ENTER STANDARD BASIS FOLLOWED BY ACTUAL BASIS' \)
23. \( + (V / 0 =B+2+4) / Q 2 \)
24. \( O L: O R+(F O[1], V O[1]) x O B / H[1], B[1] \)
25. \( + (0 =p A+ I M x (M T, M[2] x U[2]), [1] I) / S O \)
27. \( O B+, O B / H, [0.5] B \)
29. \( N M+V Q+V P+(U[2] x M[2]) x / P \)
31. \( N L+V E+V R+H[2] x / R \)
32. \( O[1; 1 2]+(O B[1] x U[2 1]) x O R \)
34. \( O[3; 1 2]+O B[2] x O R \)
36. \( O[4; 3]+O[4; 1 2] \)
37. \( O[5; 1]++f O[1 4] ; \)
38. \( O[6; 1]++f O[1 2] ; \)
39. \( O[7; 1]++f O[2 3] ; \)
40. \( O[8; 1]++f O[3 4] ; \)
41. \( O[9; 1]++f O[6 7 8] ; \)
42. \( S V+V Q, V P, V E, V R, , O[6 7 8] ; \)
43. \( N V+n N, N L , O[5] ; \)
44. \( N V+n N, N L , O[5] ; \)
45. \( S A+(U[2] x M x P), [1] (H x R x (I / U[2 1]), 1), [1] Q[1 4] ; \)
### Table: Variance Analysis

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### Note

SO: 'STATED INVENTORY IS INSUFFICIENT FOR STATED PRODUCTION'
J. MIXVARIANCE

\texttt{\textbackslash v}\texttt{MIXVARIANCE[s;I;W;VP;VM;VY;C;VN;Y}

[1] \texttt{I=0;S=10}

[2] 'ENTER STANDARD INPUT QUANTITY FOLLOWED BY STANDARD COST PER UNIT'

[3] 'FOR EACH INPUT FACTOR, ZERO WILL SIGNAL END OF INPUT FACTORS.'

[4] \texttt{RI:=(0=W+INP 2)/EI}

[5] \texttt{S=S, W}

[6] \texttt{RI}

[7] \texttt{EI:A+S*(((pS*2),2)pS}

[8] 'ENTER ACTUAL INPUT QUANTITY FOLLOWED BY ACTUAL COST PER UNIT'

[9] 'FOR EACH INPUT FACTOR.'

[10] \texttt{AI:I+I+1}

[11] \texttt{A[I;]+INP 2}

[12] \texttt{+(I<1+pS)/AI}

[13] 'ENTER STANDARD YIELD FOLLOWED BY ACTUAL YIELD (IN UNITS)

[14] \texttt{Y+INP 2}

[15] \texttt{VP++/A[;1]*S[;2]-A[;2]}

[16] \texttt{A*A,K/A}

[17] \texttt{S[;1]+S[;1]*C+(/A[;1])*+S[;1]}

[18] \texttt{S+S,A/S}


[20] \texttt{VM+*S[;2]*S[;1]-A[;1]}

[21] \texttt{VN+VP+VM+VY+(+/S[;3])*Y[1])*-/Y[2 1]}

[22] '

[23] 'PRICE VARIANCE IS $';0 \texttt{RND|VP;((VP<0.5)/' UNFAVORABLE')},(VP>0.5)/' FAVORABLE'

[24] 'MIX VARIANCE IS $';0 \texttt{RND|VM;((VM<0.5)/' UNFAVORABLE')},(VM>0.5)/' FAVORABLE'

[25] 'YIELD VARIANCE IS $';0 \texttt{RND|VY;((VY<0.5)/' UNFAVORABLE')},(VY>0.5)/' FAVORABLE'

[26] 'NET VARIANCE IS $';0 \texttt{RND|VN;((VN<0.5)/' UNFAVORABLE')},(VN>0.5)/' FAVORABLE'

\texttt{\textbackslash v}
VARIABLES USED IN COST ACCOUNT

TTA
SALES
VARIABLE COSTS
MARGINAL INCOME
FIXED COSTS
PROFIT

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
TOTAL LABOR
TOTAL OVERHEAD
TOTAL CUMULATIVE COSTS
FINISH BEGINNING W-I-P
UNITS STARTED AND FIN.

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

TTV
BUDGET
EFFICIENCY
CONTROLLABLE
OVERHEAD

NOTE: THE FIRST FIVE COLUMNS OF TTP AND THE FIRST TWO COLUMNS OF TTV ARE BLANK!
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

A. FORECAST
   B. EXTRAPOLATE
   C. SIMULATION
   D. OPTIMIZATION
   E. OPBUDGET

The supporting functions and variables are classified in Exhibit 13-2.
Exhibit 13-2
FORECAST FUNCTIONS & VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTRAPOLATE</td>
<td>MONBUD, YEARFORE,</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>MINPERAV, FOREC,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WTDMOVAV, FORE,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EXPSMOOTH</td>
<td></td>
</tr>
<tr>
<td>SIMULATION</td>
<td>SENSITY</td>
<td>-</td>
</tr>
<tr>
<td>OPTIMIZATION</td>
<td>OUTPUT, NOUTPUT</td>
<td>-</td>
</tr>
<tr>
<td>OPBUDGET</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:

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. Pessimistic.
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 DCT 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

ENTER THE YEARS FOR WHICH YOU HAVE SALES DATA

<table>
<thead>
<tr>
<th>Year</th>
<th>Data (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>1.8 2.1 2</td>
</tr>
<tr>
<td>70</td>
<td>2.1 2.1 1.8</td>
</tr>
<tr>
<td>71</td>
<td>3.2 2.1 1.9</td>
</tr>
<tr>
<td>1</td>
<td>4.2 2.3 2.1</td>
</tr>
<tr>
<td></td>
<td>5.2 2.5 2.4</td>
</tr>
<tr>
<td></td>
<td>6.2 2.5 2.6 2.7</td>
</tr>
<tr>
<td>7</td>
<td>7.2 2.7 2.9</td>
</tr>
<tr>
<td>8</td>
<td>8.2 2.7 2.5 2.7</td>
</tr>
<tr>
<td>9</td>
<td>9.2 2.1 2.2</td>
</tr>
<tr>
<td>10</td>
<td>10.2 1.8 2.2</td>
</tr>
</tbody>
</table>

DO YOU WANT TO SEE THE SUMMARY OF DATA?
YES
### SEASONAL INDEXES AS RATIO-TO-SAME-YEAR-AVERAGE

<table>
<thead>
<tr>
<th>MONTH</th>
<th>ACTUAL MONTHLY SALES (IN MILLIONS)</th>
<th>ACTUAL MONTHLY SALES AS A % OF AVERAGE SALES FOR:</th>
<th>SEASONAL INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>70</td>
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</tr>
<tr>
<td>1</td>
<td>1.80</td>
<td>2.10</td>
<td>2.00</td>
</tr>
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<td>1.60</td>
<td>2.00</td>
<td>1.80</td>
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</tr>
<tr>
<td>9</td>
<td>2.00</td>
<td>1.80</td>
<td>2.20</td>
</tr>
<tr>
<td>10</td>
<td>2.40</td>
<td>2.50</td>
<td>2.40</td>
</tr>
<tr>
<td>11</td>
<td>2.80</td>
<td>2.70</td>
<td>2.70</td>
</tr>
<tr>
<td>12</td>
<td>27.50</td>
<td>27.90</td>
<td>28.00</td>
</tr>
</tbody>
</table>

**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**

\[ 28.6 \]
<table>
<thead>
<tr>
<th>MONTH</th>
<th>AVERAGE MONTHLY SALES (BASED ON YEARLY SALES OF 28.6 MILLION)</th>
<th>INDEX OF SEASONAL VARIATION</th>
<th>MONTHLY FORECAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN.</td>
<td>2.383</td>
<td>0.85</td>
<td>2.02</td>
</tr>
<tr>
<td>FEB.</td>
<td>2.383</td>
<td>0.78</td>
<td>1.85</td>
</tr>
<tr>
<td>MAR.</td>
<td>2.383</td>
<td>0.86</td>
<td>2.06</td>
</tr>
<tr>
<td>APR.</td>
<td>2.383</td>
<td>0.95</td>
<td>2.26</td>
</tr>
<tr>
<td>MAY</td>
<td>2.383</td>
<td>1.06</td>
<td>2.54</td>
</tr>
<tr>
<td>JUNE</td>
<td>2.383</td>
<td>1.12</td>
<td>2.67</td>
</tr>
<tr>
<td>JULY</td>
<td>2.383</td>
<td>1.21</td>
<td>2.88</td>
</tr>
<tr>
<td>AUG.</td>
<td>2.383</td>
<td>1.14</td>
<td>2.71</td>
</tr>
<tr>
<td>SEP.</td>
<td>2.383</td>
<td>0.94</td>
<td>2.23</td>
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<td>OCT.</td>
<td>2.383</td>
<td>0.86</td>
<td>2.06</td>
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<td>NOV.</td>
<td>2.383</td>
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<td>2.50</td>
</tr>
<tr>
<td>DEC.</td>
<td>2.383</td>
<td>1.18</td>
<td>2.81</td>
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</tbody>
</table>

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.

\[\text{[[10]]}\]

HOW MANY MONTHS MOVING AVERAGE YOU ARE USING?

\[\text{[[4]]}\]

ENTER THE SALES FOR JUNE JULY AUG. AND SEP.

\[\text{[[2.9 3.1 2.8 2.3]]}\]
<table>
<thead>
<tr>
<th></th>
<th>JUNE</th>
<th>JULY</th>
<th>AUG.</th>
<th>SEP.</th>
<th>FORECAST FOR OCT.</th>
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</thead>
<tbody>
<tr>
<td>ACTUAL DATA (SEASONALIZED)</td>
<td>2.9</td>
<td>3.1</td>
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</tr>
<tr>
<td>SEASONAL INDEX</td>
<td>1.12</td>
<td>1.21</td>
<td>1.14</td>
<td>0.94</td>
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<tr>
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<td>DESEASONALIZED FORECAST</td>
<td>2.55</td>
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<td>2.2</td>
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</tbody>
</table>

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
ENTER THE WEIGHTS FOR THE LAST PERIODS
\( \square : \)
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
\( \square : \)
30

DO YOU WANT THE SUMMARY?
Yes

<table>
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<tr>
<th>PERIOD</th>
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<th>ACTUAL</th>
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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
0: 13

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>FORECAST</th>
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<tbody>
<tr>
<td>69</td>
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<td>JUNE</td>
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<td>2.346</td>
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<tr>
<td>71</td>
<td>MAY</td>
<td>2.346</td>
</tr>
<tr>
<td>71</td>
<td>JUNE</td>
<td>2.362</td>
</tr>
</tbody>
</table>

DO YOU WANT TO TRY AGAIN?
NO
ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN
C. 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
<table>
<thead>
<tr>
<th>MARKET SIZE</th>
<th>MARKET SHARE</th>
<th>SELLING PRICE</th>
<th>VARIABLE COST</th>
<th>FIXED COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPECTED VALUE</td>
<td>EXPECTED VALUE</td>
<td>EXPECTED VALUE</td>
<td>EXPECTED VALUE</td>
<td>EXPECTED VALUE</td>
</tr>
<tr>
<td>MOST LIKELY</td>
<td>840,000</td>
<td>6.0000</td>
<td>8.00</td>
<td>4.350</td>
</tr>
<tr>
<td>PESSIMISTIC</td>
<td>100,000</td>
<td>0.5000</td>
<td>0.370</td>
<td>15,000</td>
</tr>
<tr>
<td>LOWER QUARTER</td>
<td>345,000</td>
<td>0.5875</td>
<td>0.365</td>
<td>28,250</td>
</tr>
<tr>
<td>MIDDLE</td>
<td>520,000</td>
<td>1.3500</td>
<td>1.440</td>
<td>92,750</td>
</tr>
<tr>
<td>UPPER QUARTER</td>
<td>725,000</td>
<td>5.3375</td>
<td>0.355</td>
<td>12,375</td>
</tr>
<tr>
<td>OPTIMISTIC</td>
<td>160,000</td>
<td>0.8500</td>
<td>0.350</td>
<td>11,500</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2,690,000</strong></td>
<td><strong>14.6250</strong></td>
<td><strong>8.00</strong></td>
<td><strong>7.230</strong></td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>VARIABLE CHANGED</th>
<th>PROFIT</th>
<th>CHANGE</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO CHANGE</td>
<td>55,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MARKET SIZE</td>
<td>-35,000</td>
<td>-90,000</td>
<td>-164</td>
</tr>
<tr>
<td>MARKET SHARE</td>
<td>-50,000</td>
<td>-105,000</td>
<td>-191</td>
</tr>
<tr>
<td>SELLING PRICE</td>
<td>55,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VARIABLE COST</td>
<td>-8,000</td>
<td>-63,000</td>
<td>-115</td>
</tr>
<tr>
<td>FIXED COST</td>
<td>15,000</td>
<td>-40,000</td>
<td>-73</td>
</tr>
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</table>

### SENSITIVITY TO OPTIMISTIC VALUES

<table>
<thead>
<tr>
<th>VARIABLE CHANGED</th>
<th>PROFIT</th>
<th>CHANGE</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO CHANGE</td>
<td>55,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MARKET SIZE</td>
<td>100,000</td>
<td>45,000</td>
<td>82</td>
</tr>
<tr>
<td>MARKET SHARE</td>
<td>97,000</td>
<td>42,000</td>
<td>76</td>
</tr>
<tr>
<td>SELLING PRICE</td>
<td>55,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VARIABLE COST</td>
<td>160,000</td>
<td>105,000</td>
<td>191</td>
</tr>
<tr>
<td>FIXED COST</td>
<td>85,000</td>
<td>30,000</td>
<td>55</td>
</tr>
</tbody>
</table>

**DO YOU WANT TO TRY AGAIN?**

**NO**
D. OPTIMIZATION

ENTER THE COST OF PRODUCING THE ITEM
\[ \cdot .18 \]

ENTER THE PRICE OF THE OLD PRODUCT (E.G., SANDWICH ETC.)
\[ \cdot .25 \]

ENTER THE PRICE OF THE NEW PRODUCT
\[ \cdot .40 \]

