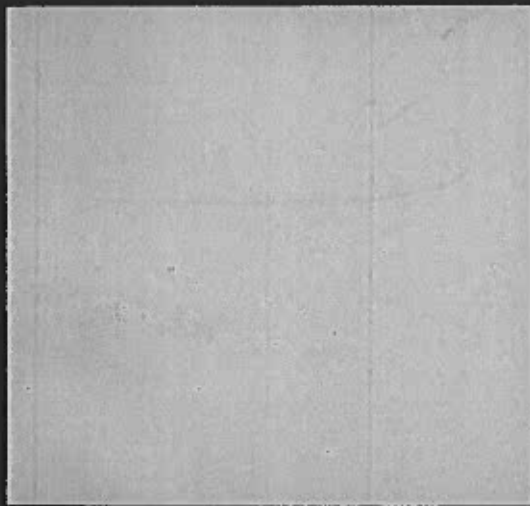TEXAS INSTRUMENTS **SOLID STATE SOFTWARE™ CARTRIDGE**

FINANCE

ADDENDUM

p. 2 The second sentence in the Directory Program section should read as follows.

It is accessed by entering **RUN "DIR"** or **RUN "CONTENTS"**.

p. 99 The second sentence of the introduction to Example 1 should read as follows.

The savings account earns 6% continuous interest.

p. 99 Ordinarily, compounding schedules are used to determine the principal and interest portions of payments that are made on a loan or debt. Example 1 of the Money Evaluator program demonstrates how to compute a compounding schedule for a savings account instead of a loan. Since the future value (balance) of a savings account increases instead of decreasing as it does with a loan, the future value of the savings account must be entered as a negative number. The interest payments are then output as negative values since they are actually additions to the balance. This procedure is illustrated for an ordinary annuity situation in steps 19 through 34 of Example 1.

TEXAS INSTRUMENTS SOLID STATE SOFTWARE™ CARTRIDGE

FINANCE

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Table of Contents

(continued)

Table of Contents (continued)

Introduction

The Finance Library is an interchangeable *Solid State Software*™ cartridge that contains nine
professionally written, easy-to-use programs chosen to serve a broad range of financial applications.
The nine programs require little or no programming knowledge or experience to use, and allow you to
begin taking advantage of the power of your computer immediately. Other *Solid State Software*
cartridges are available and can be obtained from most TI retailers or ordered directly from Texas
Instruments.

Using this Manual

One section of this manual is devoted to each library program. The most important part of each
section is the User Instructions which explain the operation of the program. The User Instructions
have a special format designed to provide a maximum of information with a minimum of words. The
first few times that you run a library program, you may wish to follow the User Instructions step-by-
step. Once you are familiar with a program, you may only need to use these instructions as a
reference. The extensive self-explanatory prompting built into the programs minimizes the need to
carry instructions with the computer.

Examples are given for each program to illustrate its capabilities and requirements. The examples also
allow you to check your cartridge by comparing your answers to those shown in this manual. Where
more than one example is given in a section, it is a good practice to work the examples consecutively.

There is an appendix in the back of this manual which lists the user accessible subprograms found
within the programs of this library. They contain many of the common and useful routines which may
be very helpful to you when writing your own programs.

Using Library Programs

The following sections discuss the Directory/Contents program and a few general guidelines for
running the programs in this library.

Directory Program

The names of the programs in this library are listed in the Directory program. It is accessed by entering RUN "CONTENTS". The program displays two names for each program—the long name which is the descriptive title of the program and the short name which is used to call the program for execution. For example, the long name for the last program in this library is MONEY EVALUATOR and its short name is "MEVAL". To run this program, type RUN "MEVAL" and press [ENTER].

There are four editing keys used to display the names in the directory.

UP arrow   displays the previous long name in the directory. If the first program name is being displayed, the directory program is exited.

DOWN arrow displays the next long name in the directory. If the last program name is being displayed, the directory program is exited.

RIGHT arrow displays the short name of a program if the long name is in the display. If a short name is in the display, the key is ignored.

LEFT arrow   displays the long name of a program if the short name is in the display. If a long name is in the display, the key is ignored.

User Instructions—Directory/Contents

Select the Directory program by entering RUN "CONTENTS".

Step	Display	Procedure/Comment	Goto
1.	FINANCE LIBRARY	Cartridge name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Long program name	Displays long program name.	5
5.		a. To see short name of same program, press right arrow.	6
		b. To see long name of previous program, press up arrow.	4
		c. To see long name of next program, press down arrow.	4
6.	Short program name	Displays short program name.	7
7.		a. To see long name of same program, press left arrow.	4
		b. To see long name of previous program, press up arrow.	4
		c. To see long name of next program, press down arrow.	4

General Guidelines

To simplify the use of *Solid State Software,* TI has implemented a few easily remembered rules for program prompts. You should closely follow the User Instructions the first time you execute a program. Thereafter, you should be able to execute the program by following these simple guidelines.

• Use of the term "enter" has a specific meaning in the User Instructions and examples within Compact Computer library programs. When you see this term, you are to key in the value or information which is indicated by the statement and then press [ENTER] to execute the entry. The [ENTER] key is also used to display consecutive outputs, to accept current values, and to continue the program following certain prompts.

• The procedure for beginning execution of library programs is explained immediately before the User Instructions of each program. This procedure involves entering the [RUN] command followed by the short name for the program in quotation marks and any other information which is necessary for the execution of the particular program.

• The first step in all Compact Computer library programs is the display of the program name. The program name remains paused in the display for three seconds and then continues to the next prompt. Pressing [ENTER] or [CLR] causes the next prompt to be displayed immediately.

• Input prompts (prompts which indicate that a value must be entered) are always followed by colons. When applicable, default values are displayed immediately after the colon. You have the option of either entering a new value for the variable or accepting the current value by pressing [ENTER]. This feature is useful when editing input.

• When you enter a value which has less digits than the displayed value, space over the extra digits to insure that only the new value is entered.

• Prompts ending in a ? are questions requiring either yes or no responses. It is only necessary to enter a y or a n in either upper or lower case as a response.

• All commands and responses except yes and no must be entered exactly as they are presented in the User Instructions of this library. **Note:** Commands and responses in this library are represented with upper case letters. However, the Compact Computer makes no distinction between upper or lower case letters so they may be used interchangeably.

• Displayed messages such as instructions and output require you to press [ENTER] to proceed to the next message or prompt. Certain prompts are paused for three seconds before proceeding to the next prompt. Pressing [ENTER] after a paused prompt causes the next prompt to be displayed immediately.

• Any special handling of the response keys is described expressly in the User Instructions or by further prompting.

• You may use equations as numeric input in response to a prompt. For example, you may use PI/2 as an input value. When the computer is waiting for a response, you may perform arithmetical computations without affecting the program. However, the value which is in the display when [ENTER] is pressed is accepted as the input. This means that you may not use an equation which requires the use of [ENTER] in its computations.

• To halt a running program, press [BREAK]. Entering CON continues the program from the point where [BREAK] was pressed even if the computer is turned off after you press [BREAK]. If [BREAK] is pressed when a prompt is in the display, the prompt may not reappear after CON is entered although the computer is still waiting for a response to that prompt.

Using the Optional Printer

If a printer is connected to the Compact Computer and you have responded YES to the Use Printer? prompt, a printed record is produced which contains all of the information needed to duplicate a particular execution of a program (with the exception of subprograms which you enter) including: the name of the program you have chosen; the options selected; the pertinent input data; and the results.

Use of the printer is made possible by responding YES to the Use Printer? prompt and then entering the appropriate peripheral ID number in response to the Enter Device Name: prompt. See the peripheral *Owner's Manual* for the appropriate ID number.

The presence of the printer also alters normal program operation. Since a printed record of the results is produced, operation of the program is not stopped for viewing individual results. Instead, a continuous list of results is printed until the output is complete.

Information on connecting the printer may be found in the peripheral *Owner's Manual.*

Using the Optional *Wafertape*™ Digital Tape Drive

The *Wafertape*™ digital tape drive may be used as a means of inputting or recording large amounts of data or for recording information in order to reproduce an exact run of a program. Those programs which are designed for use with the *Wafertape* peripheral incorporate special prompts indicating when you need to input and record your data. The only information which you must provide is the device on which the data is recorded and the filename for that data.

The prompt for entry of this information is `Enter Device.Filename:`. The device must be entered as an integer from 1 through 7. The filename may be chosen by you and may contain any printable character (except control characters) but must be 12 characters or less in length.

Information on connecting the *Wafertape* digital tape drive may be found in the *Owner's Manual*.

Caring for Cartridges

Even though the cartridges for your Compact Computer are durable devices, you should handle them with care. Follow these precautions when handling the cartridges.

- **Be sure that your body is free of static electricity.** Prior to handling any cartridge, touch some metal object to discharge any static electricity you may be carrying.
- Keep the cartridge port cover secure on the computer to keep the cartridge port dust free.
- Keep the contact area of the cartridges clean. A buildup of debris or foreign particles on the contacts can impair their operation. Keep the cartridges stored either in the original container or in the computer's cartridge port.
- Use a cotton swab soaked in alcohol to clean the cartridge and cartridge port contacts when necessary. After the alcohol has dried, remove any remaining lint with a clean, soft-bristled brush.
  CAUTION: Do not use any other liquid substance to clean the contacts.

Installing and Replacing Cartridges

The Finance Library cartridge can easily be installed or replaced. *Solid State Software* cartridges are installed in the cartridge port of the Compact Computer. Turn the computer off when installing or replacing a cartridge. Installing a cartridge while the computer is on may result in memory loss.

Use the following procedure when installing a cartridge.

1. Turn the computer off.

2. Slide the cartridge port cover back and remove it from the computer as shown in the diagram below.

3. If a cartridge is already installed, remove it by pushing the cartridge away from the keyboard until it is released. Lift the cartridge from the cartridge port.

4. Lay the cartridge to be installed in the cartridge port, with the cartridge name facing up and toward the keyboard.

5. Press firmly on the back of the cartridge and slide it toward the keyboard until the tabs on the cartridge enter the slots provided and the cartridge locks into place. Replace the cartridge port cover and check that its tabs also fit into the slots.

TABS MUST FIT
INTO SLOTS

Bonds—"BONDS"

This program computes
- The annual yield rate on a bond.
- The price of the bond on the settlement date.
- The bond's accrued interest at the settlement date.
- The bond's duration in years.

Introduction

When a company needs funds for expansion, it can acquire the funds by issuing bonds to the public. Investment in a bond is a loan to the company. The company receives the use of the investor's money for the life of the bond and the investor receives regular interest payments for the time that he holds the bond. In order to receive a yield rate higher or lower than the interest rate stated on the bond, the investor must purchase the bond at a price lower or higher than the maturity value of the bond. Thus, the bond usually has an effective interest rate which is different from the interest rate stated on the bond.

Bond Terms

Maturity Value	The price the company pays for the bond on the bond's maturity date, the face value.
Redemption Value	The price received when selling the bond.
Settlement Price	The price paid when buying the bond.
Yield Rate	The stated rate plus the difference between the settlement price and the redemption value over the length of time the bond is to be held.

In order to use the Bonds program properly, an explanation of several terms is necessary. A bond is usually sold with redeemable coupons. The coupons are redeemed at fixed intervals (typically once or twice a year) and represent the interest earned on the bonds. The stated value of a coupon is based on the annual interest rate and the maturity value of the bond. The coupon rate is not necessarily the same as the yield rate.

When buying a bond on the settlement date for the settlement price, interest usually has accumulated from the previous coupon date. This interest is the accrued interest and, in this program, is the amount of interest to which the previous owner of the bond is entitled. The redemption date is the date that the bonds will be exchanged for their redemption value. If the bonds are not sold to another investor but are redeemed on the bond's maturity date, the bond's redemption value equals its maturity value.

Duration

The Bonds program also computes the bond's duration, a relatively new method of computing the risk of a bond. The primary reason that many people have not used the duration concept is that the calculation is lengthy. The duration of the bond, stated in years, never exceeds the bond's life and follows a trend inversely proportional to the risk of the bond. For example, a bond with a duration of 9.5 years has a greater chance of returning the original investment than a bond with a duration of 11 years. The duration of a bond can be calculated by summing the number of years into the future when a cash flow (weighted by its proportion to the cost of the bond) is received.

Input Information

This program requires the following input.
- The settlement date of the bond (date when purchased).
- The redemption date of the bond (date when sold).
- The number of coupons per year.
- The type of accounting year.
- The annual coupon rate of interest.
- The maturity value of the bond.
- The value at which you plan to redeem the bond.
- The effective interest rate of the bond or the settlement price of the bond.

Either of two approaches may be used: the actual value approach which uses the dollar values involved; or the 100's standard approach in which the bond's price is stated as a percentage of the maturity value. You may also choose to use the actual/365 year method or the 30/360 year method in this program. Both methods are explained in the "Calendar" section of this manual. If you use the actual/365 method and buy the bond between dates, entry of the last coupon date prior to the settlement date and the next coupon date is required. Specify either the yield rate or the price of the bond as unknown.

Abbreviations and Formulas

The following abbreviations are used for the formulas in this section.

ACCRUED INT	Interest owed to the previous coupon owner
C	Periodic coupon payment
%CPN	Annual coupon or interest rate of loan
C/Y	Coupons per year
DURATION YRS	Duration of bond
F	Bond redemption value
i	Annual yield rate/$(100 \times C/Y)$
M	Fraction of partial coupon period in which the bond is held
M − 1	Accrued interest period
N_1	Number of complete coupon periods
N	Number of coupon periods, including any fractional portion
P	Settlement price
V	$1/(1 + L)$
%Y	Rate of annual yield

The Bonds program uses the Newton-Raphson technique when computing the annual yield rate of a bond having one or more remaining coupon periods. The rate is computed with an error of 10^{-10}. The following equations are also used in this program.

For a bond with less than one coupon payment remaining:

$$\%Y = \frac{F + C}{[(P + ACCRUED\ INT) - 1]M}$$

For a bond with more than one coupon payment remaining:

$$P = \left[\frac{V^{M-1} - V^N}{i} + (M - 1)\right] C + (F)(V^N)$$

For all cases:

$$P = \frac{F + C}{1 + (i \times M)} + (M - 1)C$$

$$ACCRUED\ INT = -[(M - 1)C]$$

$$DURATION\ YRS = \left[F(M + N_1)\ V^{N_1}\ (V^M) + \left(\frac{CV^N V^M}{i}\right)\left(\frac{(iM + 1)\frac{1}{(V^{N+1} - 1)}}{i} - N_2 + 1\right)\right.$$
$$\left. + (M - 1)C\right] \div P$$

User Instructions—Bonds

Select the Bonds program by entering RUN "BONDS".

Step	Display	Procedure/Comment	Goto
1.	BONDS	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Settlement Date...	Displays prompt. Proceed by pressing [ENTER].	5
5.	Enter MMDD.YYYY:	Enter Settlement Date in MMDD.YYYY format.	6
6.	Redemption Date...	Displays prompt. Proceed by pressing [ENTER].	7
7.	Enter MMDD.YYYY:	Enter Redemption Date in MMDD.YYYY format.	8
8.	Enter # Coupon Pmts/Yr:	Enter number of coupon payments per year.	9
9.		a. If there are no coupon payments or if the settlement and redemption dates have the same month and day.	15
		b. Otherwise.	10
10.	365 Day Year?	a. Select 365 day year by entering Y.	11
		b. Select 360 day year by entering N.	15
11.	Prior Coupon Date...	Displays prompt. Proceed by pressing [ENTER].	12
12.	Enter MMDD.YYYY:	Enter prior coupon date in MMDD.YYYY format.	13
13.	Next Coupon Date...	Displays prompt. Proceed by pressing [ENTER].	14
14.	Enter MMDD.YYYY:	Enter next coupon date in MMDD.YYYY format.	15
15.	# Payments=	Displays number of coupon payments between the settlement and redemption dates. Proceed by pressing [ENTER].	16
16.	Enter %Cpn Rate:	Enter coupon interest rate in percent.	17

(continued)

13

Step	Display	Procedure/Comment	Goto
17.	Enter Matur Val:	Enter maturity value in dollars.	18
18.	Enter Redmptn Val:	Enter redemption value in dollars.	19
19.	Compute Yield Rate?	a. Compute yield rate by entering Y.	20
		b. Compute price by entering N.	21
20.	Enter Settl Prce:	Enter settlement price in dollars.	22
21.	Enter %Yld Rate:	Enter yield rate in percent.	22
22.	Edit?	a. Edit data by entering Y.	4
		b. Accept data by entering N.	23
23.		a. If yield rate entered.	25
		b. If settlement price entered.	24
24.	Settlement Price=	Displays settlement price in dollars. Proceed by pressing [ENTER].	26
25.	% Yield Rate=	Displays yield rate in percent. Proceed by pressing [ENTER].	26
26.	Accrued Interest=	Displays accrued interest in dollars. Proceed by pressing [ENTER].	27
27.	Duration Years=	Displays duration in years. Proceed by pressing [ENTER].	28
28.	Repeat?	a. Repeat same option by entering Y.	19
		b. Continue program by entering N.	29
29.	Exit Program?	a. Exit program by entering Y.	STOP
		b. Continue program by entering N.	4

Example

You bought some bonds on May 1, 1982 to be sold to the issuer when the bonds mature on December 31, 1984. The bond's stated interest is 8% annually and is paid semi-annually on a 30/360 day year. What price should you pay for the bonds if you want to earn an effective interest rate of 12%?

Select the Bonds program by entering RUN "BONDS".

Step	Display	Procedure/Comment
1.	BONDS	Program name.
2.	Use Printer?	Enter N.
3.	Settlement Date...	Proceed by pressing [ENTER].
4.	Enter MMDD.YYYY: 0	Enter 501.1982.
5.	Redemption Date...	Proceed by pressing [ENTER].
6.	Enter MMDD.YYYY: 0	Enter 1231.1984.
7.	Enter # Coupon Pmts/Yr: 0	Enter 2.
8.	365 Day Year?	Select 360 day year by entering N.
9.	# Payments= 5.333333333	Displays number of coupon payments left. Proceed by pressing [ENTER].
10.	Enter %Cpn Rate: 0	Enter 8.
11.	Enter Matur Val: 0	Enter 100.
12.	Enter Redmptn Val: 0	Enter 100.
13.	Compute Yield Rate?	Enter N.
14.	Enter %Yld Rate: 0	Enter 12.
15.	Edit?	Enter N.
16.	Settlement Price= 91.07016199	Displays settlement price in dollars. Proceed by pressing [ENTER].
17.	Accrued Interest= 2.666666667	Displays accrued interest. Proceed by pressing [ENTER].
18.	Duration Years= 2.430401433	Displays duration years. Proceed by pressing [ENTER].
19.	Repeat?	Enter N.
20.	Exit Program?	Enter Y.

Calendar—"CAL"

This program
- Computes the number of days between dates.
- Computes the day of the week given the date.

Introduction

The Calendar program is useful when calculating the number of days between the coupon payment date of a bond and the bond settlement date. It can also show the day for any date after 1582. This subroutine of the Calendar program uses the Gregorian calendar.

Input Information

While entering the dates for computations in this program, three things must be kept in mind.
- Enter the dates in a MMDD.YYYY format; for example, to enter March 2, 1979 into the program, you may press 302.1979 or 0302.1979 but not 32.1979.
- Any attempt to enter a date before 1582 causes an error condition to occur.
- Any attempt to enter a date that does not exist causes an error condition to occur.

Error conditions for invalid dates in the month of February are not prompted in this program; therefore, entry of February 29 for any year except leap year gives erroneous results; however, leap years are accounted for during normal calculations.

Description of Year Types

When calculating the number of days between dates, you can use the 30/360 day year in which calculations are computed by using twelve 30 day months for every year, or the actual/365 day year schedule in which a common 365 day year (366 during leap years) schedule is used. The U.S. government has imposed standards upon the 360 day calendar. The following standards are those suggested by the Investment Bankers Association of America Subcommittee on Trading and Cashiering Procedures in its report, "Recommendations for Computations of Principal and Interest on Transactions in Municipal Securities."

- From the 1st to the 30th of the same month to be calculated as 29 days.
- From the 1st to the 31st of the same month to be calculated as 30 days.
- From the 1st to the 1st of the following month to be calculated as 30 days.
- From the 1st to the 28th of February to be calculated as 27 days.
- From the 30th or 31st to the 1st of the following month to be figured as one day.
- From the 30th or 31st to the 30th or 31st of the following month to be figured as 30 days.
- From the 30th or 31st to the 1st of the second following month to be figured as 1 month 1 day.

Example

To illustrate the 30/360 method of counting days, we assume a certain bond has coupon dates of May 1 and November 1. Using a date of August 9, calculate the number of days until the next coupon date and since the last coupon date.

The days from the last coupon date are:

$$(30 \times 3) + 8 = 98$$

The days to the next coupon date are:

$$(30 - 9) + (30 \times 2) + 1$$

Formulas

The computer determines the number of days between dates by computing a factor for each date and finding the difference between the two factors.

For January and February;

$$\text{Factor} = 365 \, (YYYY) + DD + 31 \, (MM - 1) + \text{Integer Portion of}$$
$$(((YYYY - 1)/4) - (3/4 \, (YYYY - 1)/100) + 1)$$

For March through December;

$$\text{Factor} = 365 \, (YYYY) + DD + 31 \, (MM - 1) - \text{Integer Portion of}$$
$$(((.4MM + 2.3) + (YYYY)/4) - 3/4 \, (YYYY)/100 + 1)$$

The day of the week is computed from the factor for that date;

$$\text{Day of the Week} = \text{Factor} + \text{Integer Portion of} \, (((-)\text{Factor}/7) \times 7)$$

where the day of the week is displayed as a number from 0 through 6 with

0 = Saturday
1 = Sunday
2 = Monday
3 = Tuesday
4 = Wednesday
5 = Thursday
6 = Friday

Keep in mind that the interest payments are 180 days apart when they are semi-annual on a 30/360 year. However, under the actual/365 approach, the difference between the semi-annual payments must be calculated.

User Instructions—Calendar

Select the Calendar program by entering RUN "CAL".

Step	Display	Procedure/Comment	Goto
1.	CALENDAR	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Compute Day of the Week?	a. Compute day of the week by entering Y.	6
		b. Display next option by entering N.	5
5.	Compute Days Between Dates?	a. Compute days between dates by entering Y.	9
		b. Continue program by entering N.	13
6.	Enter MMDD.YYYY:	Enter date in MMDD.YYYY format.	7
7.	Day=	Displays day of the week. Proceed by pressing [ENTER].	13
8.	Enter MMDD.YYYY(1):	Enter first date in MMDD.YYYY format.	9
9.	Enter MMDD.YYYY(2):	Enter last date in MMDD.YYYY format.	10
10.	365 Day Year?	a. Select 365 day year by entering Y.	12
		b. Display next option by entering N.	11
11.	360 Day Year?	a. Select 360 day year by entering Y.	12
		b. Display next option by entering N.	10
12.	Days=	Displays days between dates. Proceed by pressing [ENTER].	13
13.	Exit Program?	a. Exit program by entering Y.	STOP
		b. Continue program by entering N.	4

Example 1

Using the actual/365 method, compute the number of days in February of 1980.

Select the Calendar program by entering RUN "CAL".

Step	Display	Procedure/Comment
1.	CALENDAR	Program name.
2.	Use Printer?	Enter N.
3.	Compute Day of the Week?	Enter N.
4.	Compute Days Between Dates?	Enter Y.
5.	Enter MMDD.YYYY(1): 0	Enter 201.1980.
6.	Enter MMDD.YYYY(2): 0	Enter 301.1980.
7.	365 Day Year?	Enter Y.
8.	Days= 29	Displays number of days. Proceed by pressing [ENTER].
9.	Exit Program?	Enter Y.

Example 2

Find the day of the week that April 28, 1958 occurred.

Select the Calendar program by entering RUN "CAL".

Step	Display	Procedure/Comment
1.	CALENDAR	Program name.
2.	Use Printer?	Enter N.
3.	Compute Day of the Week?	Enter Y.
4.	Enter MMDD.YYYY: 0	Enter 428.1958.
5.	Day= Monday	Displays day of the week. Proceed by pressing [ENTER].
6.	Exit Program?	Enter Y.

Cash Flows—"CFLOW"

This program calculates
- The internal rate of return of an investment.
- The net present value of an investment.
- The financial management rate of return for an investment.
- The amortization schedule.
  a. The principal portion of the payment.
  b. The interest portion of the payment.
  c. The subtotal of principal payments.
  d. The subtotal of interest payments.
  e. The cumulative total of principal payments.
  f. The cumulative total of interest payments.
  g. The remaining balance.

Introduction

When you compare several investments, you should use the internal rate of return or the net present value of the investments to help make your decision. Calculating the amortization schedule may help you to better compare several projects in order to determine the best investment. Keep in mind that the risk of each project is not taken into account by this program.

Cash Flows Approaches

The cash flows entered into the program may be flows paid or flows received. You may choose from three cash flows approaches when using this program: grouped flows, graduated flows, and individual flows. You need the following input for this program regardless of the cash flows approach used.

Periods

The grouped flow payment procedure is useful when you pay a series of cash flows at one value and another series of cash flows at a different value. The number of series is entered as the number of groups, and each group has one cash flow value. Another number which must be entered is the number of flows for each group. The number of cash flow groups you may enter is limited by the memory capacity of the computer. With 2K byte memory, you may have approximately 40 grouped cash flows and with 6K byte memory you may have approximately 300.

The number of graduated cash flow values you may enter is also limited by the memory capacity of the computer. With 2K byte memory, you may enter up to approximately 80 graduated cash flows and with 6K byte memory you may enter up to 300. The required input for the graduated payments approach consists of the initial payment, the percentage rate each subsequent cash flow increases, and the number of payments.

If the grouped payment or the graduated payment methods of cash flows cannot be used, you must use the individual cash flows method. The individual cash flows method requires the input of the number of cash flows and each cash flow amount. The number of cash flows you may enter is limited by the memory capacity of the computer. With 2K byte memory, you may enter approximately 80 individual cash flows and with 6K byte memory, you may enter up to approximately 300.

Internal Rate of Return

The internal rate of return is the maximum rate of interest that could be paid for a project's capital over the life of the project without incurring a loss on the project. The internal rate of return may also be defined as the discount rate used to equate the sum of the future cash flows to the initial net cash outlay or initial investment.

The Cash Flows program uses the Newton-Raphson technique in computing the internal rate of return. However, if cash flows vary in direction resulting in more than one solution, the Cash Flows program finds only one solution. This solution is the internal rate of return closest to zero percent. When computing the internal rate of return, this program has an accuracy level of 10^{-9}.