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

<table>
<thead>
<tr>
<th>Demand</th>
<th>Probability</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C.V.</td>
<td>E.V.</td>
<td>C.V.</td>
<td>E.V.</td>
<td>C.V.</td>
</tr>
<tr>
<td>1</td>
<td>0.05</td>
<td>0.0700</td>
<td>0.0035</td>
<td>0.1100</td>
<td>0.0055</td>
<td>0.2900</td>
</tr>
<tr>
<td>2</td>
<td>0.25</td>
<td>0.0700</td>
<td>0.0175</td>
<td>0.1400</td>
<td>0.0350</td>
<td>0.0400</td>
</tr>
<tr>
<td>3</td>
<td>0.30</td>
<td>0.0700</td>
<td>0.0210</td>
<td>0.1400</td>
<td>0.0420</td>
<td>0.2100</td>
</tr>
<tr>
<td>4</td>
<td>0.30</td>
<td>0.0700</td>
<td>0.0210</td>
<td>0.1400</td>
<td>0.0420</td>
<td>0.2100</td>
</tr>
<tr>
<td>5</td>
<td>0.10</td>
<td>0.0700</td>
<td>0.0070</td>
<td>0.1400</td>
<td>0.0140</td>
<td>0.2100</td>
</tr>
</tbody>
</table>

**Expected Value**

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0700</td>
<td>0.1275</td>
<td>0.1225</td>
<td>0.0425</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Expected Profit from the New Product

<table>
<thead>
<tr>
<th>Demand</th>
<th>Probability</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C.V.</td>
<td>E.V.</td>
<td>C.V.</td>
<td>E.V.</td>
<td>C.V.</td>
</tr>
<tr>
<td>15</td>
<td>0.10</td>
<td>3.3000</td>
<td>0.3300</td>
<td>3.3700</td>
<td>0.3370</td>
<td>3.4275</td>
</tr>
<tr>
<td>16</td>
<td>0.20</td>
<td>3.3000</td>
<td>0.6600</td>
<td>3.5200</td>
<td>0.7040</td>
<td>3.5900</td>
</tr>
<tr>
<td>17</td>
<td>0.45</td>
<td>3.3000</td>
<td>1.1480</td>
<td>3.5200</td>
<td>1.5840</td>
<td>3.7400</td>
</tr>
<tr>
<td>18</td>
<td>0.15</td>
<td>3.3000</td>
<td>0.4950</td>
<td>3.5200</td>
<td>0.5280</td>
<td>3.7400</td>
</tr>
<tr>
<td>19</td>
<td>0.10</td>
<td>3.3000</td>
<td>0.3300</td>
<td>3.5200</td>
<td>0.3520</td>
<td>3.7400</td>
</tr>
</tbody>
</table>

**Expected Value**

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3000</td>
<td>3.5050</td>
<td>3.6787</td>
<td>3.7762</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>UNITS PER DAY</th>
<th>PROB. OF OCCURENCE</th>
<th>CONDITIONAL VALUE</th>
<th>EXPECTED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.10</td>
<td>41.25</td>
<td>4.1250</td>
</tr>
<tr>
<td>30</td>
<td>0.35</td>
<td>49.50</td>
<td>17.3250</td>
</tr>
<tr>
<td>35</td>
<td>0.20</td>
<td>57.75</td>
<td>11.5500</td>
</tr>
<tr>
<td>40</td>
<td>0.20</td>
<td>66.00</td>
<td>13.2000</td>
</tr>
<tr>
<td>45</td>
<td>0.15</td>
<td>74.25</td>
<td>11.1375</td>
</tr>
</tbody>
</table>

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

OPBUDGET
ENTER THE NAME OF THE PRODUCT (TO END HIT TAB AND RETURN).
FRISBEE
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.
□:
ENTER OVERHEAD VARIABLE RATE AND FIXED AMOUNT

ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).

ENTER THE RATE AND TIME IN MINS.

ENTER OVERHEAD VARIABLE RATE AND FIXED AMOUNT

ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).

ENTER THE RATE AND TIME IN MINS.

ENTER OVERHEAD VARIABLE RATE AND FIXED AMOUNT

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

<table>
<thead>
<tr>
<th>ITEM(S)</th>
<th>UNITS</th>
<th>SELLING PRICE</th>
<th>TOTAL SALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRISBEE</td>
<td>1,000,000.00</td>
<td>0.25</td>
<td>250,000.00</td>
</tr>
<tr>
<td>BALLS</td>
<td>750,000.00</td>
<td>0.30</td>
<td>225,000.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,750,000.00</td>
<td>0.28</td>
<td>481,250.00</td>
</tr>
</tbody>
</table>

ENTER THE BUDGET NEEDED - IF NONE HIT TAB AND RETURN.
**Usage**

**Materials Usage Budget**

<table>
<thead>
<tr>
<th>Material Req.</th>
<th>LB/UNIT</th>
<th>Prods. Lbs</th>
<th>FRISBES</th>
<th>BALLS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foam</td>
<td>0.05</td>
<td>57,500</td>
<td>0.05</td>
<td>43,125</td>
<td>100,625</td>
</tr>
<tr>
<td>Dye</td>
<td>0.03</td>
<td>34,500</td>
<td>0.05</td>
<td>43,125</td>
<td>77,625</td>
</tr>
<tr>
<td>Packaging</td>
<td>0.05</td>
<td>57,500</td>
<td>0.05</td>
<td>43,125</td>
<td>100,625</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>37,950</td>
</tr>
</tbody>
</table>

Enter the budget needed - if none hit Tab and return.

**Pur**

**Materials Purchases Budget**

<table>
<thead>
<tr>
<th>Production Data</th>
<th>Foam</th>
<th>Dye</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Needs</td>
<td>100,625.00</td>
<td>77,625.00</td>
<td>100,625.00</td>
</tr>
<tr>
<td>Planned Balance - Ending Materials Inv.</td>
<td>8,750.00</td>
<td>6,750.00</td>
<td>8,750.00</td>
</tr>
<tr>
<td>Total Needs</td>
<td>109,375.00</td>
<td>84,375.00</td>
<td>109,375.00</td>
</tr>
<tr>
<td>Less: Beginning Inventory</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Purchase Required</td>
<td>109,375.00</td>
<td>84,375.00</td>
<td>109,375.00</td>
</tr>
<tr>
<td>Price Per Unit</td>
<td>0.20</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Cost of Purchases</td>
<td>21,875.00</td>
<td>8,437.50</td>
<td>10,937.50</td>
</tr>
<tr>
<td>Total</td>
<td>41,250.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Enter the budget needed - if none hit Tab and return.
## Direct Labor Cost Budget

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>PRODUCTION</th>
<th>TO T. HRS.</th>
<th>TOTAL</th>
<th>STAMPING</th>
<th>DECORATING</th>
<th>PACKAGING</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRISBEE</td>
<td>1,150,000.00</td>
<td>4,791.67</td>
<td>28,750.00</td>
<td>4,791.67</td>
<td>28,750.00</td>
<td>9,583.33</td>
<td>57,500.00</td>
</tr>
<tr>
<td>BALLS</td>
<td>862,500.00</td>
<td>3,593.75</td>
<td>21,562.50</td>
<td>3,593.75</td>
<td>21,562.50</td>
<td>7,187.50</td>
<td>43,125.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,012,500.00</td>
<td>8,385.42</td>
<td>50,312</td>
<td>8,385.42</td>
<td>50,312</td>
<td>16,771</td>
<td>100,625</td>
</tr>
</tbody>
</table>

Enter the budget needed - if none hit TAB and return.

## Overhead

<table>
<thead>
<tr>
<th>COSTS</th>
<th>STAMPING</th>
<th>DECORATING</th>
<th>PACKAGING</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>VARIABLE OVERHEAD</td>
<td>8,385.42</td>
<td>8,385.42</td>
<td>16,770.83</td>
<td>33,541.67</td>
</tr>
<tr>
<td>FIXED OVERHEAD</td>
<td>10,000.00</td>
<td>10,000.00</td>
<td>10,000.00</td>
<td>30,000.00</td>
</tr>
<tr>
<td>TOTAL OVERHEAD</td>
<td>18,385.42</td>
<td>18,385.42</td>
<td>26,770.83</td>
<td>63,541.67</td>
</tr>
<tr>
<td>DIVIDE BY DIRECT LABOR HOURS</td>
<td>8,385.42</td>
<td>8,385.42</td>
<td>16,770.83</td>
<td>33,541.67</td>
</tr>
<tr>
<td>OVERHEAD PER DIRECT LABOR HOURS</td>
<td>2.19</td>
<td>2.19</td>
<td>1.60</td>
<td>1.99</td>
</tr>
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</table>

Enter the budget needed - if none hit TAB and return.
**PRODUCTION QUOTA BUDGET**

<table>
<thead>
<tr>
<th>ITEM(S)</th>
<th>FRISBEES</th>
<th>BALLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES (IN UNITS)</td>
<td>1,000,000</td>
<td>750,000</td>
</tr>
<tr>
<td>PLANNED BALANCE - FINISHED INVENTORY</td>
<td>100,000</td>
<td>75,000</td>
</tr>
<tr>
<td>PLANNED BALANCE - EQUIVALENT UNITS WIP</td>
<td>50,000</td>
<td>37,500</td>
</tr>
<tr>
<td>TOTAL INVENTORY REQUIRED</td>
<td>1,150,000</td>
<td>862,500</td>
</tr>
<tr>
<td>LESS: BEGINNING FINISHED INVENTORY</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BEGINNING UNITS WORK-IN-PROCESS</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRODUCTION QUOTA</td>
<td>1,150,000</td>
<td>862,500</td>
</tr>
</tbody>
</table>

ENTER THE BUDGET NEEDED - IF NONE HIT **TAB** AND RETURN.

**ENDING FINISHED GOODS INVENTORY BUDGET**

<table>
<thead>
<tr>
<th>ITEM(S)</th>
<th>FRISBEES</th>
<th>BALLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOAM</td>
<td>0.2000</td>
<td>0.0100</td>
</tr>
<tr>
<td>DYE</td>
<td>0.1000</td>
<td>0.0030</td>
</tr>
<tr>
<td>PACKAGING</td>
<td>0.1000</td>
<td>0.0050</td>
</tr>
<tr>
<td>DIRECT LABOR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STAMPING</td>
<td>6.0000</td>
<td>0.0250</td>
</tr>
<tr>
<td>DECORATING</td>
<td>6.0000</td>
<td>0.0250</td>
</tr>
<tr>
<td>PACKAGING</td>
<td>6.0000</td>
<td>0.0500</td>
</tr>
<tr>
<td>OVERHEAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STAMPING</td>
<td>2.1925</td>
<td>0.0042</td>
</tr>
<tr>
<td>DECORATING</td>
<td>2.1925</td>
<td>0.0042</td>
</tr>
<tr>
<td>PACKAGING</td>
<td>1.5963</td>
<td>0.0133</td>
</tr>
<tr>
<td>UNIT COST</td>
<td>0.1496</td>
<td>0.1516</td>
</tr>
<tr>
<td>PLANNED INVENTORY</td>
<td>100,000</td>
<td>75,000</td>
</tr>
<tr>
<td>ENDING FIN. INV.</td>
<td>14,957</td>
<td>11,368</td>
</tr>
<tr>
<td>TOTAL INVENTORY</td>
<td>26,325</td>
<td></td>
</tr>
</tbody>
</table>

ENTER THE BUDGET NEEDED - IF NONE HIT **TAB** AND RETURN.
B. EXTRAPOLATE

\[ \text{VEXTRAPOLATE} \]

1. \[ X' = 2^p_12 \]
2. \[ \text{'ENTER THE YEARS FOR WHICH YOU HAVE SALES DATA'} \]
3. \[ N = p_{PRD} + 1 \]
4. \[ \text{MATRIX} = (12, N+1)_{p0} \]
5. \[ \text{AA} = (((1+2\times N) \times 10) - 42)_{p12} \]
6. \[ \text{AB} = ((S + 5 \times 10) + ((N + 5) - 10))_{p12} \]
7. \[ \text{AD} = ((N + 5 - 8)_{p12}, (AE = ((N + 5) - 6)_{p12}) \]
8. \[ \text{AG} = (AF = ((N + 5 - 4)_{p12}, (AH = ((N + 5) - 9)_{p12}) \]
9. \[ \text{'ENTER THE MONTH AND DATA (IN MILLIONS) FOR THE 'iN;' PERIODS'} \]
10. \[ \text{FORMAT: 1 2.3 4.5 3.4 INSTEAD JAN 2.3 4.5 3.4'} \]
11. \[ \text{BEGIN: 'ENTER THE DATA (TO END TYPE A ZERO)'} \]
12. \[ \rightarrow ((1+2\times N+1)_{p12} = 0)_{\text{/NEXT}} \]
13. \[ \rightarrow ((1+2\times N+1)_{p12}, (p_{p12}) > N+1)_{/ERROR} \]
14. \[ \text{MATRIX} = (1+2\times N+1)_{p12} \]
15. \[ \rightarrow \text{BEGIN} \]
16. \[ \text{NEXT: MAT-MATRIX} [1+1, N] \]
17. \[ Z = \text{MAT} \]
18. \[ \text{MAT} = (12, N)_{p12}(12 \times N)_{p12}(TT \rightarrow /WAT)_{12} \]
19. \[ \text{SI} = (+/WAT_{+}/WAT)_{12}N \]
20. \[ \text{DO YOU WANT TO SEE THE SUMMARY OF DATA?'} \]
21. \[ \rightarrow (Y = 1)_{/SUMMARY} \]
22. \[ \text{MET: 'MONTHLY BUDGET, YEARLY FORECAST OR MIDDLE PER. AVERAGE'} \]
23. \[ \text{'MOVING AVERAGE OR EXPONENTIAL SMOOTHING'} \]
24. \[ \text{METH: 'ENTER THE METHOD OF FORECASTING. IF NONE HIT TAB AND RETURN' } \]
25. \[ \rightarrow (NADV' = 2+3t\times12)_{/M1, M2, M3, M4, M4, 0} \]
26. \[ \rightarrow \text{MET} \]
27. \[ \text{SUMMARY: 2pCR} \]
28. \[ \text{AA, 'SEASONAL INDEXES AS RATIO-TO-SAME-YEAR-AVERAGE'} \]
29. \[ \rightarrow \text{AA} \]
30. \[ \text{AB, 'ACTUAL MONTHLY SALES'} \]
31. \[ \text{AC, 'ACTUAL MONTHLY SALES', AD, 'AS A */ OF', AE,' SEASONAL'} \]
32. \[ \text{AF, 'IN MILLIONS', AG, 'AVERAGE SALES FOR', AH, ' INDEX'} \]
33. \[ \text{MF10F10.10} \Delta \text{MT}(1, 2 \times N)_{p12}(2 \times N)_{p12, PRD}_{12} \text{ (AVERAGE */)} \]
34. \[ \text{'I5, 10F10.12} \Delta \text{MT}(1, 2 \times N)_{p12}(12, MAT + MAT + MAT + SI) \]
35. \[ \rightarrow \text{CR} \]
36. \[ \rightarrow \text{MET} \]
37. \[ \text{ERROR: 'WRONG ENTRY....REENTER'} \]
38. \[ \rightarrow \text{BEGIN} \]
39. \[ \text{M1: MONBUD} \]
40. \[ \rightarrow \text{MET} \]
41. \[ \text{M2: YEARFORE} \]
42. \[ \rightarrow \text{MET} \]
43. \[ \text{M3: MIDDLEAV} \]
44. \[ \rightarrow \text{MET} \]
45. \[ \text{M4: FOREC} \]
46. \[ \rightarrow \text{MET} \]
47. \[ \rightarrow \text{MET} \]
48. \[ \rightarrow \text{MET} \]
49. \[ \rightarrow \text{MET} \]
MONBUD[0]

\[\text{MONBUD;FC;MS;SL} \]

1. Start: Enter the month for which you want the forecast.
2. Use 1 for Jan., 2 for Feb., etc.
3. How many months moving average you are using?
4. Enter the sales for the month and the moving average.
5. Enter the actual data (seasonalized).
6. Enter the deseasonalized forecast.
7. Do you want to try for others?