Net Present Value

The net present value of an investment equals the present value of cash flows received from the investment less the cost of the initial investment. The computer determines the present value of the cash flows, i.e., the value of the cash flows at the time of investment, by multiplying the cash flows by a factor. The factor is a combination of the discount rate and the number of years until each cash flow is received. The discount rate is the annual rate expressed as a percentage at which money declines in value.

The net present value is positive when the discount rate is lower than the internal rate of return, indicating that the investment is favorable. When comparing the net present value of several projects, the financial risk may be different for each project; thus, a project having the best net present value does not necessarily mean that it is the best investment.

Financial Management Rate of Return

The financial management rate of return, used primarily in real estate, is a weighted average of the risk rate on the invested cash flows and the safe rate on the borrowed cash flows. Any received cash flows are invested at the risk rate. The risk rate always exceeds the safe rate, which is the rate of interest paid on loans covering negative cash flows.

Amortization Schedule

The amortization schedule is a schedule of interest and principal payments based upon the cash flows and the interest rate entered into the amortization schedule. The amortization schedule can also print cumulative totals and periodic subtotals of the payment schedule.

The program first computes the interest due on the principal's balance; then it subtracts the interest from the cash flow for that period to compute the payment of principal for that period. Finally, the program subtracts the payment of principal from the remaining principal to give a new amount of principal due immediately after the cash flow.

Abbreviations

The following abbreviations are used in the Cash Flows program.

BAL	Remaining principal balance to be paid
CF	Cash flow
%DR	Discount rate; i.e., the annual rate at which money loses its value
%FMRR	Financial management rate of return
F/Y	Number of cash flows per year
%I	Hypothetical discount rate used on the amortization schedule
INV	Initial investment of the project
%IRR	Internal rate of return; explained in this section of the manual
NPV	Net present value; explained in this section of the manual
PMT	Payment
PMT_i	Payment of interest
PMT_p	Payment of principal
%RR	Risk rate; i.e., the rate at which any cash flows received are invested
SBT_i	Subtotal of interest payments
SBT_p	Subtotal of principal payments

%SR	Safe rate; i.e., the interest rate for loans covering negative cash flows
TOT_i	Cumulative interest paid
TOT_p	Cumulative principal paid
%Δ	Growth rate of cash flows when the graduated payments option has been selected

User Instructions—Cash Flows

Select the Cash Flows program by entering RUN "CFLOW".

Step	Display	Procedure/Comment	Goto
1.	CASH FLOWS	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	3
3.	Enter Device Name:	Enter output device name.	4
4.	Grouped Payments?	a. Select grouped payments option by entering Y.	5
		b. Display next option by entering N.	6
5.	Enter # of Groups:	Enter number of payment groups.	8
6.	Graduated Payments?	a. Select graduated payments option by entering Y.	7
		b. Select variable payments option by entering N.	9
7.	Enter %Increase:	Enter percent growth rate per payment.	9
8.	Group ##	Displays current group number. Proceed by pressing [ENTER].	9
9.	Enter # Cash Flows:	Enter the number of cash flows. For grouped payments, this should be the number of flows in this group.	10
10.	Enter Csh Flow #:	Enter cash flow amount in dollars.	11

(continued)

Step	Display	Procedure/Comment	Goto
11.		a. If all cash flows not entered.	9
		b. If graduated flows requested.	12
		c. Otherwise.	14
12.	Print Cash Flows?	a. Display all graduated cash flows by entering Y.	13
		b. Continue program by entering N.	18
13.	Csh Flow #=	Displays all graduated cash flows. Proceed by pressing [ENTER].	18
14.	Edit?	a. Edit data by entering Y.	15
		b. Accept data by entering N.	18
15.		a. For grouped payments.	16
		b. For graduated or variable cash flows.	17
16.	Enter Group ####:	Enter group number to be edited.	8
17.	Enter Cash Flow #:	Enter cash flow number to be edited.	10
18.	Enter Flows/Year:	Enter number of cash flows per year.	19
19.	Enter Init Invst:	Enter initial investment in dollars.	20
20.	Compute %IRR?	a. Compute internal rate of return by entering Y.	21
		b. Continue program by entering N.	22
21.	%IRR=	Displays percent internal rate of return. Proceed by pressing [ENTER].	22
22.	Compute NPV?	a. Compute net present value by entering Y.	23
		b. Continue program by entering N.	25
23.	Enter %Disc Rate:	Enter discount rate in percent.	24
24.	Net Present Value=	Displays net present value in dollars. Proceed by pressing [ENTER].	25

Step	Display	Procedure/Comment	Goto
25.	Compute %FMRR?	a. Compute financial management rate of return by entering Y.	26
		b. Continue program by entering N.	29
26.	Enter %Safe Rate:	Enter safe interest rate in percent.	27
27.	Enter %Risk Rate:	Enter risk interest rate in percent.	28
28.	%FMRR=	Displays percent financial management rate of return. Proceed by pressing [ENTER].	29
29.	Amortize?	a. Amortize data by entering Y.	30
		b. Continue program by entering N.	49
30.	Enter %Interest:	Enter interest rate in percent.	31
31.	Subtotals?	a. Compute subtotals by entering Y.	32
		b. Continue program by entering N.	33
32.	Enter Pmts/Subtotal:	Enter number of payments between subtotals.	33
33.	Cumulative Totals?	a. Compute totals by entering Y.	34
		b. Continue program by entering N.	34
34.	Enter First Payment #:	Enter first payment to be displayed.	35
35.	Enter Last Payment #:	Enter last payment to be displayed.	33
36.	**** Payment #### ****	Displays payment number. Proceed by pressing [ENTER].	37
37.		a. Output regular payment.	39
		b. Output final payment not equal to the regular payment.	38
38.	Final Payment=	Displays final payment amount. Proceed by pressing [ENTER].	37
39.		a. If computing subtotals.	42
		b. If not computing subtotals.	40

Step	Display	Procedure/Comment	Goto
40.	Principal Payment=	Displays principal portion of payment. Proceed by pressing [ENTER].	41
41.	Interest Payment=	Displays interest portion of payment. Proceed by pressing [ENTER].	44
42.	Subtotal Principal=	Displays subtotals for principal. Proceed by pressing [ENTER].	43
43.	Subtotal Interest=	Displays subtotals for interest. Proceed by pressing [ENTER].	44
44.		a. If computing cumulative totals.	45
		b. If not computing cumulative totals.	47
45.	Total Principal=	Displays cumulative principal. Proceed by pressing [ENTER].	46
46.	Total Interest=	Displays cumulative interest. Proceed by pressing [ENTER].	47
47.	Balance=	Displays balance. Proceed by pressing [ENTER].	48
48.		a. If more payments.	36
		b. If all payments displayed.	49
49.	Repeat?	a. Repeat program with same cash flows by entering Y.	50
		b. Continue program by entering N.	51
50.		a. For graduated flows.	18
		b. Otherwise.	14
51.	Exit Program?	a. Exit program by entering Y.	STOP
		b. Continue program by entering N.	4

Example 1

You have decided to buy some apartments for $100,000 as a three year investment. You expect to receive $36,000 in rent during the first year for these apartments; the rents will be raised to keep up with the annual inflation rate of 13% over three years. Any cash flow received is expected to be reinvested at an 18% rate of return; a cash flow paid is expected to be covered by a 10% loan. Compute the internal rate of return, net present value and financial management rate of return for the investment.

Select the Cash Flows program by entering **RUN "CFLOW"**.

Step	Display	Procedure/Comment
1.	CASH FLOWS	Program name.
2.	Use Printer?	Enter N. ·
3.	Grouped Payments?	Enter N.
4.	Graduated Payments?	Enter Y.
5.	Enter %Increase: -100	Enter 13.
6.	Enter # Cash Flows: 0	Enter 3.
7.	Enter Csh Flow 1:	Enter 36000.
8.	Print Cash Flows?	Enter Y.
9.	Csh Flow 2= 40680	Displays all requested values.
	Csh Flow 3= 45968.4	Proceed after each output by pressing [ENTER].
10.	Enter Flows/Year: 0	Enter 1.
11.	Enter Init Invst: 0	Enter 100000.
12.	Compute %IRR?	Enter Y.
13.	%IRR= 10.48107305	Displays percent internal rate of return. Proceed by pressing [ENTER].
14.	Compute NPV?	Enter Y.
15.	Enter %Disc Rate: -2.229138898	Enter 13.

Step	Display	Procedure/Comment
16.	Net Present Value= −4424.78	Displays net present value in dollars. Proceed by pressing [ENTER].
17.	Compute %FMRR?	Enter Y.
18.	Enter %Safe Rate: 0	Enter 10.
19.	Enter %Risk Rate: 13	Enter 18.
20.	%FMRR= 12.94972572	Displays percent financial management rate of return. Proceed by pressing [ENTER].
21.	Amortize?	Enter N.
22.	Repeat?	Enter N.
23.	Exit Program?	Enter Y.

Example 2

What is the amortization schedule for a $100,000 investment at a 19% interest rate and no down payment? You can afford to pay $20,000 for each of the first three years and $47,000 for the next two years.

Select the Cash Flows program by entering **RUN "CFLOW"**.

Step	Display	Procedure/Comment
1.	CASH FLOWS	Program name.
2.	Use Printer?	Enter N.
3.	Grouped Payments?	Enter Y.
4.	Enter # of Groups: 0	Enter 2.
5.	Group 1	Displays group flow number. Proceed by pressing [ENTER].
6.	Enter # Cash Flows: 0	Enter 3.

Step	Display	Procedure/Comment
7.	Enter Csh Flow 1: 0	Enter 20000.
8.	Group 2	Displays group flow number. Proceed by pressing [ENTER].
9.	Enter # Cash Flows: 0	Enter 2.
10.	Enter Csh Flow 2: 0	Enter 47000.
11.	Edit?	Enter N.
12.	Enter Flows/Year: 0	Enter 1.
13.	Enter Init Invst: 0	Enter 100000.
14.	Compute %IRR?	Enter N.
15.	Compute NPV?	Enter N.
16.	Compute %FMRR?	Enter N.
17.	Amortize?	Enter Y.
18.	Enter %Interest: 0	Enter 19.
19.	Subtotals?	Enter N.
20.	Cumulative Totals?	Enter Y.
21.	Enter First Payment #: 1	Accept current value by pressing [ENTER].
22.	Enter Last Payment #: 4	Enter 5.
23.	**** Payment 1 ****	Displays all requested values.
	Principal Payment= 1000.00	Proceed after each output by pressing
	Interest Payment= 19000.00	[ENTER].
	Total Principal= 1000.00	
	Total Interest= 19000.00	
	Balance= 99000.00	

Step	Display		Procedure/Comment
	**** Payment 2 ****		
	Principal Payment=	1190.00	
	Interest Payment=	18810.00	
	Total Principal=	2190.00	
	Total Interest=	37810.00	
	Balance=	97810.00	
	**** Payment 3 ****		
	Principal Payment=	1416.10	
	Interest Payment=	18583.90	
	Total Principal=	3606.10	
	Total Interest=	56393.90	
	Balance=	96393.90	
	**** Payment 4 ****		
	Principal Payment=	28685.16	
	Interest Payment=	18314.84	
	Total Principal=	32291.26	
	Total Interest=	74708.74	
	Balance=	67708.74	
	**** Payment 5 ****		
	Principal Payment=	34135.34	
	Interest Payment=	12864.66	
	Total Principal=	66426.60	
	Total Interest=	87573.40	
	Balance=	33573.40	
24.	Repeat?		Enter N.
25.	Exit Program?		Enter Y.

Example 3

You have bought an asset for $500,000. Compute the internal rate of return, the net present value if the discount rate equals the internal rate of return, and a yearly amortization schedule with an interest rate equal to the internal rate of return. The variable cash flows from the asset are as follows.

Cash Flow Number	Cash Flow Amount
1	$ 200,000
2	$ 150,000
3	$ 100,000
4	$ -100,000
5	$ 100,000
6	$ 200,000

The cash flows are semi-annual.

Select the Cash Flows program by entering RUN "CFLOW".

Step	Display	Procedure/Comment
1.	CASH FLOWS	Program name.
2.	Use Printer?	Enter N.
3.	Grouped Payments?	Enter N.
4.	Graduated Payments?	Select variable payments option by entering N.
5.	Enter # Cash Flows: 0	Enter 6.
6.	Enter Csh Flow 1: 0	Enter 200000.
7.	Enter Csh Flow 2: 0	Enter 150000.
8.	Enter Csh Flow 3: 0	Enter 100000.
9.	Enter Csh Flow 4: 0	Enter -100000.
10.	Enter Csh Flow 5: 0	Enter 100000.
11.	Enter Csh Flow 6: 0	Enter 200000.

Step	Display	Procedure/Comment
12.	Edit?	Enter **N**.
13.	Enter Flows/Year: 0	Enter **2**.
14.	Enter Init Invst: 0	Enter **500000**.
15.	Compute %IRR?	Enter **Y**.
16.	%IRR= 18.05522242	Displays percent internal rate of return. Proceed by pressing **[ENTER]**.
17.	Compute NPV?	Enter **Y**.
18.	Enter %Disc Rate: 0	Enter **18.05522242**.
19.	Net Present Value= 0	Displays net present value in dollars. Proceed by pressing **[ENTER]**.
20.	Compute %FMRR?	Enter **N**.
21.	Amortize?	Enter **Y**.
22.	Enter %Interest: 18.05522242	Accept current value by pressing **[ENTER]**.
23.	Subtotals?	Enter **Y**.
24.	Enter Pmts/Subtotal: 0	Enter **2**.
25.	Cumulative Totals?	Enter **Y**.
26.	Enter First Payment #: 1	Enter **2**.
27.	Enter Last Payment #: 6	Accept current value by pressing **[ENTER]**.
28.	**** Payment 2 ****	Displays all requested values.
	Subtotal Principal= 273704.22	Proceed after each output by pressing
	Subtotal Interest= 76295.78	**[ENTER]**.
	Total Principal= 273704.22	
	Total Interest= 76295.78	
	Balance= 226295.78	

Step	Display	Procedure/Comment
	**** Payment 4 ****	
	Subtotal Principal= −33674.85	
	Subtotal Interest= 33674.85	
	Total Principal= 240029.37	
	Total Interest= 109970.63	
	Balance= 259970.63	
	**** Payment 6 ****	
	Subtotal Principal= 259970.63	
	Subtotal Interest= 40029.37	
	Total Principal= 500000.00	
	Total Interest= 150000.00	
	Balance= .00	
29.	Repeat?	Enter **N**.
30.	Exit Program?	Enter **Y**.

Example 4

Compute the first payment needed for buying a home under a 30 year graduated payment mortgage schedule. Your monthly payments increase by 2.5% after every 12 payments for the first four years and remain the same after that. You have no down payment for the home and the mortgage is for $48,000 at an annual rate of 9.5%.

Select the Cash Flows program by entering **RUN "CFLOW"**.

Step	Display	Procedure/Comment
1.	CASH FLOWS	Program name.
2.	Use Printer?	Enter N.
3.	Grouped Payments?	Enter Y.
4.	Enter # of Groups: 0	Enter 5.
5.	Group 1	Displays group flow number. Proceed by pressing [ENTER].
6.	Enter # Cash Flows: 0	Enter 12.
7.	Enter Csh Flow 1: 0	Enter 1.
8.	Group 2	Displays group flow number. Proceed by pressing [ENTER].
9.	Enter # Cash Flows: 0	Enter 12.
10.	Enter Csh Flow 2: 0	Enter 1.025.
11.	Group 3	Displays group flow number. Proceed by pressing [ENTER].
12.	Enter # Cash Flows: 0	Enter 12.
13.	Enter Csh Flow 3: 0	Enter 1.025∧2.
14.	Group 4	Displays group flow number. Proceed by pressing [ENTER].
15.	Enter # Cash Flows: 0	Enter 12.
16.	Enter Csh Flow 4: 0	Enter 1.025∧3.
17.	Group 5	Displays group flow number. Proceed by pressing [ENTER].
18.	Enter # Cash Flows: 0	Enter 26*12.
19.	Enter Csh Flow 5: 0	Enter 1.025∧4.
20.	Edit?	Enter N.

Step	Display	Procedure/Comment
21.	Enter Flows/Year: 0	Enter 12.
22.	Enter Init Invst: 0	Accept current value by pressing [ENTER].
23.	Compute %IRR?	Enter N.
24.	Compute NPV?	Enter Y.
25.	Enter %Disc Rate: 0	Enter 9.5.
26.	Net Present Value= 128.54	Displays net present value. Proceed by pressing [ENTER].
27.	Compute %FMRR?	Enter N.
28.	Amortize?	Enter N.
29.	Repeat?	Enter N.
30.	Exit Program?	Enter Y.

To compute the first payment, divide the mortgage amount (48000) by the net present value (128.54).

Step	Display	Procedure/Comment
31.		Enter 48000/128.54.
32.	373.4246149	Displays the first payment.

Data Forecasting—"FCAST"

This program
- Estimates the level, trend, and seasonal coefficients.
- Revises the level, trend, and seasonal coefficients once new data is given.
- Forecasts information for future periods.

Introduction

The ability to forecast information, such as sales, is important for the maintenance of a business. Planning the various expenses and revenues of your business is accomplished through keeping records of each expense and revenue for regular time periods. These records are collectively called historical data.

Input and Program Information

To enable you to maintain an up-to-date forecast, the Data Forecasting program offers three options: estimate, revise, and forecast. Use the estimate option first to estimate coefficients for an initial cycle of historical data. Use the revise option to enter a new period of information and estimate the coefficients for the newly entered period of information. Use the forecast option to obtain a forecast of the data in future periods. A forecast can be made before or after a revision is made. If you are unfamiliar with the various forecasting models, you should study the explanations of the models given in the forecasting section.

The use of the optional cassette interface simplifies the execution of this program when a large amount of data is being used since it provides for the storing and reading of data on cassette tape. The cassette interface allows you to save the constants and the coefficients.

The amount of historical data which can be entered varies with the memory capacity of the computer. With 2K byte memory, you may enter approximately 50 historical periods and with 6K byte memory, you may enter approximately 300.

The Estimate Option

This option is designed to be used only for the initial entry of a cycle of historical data. The estimate option estimates the coefficients of a model based on the constants and historical data entered. These coefficients precisely establish the forecasting model thus eliminating the need to retain the historical data.

When you select the estimate option, the computer prompts Enter Periods. The number entered in response to this prompt specifies the number of periods of historical data that occur in each cycle. For example, an electric utility company could enter data for 24 periods to simulate one day of hourly kilowatt usage, whereas a restaurant could enter data for 12 periods for a year's monthly statements of gross revenue.

Once you enter the number of periods per cycle, the program proceeds with the entry of constants and the data for each period. If your model uses seasonal, trend, and level constants, the program requires one datum in excess of the number of periods entered. The value entered for this extra period must be the actual value encountered for that period. This extra period is needed in order to estimate the trend coefficient correctly.

The Revise Option

Once the model's coefficients have been computed for your forecasting model, the revise option allows you to update the forecasting model. When adding a data period, remember that the future periods are numbered in sequence repeating the first cycle entered. For example, suppose that data for 12 periods of historical data have been entered. The revision should be designated for future period 1 (unless the level trend and seasonal model is used—for this the revision should be designated for future period 2). The following input is required for the revise option.

- The number of periods per cycle.
- The level constant.
- The trend constant.
- The seasonal constant.
- The new actual data.
- The period in which the new actual data occurs (the first period following previously entered data).

The Forecast Option

This option provides forecast information based on the historical data entered, revisions made, and the coefficients entered. Periods are numbered consecutively until a cycle is complete. The period following the last specified data period is the first future period. If the level, trend, and seasonal model is used and has no revisions, the forecast should be made beginning with the second future period. If the level and seasonal model is used and has no revisions, the forecast should be made beginning with future period 1. The following input is required for the forecast option.

- The level constant.
- The trend constant.
- The seasonal constant.
- The level coefficient.
- The trend coefficient.
- The seasonal coefficient.
- The number of periods to be forecast.
- The first period to be forecast (the period following the last actual data period).

Constants Used by the Forecasting Models

Each of the following three constants is a weighting factor between zero and one and is typically 0.15. You must enter a value greater than zero for the level constant. If a trend or seasonal coefficient is not desired, enter zero for the inappropriate constant.

The level constant describes the influence which the most recent period of data has on the forecast. The newest period of data has a greater influence on the forecast as the level constant gets closer to one.

The trend constant describes the sensitivity of the data to upward or downward trend. If the trend constant is zero, the trend is assumed neither upward nor downward.

The seasonal constant describes the sensitivity of the data to seasonal tendencies. If the seasonal constant is zero, the value for a period relative to the mean within a cycle is assumed to have no bearing on the same period in the next cycle.

Level Coefficient Model

This model, the simplest of the three models, should be used when the data set entered contains no significant trend or seasonality. For this model, the forecast option forecasts future data by taking the weighted average of the previously forecast data and the actual data.

Level and Trend Model

If the historical data set shows an approximately linear trend either upward or downward but with no seasonality, this model should be used. In addition to the level constant, an estimate of the trend constant is required.

Level and Seasonal Model

If the historical data set shows a seasonality in its fluctuations but has no upward or downward trend, this model should be used. A seasonal coefficient for each actual data period is computed. With the revise option, each time a set of data is revised, a new seasonal coefficient is computed for the period of revised data.

Level, Trend, and Seasonal Model

This model should be used when the data contains both a trend and a seasonality coefficient. As with the seasonal model, new seasonal, trend, and level coefficients are computed with each revision of a period. All three constants must be entered in this model to assure correct coefficients and forecast values.

Abbreviations and Formulas

The following abbreviations are used in the Forecasting program.

D_t Historical datum for period t

$D(XX)$ Historical datum for period XX

$DF_t, t+k$ Forecast demand at time period t for forecast period $t+k$ where $K = 1, 2, 3, ... n$

F_t Level coefficient for period t

k Used as a subscript to denote a future period

K_l Level constant

K_s Seasonal constant

K_t Trend constant

M Number of periods per cycle

S_t Seasonal coefficient for period t

$S(XX)$ Seasonal coefficient for period XX

S_t, new   New value for seasonal coefficient in period t

S_t, old   Old value for seasonal coefficient in period t

t Time period number

Te Trend coefficient for period t

The following formulas are used with the Estimate Option of the Forecasting program.

$$F_{t+1} = F_t + K_t \left(\frac{D_{t+1}}{S_{t(old)}} - T_t - F_t \right) + T_t$$

The following formulas are used with the Revise Option of the Forecasting program.

$$T_{t+1} = T_t + K_t (F_{t+1} - F_t - T_t)$$

$$S_{t(new)} = S_{t(old)} + K_s \left(\frac{D_{t+1}}{F_{t+1}} - S_{t(old)} \right)$$

The following formula is used with the Forecast Option of the Forecasting program.

$$DF_{t, t+k} = (F_{t+1} + KT_{t+1})S_L$$
$$K = 1, 2, 3, \cdots, n$$
$$L = K(mod\ t)$$

User Instructions—Data Forecasting

Select the Data Forecasting program by entering RUN "FCAST".

Step	Display	Procedure/Comment	Goto
1.	DATA FORECASTING	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Estimate?	a. Estimate coefficients by entering Y.	5
		b. Display next option by entering N.	6
5.		a. First time through program.	10
		b. Otherwise.	13
6.	Revise?	a. Revise coefficients by entering Y.	7
		b. Display next option by entering N.	8
7.		a. First time through program.	10
		b. Otherwise.	13
8.	Forecast?	a. Forecast future performance by entering Y.	9
		b. Continue program by entering N.	45
9.		a. First time through program.	10
		b. Otherwise.	13
10.	Read From Media?	a. If data has been saved on a recording media, enter Y.	11
		b. If data has not been previously saved, enter N.	13
11.	Enter Device.Filename:	Enter file specification in format "Device.Filename".	12
12.		a. If in estimate or revise modes.	34
		b. If in forecast mode.	36

(continued)

Step	Display	Procedure/Comment	Goto
13.	Data Loaded?	a. If data has been input through a previous run or off a recording media, enter Y.	14
		b. If no data has been previously entered, enter N.	15
14.		a. If in estimate mode.	39
		b. If in revise mode.	34
		c. If in forecast mode.	36
15.	Enter Level Cnst:	Enter level smoothing constant.	16
16.	Enter Trend Cnst:	Enter trend smoothing constant.	17
17.	Enter Season Cnst:	Enter seasonal smoothing constant.	18
18.		a. If in estimate mode.	21
		b. If in revise or forecast mode.	19
19.	Enter Level Coef:	Enter level smoothing coefficient.	20
20.	Enter Trend Coef:	Enter trend smoothing coefficient.	21
21.	Enter Periods:	Enter number of periods per cycle.	22
22.	Edit?	a. Edit data by entering Y.	15
		b. Accept data by entering N.	23
23.		a. If seasonal constant is greater than zero and not in estimate mode.	24
		b. Otherwise.	32
24.	Enter S(X):	Enter seasonal smoothing coefficients for each period.	25
25.	Edit?	a. Edit seasonal coefficients by entering Y.	27
		b. Accept data by entering N.	26
26.		a. If not in forecast mode.	34
		b. If in forecast mode.	36

(continued)

Step	Display	Procedure/Comment	Goto
27.	Edit All Data?	a. Edit all coefficients by entering Y.	25
		b. Edit one element by entering N.	28
28.	Enter Element Number:	Enter element number to be changed.	29
29.	Enter S(X):	Enter new value.	30
30.	Edit More Elements?	a. Continue editing by entering Y.	28
		b. Accept data by entering N.	31
31.		a. If not in forecast mode.	34
		b. If in forecast mode.	36
32.	Enter D(X):	Enter historical data. After entry, editing is allowed as in step 25.	33
33.		a. If in estimate mode.	39
		b. If in revise mode.	34
		c. If in forecast mode.	36
34.	Enter Revised Period #:	Enter period number to be revised.	35
35.	Enter D(X):	Enter new data point.	39
36.	Enter # Forecast Prds:	Enter number of periods to be forecast.	37
37.	Enter 1st Forecast Prd:	Enter period where forcasting is to begin.	38
38.	Period ###=	Displays forecast for each period requested. Proceed by pressing [ENTER].	43
39.	F(T)=	Displays level coefficient. Proceed by pressing [ENTER].	40
40.	T(T)=	Displays trend coefficient. Proceed by pressing [ENTER].	41
41.		a. If seasonal constant is zero.	43
		b. If seasonal constant is not zero.	42

Step	Display	Procedure/Comment	Goto
42.	D(#)=	Displays seasonal coefficients for each period. Proceed by pressing [ENTER].	43
43.	Record to Media?	a. Save data for future use by entering Y.	44
		b. Continue program by entering N.	45
44.	Enter Device.Filename?	Enter file in which to save data in the form "Device.Filename".	45
45.	Exit Program?	a. Exit program by entering Y.	STOP
		b. Continue program by entering N.	4

Example 1

Using the level, trend, and seasonal forecasting model, estimate the model coefficients and forecast data for the first two periods following the actual data. The data falls in a four period cycle and is as follows.