YEARFORE[0]

\[\text{YEARFORE;FC} \]

1. Start: Enter the forecast of yearly sales.
2. Average monthly sales based on yearly sales seasonal variation.
3. Do you want to try for others?
VMIDPERA[]

VMIDPERA;VM;YS;VNN;B;A;VV;I;J;PK;J;K;FMAST;AX;AY;AZ;AV

13-25

START: 'ENTER THE NUMBER OF MONTHS TO BE USED'

NNN+(B+(A-1)+2)+NN+(pZ)-(A+[])-1

AX+(NN,7)p'

I+1+I=0

FCS+NNO0

TRA:FCS[I]+(+Z[I+1A])+A

→(I=NN)/OUT1

I+I+I

I=1+1+1

→TRA

OUT1;J+K=1

TRB:+(NNN[J]>K12)/NQ1

YC+Y C,FSDK],(NNN[J]=(K+1)x12).FCS[J]

→(J=pNNN)/OUT2

J+K+1

→TRB

NQ1:K+K+1

→TRB

OUT2:NFMAT+((+YC)+3),3)wYC

AY='I4' ΔFMT NFMAT[1]

AZ='A1' ΔFMT MM[NFMAT[2];]

AW='F10,3' ΔFMT NFMAT[3]

2pCR

'YEAR MONTH FORECAST'

AY,AX,AZ,AW

2pCR

'DO YOU WANT TO TRY AGAIN?'

→('Y'=1+0)/START

V

VFOREC[]V

V FOREC

[1] FORE

[2] ST: 'ENTER MOVING AVERAGE OR EXPONENTIAL SMOOTHING'

[3] ←('ME '1+0)/M1,M2,0

[4] →ST


[6] →ST


[8] →ST

V
VWTDMOVAV[]

\[ VWTDMOVAV: PO; RW; LW; FC; M \]
\[ PC+MOS \]
\[ BEGIN: 'DO YOU WANT ONE PLACE OR MULTIPLE PLACE' \]
\[ ->'Y'=1(M)/MUL \]
\[ 'WEIGHT TO BE ASSIGNED TO THE LAST OBSERVATION (AS A PERCENT)' \]
\[ RW+1-LW+1*p[1]*100 \]
\[ FC+((+/PO[(NW-1)])+(NW-1))xRW+PO[NW]*LW \]
\[ FCST: 2pc \]
\[ 'FORECAST FOR THE MONTH 'M[FCP]; ' IS '2 RND FC \]
\[ 2pc \]
\[ 'DO YOU WANT THE OTHER METHOD?' \]
\[ ->('YN'='1M)/BEGIN,0 \]
\[ MULT: 'ENTER THE WEIGHTS FOR THE LAST PERIODS' \]
\[ RW+1+/LW+/1*100 \]
\[ FC+((+/PO[(NW)])+LW+/PO[(NW-pNW)+pLW]*LW \]
\[ +FCST \]

VEXPSMOOTH[]

\[ VEXPSMOOTH: ACT; AL; MOST; FC; I \]
\[ 'ENTER THE PERCENTAGE WEIGHTING TO CURRENT OBSERVATION' \]
\[ ACT+MOS*AL+1*p[1]*100 \]
\[ MOST+MOS*(1-AL) \]
\[ FC+(NW+1)0 \]
\[ FC[I]=MOS[I] \]
\[ I=2 \]
\[ TRA:FC[I]+ACT[I-1]+FC[I-1]*(1-AL) \]
\[ ->(I=0)/NEXT \]
\[ I=I+1 \]
\[ +TRA \]
\[ NEXT: FC[I]+1+(FC[I]*(1-AL)+ACT[I] \]
\[ 'DO YOU WANT THE SUMMARY?' \]
\[ ->('Y'='1M)/SUM \]
\[ 2pc \]
\[ 'THE FORECAST FOR THE PERIOD 'MFCP;' IS 'FC[I+1] \]
\[ 0 \]
\[ SUM: 2pc \]
\[ 'PERIOD FORECAST ACTUAL' \]
\[ 'IS, X5; CI10, X5; CI10' Afmt((C,FCP); FC; MOS) \]
\[ 0 \]

VFORE[]

\[ VFORE \]
\[ M=12 4 p'JAN.FEB.MAR.APR.MAY JUNE JULY AUG.SEP.OCT.NOV.DEC.' \]
\[ 'ENTER THE PERIOD FOR WHICH YOU NEED FORECASTING (E.G., 1 FOR JAN. ETC..)' \]
\[ FCPT=1 \]
\[ 'ENTER THE PAST OBSERVATIONS TO BE USED' \]
\[ C+(D+12+FCP)-NN=1+(NN-pNN) \]
C. SIMULATION

VSIMULATION[1][2][3][4][5][6][7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32][33][34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50]
HELP: EVENT
'ENTER THE MARKET SIZE UNDER EACH CONDITION, FOLLOWED BY THEIR RESPECTIVE'
'PROBABILITY ASSESSMENTS.'
ENTRY
SENS: SENSITY
2pCR
'DO YOU WANT TO TRY AGAIN?'
('Y' = 1) / START

SENSITIVITY

V SENSITIVITY; M; MX; PR1; PR2; A; B; CH1; CH2; PER1; PER2

1. 'NO CHANGE MARKET SIZE MARKET SHARE' 
2. 'SELLING PRICE VARIABLE COST FIXED COST' 
3. N = 6 15 PM 
4. MX=MXX(2x15)-1 
5. ->(MX[2;3]=0)/NXT 
6. MX[3]=6pMX[1;3] 
7. NXT: PR1+PR2+6p0 
8. A+MX[1;1]xMX[1;2]+100 
9. B+MX[1;3]-MX[1;4] 
10. PR1[1]=(AxB)-MX[1;5] 
12. PR1[3]=(MX[1;1]xMX[2;2]xB+100)-MX[1;5] 
13. PR1[4]=(A+MX[2;3]-MX[1;4])-MX[1;5] 
15. PR1[6]=(AxB)-MX[2;5] 
17. PR2[2]=(MX[6;1]xMX[1;2]xB+100)-MX[1;5] 
20. PR2[5]=(A+MX[1;3]-MX[6;4])-MX[1;5] 
22. CH1+PR1-PR1[1] 
23. CH2+PR2-PR2[1] 
24. PER1=(CH1+PR1[1])x100 
25. PER2=(CH2+PR2[1])x100 
26. 2pCR 
27. ' SENSITIVITY TO PESSIMISTIC VALUES', (33pBS), 33p' '-' 
28. 'VARIABLE CHANGED PROFIT CHANGE PERCENT' 
29. ' ' 
30. ('A1' ±PMT M), ('X5,2CI12,X5,I4' ±PMT(PR1;CH1;PER1)) 
31. 1pCR 
32. ' SENSITIVITY TO OPTIMISTIC VALUES', (32pBS), 32p' '-' 
33. 'VARIABLE CHANGED PROFIT CHANGE PERCENT' 
34. ' ' 
35. ('A1' ±PMT M), ('X5,2CI12,X5,I4' ±PMT(PR2;CH2;PER2)) 

V
D. OPTIMIZATION

\texttt{V OPTIMIZATION;B:C;AA;CO;PN;DE1;PR1;PR2;PP;LOP;DE2
[1] B++;  
[2] C++;  
[3] AA++;  
[7] 'ENTER THE DIFFERENT DEMANDS FOR THE OLD PRODUCT'  
[8] DE1+1  
[9] 'ENTER THE CORRESPONDING PROBABILITIES'  
[10] PR1+(pDE1)pO  
[12] LOP+1  
[13] 'ENTER THE DIFFERENT DEMANDS FOR THE NEW PRODUCT'  
[14] DE2+1  
[15] 'ENTER THE CORRESPONDING PROBABILITIES'  
[16] PR2+(pDE2)pD  
[17] 'ENTER THE DIFFERENT PRODUCTION POSSIBILITIES'  
[18] PP+1  
[19] 2pCR  
[20] 'EXPECTED PROFIT FROM THE OLD PRODUCT', (36pBS), 36p'='  
[21] '  
[22] LOP OUTPUT PO,CO,DE1,PR1  
[23] 1pCR  
[24] 'EXPECTED PROFIT FROM THE NEW PRODUCT', (36pBS), 36p'='  
[25] '  
[26] PP OUTPUT PN,CO,DE2,PR2  
[27] 1pCR  
[28] 'DO YOU WANT TO TRY AGAIN?'  
[29] +(Y'=1+!)}/START
VOUTPUT

\[ \n + X \text{ OUTPUT } X;N;DE;K;L;I;J;M;MAT;L;NMAT;N2 \]
\[ N\times(p(2+X))\times2 \]
\[ MAT\times(N,2+2\times N2+2pX)p0 \]
\[ MAT[1]=DE\times N+2+X \]
\[ MAT[2]=(2+X)hX \]
\[ K+L(i+J+J+1+N)+0 \]
\[ TRA\times MAT[M+1(N-N);K]+(N-N)p((-X\times 2)\times DE[I]) \]
\[ \rightarrow(M-N+1)/TRB \]
\[ MAT[2]=2x((N2-J))+((DE[I]xX[2])-DE[J+1(N2-J)]\times X[2]) \]
\[ I=J=J+1+N+1 \]
\[ X+L=L+2 \]
\[ I=I=2 \]
\[ TRC:MAT[I+2]=\times/MAT[I+2-I+1] \]
\[ \rightarrow(I=2+N)/OUT \]
\[ I=I=2 \]
\[ TRC \]
\[ OUT\times 2pCR \]
\[ S+(16P)\times,'A1' \Delta FMT(1,N2\times pAA)pAA \]
\[ NMAT=MAT[2+(2\times N)] \]
\[ '\text{PER PROBA}' \]
\[ 'DAY BILITY' \]
\[ S \]
\[ (16P)\times,'A1' \Delta FMT(1,2xN2\times pB)pB \]
\[ 'I5,X1,F8,2,15M0([M WELL)]p0 020.4' \Delta FMT(MAT[1]';MAT[2]';NMAT) \]
\[ (2pP)\times,'A1' \Delta FMT(1,N2\times pC)pC \]
\[ '\text{EXPECTED VALUE}',10M0([M WELL)]p0 020.4' \Delta FMT(1,N2\times p(\text{FV}+/\text{NMAT}[2\times N2])) \]
\[ 2pCR \]
\[ \n\]
\( V \)

\[ V Y \ N O U T P U T 2 ; N ; N 1 ; D E ; K ; L ; I ; J ; M ; I ; N M A T \]

\[ \begin{array}{l}
[1] \quad N+(p(2+2)) \times 2 \\
[2] \quad M A T+(N, 2+2 \times N) \times p \times 0 \\
[3] \quad M A T[; 1]+D E+N+2+Z \\
[4] \quad M A T[; 2]+(2+N)+Z \\
[5] \quad K+L+2+I+J+1+N+0 \\
[6] \quad T R A: M A T[; N+(N-M)+K]+(N-M)\times(\times 2[; 1]) \times D E[I] \\
[7] \quad \times(M=N-1) / T R B \\
[8] \quad M A T[J, I; L+(2 \times(N-I-J))]+(D E[J] \times / 2[; 2])+(N-I-J)+E V \\
[9] \quad I+J+1+N+M+0 \\
[10] \quad K+L+L+2 \\
[11] \quad \times T R A \\
[12] \quad T R B ; L+2 \\
[13] \quad T R C: M A T[; I; 2]+I \times / M A T[; 2, I+1] \\
[14] \quad \times(I=2 \times N 1) / O U T \\
[15] \quad I+L+2 \\
[16] \quad \times T R C \\
[17] \quad O U T ; 2 \times C R \\
[18] \quad S+(16^{p'} ') \times A 1' \times F M T(1, N 1 \times p A A) \times p A A \\
[19] \quad N M A T+M A T[; 2+1(2 \times N 1)] \\
[20] \quad ' I D E M A N D N, X 2, 10 \times T O 20' \times F M T(1, N 1) \times p Y \\
[21] \quad ' P E R P R O B A-' \\
[22] \quad ' D A Y B I L I T Y' \\
[23] \quad S \\
[24] \quad (16^{p'} ') \times A 1' \times F M T(1, 2 \times N 1 \times o B) \times p B \\
[25] \quad ' I 5, X 1, P 2, 2, 15 M 1(1) R I N [P 10.4' \times F M T(M A T[; 1]; M A T[; 2]; N M A T) \\
[26] \quad (24^{p'} ') \times A 1' \times F M T(1, N 1 \times p C) \times p C \\
[27] \quad ' I E X P E C T E D V A L U E N, 10 M 1(1) R I N [P 20.4' \times F M T(1, N 1) \times p (+/ N M A T[; 2 \times N 1]) \\
[28] \quad 2 \times C R \\
\end{array} \]