Period	Data
1	100
2	200
3	300
4	400
5	500

Use .15 as your value for the smoothing constants.

Select the Data Forecasting program by entering RUN "FCAST".

Step	Display	Procedure/Comment
1.	DATA FORECASTING	Program name.
2.	Use Printer?	Enter N.
3.	Estimate?	Enter Y.
4.	Read From Media?	Enter N.
5.	Data Loaded?	Enter N.
6.	Enter Level Cnst: 0	Enter .15.
7.	Enter Trend Cnst: 0	Enter .15.
8.	Enter Season Cnst: 0	Enter .15.
9.	Enter Periods: 0	Enter 4.
10.	Edit?	Enter N.
11.	Enter D(1): 0	Enter 100.
12.	Enter D(2): 0	Enter 200.
13.	Enter D(3): 0	Enter 300.
14.	Enter D(4): 0	Enter 400.
15.	Enter D(5): 0	Enter 500.
16.	Edit?	Enter N.
17.	F(T)= 500	Displays level coefficient. Proceed by pressing [ENTER].
18.	T(T)= 100	Displays trend coefficient. Proceed by pressing [ENTER].
19.	S(1)= 1 S(2)= 1 S(3)= 1 S(4)= 1	Displays seasonal smoothing coefficients for each period. Proceed after each output by pressing [ENTER].

(continued)

Step	Display	Procedure/Comment
20.	Record to Media?	Enter N.
21.	Exit Program?	Enter N.
22.	Estimate?	Enter N.
23.	Revise?	Enter N.
24.	Forecast?	Enter Y.
25.	Data Loaded?	Enter Y.
26.	Enter # Forecast Prds: 0	Enter 2.
27.	Enter 1st Forecast Prd: 0	Enter 2.
28.	Period 2= 600 Period 3= 700	Displays forecast for each period. Proceed after each output by pressing [ENTER].
29.	Exit Program?	Enter Y.

Example 2

Using the level and seasonal forecasting model, estimate the model coefficients and forecast data for the first two periods following the actual data. The data falls in a four period cycle and is as follows.

Period	Data
1	100
2	200
3	300
4	400
5	500

The fifth period is the period to be added on in the revise mode.

Use .15 as your value for the smoothing constants.

Select the Data Forecasting program by entering RUN "FCAST".

Step	Display	Procedure/Comment
1.	DATA FORECASTING	Program name.
2.	Use Printer?	Enter N.
3.	Estimate?	Enter Y.
4.	Read From Media?	Enter N.
5.	Data Loaded?	Enter N.
6.	Enter Level Cnst: 0	Enter .15.
7.	Enter Trend Cnst: 0	Accept current value by pressing [ENTER].
8.	Enter Season Cnst: 0	Enter .15.
9.	Enter Periods: 0	Enter 4.
10.	Edit?	Enter N.
11.	Enter D(1): 0	Enter 100.
12.	Enter D(2): 0	Enter 200.
13.	Enter D(3): 0	Enter 300.
14.	Enter D(4): 0	Enter 400.
15.	Edit?	Enter N.
16.	F(T)= 250	Displays level coefficient. Proceed by pressing [ENTER].
17.	S(1)= .4 S(2)= .8 S(3)= 1.2 S(4)= 1.6	Displays seasonal smoothing coefficients for each period. Proceed after each output by pressing [ENTER].
18.	Record to Media?	Enter N.
19.	Exit Program?	Enter N.

Step	Display	Procedure/Comment
20.	Estimate?	Enter N.
21.	Revise?	Enter Y.
22.	Data Loaded?	Enter Y.
23.	Enter Revised Period #: 0	Enter 1.
24.	Enter D(1): 100	Enter 500.
25.	Edit?	Enter N.
26.	F(T)= 400 S(1)= .5275	Displays new level and seasonal coefficients. Proceed after each output by pressing [ENTER].
27.	Record to Media?	Enter N.
28.	Exit Program?	Enter N.
29.	Estimate?	Enter N.
30.	Revise?	Enter N.
31.	Forecast?	Enter Y.
32.	Data Loaded?	Enter Y.
33.	Enter # Forecast Prds: 0	Enter 2.
34.	Enter 1st Forecast Prd: 0	Enter 2.
35.	Period 2= 320 Period 3= 480	Displays forecast for each period. Proceed after each output by pressing [ENTER].
36.	Exit Program?	Enter Y.

Depreciation—"DEP"

The Depreciation program allows you to compute

- The annual depreciation.
- The cumulative depreciation to date.
- The current book value.
- The remaining book value.

Introduction

Most businesses possess assets which are considered long term, i.e., assets which remain with the company for longer than one year. Unfortunately, some of these long term assets lose their value over the years because of obsolescence or the normal wear resulting from their use. They must be depreciated in order to better reflect the value of the asset. The depreciation concept is not designed to reflect the market value of an asset, but it is a "paper expense", involving no cash outflows from your company, lowering your income tax, and reflecting some time value of an asset.

In order to calculate the depreciation expense by any method, you need to know several terms. The starting book value is the purchase price of the asset. In order to calculate the depreciable amount of an asset, you must subtract the salvage value of the asset from the starting book value. The depreciable amount is depreciated in various amounts over the economic useful life, which is the estimated life of the asset. The accumulated depreciation of the asset is the total amount of depreciation taken out of the asset's value. In order to calculate the current book value of the asset, you must subtract the accumulated depreciation of the asset from the starting book value. The remaining depreciable value is then calculated by subtracting the salvage value from the current book value. These basic depreciation equations are shown below.

Current Book Value = Starting Book Value – Accumulated Depreciation

Remaining Depreciable Value = Current Book Value – Salvage Value

Program Input and Options

In order to use this program, you need the starting book value, the economic useful life in years, and the salvage value of the asset. If you are using the declining balance method, you may also enter the percentage declining factor which is explained in the declining balance section of this discussion.

You must choose from four depreciation methods for your computations: straight line, declining balance, sum-of-the-years'-digits, and the arithmetic progressive methods. The various depreciation methods used by this program are explained in the following sections.

One of the options of this program allows you to compute the depreciation of an asset acquired during the year. In order to do so, you must enter Y to the prompt Partial First Year? and enter the number of months you had the asset during the year after the prompt Enter Months.

This program also allows you to decide upon the set of consecutive years you want displayed. For example, if you want to see the depreciation amounts for five years beginning with year three, enter 3 at the prompt Enter First Year # then enter 5 after the computer prompts Enter # of Years. The computer then displays the depreciation amount for year three, the cumulative depreciation, the current book value, and the remaining book value. The computer repeats this sequence until data from all five years have been displayed.

Abbreviations

The Depreciation formulas in this manual use the following abbreviations.

CBV   Current book value

CUM   Accumulated depreciation to date of an asset

DEP   Annual depreciation expense

EUL   Economic useful life; i.e., the estimated life of the asset

%FAC   Percent declining factor

MOS   Number of months in first partially depreciated year

RDV   Remaining depreciable value of an asset

SAL   Salvage value

SBV   Starting book value, i.e., the purchase price of an asset

SYD   Sum of the years'-digits

YR   Year of asset's life

Straight Line

The straight line depreciation method provides a constant depreciation expense of an asset over the life of the asset. This method assumes that the asset's value decreases by the same amount each year. The annual depreciation expense is calculated by dividing the economic useful life into the total depreciable amount of the asset. However, when computing a partial year's depreciation, the program computes the yearly depreciation and multiplies it by the portion of the year the asset was held.

The Depreciation program uses the following equations for straight line method calculations.
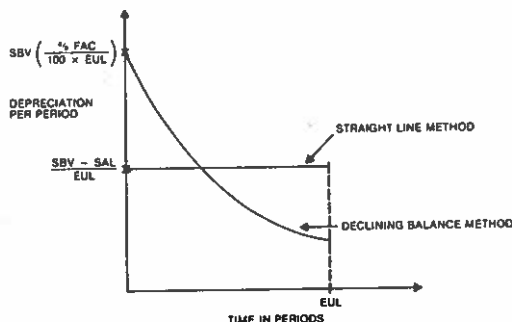
$$DEP = \frac{SBV - SAL}{EUL}$$

$$CUM = DEP \times YR$$

$$CBV = RDV + SAL$$

$$RDV = (EUL - YR) \times DEP$$

Declining Balance

The declining balance depreciation method allows you to write off most of an asset's cost as an expense during the first few years of the asset's life. Because of this you pay a lower income tax over the first few years of the asset's life than if you use straight line depreciation. The following graph shows a comparison of the two methods.

As you can see from this graph, the annual straight line depreciation expense exceeds the declining balance depreciation expense toward the end of the asset's life. In order to take full advantage of the tax benefits available when a combination of the two methods is used, the Depreciation program allows you to switch from the declining balance method to the straight line method when the straight line depreciation amount is higher than the amount calculated by the declining balance method. In order to make a profitable switch to straight line depreciation in the middle of an asset's life, enter Y in response to the prompt Straight Line Crossover?.

The next option in this program is to express the declining factor in American or European form. The American factor is used for computation of the annual depreciation expense in the following formula.

$$\text{DEPRECIATION FOR YEAR}_i = \left(\frac{CBV_{i-1}}{EUL}\right) \times \text{AMERICAN FACTOR}$$

The European declining factor in this program is the American factor divided by the economic useful life of the asset. For example, if you want an American declining factor of 200% for a 10 year asset, the corresponding European factor is 20% = (200% ÷ 10).

Next, you may enter the declining percentage factor or let the program compute the factor for you. The computer's computation of the declining percentage factor is designed primarily for European use. While computing the annual depreciation by the declining balance method, you must keep in mind that the highest legal depreciation you may calculate for American applications is 200% of the straight line amount; however, the computer can handle a figure higher than 200%. If you want to enter the factor yourself, enter N in response to the prompt Compute % Factor?. You may then enter the declining percentage factor. If you want the computer to compute the factor, you must enter Y to the prompt Compute % Factor?.

The following formulas are used for computations involving the declining balance method.

$$\text{DEP} = \text{SBV}\left(1 - \frac{\% \text{ FAC}}{100 \times \text{EUL}}\right)^{YR-1}\left(\frac{\% \text{ FAC}}{100 \times \text{EUL}}\right)$$

$$\text{CUM} = \text{SBV}\left[1 - \left(1 - \frac{\% \text{ FAC}}{100 \times \text{EUL}}\right)^{YR}\right]$$

Sum-of-the-Years'-Digits

The sum-of-the-years'-digits depreciation method, like the declining balance method, is based on an accelerated depreciation rate. This method is advantageous because of the lower income taxes paid during the earlier years of the asset's life.

The sum-of-the-years'-digits method gets its name from the denominator of the fraction used in computing depreciation. The denominator is the sum of the years in which the asset is to be used.

Example

Estimated asset life = 5 years. The asset is to be used in years 1, 2, 3, 4, and 5.

Value of denominator = 1 + 2 + 3 + 4 + 5
= 15

The value for the numerator is found by using the formula EUL + 1 − YR. For example, if you want to calculate the amount of depreciation in the fourth year of an asset with an estimated life of five years, the numerator would be 5 + 1 − 4 = 2, because the asset must be depreciated over year four and year five. As a result, the fraction used for this calculation is 2/15.

Next, you would take the fraction and multiply it by the depreciable value of the asset (starting book value − salvage value) to get that year's depreciation for the asset.

The following formulas are used for computing the depreciation using the sum-of-the-years'-digits method.

$$SYD = \frac{EUL \times (EUL + 1)}{2}$$

$$DEP = \left(\frac{EUL + 1 - YR}{SYD}\right)\left(SBV - SAL\right)$$

$$CUM = YR\left[(2 \times EUL) + 1 - YR\right]\left(\frac{SBV - SAL}{EUL^2 + EUL}\right)$$

Arithmetic Progressive

The arithmetic progressive depreciation method is based on a decelerated depreciation rate and is primarily used in Europe. With this method, the annual depreciation expense is increased each year. As a result, this depreciation method saves on the income taxes paid in the later years of an asset's life but not in the asset's early life. Therefore, money which could have been saved and invested during the early life of the asset while using any of the other depreciation methods must now be used for payment of income taxes.

Arithmetic progressive depreciation follows a trend reverse to that of the sum-of-the-years'-digits depreciation—the numerator of the multiplier is the age of the asset rounded up instead of the number of years left in the life of the asset.

The following formulas are used for calculations using the arithmetic progressive method.

$$SYD = \frac{EUL \times (EUL + 1)}{2}$$

$$DEP = \left(\frac{YR}{SYD}\right)\left(SBV - SAL\right)$$

$$CUM = \frac{2(SBV - SAL)}{EUL(EUL + 1)}\left[\frac{YR^2}{2} - \frac{YR}{2} + YR\right]$$

User Instructions—Depreciation

Select the Depreciation program by entering **RUN "DEP"**.

Step	Display	Procedure/Comment	Goto
1.	DEPRECIATION	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering **Y**.	3
		b. Reject printer usage by entering **N**.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Enter Book Val:	Enter starting book value in dollars.	5
5.	Enter Useful Life:	Enter economic useful life in years.	6
6.	Enter Salvage Val:	Enter the salvage value in dollars.	7
7.	Depreciation Method...	The options for type of depreciation are displayed. Proceed by pressing [ENTER].	8
8.	Straight Line?	a. Select straight line option by entering **Y**.	17
		b. Display next option by entering **N**.	9
9.	Declining Balance?	a. Select declining balance option by entering **Y**.	10
		b. Display next option by entering **N**.	15
10.	Compute %Factor?	a. Compute depreciation factor by entering **Y**.	17
		b. Continue program by entering **N**.	11
11.	Straight Line Crossover?	a. Accept straight line crossover by entering **Y**.	12
		b. Continue program by entering **N**.	12
12.	U.S. Method?	a. Select U.S. method by entering **Y**.	14
		b. Display next option by entering **N**.	13
13.	European Method?	a. Select European method by entering **Y**.	14
		b. Display next option by entering **N**.	12
14.	Enter % Factor:	Enter depreciation factor in percent.	17

(continued)

Step	Display	Procedure/Comment	Goto
15.	Sum of Years Digits?	a. Select sum-of-the-years'-digits option by entering **Y**.	17
		b. Display next option by entering **N**.	16
16.	Arithmetic Progressive?	a. Select arithmetic progressive option by entering **Y**.	17
		b. Display next option by entering **N**.	8
17.	Partial First Year?	a. Accept partial first year by entering **Y**.	18
		b. Continue program by entering **N**.	19
18.	Enter Months:	Enter number of months in partial first year.	19
19.	Enter First Year #:	Enter year number where output should begin.	20
20.	Enter # of Years:	Enter number of years that output should continue.	21
21.	Edit?	a. Edit data by entering **Y**.	4
		b. Accept data by entering **N**.	22
22.	****Year #### ****	Displays year number. Proceed by pressing [ENTER].	23
23.	Depr This Prd=	Displays depreciation this period. Proceed by pressing [ENTER].	24
24.	Total Depr.=	Displays total depreciation. Proceed by pressing [ENTER].	25
25.	Book Value Left=	Displays book value left. Proceed by pressing [ENTER].	26
26.	Depr Value Left=	Displays depreciation value left. Proceed by pressing [ENTER].	27
27.	Exit Program?	a. Exit program by entering **Y**.	STOP
		b. Continue program by entering **N**.	4

Example 1

Calculate the annual depreciation using sum-of-the-years'-digits method for an asset with a purchase price of $11,000, a salvage value of $2000, and an estimated life of three years. Display the results for years one through four because the asset is partially depreciated in year one. The asset was purchased in November of year one.

Select the Depreciation program by entering **RUN "DEP"**.

Step	Display		Procedure/Comment
1.	DEPRECIATION		Program name.
2.	Use Printer?		Enter **N**.
3.	Enter Book Val: 0		Enter **11000**.
4.	Enter Useful Life: 0		Enter **3**.
5.	Enter Salvage Val: 0		Enter **2000**.
6.	Depreciation Method...		Proceed by pressing **[ENTER]**.
7.	Straight Line?		Enter **N**.
8.	Declining Balance?		Enter **N**.
9.	Sum of Years Digits?		Enter **Y**.
10.	Partial First Year?		Enter **Y**.
11.	Enter Months: 0		Enter **2**.
12.	Enter First Year #: 0		Enter **1**.
13.	Enter # of Years: 0		Enter **4**.
14.	Edit?		Enter **N**.
15.	**** Year # 1 ****		Displays all requested values.
	Depr This Prd=	750.00	Proceed after each output by
	Total Depr.=	750.00	pressing **[ENTER]**.
	Book Value Left=	10250.00	
	Depr Value Left=	8250.00	

(continued)

Step	Display		Procedure/Comment
	**** Year # 2 ****		
	Depr This Prd=	4250.00	
	Total Depr.=	5000.00	
	Book Value Left=	6000.00	
	Depr Value Left=	4000.00	
	**** Year # 3 ****		
	Depr This Prd=	2750.00	
	Total Depr.=	7750.00	
	Book Value Left=	3250.00	
	Depr Value Left=	1250.00	
	**** Year # 4 ****		
	Depr This Prd=	1250.00	
	Total Depr.=	9000.00	
	Book Value Left=	2000.00	
	Depr Value Left=	.00	
16.	Exit Program?		Enter **Y**.

Example 2

Calculate the annual depreciation for an asset using the declining balance method with a purchase price of $11,500, a salvage value of $100, an estimated life of five years and a declining factor of 200 using the U.S. method. Switch to straight line depreciation when the annual straight line depreciation is higher than the declining balance depreciation amount and display the results for years one through five.

Select the Depreciation program by entering RUN "DEP".

Step	Display	Procedure/Comment
1.	DEPRECIATION	Program name.
2.	Use Printer?	Enter N.
3.	Enter Book Val: 0	Enter 11500.
4.	Enter Useful Life: 0	Enter 5.
5.	Enter Salvage Val: 0	Enter 100.
6.	Depreciation Method...	Proceed by pressing [ENTER].
7.	Straight Line?	Enter N.
8.	Declining Balance?	Enter Y.
9.	Compute %Factor?	Enter N.
10.	Straight Line Crossover?	Enter Y.
11.	U.S. Method?	Enter Y.
12.	Enter % Factor: 0	Enter 200.
13.	Partial First Year?	Enter N.
14.	Enter First Year #: 0	Enter 1.
15.	Enter # of Years: 0	Enter 5.
16.	Edit?	Enter N.
17.	**** Year # 1 ****	Displays all requested values.
	Depr This Prd= 4600.00	Proceed after each output by
	Total Depr.= 4600.00	pressing [ENTER].
	Book Value Left= 6900.00	
	Depr Value Left= 6800.00	

(continued)

Step	Display	Procedure/Comment
	**** Year # 2 ****	
	Depr This Prd= 2760.00	
	Total Depr.= 7360.00	
	Book Value Left= 4140.00	
	Depr Value Left= 4040.00	
	**** Year # 3 ****	
	Depr This Prd= 1656.00	
	Total Depr.= 9016.00	
	Book Value Left= 2484.00	
	Depr Value Left= 2384.00	
	**** Year # 4 ****	
	Depr This Prd= 1192.00	
	Total Depr.= 10208.00	
	Book Value Left= 1292.00	
	Depr Value Left= 1192.00	
	**** Year # 5 ****	
	Depr This Prd= 1192.00	
	Total Depr.= 11400.00	
	Book Value Left= 100.00	
	Depr Value Left= .00	
18.	Exit Program?	Enter Y.

Financial Needs Forecasting—"FNEED"

This program computes any one of the following given the other six elements.

- Current amount of assets that vary with sales.
- Current amount of liabilities that vary with sales.
- Amount of current sales.
- Net profit percentage to current sales.
- Amount of projected sales for next period.
- Percentage of dividend payments to net profit.
- Amount of external funds needed.

Introduction

When a company experiences an increase in sales while it is operating at full capacity, the company must obviously expand. However, the amount to be spent in expansion must be either borrowed from outside sources or financed by the increased sales of the company. The Financial Needs Forecasting program enables you to see if the sales for the next period will pay for the increased need for capital.

This program, which is based on the "percent of sales" forecasting method, is best used for relatively short term financial projections. Since decisions to expand need to be drawn with specific details, this program serves as a check to see if future capital expenditures will be in line with future sales.

Input and Definitions

The entry for current variable assets is to include the capital used for production. Production capital does not depreciate since the sales forecasting method assumes that depreciation generates cash for the replacement of the capital. Instead of using the historical cost of the capital, you may also want to adjust the original cost of the capital by an inflation index in order to better reflect the external funds needed. Other accounts to be considered when entering the variable assets include the cash, accounts receivable, and inventories which vary with the sales of a certain product.

The current amount of variable liabilities include the accounts payable resulting from purchases or production of the products and the accrued wages and taxes needed for the product. The net profit percentage entered in this program is the after-tax percentage of net profit on sales. The accuracy of this program's results depends largely on the accuracy of the projected sales figure.

Abbreviations and Formulas

The following abbreviations are used in this section of the manual.

AST	Current amount of assets that vary with sales
%DV	Dividend payment rate to net income
EFN	External funds needed
LIA	Current amount of liabilities that vary with sales
%NP	Net profit percentage of sales
S	Sales
Sp	Projected sales for next period

The following formula is used in the Financial Needs Forecasting program.

$$EFN = \frac{AST - LIA}{S}(S - S_p) - \frac{(\%NP)\,S_p}{100}\left(\frac{1 - \%DV}{100}\right)$$

The first half of this equation computes the amount of expenditures needed. Note that the expenditures needed are based primarily on the (AST – LIA)/S ratio. If the historical cost of the variable capital is used rather than an inflation adjusted figure, the estimated funds needed may be understated. The second part of the equation calculates the amount of the expenditures to be paid off by the net income of the next period. If the external funds needed are calculated to be positive, capital financing is needed. When the external funds are negative, no capital funds are needed and a profit may be generated. In general, the equation allows for small capital expenditures to be funded by operations and large capital expenditures to be financed with sources other than operations.

User Instructions—Financial Needs Forecasting

Select the Financial Needs Forecasting program by entering RUN "FNEED".

Step	Display	Procedure/Comment	Goto
1.	FINANCIAL NEEDS FORECASTING	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	0=Menu 1=Assets 2=Sales 3=Liab. 4=Profit 5=Proj. Sales 6=Dividend 7=Fund Needed 8=Exit	Displays Menu.	5
5.	Enter Compute Option:	Enter option number from Menu for unknown value to be computed.	
		0 = Repeat Menu	6
		1 = Assets	6
		2 = Sales	6
		3 = Liabilities	6
		4 = Profit	6
		5 = Projected Sales	6
		6 = Dividends	6
		7 = Funds Needed	6
		8 = Exit	STOP
6.	Enter Assets:	Enter assets. Ignored if assets selected in Menu.	7
7.	Enter Pres Sales:	Enter present sales. Ignored if sales selected in Menu.	8
8.	Enter Liability:	Enter liability. Ignored if liability selected in Menu.	9
9.	Enter %Net Profit:	Enter percent profit. Ignored if profit selected in Menu.	10

(continued)

71

Step	Display	Procedure/Comment	Goto
10.	Enter Proj Sales:	Enter sales. Ignored if sales selected in Menu.	11
11.	Enter %Dividends:	Enter percent dividends. Ignored if dividends selected in Menu.	12
12.	Enter Funds:	Enter funds needed. Ignored if funds needed selected in Menu.	13
13.	Edit?	a. Edit data by entering Y. b. Accept data by entering N.	6 14
14.	Value=	Displays selected result. Proceed by pressing [ENTER].	4

Example 1

Assume your plant is operating at full capacity. The current variable assets to a certain product amounts to $75,000 and the current variable liabilities amount to $37,000. Sales this year amount to $800,000 and will probably be $900,000 next year in your inflation free country. The net profit percentage amounts to 3% of sales and the dividend rate is 50% of net profit. Will your company need some capital funding to expand your plant merely to keep up with expected sales?

Select the Financial Needs Forecasting program by entering **RUN "FNEED"**.

Step	Display	Procedure/Comment
1.	FINANCIAL NEEDS FORECASTING	Program name.
2.	Use Printer?	Enter N.
3.	0=Menu 1=Assets 2=Sales 3=Liab. 4=Profit 5=Proj. Sales 6=Dividend 7=Fund Needed 8=Exit	Displays Menu.
4.	Enter Compute Option: 0	Enter 7.
5.	Enter Assets: 0	Enter 75000.
6.	Enter Pres Sales: 0	Enter 800000.
7.	Enter Liability: 0	Enter 37000.
8.	Enter %Net Profit: 0	Enter 3.
9.	Enter Proj Sales: 0	Enter 900000.
10.	Enter %Dividends: 0	Enter 50.
11.	Edit?	Enter N.
12.	Needed Funds= -8750	Displays needed funds. Proceed by pressing [ENTER].
13.	Enter Compute Option: 7	Exit program by entering 8.

Example 2

Assume your plant is operating at full capacity and you want income to increase by $10,000 over the next year. What will your sales figure have to be next year in order to increase your profit without incurring a debt in expansion? Your current variable assets amount to $90,000, this year's sales were $800,000 and variable liabilities amount to $45,000. The net profit percentage amounts to 2% of sales and the dividend rate is 50% of net profit.

Select the Financial Needs Forecasting program by entering RUN "FNEED".

Step	Display	Procedure/Comment
1.	FINANCIAL NEEDS FORECASTING	Program name.
2.	Use Printer?	Enter N.
3.	0=Menu 1=Assets 2=Sales 3=Liab. 4=Profit 5=Proj. Sales 6=Dividend 7=Fund Needed 8=Exit	Displays Menu.
4.	Enter Compute Option: 0	Enter 5.
5.	Enter Assets: 0	Enter 90000.
6.	Enter Pres Sales: 0	Enter 800000.
7.	Enter Liability: 0	Enter 45000.
8.	Enter %Net Profit: 0	Enter 2.
9.	Enter %Dividends: 0	Enter 50.
10.	Enter Funds: 0	Enter −10000.
11.	Edit?	Enter N.
12.	Projected Sales= 756756.7568	Displays projected sales. Proceed by pressing [ENTER].
13.	Enter Compute Option: 5	Exit program by entering 8.