\( V \)
\textbf{VDOCT[]V}

\textbf{V DOCT;TRV;TFC;NU;CP;EDP;TEV;EV;CV}

[1] \textbf{START: 'ENTER THE TOTAL REVENUE AND TOTAL VARIABLE EXPENSE PER UNIT'}

[2] \textbf{TRV} \textbf{+2pO}

[3] \textbf{'ENTER THE TOTAL FIXED COSTS'}

[4] \textbf{TFC} \textbf{+1pO}

[5] \textbf{'ENTER THE NUMBER OF UNITS PER DAY (E.G., CARS ETC.,)'}

[6] \textbf{NU+O}

[7] \textbf{'ENTER THE CORRESPONDING PROBABILITIES'}

[8] \textbf{CP} \textbf{+(pNU)}\textbf{pD}

[9] \textbf{EDP} \textbf{+(TEV} \textbf{+/(EV+(NVxTRV(1))-(NVxTRV(2)))xCP)-TFC}

[10] \textbf{'DO YOU WANT THE SUMMARY?'}

[11] \textbf{+('-Y'=1+I))/SUM}

[12] \textbf{'THE EXPECTED DAILY PROFIT IS ' ;2 RND EDP}

[13] \textbf{2pQ}

[14] \textbf{TR:2pQ}

[15] \textbf{'DO YOU WANT TO TRY AGAIN?'}

[16] \textbf{+('-YN'=1+I))/START,0}

[17] \textbf{SUM:2pQ}

[18] \textbf{'}

\textbf{CONDITIONAL}

[19] \textbf{'EXPECTED VALUE', ('F10.4' \textbf{AFMT TEV})}

[20] \textbf{'}

[21] \textbf{'}

[22] \textbf{'}

[23] \textbf{'}

[24] \textbf{'}

[25] \textbf{'}

[26] \textbf{'}

[27] \textbf{TR}
E. OPBUDGET

```fortran
V OPBUDGET(0)

V OPBUDGET(0) PR MAT MRQ LB PT VF PR MAT MRQ LB VF RT M1 M2 M 0 M41 M50 M51 M6 SFP W B WBE PBE N B N SB1 PQB MUB MPB DLCB OHC EFCIB TOT DTOT UC PI EFI PQ 4A 4B MP OR

[1] PR MAT MRQ LB PT VF 10


[3] PR PR PR 20+0

[4] (+(' =1+PR)/NXT

[5] +ST


[7] SFP (2*N) INC 'ENTER SALES FORECAST AND PRICE FOR THE ABOVE'

[8] MBE=0.01*(N,2)p(2+N) INC 'ENTER MATERIAL INVENTORY - BEG. AND END. (AS A PERCENT 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'


[12] FBE=0.01*(N,2)p(2+N) INC 'ENTER FINISHED GOODS INVENTORY - BEG. AND END (AS A PERCENT OF SALES).'


[14] MAT MAT MAT 20+0

[15] (+(' =1+MAT)/NQ1

[16] MRQ MRQ MRQ+(1+N) INC 'ENTER PRICE PER POUND AND MATERIAL REQUIRED FOR ABOVE PRODUCTS (IN POUNDS).'

[17] +NQ

[18] NQ1: 'ENTER THE NAME OF LABOR (TO END HIT TAB AND RETURN).'

[19] LB LB LB 20+0

[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 MAT+(N-((pMAT) 20)-1) 20)pMAT


[26] M50+(NN=(pLB) 20)-1) 20)pLB

[27] M51+(NN,1+N)pRT+((NN,1+N)p 1 60 60

[28] M6+(NN,2)pVF

[29] SB1+(N+1,3)p0


[32] PQB=(7,N)p0

[33] PQB[4;]+PQB[1;]+(PQB[2;]+M2[;1]xSBE[;2]) xPQB[3;]+(PQB[1;]+M2[;1]xSBE[;2])

[34] PQB[4;]+PQB[1;]+(PQB[2;]+M2[;1]xSBE[;2])

[35] PQB[5;]+PQB[1;]+(PQB[2;]+M2[;1]xSBE[;2])

[36] PQB[7;]+PQB[1;]+(PQB[2;]+M2[;1]xSBE[;2])

[37] MUB=(N,3+2*N)p0


[39] MUB[;1+2*N]+M41[;1+N]

[40] TOT++/MUB[;3+2*N]

[41] MFP=(7,N)p0

```
13-34

[43] MPB[4;]←/((N,N)p,M2[;1])×((M,N)p,MBE[;1])×M41[;1+1N]
[44] MPB[5;]←MPB[3;4 ;]
[45] MPB[6;]←MPB[1;1]
[46] MPB[7;]←MPB[5;6 ;]
[47] DLCB←(N,2+2×NN)p0
[48] DLCB[;1+2×NN]+=DLCB[;2×NN]+(M51[;1+1N])×(N,N)p, DLCB[;1]+PQB[;7;]×[(NN,N)p, M51[;1]
[49] DLCB[;2×NN]←/DLCB[;1+2×NN]
[50] DTOT ←/DLCB
[51] OHB←(5,NN)p0
[53] OHB[4;]←DTOT[2×NN]
[54] OHB[5;]←#OHB[3 4 ;]
[55] OTOT←(+/OHB[;4;]),(+/OHB[;5;NN])×NN
[56] EFCIB←((N+2×NN),1+2×N)p0
[57] EFCIB[;1]←M41[;1], M51[;1], OHB[5;]
[58] EFCIB[;2×NN]←(M41[;1+1N],[1] M51[;1+1N]),[1] M51[;1+1N]
[59] EFCIB[;1+2×NN]←EFCIB[;2×NN]×(N,2+2×NN)pEFCIB[;1]
[60] UC←EFCIB[;1+2×N]
[61] PI←M2[;1]×FBE[;2;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] →('ARSVUIN '=-1.2×N)/B1,B2,B3,B4,B5,B6,B7,0
[67] →BUD
[68] B1: 'SALES BUDGET',

[69] M44←((N+1),20)p(.M1), 'TOTAL ITEM(S) UNITS SELLING PRICE TOTAL SALES'  
[70] 'ITEM(S)  UNITS SELLING PRICE TOTAL SALES'  
[71]  ' '  
[72] ('A1' ΔFMT M44),('3CF15.2' ΔFMT SB1)
[73] 1pCR
[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 PQ
[84] 'ITEM(S)';33p ';('A1' ΔFMT(1,20×N)p,M1)
<table>
<thead>
<tr>
<th>MATERIALS USAGE BUDGET</th>
<th>PRODUCTION NEEDS</th>
<th>DIRECT LABOR COST BUDGET</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LB/UNIT</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>PROD. LBS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MATERIAL REQ.</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>7p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>USAGE UNIT COST</strong></td>
<td><strong>PRICE PER UNIT</strong></td>
<td></td>
</tr>
<tr>
<td>30p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COST OF USAGE</strong></td>
<td><strong>COST OF PURCHASES</strong></td>
<td></td>
</tr>
<tr>
<td>30p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRODUCT</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>12p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PROJECT DATA</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>28p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRODUCT</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>12p</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATERIALS PURCHASES BUDGET</th>
<th>OVERHEAD BUDGET</th>
<th>VARIABLE OVERHEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>29+17xN+1p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PURCHASE REQUIRED</strong></td>
<td><strong>TOTAL NEEDS</strong></td>
<td></td>
</tr>
<tr>
<td>1pCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LESS: BEGINNING INVENTORY</strong></td>
<td><strong>PRODUCT</strong></td>
<td></td>
</tr>
<tr>
<td>1pCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRICE PER UNIT</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>1pCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COST OF PURCHASES</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>1pCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRODUCT</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>12p</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
<tr>
<td>15+27xN-1p</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **TOTAL**                   | **TOTAL**       |                  |
| 15+27xN-1p                  |                  |                  |

| **TOTAL**                   | **TOTAL**       |                  |
| 15+27xN-1p                  |                  |                  |

| **TOTAL**                   | **TOTAL**       |                  |
| 15+27xN-1p                  |                  |                  |
END OF FINISHED GOODS INVENTORY BUDGET

AC='UNITS'
AD='REQUIRED AMOUNT'
38p' ;('A1' AFMT(1,20xN)p,M1)
24p' ;('ITEM(S)' ;'COST' ;('A1' AFMT(1,NxP4Q)p4Q)
17p' ;('MATERIALS', (9pBS),9p'
'
('A1' AFMT M40),('10F10.4' AFMT EFCIB[N;])
'
'DIRECT LABOR',(12pBS),12p'
'
('A1' AFMT M50),('10F10.4' AFMT EFCIB[N+1NN;])
'
'OVERHEAD',(8pBS),8p'
'
('A1' AFMT M50),('10F10.4' AFMT EFCIB[N+1NN+1NN;])
'
'UNIT COSTS',X21,10P20.4' AFMT(1,pUC)pUC
'PLANNED INVENTORY',X13,10CI20' AFMT(1,pPI)pPI
'ENDING FIN. INV.',X14,10CI20' AFMT(1,pEFI)pEFI
'
'TOTAL INVENTORY';(15+10xN)p'; ('CI20' AFMT+EFI)
1pCR
→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

A. STATISTICS

   B. STAT
      1. STATRUN
         1. GROUPT
         2. GROUPZ
         3. GROUPCHI
         4. SSIZE

C. GSTAT

The functions and supporting variables for these workspaces are defined further in Exhibit 14-2.
### Exhibit 14-2

**STATISTICAL FUNCTIONS AND VARIABLES**

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATRUN</td>
<td>NORM, BINOM, CHT, CHI, TM, TT, TP, ZZ, ZT, ZM, UGROUP, REGRESS, REG, BASIC, FT, CT</td>
<td>SET, LL, PP, N</td>
</tr>
<tr>
<td>GROUPT</td>
<td>READ</td>
<td>-</td>
</tr>
<tr>
<td>GROUPZ</td>
<td>READ, ZT</td>
<td>-</td>
</tr>
<tr>
<td>GROUPCHI</td>
<td>READ, CHT, NORM, BINOM, UNI</td>
<td>-</td>
</tr>
<tr>
<td>SSIZE</td>
<td>ZT</td>
<td>-</td>
</tr>
</tbody>
</table>

### 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 instruction 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 instruction: 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 accomplished 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 ADDITIONAL 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

<table>
<thead>
<tr>
<th>TERM</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74.000</td>
</tr>
<tr>
<td>2</td>
<td>55.000</td>
</tr>
<tr>
<td>3</td>
<td>72.000</td>
</tr>
<tr>
<td>4</td>
<td>69.000</td>
</tr>
</tbody>
</table>

### Set Number 2

<table>
<thead>
<tr>
<th>TERM</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75.000</td>
</tr>
<tr>
<td>2</td>
<td>78.000</td>
</tr>
<tr>
<td>3</td>
<td>74.000</td>
</tr>
<tr>
<td>4</td>
<td>76.000</td>
</tr>
<tr>
<td>5</td>
<td>72.000</td>
</tr>
</tbody>
</table>

### Set Number 3

<table>
<thead>
<tr>
<th>TERM</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>56.000</td>
</tr>
<tr>
<td>2</td>
<td>55.000</td>
</tr>
<tr>
<td>3</td>
<td>53.000</td>
</tr>
<tr>
<td>4</td>
<td>52.000</td>
</tr>
</tbody>
</table>

**Entry Type:** Q

**Statistical Mode:**

The valid modes are: Enter, Basic, Dispersion, Hypothesis, Regression, and Quit

**Statistical Mode:** B 1 2 3

<table>
<thead>
<tr>
<th>No.</th>
<th>Length</th>
<th>Min</th>
<th>Max</th>
<th>Median</th>
<th>Arithmetic Mean</th>
<th>Geometric Mean</th>
<th>Harmonic Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>65.000</td>
<td>74.000</td>
<td>69.000</td>
<td>70.000</td>
<td>69.917</td>
<td>69.833</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>72.000</td>
<td>78.000</td>
<td>75.000</td>
<td>75.000</td>
<td>74.973</td>
<td>74.947</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>52.000</td>
<td>56.000</td>
<td>53.000</td>
<td>54.000</td>
<td>53.977</td>
<td>53.954</td>
</tr>
</tbody>
</table>

**Statistical Mode:** D 1 2 3
<table>
<thead>
<tr>
<th>NO.</th>
<th>RANGE</th>
<th>AVERAGE</th>
<th>STANDARD DEVIATION</th>
<th>VARIANCE</th>
<th>SKEWNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.000</td>
<td>3.000</td>
<td>3.391</td>
<td>11.500</td>
<td>**********</td>
</tr>
<tr>
<td>2</td>
<td>6.000</td>
<td>1.600</td>
<td>2.000</td>
<td>4.000</td>
<td>**********</td>
</tr>
<tr>
<td>3</td>
<td>4.000</td>
<td>1.500</td>
<td>1.581</td>
<td>2.500</td>
<td>**********</td>
</tr>
</tbody>
</table>

**STATISTICAL MODE:** H
**HYPOTHESIS TYPE:** F 1 2 3
**LEVEL OF SIGNIFICANCE:** .05
**VARIATION BETWEEN CLASSES** | **VARIATION WITHIN CLASSES** | **F-VALUE** | **CRITICAL POINT**
7.60                          | 516.00                        | 4.10        | 67.99

-> ACCEPT <-

**STATISTICAL MODE:** H
**HYPOTHESIS TYPE:** Z 1 2
**LEVEL OF SIGNIFICANCE:** .05
**MEAN 1** | **MEAN 2** | **ST ERROR** | **Z-VALUE** | **CRITICAL 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 TAILED TEST**
**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
(15p0),(30p1),(45p2),10p3
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 STD ERROR OF ESTIMATE IS: 1.975
THE STANDARD ERROR AND T-VALUES OF THE INDEPENDENT VARIABLES ARE:

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>STANDARD ERROR</th>
<th>T-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>1.512</td>
<td>1.230</td>
</tr>
<tr>
<td>X1</td>
<td>0.659</td>
<td>1.203</td>
</tr>
</tbody>
</table>

DO YOU WISH TO SEE A CORRELATION MATRIX? YES
DO YOU WISH A TABLE OF THE ACTUAL VS THE EXPECTED VALUES OF THE DEPENDENT VARIABLE? YES

| PERIOD | ACTUAL | EXPECTED | DIFFERENCE | %/
|--------|--------|----------|------------|---
| 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: O
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

<table>
<thead>
<tr>
<th>LENGTH</th>
<th>ARITH</th>
<th>VARIANCE</th>
<th>STD DEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEAN</td>
<td>20.00</td>
<td>5.10</td>
<td>4.99</td>
</tr>
</tbody>
</table>

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: ?

<table>
<thead>
<tr>
<th>MEAN</th>
<th>S.D.</th>
<th>ST.ERROR</th>
<th>T-VALUE</th>
<th>CRITICAL POINT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.10</td>
<td>2.23</td>
<td>0.51</td>
<td>1.73</td>
<td>5.88</td>
</tr>
</tbody>
</table>

-> 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

<table>
<thead>
<tr>
<th>CLASS NO.</th>
<th>MINIMUM VALUE</th>
<th>MAXIMUM VALUE</th>
<th>CLASS SIZE</th>
<th>AVERAGE VALUE</th>
<th>F(X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.000</td>
<td>2.000</td>
<td>2.000</td>
<td>1.000</td>
<td>2.000</td>
</tr>
<tr>
<td>2</td>
<td>2.000</td>
<td>4.000</td>
<td>5.000</td>
<td>3.000</td>
<td>15.000</td>
</tr>
<tr>
<td>3</td>
<td>4.000</td>
<td>6.000</td>
<td>4.000</td>
<td>5.000</td>
<td>20.000</td>
</tr>
<tr>
<td>4</td>
<td>6.000</td>
<td>8.000</td>
<td>8.000</td>
<td>7.000</td>
<td>56.000</td>
</tr>
</tbody>
</table>

LENGTH | ARITH ANEAN | VARIANCE | STD DEV
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19.00</td>
<td>4.89</td>
<td>4.41</td>
<td>2.10</td>
</tr>
</tbody>
</table>

LEVEL OF SIGNIFICANCE: .05
ONE OR TWO TAILED TEST?
POPULATION MEAN: 5
ENTER POPULATION STANDARD DEVIATION OR ? IF UNKNOWN: ?