Lease/Purchase—"LPURO"

This program indicates whether to lease or buy an asset once the need for the asset has been established.

Introduction

Once a need for a particular asset has been established, the decision must be made whether to lease the asset or purchase it. In order to make the most profitable decision on whether to lease or purchase the asset, you must consider tax rates, the maintenance expense of the asset each year, and the method of depreciation for the asset.

Program Information

The Lease/Purchase program has several options. You are able to select your depreciation method from a choice of the straight line, declining balance, sum-of-the-years'-digits, or arithmetic progressive. The other option in the program allows you to specify the growth method of the operating expenses. Your operating expenses handled by this program may stay constant, increase by a fixed amount each year, or increase by a fixed percentage each year.

In order to run the Lease/Purchase program, the following input is required.

- The price of the asset.
- The economic useful life of the asset in years, which is also the life of the loan required to purchase the asset or the length of the lease on the asset.
- The operating income tax rate.
- The capital gains tax rate, which is usually half of the income tax rate.
- The interest rate on loans to acquire the asset.
- The rate of interest paid on retained earnings; i.e., the after-tax cost of internal capital.
- The lease payments made at the beginning of each period.
- The salvage book value of the asset; i.e., the starting book value less all depreciation of the asset over the economic useful life of the asset.

- The salvage market value; i.e., the cash expected to be received from sale of the asset at the end of its economic useful life.
- The first year's operating cost of the asset, which includes maintenance costs; the lease covers the operating costs.
- The growth pattern of the operating costs.
- The depreciation method to be used on the asset; the depreciation methods are explained in the "Depreciation" section of this manual.

After all of the data is entered into the program, the computer determines whether to lease or purchase the asset by the following principle.

Lease Advantage = Net Present Value of Lease Cost − Net Present Value of Buying Cost

The computer determines the lease advantage by a formula shown at the end of this discussion which computes the lease's net present value. If the net present value of the lease is greater than zero, the lease is more advantageous than the asset's purchase, and the computer displays Lease Advantage= then the present value of the total savings over the life of the asset. Otherwise, the computer displays Buy Advantage = and the present value of the savings if the asset was purchased.

Abbreviations and Formulas

The abbreviations in this section of the manual are as follows.

%CC	After-tax percentage cost of internal capital; i.e., annual earnings rate on retained earnings
%CD	Loan interest rate
d_1	After-tax percentage cost of debt
DEP	Annual depreciation expense
i	Subscript used to denote period number
K_i	Interest on loan for period i
OC	First year's operating cost; includes maintenance expense
P	Purchase price of asset

PMT	Annual lease payment
Sd	Salvage depreciation; i.e., salvage book value
Sm	Salvage market value
$\%T_c$	Capital gains tax rate
$\%T_i$	Income tax rate
YRS	Economic useful life of the asset, length of lease, or length of loan in years.

The following formula is used in computing the lease advantage.

Net Present Value of Lease =

$$\% T_i \sum_{i=1}^{YRS} \frac{PMT_i}{(1+d_1)^{i-1}} - \sum_{i=1}^{YRS} \frac{K_i}{(1+d_1)^i} - \sum_{i=1}^{YRS} \frac{DEP_i}{(1+d_1)^i}$$

$$- \sum_{i=1}^{YRS} \frac{PMT_i}{(1+\%CD)^{i-1}} + \sum_{i=1}^{YRS} \frac{OC_i\,(1-\%T_i)}{(1+\%CC)^i} - \left[\frac{Sm-(Sm-Sd\,(\%T_c)}{(1+\%CC)^{YRS}}\right]$$

User Instructions—Lease/Purchase

Select the Lease/Purchase program by entering RUN "LPURC".

Step	Display	Procedure/Comment	Goto
1.	LEASE/PURCHASE	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Enter Price:	Enter purchase price of asset.	5
5.	Enter # of Years:	Enter economic useful life or time expected to hold asset.	6
6.	Enter %Income Tx:	Enter income tax rate.	7
7.	Enter %Cap Gain Tx:	Enter capital gains tax rate.	8
8.	Enter Pre-Tx %Cst Debt:	Enter interest rate on loan.	9
9.	Enter %Cst Cap > Tax:	Enter interest rate received from retained earnings.	10
10.	Enter Lease Pmt:	Enter annual lease payment.	11
11.	Enter Dep Sal Val:	Enter book salvage value.	12
12.	Enter Mkt Sal Val:	Enter salvage market value.	13
13.	Enter Op Cost/Yr:	Enter annual operating costs.	14
14.	Constant Cost?	a. Select constant cost option by entering Y.	19
		b. Display next option by entering N.	15
15.	Linear Growth?	a. Select linear growth option by entering Y.	16
		b. Display next option by entering N.	17
16.	Enter Increase/Yr:	Enter amount of increase.	19
17.	Exponential Growth?	a. Select exponential growth option by entering Y.	18
		b. Display next option by entering N.	14

(continued)

(continued)

Step	Display	Procedure/Comment	Goto
18.	Enter %Increase/Yr:	Enter rate of operating cost change.	19
19.	Depreciation Method...	The options for type of depreciation are displayed. Proceed by pressing [ENTER].	20
20.	Straight Line?	a. Select straight line option by entering Y.	25
		b. Display next option by entering N.	21
21.	Arithmetic Progressive?	a. Select arithmetic progressive option by entering Y.	25
		b. Display next option by entering N.	22
22.	Declining Balance?	a. Select declining balance option by entering Y.	23
		b. Display next option by entering N.	24
23.	Enter %Factor:	Enter declining factor.	25
24.	Sum of Years Digits?	a. Select sum-of-the-years'-digits option by entering Y.	25
		b. Display next option by entering N.	20
25.	Edit?	a. Edit data by entering Y.	4
		b. Accept data by entering N.	26
26.		a. If net present value of lease is greater than zero.	27
		b. If net present value of lease is less than or equal to zero.	28
27.	Lease Advantage=	Displays lease advantage. Proceed by pressing [ENTER].	29
28.	Buy Advantage=	Displays buy advantage. Proceed by pressing [ENTER].	29
29.	Exit Program?	a. Exit program by entering Y.	STOP
		b. Continue program by entering N.	4

Example

Assume that you have an option to buy an asset for $200,000 or to lease it for $30,000 a year. The asset will be used for 10 years. Your average income tax rate is 40% and your average tax rate on capital gains is 20%. The interest rate on loans for your company is 18%; the investment's return rate from your retained earnings is 10%. At the end of the asset's life, it will have a salvage book value of $5,000 and an estimated market value of $10,000. The asset's maintenance costs are expected to be $4,500 the first year and will increase by 12% annually. The company uses the sum-of-the-years'-digits depreciation method. Would a lease on this asset be more profitable than a purchase?

Select the Lease/Purchase program by entering **RUN "LPURC"**.

Step	Display	Procedure/Comment
1.	LEASE/PURCHASE	Program name.
2.	Use Printer?	Enter **N.**
3.	Enter Price: 0	Enter **200000.**
4.	Enter # of Years: 0	Enter **10.**
5.	Enter %Income Tx: 0	Enter **40.**
6.	Enter %Cap Gain Tx: 0	Enter **20.**
7.	Enter Pre-Tx %Cst Debt: 0	Enter **18.**
8.	Enter %Cst Cap > Tax: 0	Enter **10.**
9.	Enter Lease Pmt: 0	Enter **30000.**
10.	Enter Dep Sal Val: 0	Enter **5000.**
11.	Enter Mkt Sal Val: 0	Enter **10000.**
12.	Enter Op Cost/Yr: 0	Enter **4500.**
13.	Constant Cost?	Enter **N.**
14.	Linear Growth?	Enter **N.**
15.	Exponential Growth?	Enter **Y.**

(continued)

Step	Display	Procedure/Comment
16.	Enter %Increase/Yr: 0	Enter **12.**
17.	Depreciation Method...	Proceed by pressing **[ENTER].**
18.	Straight Line?	Enter **N.**
19.	Arithmetic Progressive?	Enter **N.**
20.	Declining Balance?	Enter **N.**
21.	Sum of Years Digits?	Enter **Y.**
22.	Edit?	Enter **N.**
23.	Lease Advantage= 25430.42	Displays lease advantage. Proceed by pressing **[ENTER].**
24.	Exit Program?	Enter **Y.**

Machine Replacement—"MREPL"

This program computes
- The annual net expense of an asset to be purchased.
- The annual net expense of a held asset.
- The difference between the two.

Introduction

The Machine Replacement program, which is primarily a European program, is provided as an alternative to the Lease/Purchase program when you are making a decision about replacing a machine. This program computes the average net expenditures of two assets and compares the two to see if replacing the old asset with the new asset is profitable.

The Machine Replacement program subtracts the average net expenditures of the new machine from the average net expenditures of the old machine to get the net expense value. If the net expense value is greater than zero, the replacement may be more profitable than the old asset, and the computer displays Advantage=New. Otherwise, the net expense value is less than or equal to zero, the replacement may not be as profitable as the old asset, and the computer displays Advantage=Old.

Input and Program Information

This program requires the following input.
- Economic useful life of the new asset (the estimated life of the asset in years).
- The percentage cost of capital (the annual interest rate on loans).
- Price of the new asset.
- Salvage value of the new asset.
- Annual operating cost of the new asset.
- Remaining useful life of the old asset.
- Present market value of the old asset.
- Salvage value of the old asset.
- Annual operating cost of the old asset.

Since this program uses fixed interest rates and equal depreciation amounts for the two assets, it may not precisely apply under certain situations commonly encountered in American business.

Abbreviations and Formulas

The abbreviations used in this section follow in alphabetical order.

%CC	Percent cost of capital to firm; annual interest rate paid for the capital
EL_n	Economic useful life of the new asset
MV_o	Present market value of the old asset
Net	Total net expense
New	Average expenditures of new asset
OC_n	Annual operating cost of the new asset; includes maintenance costs
OC_o	Annual operating cost of the old asset; includes maintenance costs
Old	Average expenditures of old asset
P	Price of new asset
RL_o	Remaining useful life of old asset
SV_n	Salvage value of new asset
SV_o	Salvage value of old asset

The Machine Replacement program uses the following formulas.

$$New = \frac{\left[(P - SV_n)\frac{\%CC}{100}\left(1 + \frac{\%CC}{100}\right)^{RL_o}\right]}{\left(1 + \frac{\%CC}{100}\right)^{RL_o} - 1} + \left(SV_n\right)\frac{\%CC}{100} + OC_n$$

$$Old = \frac{\left[(MV_0 - SV_0)\frac{\%CC}{100}\left(1 + \frac{\%CC}{100}\right)^{RL_o}\right]}{\left(1 + \frac{\%CC}{100}\right)^{RL_o} - 1} + \left(SV_0\right)\frac{\%CC}{100} + OC_0$$

Net = Old − New

User Instructions—Machine Replacement

Select the Machine Replacement program by entering RUN "MREPL".

Step	Display	Procedure/Comment	Goto
1.	MACHINE REPLACEMENT	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Enter New Mach Life:	Enter economic useful life of new machine.	5
5.	Enter %Cst of Cap:	Enter interest rate of loans.	6
6.	Enter New Mach Cst:	Enter cost of new machine.	7
7.	Enter New Sal Val:	Enter salvage value of new machine.	8
8.	Enter New Op Cst/Yr:	Enter annual operation cost of new machine.	9
9.	Edit?	a. Edit data by entering Y.	4
		b. Accept data by entering N.	10
10.	Enter Old Mach Life:	Enter remaining economic useful life of old machine.	11
11.	Enter Old Mkt Val:	Enter current market value of old machine.	12
12.	Enter Old Sal Val:	Enter salvage value of old machine.	13
13.	Enter Old Op Cst/Yr:	Enter annual operation cost of old machine.	14

(continued)

Step	Display	Procedure/Comment	Goto
14.	Edit?	a. Edit data by entering **Y**.	10
		b. Accept data by entering **N**.	15
15.	New=	Displays annual net expense for new and old	
	Old=	machine as well as the difference between	
	Net=	them. Proceed after each output by pressing	
		[ENTER].	16
16.		a. If total net expense is greater than zero.	17
		b. If total net expense is less than or equal to	
		zero.	18
17.	Advantage= New	Displays advantage. Proceed by pressing	
		[ENTER].	19
18.	Advantage= Old	Displays advantage. Proceed by pressing	
		[ENTER].	19
19.	Exit Program?	a. Exit program by entering **Y**.	STOP
		b. Continue program by entering **N**.	4

Example

Let the computer decide whether to purchase a new asset or not given the following data.

Economic useful life of new asset = 10 years
Interest rate on loan = 20%
Price of new asset = $10,000
Salvage value of new asset = $1000
Annual operating cost of new asset = $1000
Remaining life of old asset = 5 years
Present market value of old asset = $2500
Salvage value of old asset = $750
Annual operating cost of old asset = $1500

Select the Machine Replacement program by entering **RUN "MREPL"**.