<table>
<thead>
<tr>
<th>MEAN</th>
<th>S.D.</th>
<th>ST. ERROR</th>
<th>Z-VALUE</th>
<th>CRITICAL POINT(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.89</td>
<td>2.10</td>
<td>0.49</td>
<td>2.24</td>
<td>3.89 6.11</td>
</tr>
</tbody>
</table>

-> 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
B-1 STATRUN

\[ \text{BSTATRUN}() \]
\[ \text{STATRUN;A} \]

[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 ADDITIONAL INFORMATION'

[2] \[ \text{TOP:}+\text{'EBDHRQ'=A+AKI 'STATISTICAL MODE: '},2pBS)/\text{ENTER,BAS,DISP},HYP,REGRE,0 \]


[4] \[ \rightarrow \text{TOP} \]

[5] \[ \text{ENTER:UGROUP} \]

[6] \[ \rightarrow \text{TOP} \]

[7] \[ \text{BAS:BASIC A} \]

[8] \[ \rightarrow \text{TOP} \]

[9] \[ \text{DISP:DISPS A} \]

[10] \[ \rightarrow \text{TOP} \]

[11] \[ \text{HYP:HYPO} \]

[12] \[ \rightarrow \text{TOP} \]

[13] \[ \text{REGRE:REGRESS A} \]

[14] \[ \rightarrow \text{TOP} \]

\[ \text{VBASIC}() \]
\[ \text{BASIC A;V;J} \]

[1] \[ \rightarrow(\lambda/(O<pV),V+\Delta V I A+(A\rightarrow ')\rightarrow A)/B1 \]

[2] 'THE PROPER FORM OF A BASIC REQUEST IS:
B, FOLLOWED BY A SERIES OF SET NUMBERS'

[3] \[ \rightarrow 0 \]

[4] \[ B1:\rightarrow(\lambda/(O<V),(pLL)\geq V<,\Delta PI A)/B2 \]

[5] 'SET NUMBER OUT OF RANGE'

[6] \[ \rightarrow 0 \]


\[ \begin{array}{cccccc}
\text{NO.} & \text{LENGTH} & \text{MIN} & \text{MAX} & \text{MEDIAN} & \text{ARITH} \\
\text{GEO.} & \text{HARM.} & \text{MEAN} & \text{MEAN} & \text{MEAN} & \text{MEAN} \\
\end{array} \]

[8] \[ B3:J+=((+V\rightarrow pV),((x/V)*pV),\rightarrow(\rightarrow+1E-74),V+SET[PP[V[1]]+vLL[V[1]]]] \]

[9] \[ '214,6F12.3' \text{\Delta FMT}(18 pV[1],LL[V[1]],l/V),(r/V),(l/V),(V\&V)][(pV) \rightarrow 2])J) \]

[10] \[ \rightarrow(0=pV+1+V)/0 \]

[11] \[ \rightarrow B3 \]
VUGROUP[ ]
V UGROUP;E;SET;V;J;J;I
[1] L+LL
[2] E+PE
[3] SET+SET
[4] 'THERE ARE ;(pE);' SETS OF DATA STORED CURRENTLY'
[5] TOP:+('ACDLQS'='1+A+AKI 'ENTRY TYPE; ',2pBS)/ADD,CHANGE,DELETE, LIST,END,SUM
[6] 'THE VALID ENTRIES ARE: ADD,CHANGE,DELETE,LIST, SUMMARY AND QUI T'
[7] +TOP
[8] ADD:+((V/ΔVI A)ν2≠β V+ΔFI A+(A' ')'+A)/ERRA
[10] E+P,(-1+P)''-1+L
[11] L+L,0
[13] UC12:J+10
[14] 'ENTER ;V[2];' VALUES TO BE ADDED TO THE SET NUMBER ';V[1]
[16] SET+(JJ+SET),J,(JJ+P[V[1]]+[L[V[1]]]+SET
[17] JJ+(0,V[1])≤''1+pP)\pJ
[19] E+P+JJ
[20] +(0=pV+2+V)/TOP
[21] +ADD
[22] CHANGE:+((V/ΔVI A)ν3≠β V+FI A+(A' ')'+A)/ERRC
[23] +((pE)≥V[1])/CH1
[24] 'INVALID SET NUMBER'
[25] +TOP
[26] CH1:=(L[V[1]]≥V[3])/CH2
[27] 'INVALID TERM NUMBER REFERENCED'
[28] +TOP
[29] CH2:J+10
[30] 'ENTER ;(J=1+/-V[3 2]);' VALUES'
[31] CH21:+(0=pA+AKI CR.'□: ')/TOP
[32] +(A/ΔVI A)/CH3
[33] 'INVALID NUMERIC ENTRY'
[34] +CH21
[35] CH3:+(J≥(pI)+pV+ΔFI A)/CH4
[36] 'TOO MANY TERMS, PLEASE REENTER LAST LINE'
[37] +CH21
[38] CH4:+(J=(pI)+pV)/CH5
[39] I+I,Y
[40] +CH21
[41] CH5;SET(P[V[1]]+V[2]+0,1/(V[3 2]))''I,Y
[42] +TOP
[43] DELETE:+((V/ΔVI A)ν3≠β V+ΔFI A+(A' ')'+A)/ERRD
[44] +((pE)≥V[1])∧V[1]>0)/D1
[45] 'INVALID SET NUMBER'
[46] +TOP
[48] 'TERM SPECIFIED DOES NOT EXIST'
[49] +TOP
[50] D2;SET+((P[V[1]]+V[2]-1)+SET),(P[V[1]]+V[3])+SET
\[ j+(0,v[1]^2\cdot-1+p_e)/(.-v[3]+2)+1 \]

\[ e^e=j \]

\[ \rightarrow(0\cdot e[v[1]]+e[v[1]]\cdot-1+.-v[3]+2)/d3 \]

\[ l+(v+(v[1]+1)p)/l \]

\[ l^e=v/l \]

\[ d3:+top \]

\[ list:+(v/\Delta v a+(a+'))+/errl \]

\[ \rightarrow((\Delta v)\cdot v),0<v+\Delta f a)/l1 \]

"invalid set number"

\[ top \]

\[ l1:v+set[e[v[1]]+1l[v[1]]] \]

\[ 'set number';v[1];' \]

\[ term value' \]

\[ 'i4,fi0.3' \Delta fmt(((p v),1)\cdot1\cdot v),((p v),1)\cdot v) \]

\[ +(0=p v+1+v)/top \]

\[ l1 \]

\[ sum: 'set length' \]

\[ 'i3,fi0' \Delta fmt(((p l),1)\cdot1\cdot l),((p l),1)\cdot l) \]

\[ top \]

\[ erra: 'the proper form of an add command is: add, set number, no. of terms' \]

\[ top \]

\[ errc: 'the proper form of a change command is:' \]

\[ 'change, set number, first term to change, last term to change' \]

\[ top \]

\[ errd: 'the proper form of a delete command is:' \]

\[ 'delete, set number, first term to delete, last term to delete' \]

\[ top \]

\[ errl: 'the proper form of the list command is:' \]

\[ 'list, set number' \]

\[ top \]

\[ end: set+set \]

\[ ee+e \]

\[ ll+ll \]
\( \text{DISPS}[] \) 
\( \text{DISPS} A; V; S; I \)

1. \( + (A / (0 \times V), V \times \Delta V A \times (A' + A) / D1 \)
2. 'THE PROPER FORM OF A DISPERSION REQUEST IS:
   D, FOLLOWED BY A SERIES OF SET NUMBERS'
3. \( \rightarrow 0 \)
4. \( D1: + (\text{A} / (0 \times V), (V \times \Delta V) A / \text{V}) / D1 \)
5. 'SET NUMBER OUT OF RANGE'
6. \( \rightarrow 0 \)
7. 
   \begin{tabular}{|c|c|c|c|c|}
   \hline
   NO. & RANGE & AVERAGE & STANDARD & VARIANCE & SKEWNESS \\
   \hline
   SS & DEVIATION & DEVIATION & & & \\
   \hline
   \end{tabular}
8. \( D3: + (A + \Delta V) + S + (V + (V + \text{A} + \text{SET} [\text{PE}[V[1]]]) + LL [V[1]])) / 0.5 \)
9. 'I4,4F12.3, X3, F10.2' \( \text{AFPMT}(1 6 \text{V}[1], (/(V + \text{V}))(\text{V}[1], 1), ((/X) \text{V} + \text{V}) + S, VA, I \)
10. \( \rightarrow 0 = p + 1 + V) / 0 \)
11. \( \rightarrow D3 \)

\( \text{HYPO}[] \) 
\( \text{HYPO} V; I; T \)

1. \( H0: + (5 \times T + \text{'T2CF'} I + A + \text{AKI 'HYPOTHESIS TYPE'} ) / L0 \)
2. \( \rightarrow 0, p \text{C 'THE VALID TYPES ARE: }
   \text{T-TEST, Z-TEST, CHI-SQUARE, AND F-TEST'}, CR \)
3. \( L0: + (A / (A + \Delta V) A + (A' + A) / L1 \)
4. \( \rightarrow H0, p \text{C 'INVALID SET NUMBER', CR} \)
5. \( L1: + (A / (V + 0), (A / V + V), (A / (V + \text{V})) A + \text{SET} [\text{PE}[V[1]]]) / L2 \)
6. \( \rightarrow H0, p \text{C 'SET NUMBER OUT OF RANGE', CR} \)
7. \( L2: + (T = 1 2 3 4) / T, Z, \text{CHC, FTC} \)
8. \( \rightarrow H0, p \text{C 'SOMETHING WRONG', CR} \)
9. \( T: + (1 2 = p V) / T1, T3 \)
10. \( \rightarrow H0, p \text{C 'THE PROPER FORM OF A T-TEST REQUEST IS: }
    T, SET NUMBER OR TWO SET NUMBERS', CR \)
11. \( T1: + (T = \text{SET}[\text{PE}[V[1]]]) + LL[V[1]] \)
12. \( \rightarrow 0 \)
13. \( T3: + (T = \text{SET}[\text{PE}[V[1]]]) + LL[V[1]] \)
14. \( \rightarrow 0 \)
15. \( Z: + (1 2 = p V) / Z1, Z2 \)
16. \( \rightarrow H0, p \text{C 'THE PROPER FORM OF A Z-TEST REQUEST IS: }
    Z, SET NUMBER OR TWO SET NUMBERS', CR \)
17. \( Z1: + (Z = \text{SET}[\text{PE}[V[1]]]) + LL[V[1]] \)
18. \( \rightarrow 0 \)
19. \( Z2: + (Z = \text{SET}[\text{PE}[V[1]]]) + LL[V[1]] \)
20. \( \rightarrow 0 \)
21. \( \text{CHC}: + (V / 1 2 = p V) / \text{CH2} \)
22. 'THE PROPER FORM OF A CHI-SQUARE REQUEST IS:
    C, FOLLOWED BY ONE OR TWO SET NUMBERS'
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

THE RESULTING EQUATION IS:

THE SQUARE OF THE MULTIPLE CORR COEFF IS:

THE ST ERROR OF ESTIMATE IS:

THE STANDARD ERROR AND T-VALUES OF THE INDEPENDENT VARIABLES ARE:

STANDARD ERROR T-VALUE

THE ACTUAL VS THE EXPECTED VALUES OF THE DEPENDENT VARIABLE?
[31] FORM COLNAMES 'aPERIODaACTUALaEXPECTEDaDIFFERENCEa0/o ' 
[32] FORM ATMT 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:+O 

\[ \text{\texttt{VCHT[[]]} \text{\texttt{V}}} \] 
\[ \text{\texttt{R+L CSET V;T;VA}} \] 
[1] \[ +(v/A=0, (FE 19) A=22+ \text{\texttt{1 STATTAB'})/L0} \] 
[2] \[ '1 STATTAB' FE 4, (T+(\text{\texttt{11}}) 0, (FE 18) \text{\texttt{10}}, 32948 \] 
[3] \[ \text{\texttt{L1}} \] 
[4] \[ L0: T+(1+A)/FE 18 \] 
[5] \[ L1: +(L2 0.1 0.05 0.001)/L11, L2, L3 \] 
[6] \[ L11: R+(FE 6, T, 5, 32948)[3; V[30]] \] 
[7] \[ \text{\texttt{L0}} \] 
[8] \[ L2: R+VA[2]+((0.1-L)+0.05) \times /VA+, (FE 6, T, 5, 32948)[2 3 ; V] \] 
[9] \[ \text{\texttt{L0}} \] 
[10] \[ L3: R+VA[2]+((0.05-L)+0.049) \times /VA+, (FE 6, T, 5, 32948)[1 2 ; V] \] 

\[ \text{\texttt{VCHI[[]]} \text{\texttt{V}}} \] 
\[ \text{\texttt{CHI B; V1; F1; F2; L}} \] 
[1] \[ L0: +(A/(2\%V), V+AVI B)/L1 \] 
[2] \[ \text{\texttt{L0}}, pV+ 'INVALID SET NUMBER' \] 
[3] \[ L1: +(A/(L)=V), ((pLL)\%V), 0<V+AVI B)/L12 \] 
[4] \[ \text{\texttt{L1}}, pV+ 'INVALID SET NUMBER', CR \] 
[5] \[ L12: +=((pV)1)/DOU \] 
[6] \[ L2: +((4)='UBN' \text{\texttt{D+1+AKI 'ENTER PROBABILITY DISTRIBUTION DESIRED: }}) \] 
[7] \[ \text{\texttt{CR}} \] 
[8] \[ \text{\texttt{ERR}:'DISTRIBUTIONS AVAILABLE ARE: UNIFORM, BINOMIAL, OR NORMAL'}, \] 
[9] \[ \text{\texttt{CR}} \] 
[10] \[ \text{\texttt{L2}} \] 
[11] \[ \text{\texttt{UN}}: F+(F1+LL[V[1]]) \text{\texttt{UNI}F} - E+PRE SET[PP[V[1]]+\text{\texttt{L}}} \text{\texttt{[I+V[1]]}] \] 
[12] \[ \text{\texttt{OUTP}} \] 
[13] \[ \text{\texttt{BI}}: F+(F1+LL[V[1]]) \text{\texttt{BINOM}F} - E+PRE SET[PP[V[1]]+\text{\texttt{L}}} \text{\texttt{[I+V[1]]}] \] 
[14] \[ \text{\texttt{OUTP}} \] 
[15] \[ \text{\texttt{NO}}: F+(F1+LL[V[1]]) \text{\texttt{NORM}F} - E+PRE SET[PP[V[1]]+\text{\texttt{L}}} \text{\texttt{[I+V[1]]}] \] 
[16] \[ \text{\texttt{OUTP}} \] 
[17] \[ \text{\texttt{DOU}}: +=(F1+PRE SET[PP[V[1]]+\text{\texttt{LL}} [V[1]]])[L5] \] 
[18] \[ \text{\texttt{L5}}: +=(20+pF+F1-F2)/\text{\texttt{OUTP}} \]
[19] →(A, Y 'TOO MANY CLASSES, MUST BE LESS THAN 20', CR, 'DO YOU WISH TO RE-SPECIFY?') / DOU
[20] →0
[21] OUTPUT: →(A/(0.001 ≤ L), 0.1 ≤ L ≤ NIP 'ENTER LEVEL OF SIGNIFICANCE:') / L6
[22] →OUTPUT, p™ 'THE VALUE ENTERED MUST BE BETWEEN .001 AND .1', CR
[23] L6: 'Χ²-SQUARED = Σ, Χ F10.3, Χ CRITICAL VALUE IS Σ, Χ F10.3' ΔFMT(1 2 ρ(1++/(F*2)+F1), F2+L ChT(pF)-1)
[24] →(F1 ≤ F2)/ACC
[25] L6, (5p','), '→ REJECT <-'
[26] →0
[27] ACC: LF, (5p','), '→ ACCEPT <-'

\begin{verbatim}
VF1[[]]V
V FT A;N;L1;D1;D2;D;F;W;FV
[1] D+(+/A)pV\((V+;N+\geq \lceil /N\rceil)W+,(A-Q((\lceil /N\rceil);pW)\rho (+/A)\cdot N))+.^
[2] 2
[3] L0:→((0< L), 1≥L+NIP 'LEVEL OF SIGNIFICANCE:') / L1
[4] →L0, p™ 'VALUE SHOULD BE BETWEEN 0.0 AND 1.0', CR
[5] L1: 'VARIATION VARIATION F-VALUE CRITICAL '
[6] 'BTWN CLASSES WITHIN CLASSES POINT'
[7] '4F12.2' ΔFMT(D;W;FV=(L FF D1,D2));F)
[8] →(F=PV)/ACC
[9] LF, (5p','), '→ REJECT <-'
[10] →0
\end{verbatim}

\begin{verbatim}
VZM[[]]V
V ZM B;SE;C;B;C;ME;T
[1] LR+0
[2] L0:→((0< L), 1≥L+NIP 'LEVEL OF SIGNIFICANCE:') / L1
[3] →L0, p™ 'VALUE MUST BE BETWEEN 0.0 AND 1.0'
[5] 0.5
[6] 'MEAN 1 MEAN 2 ST ERROR Z-VALUE CRITICAL '
[7] '4F10.3,2F9.3' ΔFMT(1 6 ρ(ME+(MS C)[2],(MS B)[2])),SE,T, C+
[8] 1 1 \times C)
\end{verbatim}
VTT[1]

V TT B;L;T;C;OT;ME;M;SE;SD:A

[1] LO:-((0-L),1>7+NIP 'LEVEL OF SIGNIFICANCE')/L1
[2] -L0, pTT 'THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0'
[3] L1:-((1+4/OT+(4 3 p'ONETWO1 2 '))=3+AKI 'ONE OR TWO TAILED TES T')/L2
[4] -L1, pTT '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, pTT 'ENTER LEFT OR RIGHT'
[8] L3:+(1=p, M+NIP 'POPULATION MEAN:')/L4
[9] -L3, pTT 'ENTER ONE VALUE'
[10] L4:+('?'*1+A=AKI 'ENTER POPULATION STANDARD DEVIATION: ')/L5
[11] -L6, SD+(MS B)[1]*/(O 1 +pB)*0.5
[12] L5:+(1=AVI A)/L55
[14] L55:~/FI

\[ \begin{align*}
& \text{OF MEAN POINT(S)}' \\
& \text{'6F10.2' A;pMT(1.4+|OT|p)((ME+MS B)[1]+T+T TP} \\
& \text{+pB)*(SE+SD+((pB)0.5))*(OT)+(1 1)} \\
& \text{+(AVI A)/L55}
\end{align*} \]

VZZ[1]

V ZZ B;L;T;C;OT;ME;M;SE;SD:A

[1] LO:-((0-L),1>7+NIP 'LEVEL OF SIGNIFICANCE')/L1
[2] -L0, pTT 'THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0'
[3] L1:-((1+4/OT+(4 3 p'ONETWO1 2 '))=3+AKI 'ONE OR TWO TAILED TES T')/L2
[4] -L1, pTT '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, pTT 'ENTER LEFT OR RIGHT'
[8] L3:+(1=p, M+NIP 'POPULATION MEAN:')/L4
[9] -L3, pTT 'ENTER ONE VALUE'
[10] L4:+('?'*1+A=AKI 'ENTER POPULATION STANDARD DEVIATION OR IF UN

\[ \begin{align*}
& \text{KNOWN:)'/L5}
\end{align*} \]

[11] -L6, SD+(MS B)[1]*/(O 1 +pB)*0.5
[12] L5:+(1=AVI A)/L55
[14] L55:~/FI
[15] L6:MEAN S.D. ST. ERROR Z-VALUE CRITICAL POINT(S)'

\[ \begin{align*}
& \text{'6F10.2' A;pMT(1.4+|OT|p)((ME+MS B)[1] SE, T+C+T+T TP} \\
& \text{+pB)*(SE+SD+((pB)0.5))*(OT)+(1 1)} \\
\end{align*} \]
\[(17) \quad \rightarrow (A/(x \in ME[2]) = (OT) + (-1) 1)/AC\]
\[(18) \quad LE, (5p \cdot '), \rightarrow \text{REJECT} \leftarrow \]
\[(19) \quad +0\]
\[(20) \quad AC; LE, (5p \cdot '), \rightarrow \text{ACCEPT} \leftarrow \]

```
VTP[0]

\( V R+L T P \; V; T; VA \)
[1] \( \rightarrow (V/A + 0, (PE 19) \cdot =22+1 \) \text{STATTAB} /L0
[2] \( '1 \text{STATTAB} \; PE \; 4, (T+((11) < 0, PE 18) < 0), 32948 \)
[3] \( +L1 \)
[4] \( L0; T+((1+A)/PE 18 \)
[5] \( L1; \rightarrow (30 \times V) / \text{LARGE} \)
[6] \( \rightarrow (L2 \; 0.1 \; 0.05 \; 0.001) / L11, L2, L3 \)
[7] \( L11; R+(PE \; 6, T, 4, 32948) [3 ; W] 30 \)
[8] \( +0 \)
[9] \( L2; R+VA[2]+((0.1-L) * 0.05) \times / VA+, (PE \; 6, T, 4, 32948) [2 ; W] 30 \)
[10] \( +0 \)
[11] \( L3; R+VA[2]+((0.05-L) * 0.049) \times / VA+, (PE \; 6, T, 4, 32948) [1 ; W] 30 \)
[12] \( +0 \)
[13] \( \text{LARGE; R+ZT 1, 1-L} \)
```
**C-1 GROUPT**

\[ V \text{GROUPT}[\[\[\]\]V} \]

\[ V \text{ GROUPT} \]

[1] READ
[2] \[ LO: \rightarrow ((0 < L), 1 \rightarrow L + \text{NIP} \ ' \text{LEVEL OF SIGNIFICANCE}')/L1 \]
[3] \[ \rightarrow L0, p \rightarrow ' \text{THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0}' \]
[4] \[ L1: \rightarrow (1 = \rightarrow OT + (4 \rightarrow 3 \rightarrow p \ ' \text{ONETWO1 2 }') \rightarrow = 3 + \text{AKI} ' \text{ONE OR TWO TAILED TEST}' /L2 \]
[5] \[ \rightarrow L1, p \rightarrow ' \text{ENTER ONE, TWO, 1 OR 2', CR} \]
[6] \[ L2: \rightarrow (2 = OT + OT / 1 \ 2 \ 1 \ 2)/L3 \]
[7] \[ L25: \rightarrow (0 = OT + (1 \ 1 \ 0)\rightarrow [' \text{LR}': 1 + \text{AKI} ' \text{LEFT OR RIGHT TEST: }'])/L3 \]
[8] \[ \rightarrow L25, p \rightarrow ' \text{ENTER LEFT OR RIGHT}' \]
[9] \[ L3: \rightarrow (1 = p, m + \text{NIP} ' \text{POPULATION MEAN: }')/L4 \]
[10] \[ \rightarrow L3, p \rightarrow ' \text{ENTER ONE VALUE}' \]
[11] \[ L4: \rightarrow (' ?' \rightarrow + A + \text{AKI} ' \text{ENTER POPULATION STANDARD DEVIATION OR ? IF UN KNOWN:}')/L5 \]
[12] \[ \rightarrow L5, D = + \{4\} x (4/0 \ 1 + \{1\} * 0.5 \]
[13] \[ L5: \rightarrow (1 = \text{AVI A})/L55 \]
[14] \[ \rightarrow L3, p \rightarrow ' \text{ENTER ONE VALUE, OR IF UNKNOWN, ?}' \]
[15] \[ L55: \rightarrow D = + \{A\} \]
[16] \[ L6: ' \text{MEAN S.D. ST.ERROR T-VALUE CRITICAL POINT(S)'} \]
[17] \[ '6F10.2' \rightarrow D = \{A\} \rightarrow \{M = \{1\} / 0 \ 1 + \{1\} * 0.5 \]
[18] \[ L5: \rightarrow L6, D = + \{4\} x (4/0 \ 1 + \{1\} * 0.5 \]
[19] \[ L55: \rightarrow D = + \{A\} \]
[20] \[ L6: ' \text{MEAN S.D. ST.ERROR T-VALUE CRITICAL POINT(S)'} \]

\[ L6: ' \text{MEAN S.D. ST.ERROR T-VALUE CRITICAL POINT(S)'} \]

\[ C-2 GROUPT \]

\[ V \text{GROUPT}[\[\[\]\]V} \]

\[ V \text{ GROUPT} \]

[1] READ
[2] \[ LO: \rightarrow ((0 < L), 1 \rightarrow L + \text{NIP} \ ' \text{LEVEL OF SIGNIFICANCE}')/L1 \]
[3] \[ \rightarrow L0, p \rightarrow ' \text{THE VALUE SHOULD BE BETWEEN 0.0 AND 1.0}' \]
[4] \[ L1: \rightarrow (1 = \rightarrow OT + (4 \rightarrow 3 \rightarrow p \ ' \text{ONETWO1 2 }') \rightarrow = 3 + \text{AKI} ' \text{ONE OR TWO TAILED TEST}' /L2 \]
[5] \[ \rightarrow L1, p \rightarrow ' \text{ENTER ONE, TWO, 1 OR 2', CR} \]
[6] \[ L2: \rightarrow (2 = OT + OT / 1 \ 2 \ 1 \ 2)/L3 \]
[7] \[ L25: \rightarrow (0 = OT + (1 \ 1 \ 0)\rightarrow [' \text{LR}': 1 + \text{AKI} ' \text{LEFT OR RIGHT TEST: }'])/L3 \]
[8] \[ \rightarrow L25, p \rightarrow ' \text{ENTER LEFT OR RIGHT}' \]
[9] \[ L3: \rightarrow (1 = p, m + \text{NIP} ' \text{POPULATION MEAN: }')/L4 \]
[10] \[ \rightarrow L3, p \rightarrow ' \text{ENTER ONE VALUE}' \]
[11] \[ L4: \rightarrow (' ?' \rightarrow + A + \text{AKI} ' \text{ENTER POPULATION STANDARD DEVIATION OR ? IF UN KNOWN:}')/L5 \]
[12] \[ \rightarrow L5, D = + \{4\} x (4/0 \ 1 + \{1\} * 0.5 \]
[13] \[ L5: \rightarrow (1 = \text{AVI A})/L55 \]
[14] \[ \rightarrow L3, p \rightarrow ' \text{ENTER ONE VALUE, OR IF UNKNOWN, ?}' \]
[15] \[ L55: \rightarrow D = + \{A\} \]

\[ C-2 GROUPT \]

\[ V \text{GROUPT}[\[\[\]\]V} \]

\[ V \text{ GROUPT} \]
## MEAN S.D. ST. ERROR Z-VALUE CRITICAL POINT(S)

<table>
<thead>
<tr>
<th>Value</th>
<th>Calculation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6F10.2</td>
<td>$\Delta FMT(1.4+</td>
<td>OT</td>
</tr>
<tr>
<td>(*)</td>
<td>$+(\sqrt{\Sigma-\Sigma(2.2)})=(OT)+(-11)/AC$</td>
<td>Additional calculation</td>
</tr>
<tr>
<td>LE, ($5p'$'), '-&gt; REJECT &lt;-'</td>
<td></td>
<td>Decision based on calculated value</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
C-4 SSIZE

\[ VSSIZE \subset \{ \text{\#} \} \]
\[ VSSIZE \subset M; L; E \]
[1] \( \bar{X} + \text{NIP} \) 'ENTER PRELIMINARY SAMPLE STANDARD DEVIATION'
[2] \( S_0 : (0 < N + \text{NIP} \) 'ENTER PRELIMINARY SAMPLE SIZE') / S1
[3] \( \rightarrow S_0, \rho \subset \) 'SIZE MUST BE GREATER THAN 0'
[4] \( S_1 : ((1 > L), 0 < L + \text{NIP} \) 'ENTER DESIRED LEVEL OF SIGNIFICANCE') / S2
[5] \( \rightarrow S_1, \rho \subset \) 'VALUE MUST BE BETWEEN 0 AND 1'
[6] \( S_2 : \) 'STANDARD ERROR OF PRELIMINARY SAMPLE IS + OR - ' ; \((0.5 \times 2 + (2t_{1,1-L}))\)
[7] \( \bar{X} + \text{NIP} \) 'ENTER DESIRED SAMPLE ERROR '
[8] ' SAMPLE SIZE SHOULD BE ' ; \((2 \times 2 + 2) \times 2) \]
\[ V \]
VREAD[[]]

V READ
[1] LO:+'ENTER NUMBER OF CLASSES:')/L1
[2] →L0,ρM+'ENTER ONE VALUE BETWEEN 1 AND 20',CR
[4] I+1
[5] TAB+ 0 3 ρ0
[6] L2:'ENTER CLASS \( \text{i} \)' VALUES'
[7] →(+/(A+INP 3)[1 2])/L25
[8] →L2,ρQ+'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,ρ((N,1)ρTAB[;3])×D+(N,1)ρ(+/TAB[; 1 2])×2
[12] →(\( \text{A} \)\( \text{Y} \) 'DO YOU WISH TO SEE YOUR INPUT?')/NO
[13] 'CLASS MINIMUM MAXIMUM CLASS AVERAGE \( F(X) \)'
[14] 'NO. VALUE VALUE SIZE VALUE
\( IS,5F10.3 \) \( AFMT((N,1)ρ\!\!N),TAB) \)
[15] 'NO:CR
[17] TAB[;3]×0.5
[18] ' LENGTH ARITH VARIANCE STD DEV'
[19] ' MEAN'
[20] 'F10.2' \( AFMT(1 4 \rho\!\!D) \)

V
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

A. MATHEMATICS
   B. GENOR
      1. ASSIGNMENT
      2. QUEUE
   C. LP
      1. LPENTER
      2. LPRUN
      3. LPEDIT
   D. CPM
      1. CPMENTER
      2. CPHRUN
      3. CPMEDIT
      4. COSTENTER
      5. COSTEDIT
      6. PERTCOST
The functions and supporting variables in these workspaces are defined further in Exhibit 15-2.

**Exhibit 15-2**
MATHEMATICAL FUNCTIONS AND VARIABLES

<table>
<thead>
<tr>
<th>MAJOR FUNCTIONS</th>
<th>SUPPORTING FUNCTIONS</th>
<th>SUPPORTING VARIABLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSIGNMENT</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>QUEUE</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LPENTER</td>
<td>PICK</td>
<td>TABLE</td>
</tr>
<tr>
<td>LPRUN</td>
<td>PICK, EX, ADDN, MM</td>
<td>TABLE</td>
</tr>
<tr>
<td>LPEDIT</td>
<td>LINEEDIT, MM</td>
<td>TABLE</td>
</tr>
<tr>
<td>CPENTER</td>
<td>ENT, COMOUT</td>
<td>TABLE</td>
</tr>
<tr>
<td>CPMRUN</td>
<td>COMOUT, MM, CHK, CRT</td>
<td>TABLE</td>
</tr>
<tr>
<td>CPMEDIT</td>
<td>LINEEDIT, MM</td>
<td>TABLE</td>
</tr>
<tr>
<td>COSTENTER</td>
<td>MM</td>
<td>TABLE, COSTS</td>
</tr>
<tr>
<td>COSTEDIT</td>
<td>LINEEDIT, MM</td>
<td>COSTS</td>
</tr>
<tr>
<td>PERTCOST</td>
<td>CHECK, MM, CHK, COMOUT, COSTS</td>
<td>COSTS, CPM2R, CHECK, PERT</td>
</tr>
</tbody>
</table>

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 program's 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 \( Z = 9X_1 + 10X_2 \)

c. The constraint equations in the form \( 11X_1 + 9X_2 \leq 9900 \).

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 constraint, 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:

```plaintext
)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 alphanumeric name up to 6 characters), the duration time, and the nodes preceding 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 represents 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 CPEDIT 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 CPMPRUN, 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**

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

**WORKER 2**

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>

**WORKER 3**

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
</tr>
</tbody>
</table>

**WORKER 4**

<table>
<thead>
<tr>
<th>Task</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
</tr>
</tbody>
</table>

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

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

C-2 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

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Shadow</th>
<th>LB</th>
<th>Current</th>
<th>UB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.5072E-1</td>
<td>9.0600E3</td>
<td>9.9000E3</td>
<td>1.3200E4</td>
</tr>
<tr>
<td>2</td>
<td>4.2029E-1</td>
<td>6.3000E3</td>
<td>8.4000E3</td>
<td>8.6754E3</td>
</tr>
<tr>
<td>3</td>
<td>0.0000E0</td>
<td>9.1130E3</td>
<td>9.6000E3</td>
<td>7.2370E75</td>
</tr>
</tbody>
</table>

Price

<table>
<thead>
<tr>
<th>Price</th>
<th>PROD1</th>
<th>PROD2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.8333E0</td>
<td>1.2222E1</td>
</tr>
<tr>
<td></td>
<td>7.3636E0</td>
<td>1.5429E1</td>
</tr>
</tbody>
</table>

-> End <-
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 Q 1
   ♣ 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

<table>
<thead>
<tr>
<th>CONSTRAINT</th>
<th>SHADOW</th>
<th>LB</th>
<th>CURRENT</th>
<th>UB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.8852E-1</td>
<td>5.4000E3</td>
<td>6.6000E3</td>
<td>9.0600E3</td>
</tr>
<tr>
<td>2</td>
<td>0.0000E0</td>
<td>7.5934E3</td>
<td>8.4000E3</td>
<td>7.2370E75</td>
</tr>
<tr>
<td>3</td>
<td>2.3770E-1</td>
<td>3.6000E3</td>
<td>9.6000E3</td>
<td>1.1026E4</td>
</tr>
</tbody>
</table>

| 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
[4] C-D 4 A-C
[5] B-D 5 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 CPMPRUN

CPMPRUN
PROJECT CPM EXAMPLE

THE CRITICAL PATH IS
START -> A-C -> C-D -> D-F -> FIN

THE LENGTH OF THE CRITICAL PATH IS 14

<table>
<thead>
<tr>
<th>NODE</th>
<th>DURATION</th>
<th>EARLY START</th>
<th>EARLY FINISH</th>
<th>LATE START</th>
<th>LATE FINISH</th>
<th>TOTAL SLACK</th>
<th>FREE SLACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>START</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>A-B</td>
<td>2.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
<td>3.00</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>A-C</td>
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<td>4.00</td>
<td>0.00</td>
<td>4.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>C-D</td>
<td>4.00</td>
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<td>4.00</td>
<td>8.00</td>
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<tr>
<td>B-D</td>
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<td>8.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>B-E</td>
<td>3.00</td>
<td>2.00</td>
<td>5.00</td>
<td>8.00</td>
<td>11.00</td>
<td>6.00</td>
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</tr>
<tr>
<td>E-F</td>
<td>3.00</td>
<td>5.00</td>
<td>8.00</td>
<td>11.00</td>
<td>14.00</td>
<td>6.00</td>
<td>6.00</td>
</tr>
<tr>
<td>D-F</td>
<td>6.00</td>
<td>8.00</td>
<td>14.00</td>
<td>8.00</td>
<td>14.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>FIN</td>
<td>0.00</td>
<td>14.00</td>
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<td>14.00</td>
<td>14.00</td>
<td>0.00</td>
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</tr>
</tbody>
</table>
D-3 CPMEDIT

CPMEDIT COMMAND
THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT

COMMAND E
[1] START 0
[4] C-D 4 A-C
[5] B-D 5 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
/1

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

<table>
<thead>
<tr>
<th>NODE</th>
<th>DURATION</th>
<th>EARLY START</th>
<th>EARLY FINISH</th>
<th>LATE START</th>
<th>LATE FINISH</th>
<th>TOTAL SLACK</th>
<th>FREE SLACK</th>
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<tbody>
<tr>
<td>START</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>A-B</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>4.00</td>
<td>6.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>A-C</td>
<td>7.00</td>
<td>0.00</td>
<td>7.00</td>
<td>0.00</td>
<td>7.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>C-D</td>
<td>4.00</td>
<td>7.00</td>
<td>11.00</td>
<td>7.00</td>
<td>11.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>B-D</td>
<td>5.00</td>
<td>2.00</td>
<td>7.00</td>
<td>6.00</td>
<td>11.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>B-E</td>
<td>3.00</td>
<td>2.00</td>
<td>5.00</td>
<td>11.00</td>
<td>14.00</td>
<td>9.00</td>
<td>0.00</td>
</tr>
<tr>
<td>E-F</td>
<td>3.00</td>
<td>5.00</td>
<td>8.00</td>
<td>14.00</td>
<td>17.00</td>
<td>9.00</td>
<td>9.00</td>
</tr>
<tr>
<td>D-F</td>
<td>5.00</td>
<td>11.00</td>
<td>17.00</td>
<td>11.00</td>
<td>17.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>FIN</td>
<td>0.00</td>
<td>17.00</td>
<td>17.00</td>
<td>17.00</td>
<td>17.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
CPM ENTER
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, PRECEDEING ACTIVITIES

[1] START 0
[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 COST ENTER

COST ENTER
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
COSTEDIT

COMMAND E
[ 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**

<table>
<thead>
<tr>
<th>NODE</th>
<th>DURATION</th>
<th>EARLY START</th>
<th>EARLY FINISH</th>
<th>LATE START</th>
<th>LATE FINISH</th>
<th>TOTAL SLACK</th>
<th>FREE SLACK</th>
<th>TOTAL FREE SLACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>START</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>A-B</td>
<td>2.00</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>A-C</td>
<td>4.00</td>
<td>0.00</td>
<td>4.00</td>
<td>0.00</td>
<td>4.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>B-E</td>
<td>3.00</td>
<td>2.00</td>
<td>5.00</td>
<td>5.00</td>
<td>8.00</td>
<td>3.00</td>
<td>0.00</td>
<td>3.00</td>
</tr>
<tr>
<td>C-D</td>
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<td>4.00</td>
<td>7.00</td>
<td>4.00</td>
<td>7.00</td>
<td>0.00</td>
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<td>0.00</td>
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<tr>
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<td>0.00</td>
<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
<td>11.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**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

\[ VASSIGNMENT() \]
\[ \downarrow \]
\[ V ASSIGNMENT; L: A, TAB; V: B, Z; RR; R: W, WW; J: JJ; I; JOBS; WORK; TOT; T \]

\[ [1] \] \[ L0: A+LIP 'ENTER NUMBER OF TASKS AND NUMBER OF WORKERS TO COMPLETE TASKS:' \]

\[ [2] \] \[ L2: L+1 \]

\[ [3] \] \[ 'ENTER THE TOTAL COSTS FOR THE '; A[1]; ' TASKS BY WORKER' \]

\[ [4] \] \[ TAB+(0,A[1])p0 \]

\[ [5] \] \[ L3: 'WORKER '; L \]

\[ [6] \] \[ TAB+TAB, [1](A)pINP 1, A \]

\[ [7] \] \[ +(A+L+L+1)/L3 \]

\[ [8] \] \[ STAB+TAB \]

\[ [9] \] \[ TAB+(TAB-(q(A,A)pL)/TAB) \]

\[ [10] \] \[ TAB+(TAB-(A,A)pL)/TAB \]

\[ [11] \] \[ LP: V+2S+Z+O=TAB \]

\[ [12] \] \[ Z[(B+2S+Z)/(V/A)]+0 \]

\[ [13] \] \[ Z[(V/A)]+0 \]

\[ [14] \] \[ +(A+V,B, Z)/SOL \]

\[ [15] \] \[ TAB[(J+L)+TAB, (J+(V/A)); L+B/A]+MIN+J/TAB \]

\[ [16] \] \[ RR+, TAB \]

\[ [17] \] \[ R+(A,A)+1 \]

\[ [18] \] \[ R[(V/A)]+0 \]

\[ [19] \] \[ R[(B/A)]+0 \]

\[ [20] \] \[ RR[R]-HR[R]+(, R)/(A×A)-MIN \]

\[ [21] \] \[ TAB+(A,A)pRR \]

\[ [22] \] \[ +LP \]

\[ [23] \] \[ SOL: W+JOBS+1pWORK+(A)p0 \]

\[ [24] \] \[ LP2:L+1 \]

\[ [25] \] \[ LP25: (+0×pJ+(JJ+I=+2+0=TAB)/(1+pTAB))/LP3 \]

\[ [26] \] \[ +((1+pTAB)×I+I+1)/LP25 \]

\[ [27] \] \[ LP3: WORK[(W(WW+(-@ΩZ[J]+1)]+JOBS[J]] \]

\[ [28] \] \[ +(A/0×WORK)/FIN \]

\[ [29] \] \[ TAB+(~J)/TAB \]

\[ [30] \] \[ JOBS+(~JJ)/JOBS \]

\[ [31] \] \[ TAB+(~(1+pTAB)×W)+TAB \]

\[ [32] \] \[ W+(~(1×W)×WW)/W \]

\[ [33] \] \[ +LP2 \]

\[ [34] \] \[ FIN: J+WORK \]

\[ [35] \] \[ TOT+0 \]

\[ [36] \] \[ I+1 \]


\[ [38] \] \[ TOT+TOT+STAB[I; J[I]] \]

\[ [39] \] \[ +(Az+I+1)/L6 \]

\[ [40] \] \[ 'P TOTAL COST IS $24.2' AFMT TOT \]

\[ [41] \] \[ ERR:+0 \]
B-2 QUEUE

\( \text{VQUEUE[]V} \)

\( \text{V QUEUE} \)

\[ \text{L1: 'ENTER ARRIVAL RATE AND SERVICE RATE: '} \]

\[ \text{1,0}\text{ENTER TWO POSITIVE NUMBERS REPRESENTING ARRIVAL RATES AND SERVICE RATES', CR} \]

\[ \text{L1: 'LENGTH OF QUEUE IS: '} (\text{A[1]} \times \text{A[1]}) + \text{S} \times \text{A[2]} \times \text{1} / \text{A[2 1]} \]

\[ \text{AVERAGE WAITING TIME IN QUEUE IS: '} \text{A[1]} \times \text{S} \]

\[ \text{AVERAGE WAITING TIME IN QUEUE AND SERVICE IS: '} \text{S} / \text{A[2 1]} \]

\( \text{V} \)
C-1 LPENTER

\verbatiminput{C-1_LPENTER}

C-2 LPRUN

\[ \text{LPRUN}[] \]

1. \( S \gets (S + 0) \)
2. \( S \gets 0 \)
3. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
4. \'PROBLEM HAS NOT BEEN DEFINED.' CR/exec \'EXECUTE \text{LPENTER} \text{TO ENTER PROBLEM}''
5. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
6. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
7. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
8. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
9. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
10. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
11. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
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14. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
15. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
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18. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
19. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
20. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
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41. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
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46. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
47. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
48. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
49. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
50. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
51. \((0 + 2 + \text{ami TABLE}) / \text{CONT1} \)
THE OPTIMAL VALUE OF THE OBJECTIVE FUNCTION IS: \$F_{10.3}\$

THE VARIABLES IN THE SOLUTION ARE: \$E_{2}, E_{12.5}\$

DO YOU WISH SENSITIVITY ANALYSIS? /

THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT'
\textproc{V}PICK[\ ]V
\textproc{V}R+PICK IN

[1] \(+(1+/IN\in\text{BAD})/4\)
[2] 'AN ILLEGAL CHARACTER WAS USED IN THIS EQUATION'
[3] +R=0
[4] \(A1+IN\in\text{ALPHA}\)
[5] \(F+(V\backslash(V+\neg(A2\cdot A0,-1\cdot A2))/A2+IN\in\text{ALPHA})/\wp A+IN+,IN\)
[6] \(E+((1+A3+IN\in'+-''),1)/\wp IN\)
[7] \(+(\wp E)=\wp F)/10\)
[8] 'THE SYNTAX IS IMPROPER'
[9] +R=0
[10] \(+(0=\wp A+((2+\neg 1,-1+E)=F)/F))/16\)
[11] \(AA+((\wp A)+\wp IN)p1\)
[12] \(AA[\Delta+(0,\neg 1+\wp A)+\Delta]+0\)
[13] \(IN+AA\backslash IN\)
[14] \(IN[\Delta]+'1'\)
[15] +4
[16] \(C+1/IN+1+E-F\)
[17] \(A4+((A1+(\wp F,\geq(\wp IN))\wp F,\leq(\wp IN)))/IN\)
[18] \(M+((\wp H),6,\wp (\wp H),\geq(16))\backslash A4\)
[19] \(A((A1/A3)/\wp IN)+'1'\)
[20] \(0,R+\wp T+(\Delta F I A)^{-1}(-(\wp H)+'\ast(A3)/IN\)
\textproc{V}
VADDN[]

V ADDN Z
[1] SLaS-SLaS,[[1] 6+(3 3 p'SURARTSLK'[(2+Z);], '0123456789'[((1+1
10*(L-2))p10)\tau(L-1)]

VEX[]

V R=EX N
[1] \rightarrow(=0)/CONT1
[2] R=((-1+(pMAT)[2])p1), 0, 1
[3] MAT\rightarrow\overline{MAT}
[4] S=S+1
[5] CONT1:R=((-1+(pMAT)[2])p1)
[6] R=+(v/ZACTA.=QM), ((S-W)p0), (Wp1), 1

VLINEEDIT[]

V Z=LNEEDIT A;W;I
[1] Z=(W='0123456789ABCDPHELGHIJKLMN'\times5+(pA)\times\overline{W})-I+2\geq10
[2] V=((-4+(W\times-2)+(W\times24)\times5\times(W-9), 0)\times1-4+pA), -4+pA
[3] Z=5p1
[4] L2:Z+Z, (V[I]-V[I-1])p1, W[V[I]]p0
[5] \rightarrow((pV)\times I+I+1)//L2
[6] \rightarrow((-Z(5p0), 1+\overline{W}<0)\times Z\overline{A}
[7] \rightarrow((\overline{W}\times Z+5+\overline{W})//0

VMM[]

V R=CH MM MT;G
[1] R=+\overline{MT}=CH)\times pMT
[2] \rightarrow((R+R-1, 1+1R)
[3] \rightarrow(\overline{MT}=CH)\times MT
[4] R=+(pR), G(p, R*\geq G)\times(\overline{MT}=CH)\times MT
[15] \( LP2 := ((N-1)\times \varphi_V) / (, \text{TAB}((, \text{PREDESS}[I2;] = 1) / \text{TAB}[3]) - , \text{TAB}[I2+1+p \text{V}; 3]) / LP2 \)

[16] \( \text{TAB}[; 7] := \varphi_V, 0 \)


[18] \( \text{TAB}[; 8] := \text{TAB}[; 5] + \text{Z} + \text{L-LIM} + \text{TAB}[; 3] \)

\[ \forall C \text{R} \]

\[ \forall \text{LINEEDIT}[] \text{R} \]

\[ \forall \text{VMEM}[] \text{R} \]

\[ \forall \text{R} \text{CH} \text{MM MT G} \]

\[ \forall \text{R} \text{CH} \text{MM MT G} \]

\[ \forall \text{R} \text{CH} \text{MM MT G} \]

\[ \forall \text{R} \text{CH} \text{MM MT G} \]
D-1 CPMENTER

VCMPENTER[0]v

\n
CPMENTER

1 ZACT+ 0 0 9'
2 EA, TABLE+ 0 0 0 0
3 \( O=p \) PROJECT-AKI 'ENTER PROJECT TITLE ')/O
4 EA+YN 'DO YOU WANT TO USE THE LONG FORM OF EXPECTED TIME?'
5 INSTR[(-) ;]
6 IN:+(0=pC+AVI ENT+COMOUT)/O
7 \( \{0/(0 1 ,((2\times ID) p1),(0\times 2 \times pC,p0)=C) /PUT
8 'THE ENTRY FORM SHOULD BE:'
9 'ACTIVITY TITLE, EXPECTED TIME(S), ACTIVITY(S) PRECEEDING'
10 'THIS ACTIVITY'
11 \( \rightarrow \) IN
12 PUT:+(\~V/ZACTA.=NEXT+6+(ENT\' ') \( \times \) ENT)/GOOD
13 'THIS ACTIVITY HAS ALREADY BEEN ENTERED'
14 \( \rightarrow \) IN
15 GOOD:+ZACT+ZACT, [1] NEXT
16 \( (0<l=1) / ) \( \times \) TABLE)/ADD
17 TABLE+TABLE+.((1+p TABLE),[2] p9
18 U=0
19 ADD:+TABLE+TABLE, [1] ENT,(U) p9
20 N+N+1
21 \( \rightarrow \) IN

\n
D-2 CPMRUN

\n
VCMPRUN[0]v

\n
CPMRUN

1 ENDP++N+1+TABLE
2 \R=0
3 RES+:+(\( R=1 2 ) ) /CPM0, CPM2
4 ZACT+ 0 0 9'
5 PREDESS+(0, \( N ) p 0
6 T+1 0
7 \( I=0
8 \( \rightarrow \) (.)/RD2
9 READ:+(N<\( I+I+1 ) ) /COMPUTE
10 A+TABLE[\( I;],', '
11 CPM0+:+(CHECK A ) /READ
12 T[J]+1+AFI A
13 A+(A\' ')\( \times \) A
14 \( \rightarrow \) CPM2
15 RD2:+(N<\( I+I+1 ) ) /COMPUTE
16 A+TABLE[\( I;],', '
17 CPM4+:+(CHECK A ) /RD2
18 T[J]+ (+/ 1 4 1 \times 3+AFI A) \times 6
19 A+(A\' ')\( \times \) pA)[3]+ A
20 CPM2:X+1 0
21 CPM3+:+(A/A\' ') \( \times \) BACK
22 \( \rightarrow \) (\( \times \) J\( \times \) ZACTA.=PR\( \times \) PRE+6p((I+A\' ') \( \times \) A),6p ' ) /MATCH
23 ZACT+ZACT, [1] 1 6 p PRE
24 PREDESS+PREDESS, [1](\( 1, N ) p 0
25 JW+(\( p T+T, 0 ) =1 1+p ZACT
MATCH: X+X, JJ/1+1 p ZACT
A+I+A
→ CPN3
BACK: PREDESS[J; X]+1
→ ((E+1)=12)/READ, RD2
COMPUTE: OR+/0
PREDESS+&PREDESS
V+Np1
V[I2+(V\:\\sim)(1 V/V[1] PREDESS);1]+0
→ (N>OR+OR, I2)/34
PREDESS+PREDESS[OR;OR]
TAB=(N,1)pT[OR]), (N,6)p 0
V+ip0
MA1:=(N>OR+V, [1 V[J]+TAB((J+(,PREDESS[1+OR V]=1)/N);1))/MA1
TAB[;2]+V
TAB[;3]+TAB[;1 2]
TAB[;6]+TAB[;4 2]
TAB[;5]+V
TAB[;4]+TAB[; 5 1]
TAB[;6]+TAB[; 4 2]
V+0
MA2:=(N>OR+V, [1 V[I1+(OR V)]-TAB(1+(,PREDESS[N-OR V]=1)/N);1]), V
MA2)
TAB[;7]+V,0
CP+(,TAB[;6]=0)/N
LIM=/TAB[;3]
(30p') ',PROJECT ',PROJECT, 4p CR
'THE CRITICAL PATH IS'
' THE LENGTH OF THE CRITICAL PATH IS ';LIM
' '
NODE DURATION EARLY EARLY LATE LATE TOTAL
FREE START FINISH START FINISH SLACK

ZACT[OR;],('X1,8F9.2' \afmt TAB)
D-3 CPMEDIT

\[\text{VCPMEDIT}[\text{V}] \text{v}\]
\[\text{VCPMEDIT;}\text{TT};\text{E};\text{LL};\text{TT}\]

1. \[N+1+\text{TT}+\text{TABLE}\]
2. \[\text{TT}+(\text{E}+\text{E}+1+\text{TT})-(\text{TT}=\text{TT})/\text{TT}\]
3. \[\text{E}+(\text{E}+1+\text{E}+1+\text{E})+(\text{E}+1+\text{E})\text{P}L\]
4. \[\text{LP}10:=(\text{E}+\text{E}+1+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}L\]
5. \[\text{LP}10;\text{O}+\text{O}+\text{O}+\text{O};\text{THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT}\]

COSTENTER

\[\text{VCOSTENTER}[\text{V}] \text{v}\]
\[\text{VCOSTENTER}\]

1. \[\text{COSTS}+0\]
2. \['\text{ENTER COST DISTRIBUTION FOR EACH OF THE FOLLOWING ACTIVITIES'}\]
3. \['\text{THE PROPER ENTRY FORM IS: ORIGINAL COST, TIME INCREMENT, INCREASE IN COST, ETC.}']
4. \[I+1\]
5. \[\text{P}1:=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}15\]
6. \[\text{P}15:=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}2\]
7. \[\text{P}2:=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}2\]
8. \[\text{P}3:=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}3\]
9. \[\text{CALC:}=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}1\]
10. \[\text{CALC:}=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}1\]
11. \[\text{CALC:}=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}1\]
12. \[\text{P}3:=(\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E}+\text{E})/\text{P}1\]

\[\text{v}\]
\textbf{D-5 COSTEDIT}

\begin{verbatim}
\texttt{\v{C}OSTEDIT[\ powsta\v{c}]]}
\texttt{\v{C}OSTEDIT;TT;\v{E}L;TT;\v{W};LL}
[1] \texttt{\v{N}+1=TT+\text{CR MM COSTS}}
[2] \texttt{TT+((L+1+\v{E}pTT)-(TT=1)'1l)+@1+pTT)/TT}
[3] \texttt{\v{E}+(\v{L}+)/((\v{W}+)/((\v{N}+)/\v{W}))}\v{W}L}
[4] \texttt{LP10:=(\text{PADCQ}=1+A+AKI \ 'COMMAND -',2\text{BS}/PR,ADD,DEL,CHANGE,END}
[5] \texttt{LP10,0+\text{THE OPTIONS ARE: ADD, CHANGE, DELETE, PRINT AND QUIT}}
[6] \texttt{',CR}
[7] \texttt{PR:(\text{PT}[\v{I}3,\v{W}]}\v{W} \ 'AFMT\v{W}(\v{N}),(\v{W}+/\v{L})\v{W}(.\v{L}+rz:1/\v{L})/TT}
[8] \texttt{LP10}
[9] \texttt{CHANGE:=(\v{L}O=\v{L}L+1+\v{E}FI A+(A+ ') \ '+A)/CH2}
[10] \texttt{LNERR:LP10,0+\text{IMPROPER LINE NUMBER}}
[11] \texttt{CH2:=(\v{L}+)/((\v{L}LLL)/LL),LL=/LNERR}
[12] \texttt{TT+=(\v{L}LL)+TT,(T+LINEEDIT T),\v{L}[LL]+1+TT}
[13] \texttt{\v{P}[LL+1]+\v{P}[LL+1]-LL[LL]-\v{P}T}
[14] \texttt{LL[LL]+\v{P}T}
[15] \texttt{LP10}
[16] \texttt{DEL:=(\v{L}O=\v{L}L+2+\v{E}FI A+(A+ ') \ '+A)/LNERR}
[17] \texttt{TT+=(\v{L}LL[1]+TT),\v{P}[1+LL[2]]+TT}
[18] \texttt{\v{W}+\v{P}E-1+\v{P}E1-(\v{L}LL[1]+\v{LL}[2]+1)/E}
[19] \texttt{\v{L}LL+E}
[20] \texttt{LP10}
[21] \texttt{ADD:TT+TT,T+AKI,\text{PT}[\v{I}3,\v{W}]}\v{W} \ 'AFMT \v{W}+\v{W}+1}
[22] \texttt{\v{P}E,-1+\v{P}E-1+\v{L}+LL+\v{E}T}
[23] \texttt{LP10}
[24] \texttt{END:TT+(\v{N}+\v{E}TT)+\v{W}1}
[25] \texttt{TT[1+\v{E}pTT]+\v{W}]+0}
[26] \texttt{COSTS+TT}
[27] \texttt{COSTS[\v{~}TT]/pCOSTS}+\text{CR}
\end{verbatim}
[52] MA1:+((N-pV-V,1/V[;j]+TAB[(j+,PREDESS[;1+pV]=1)/;N];1]])/MA1
[53] TAB[;2]=V
[54] TAB[;3]=/TAB[;1 2]
[55] V=1pTAB[;N;3]
[56] MA2:+((N-pV-V,1/V[;I1+(pV)-N]-TAB[(I1+,PREDESS[;N-pV]=1)/;N];1]),V

[57] TAB[;5]=V
[58] TAB[;4]=/TAB[;5 1]
[59] TAB[;6]=/TAB[;4 2]
[60] V=0
[61] MA3:+((N-1)-pV+V,1/((.TAB[((.PREDESS[I2]=1)/;N];2])-TAB[(I2+1+p
V);3])/MA3
[62] TAB[;7]=V,0
[63] CP+,TAB[;6]=0)/;N
[64] TAB[;8]=TAB[;6]+2+L-LIM+/TAB[;3]
[65] +(L>LIM)/OUTPUT
[66] PERT

[67] OUTPUT:CPM2R
[68] CP+CRT(,TAB[;6]=0)/;N
[69] (40p', 'PROJECT,CR,CR
[70] 'THE CRITICAL PATH IS'
[71] '
[72] NOS,ZACT[OR[CP]]; ((pCP),4p((4x-1+pCP)p' -> '),',
[73] '
[74] 'THE LENGTH OF THE CRITICAL PATH IS ';LIM
[75] '
[76] 'THE TOTAL FREE SLACK IS ';L
[77] '
[78] 'NODE DURATION EARLY EARLY LATE LATE TOTAL FREE TOTAL FREE

FREE START FINISH START FINISH SLACK SLACK

[79] ZACT[OR;], ('X1,6P9.2' AFMT TAB)
[80] CR
[81] 'ACTIVITY ORIGINAL COST OPTIMIZED COST'
[82] ZACT[OR;], ('X5,2P10.2' AFMT((2, (pCOST), pOCOST, COST))
[83] 'TOTAL INCREASE IN COST';P9.2' AFMT+/COST-OCOST
[84] ERR=0
[85] UNsolve=O
[86] SUSERR:'THERE IS A NODE DEFINED AS PRECEEDING ANOTHER THAT DOES NOT EXIST'
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