Step	Display		Procedure/Comment
1.	MACHINE REPLACEMENT		Program name.
2.	Use Printer?		Enter **N**.
3.	Enter New Mach Life: 0		Enter **10**.
4.	Enter %Cst of Cap: 0		Enter **20**.
5.	Enter New Mach Cst: 0		Enter **10000**.
6.	Enter New Sal Val: 0		Enter **1000**.
7.	Enter New Op Cst/Yr: 0		Enter **1000**.
8.	Edit?		Enter **N**.
9.	Enter Old Mach Life: 0		Enter **5**.
10.	Enter Old Mkt Val: 0		Enter **2500**.
11.	Enter Old Sal Val: 0		Enter **750**.
12.	Enter Old Op Cst/Yr: 0		Enter **1500**.
13.	Edit?		Enter **N**.
14.	New=	3346.70	Displays annual net expense for new and old
	Old=	2235.16	machine as well as the difference between
	Net=	1111.54	them. Proceed after each output by pressing
			[ENTER].
15.	Advantage= Old		Displays advantage. Proceed by pressing
			[ENTER].
16.	Exit Program?		Enter **Y**.

Money Evaluator—"MEVAL"

This program computes the following annuity values.

- The payment amount.
- The total number of payments.
- The annual interest rate.
- The present value.
- The future value.
- The amortization schedule.
    - a. The annual debt payment.
    - b. The principal portion of the payment.
    - c. The interest portion of the payment.
    - d. The principal subtotal.
    - e. The interest subtotal.
    - f. The cumulative total of principal payments.
    - g. The cumulative total of interest payments.
    - h. The remaining principal balance.

Introduction

The Money Evaluator program* calculates any of the five annuity values listed above when given the other four values, the number of compounding periods per year, and the number of payments per year. You may calculate any of the above values with the number of compounding and payment periods per year differing from each other when using this program. The computations may differ depending on the type of annuity chosen.

*This program was adapted from a TI-59 PPX program (#198054E).

Present Value vs. Future Value

The present value case, often referred to as discounting backwards, is most commonly used when paying off a loan. This involves paying off a loan amount (the present value in this case) until you reach a balloon payment, which is the future value or the remaining principal to be paid after the final annuity payment.

The present value case may be used in another sense. Money received tomorrow is not worth as much as money received today because of the lost earning potential of the money. Thus, the present value of an annuity is the sum of the discounted payments of that annuity. When in the present value case, each annuity payment, with the possible exception of the balloon payment, is worth less than the preceding one because of time value factors such as inflation and lost investment opportunities.

In contrast to the present value case, the future value case is relatively straightforward. The future value of an annuity is the annuity payments plus the interest earned on the account as a whole.
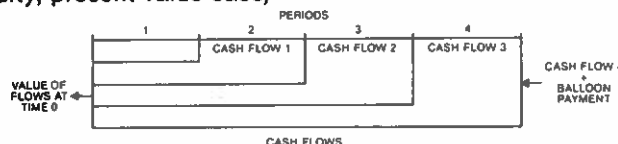
If you want to calculate the present value or future value for a given amount of money, enter 0 as the payment amount. The program then skips the amortizing option, because there is no annuity to amortize.

This program does not compute the present value while using the future value case or the future value while using the present value case.
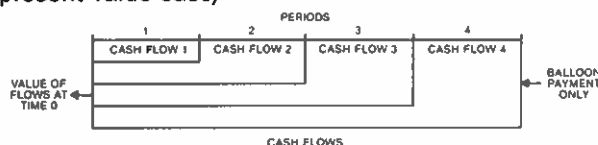
Annuity Due vs. Ordinary Annuity

You can compute any value by using the annuity due or the ordinary annuity methods. When using the annuity due method, the payments occur at the beginning of each payment period. In contrast, the payments for an ordinary annuity occur at the end of each payment period. Thus, the difference between an annuity due and an ordinary annuity is the extra period's interest earned by an annuity due. The two annuities, along with the present and future value concepts, are illustrated below for a life of five periods.

Case 1: End of period payments discounted backwards.
(Ordinary annuity, present value case)

Case 2: Beginning of period payments discounted backwards.
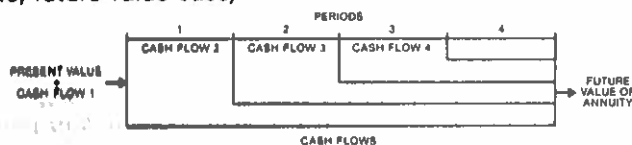(Annuity due, present value case)

Case 3: End of period payments compounded forward.
(Ordinary annuity, future value case)

Case 4: Beginning of period payments compounded forward.
(Annuity due, future value case)

Note: This program assumes the periods are equal in length.

Interest Rate Methods

Three different interest rate methods may be used in this program—the nominal annual rate (primarily used in the U.S.), the effective annual rate (primarily used in Europe), or the continuous rate. As an example of the relationship between these rates, consider a savings account earning a nominal rate of 6% per year and compounded monthly. In this case, the balance of the account would be increased by 6% ÷ 12 = .5% at the end of each month. After a year, an initial investment of $100 would be worth $106.17 = $100 $(1 + .005)^{12}$. This translates to a yearly effective rate of 6.16778%. In contrast, the continuous rate is compounded continuously; it has no compounding periods by definition. After a year of continuous compounding, an initial investment of $100 would be worth $106.18 = $100 $\times e^{.06}$. Thus, a 6% continuous rate would translate to an effective rate of 6.18365%. The length of the period to be compounded under the continuous compounding method is the number of years of compounding.

Amortization Schedule

The Money Evaluator program calculates the amortization schedule only when you select the present value case, i.e., discount backwards. When the payment amount equals zero, the program skips the amortizing option of this program.

When amortizing, the future value is treated as a balloon payment to be paid at the end of the last period. If you want the balloon payment to be paid at the beginning of the last period, you should use the Cash Flows program in this library. Regardless of the amortization schedule used, the remaining balance is the balance immediately following the payment.

Simple Compounding Theory

The use of money over a period of time is of value to the one using the money. An investor gives up the use of money and in return earns interest. A borrower acquires the use of money and in return pays interest. The basic concept is familiar to anyone who has put money in a savings account. If the money is earning 6% annual interest, then $1 deposited today is worth $1.06 in one year, and $1.34 in five years. Note that in five years the dollar has not increased by merely six cents per year, to a value of $1.30, but has grown an additional four cents. This is because the interest has earned interest; a concept known as compounding.

The algebraic expression for this calculation is

$$FV = PV \ (1 + \%I \div 100 \div C/Y)^N$$

The future value (FV) of an existing amount of money is equal to the present value of the money (PV), compounded for N periods with C/Y compounding periods per year at an annual interest rate %I. N is equal to the number of years $\times$ C/Y.

This program may be used to solve for any term in the above equation assuming the following conditions.

- The periods are of equal length.
- The interest earned is added to the principal at the end of each period.
- The interest rate is constant over each period.

Abbreviations and Formulas

Abbreviations used for the formulas in the Money Evaluator section of the manual are as follows.

ADP	Annual debt payment
BAL	Remaining balance
BAL_o	Balance at beginning of period
CPD FWD	Future value case; i.e., compound forward
C/Y	Compounding periods per year
DISCT BKWD	Present value case; i.e., discount backwards
%I	Annual interest rate
I_f	Decimal interest rate per period converted for compounding methods
FV	Future value; also balloon payment
N	Total number of payments
PMT	Cash payment per period
PMT_i	Payment of interest in period i
PMT_p	Payment of principal in period i
PV	Present value
P/Y	Payments per year
SBT_i	Subtotal of interest payments
SBT_p	Subtotal of principal payments
TOT_i	Cumulative interest paid
TOT_p	Cumulative principal paid

The formulas used in the Money Evaluator program are as follows.

$$PMT = \left[FV - \left(\frac{PV - FV}{(1 + I_f)^N - 1} \right) \right] (I_f)$$

$$PV = \frac{PMT}{I_f} - \left(\frac{PMT}{I_f} - FV \right) \left(1 + I_f \right)^{-N}$$

$$N = \frac{\ln \left[\dfrac{\dfrac{PMT}{I_f} - PV}{\left(\dfrac{PMT}{I_f} \right) - PV + (PV - FV)} \right]}{\ln (1 + I_f)^{-1}}$$

The decimal interest rate per period is found by the Newton-Raphson technique to an accuracy level of 10^{-9}.

User Instructions—Money Evaluator

Select the Money Evaluator program by entering RUN "MEVAL".

Step	Display	Procedure/Comment	Goto
1.	MONEY EVALUATOR	Program name.	2
2.	Use Printer?	a. Accept printer usage by entering Y.	3
		b. Reject printer usage by entering N.	4
3.	Enter Device Name:	Enter output device name.	4
4.	Nominal Interest?	a. Select nominal interest option by entering Y.	7
		b. Display next option by entering N.	5
5.	Effective Interest?	a. Select effective interest option by entering Y.	7
		b. Display next option by entering N.	6
6.	Continuous Interest?	a. Select continuous interest option by entering Y.	7
		b. Display next option by entering N.	4
7.	Enter Compounding Prds/Yr:	Enter number of compounding periods per year.	8

Step	Display	Procedure/Comment	Goto
8.	Enter # Pmts/Yr:	Enter number of payments per year.	9
9.	0=Menu 1=Payment 2=# Payments 3=Interest 4=Present Value 5=Future Value 6=Amortize	Displays Menu.	10
10.	Enter Compute Option: 0	Enter option number from Menu for unknown value to be computed.	
		0 = Repeat Menu	11
		1 = Payment	11
		2 = Number of Payments	11
		3 = Interest	11
		4 = Present Value	11
		5 = Future Value	11
		6 = Amortize	11
11.	Enter Payment:	Enter payment. Ignored if payment selected in Menu.	12
12.	Enter # Payments:	Enter number of payments. Ignored if payments selected in Menu.	13
13.	Enter %Interest:	Enter interest rate. Ignored if interest selected in Menu.	14
14.	Enter Pres Val:	Enter present value. Ignored if present value selected in Menu.	15
15.	Enter Future Val:	Enter future value. Ignored if future value selected in Menu.	16
16.		a. If payment is zero and payment option not selected.	21
		b. Otherwise.	17

Step	Display	Procedure/Comment	Goto
17.	End of Period Payments?	a. Select end of period payments option by entering Y.	19
		b. Display next option by entering N.	18
18.	Beginning of Period Payments?	a. Select beginning of period payments option by entering Y.	19
		b. Display next option by entering N.	17
19.	Discount Backward?	a. Select discount backward option by entering Y.	21
		b. Display next option by entering N.	20
20.	Compound Forward?	a. Select compound forward option by entering Y.	21
		b. Display next option by entering N.	19
21.	Edit?	a. Edit data by entering Y.	11
		b. Accept data by entering N.	22
22.		a. If amortization option selected.	24
		b. If amortization option not selected.	23
23.	Value=	Displays selected variable. Proceed by pressing [ENTER].	24
24.		a. If payment is zero or future value selected.	44
		b. Otherwise.	25
25.	Amortize?	a. Amortize data by entering Y.	26
		b. Continue program by entering N.	44
26.	Annual Debt Payment=	Displays annual debt payment. Proceed by pressing [ENTER].	27
27.	Subtotals?	a. Compute subtotals by entering Y.	28
		b. Continue program by entering N.	29

Step	Display	Procedure/Comment	Goto
28.	Enter Pmts/Subtotal:	Enter number of payments between subtotals.	29
29.	Cumulative Totals?	a. Compute totals by entering Y.	30
		b. Continue program by entering N.	30
30.	Enter First Payment #:	Enter first payment to be displayed.	31
31.	Enter Last Payment #:	Enter last payment to be displayed.	32
32.	**** Payment # ****	Displays payment number. Proceed by pressing [ENTER].	33
33.		a. If final payment is displayed and equals another payment.	34
		b. If subtotals selected.	38
		c. If subtotals not selected.	35
34.	Final Payment=	Displays final payment. Proceed by pressing [ENTER].	33
35.	Principal Payment=	Displays principal. Proceed by pressing [ENTER].	36
36.	Interest Payment=	Displays interest. Proceed by pressing [ENTER].	37
37.		a. If cumulative totals selected.	40
		b. If cumulative totals not selected.	42
38.	Subtotal Principal=	Displays principal subtotals. Proceed by pressing [ENTER].	39
39.	Subtotal Interest=	Displays interest subtotals. Proceed by pressing [ENTER].	37
40.	Total Principal=	Displays cumulative principal. Proceed by pressing [ENTER].	41
41.	Total Interest=	Displays cumulative interest. Proceed by pressing [ENTER].	42

Step	Display	Procedure/Comment	Goto
42.	Balance=	Displays balance. Proceed by pressing [ENTER].	43
43.		a. If all payments displayed.	44
		b. If more payments.	32
44.	Repeat?	a. Repeat program with same interest and payments by entering Y.	9
		b. Continue program by entering N.	45
45.	Exit Program?	a. Exit program by entering Y.	STOP
		b. Continue program by entering N.	4

Example 1

What is the future value of a savings account if you deposit $1,500 each year for three years? The savings account earns 6% continuous interest compounded monthly. There is no money in the account currently. Compute the future value and compounding schedule using both the ordinary annuity and annuity due methods.

Select the Money Evaluator program by entering RUN "MEVAL".

Step	Display	Procedure/Comment
1.	MONEY EVALUATOR	Program name.
2.	Use Printer?	Enter N.
3.	Nominal Interest?	Enter N.
4.	Effective Interest?	Enter N.
5.	Continuous Interest?	Enter Y.
6.	Enter # Pmts/Yr: 0	Enter 1.
7.	0=Menu 1=Payment 2=# Payments 3=Interest 4=Present Value 5=Future Value 6=Amortize	Displays Menu.

(continued)

Step	Display	Procedure/Comment
8.	Enter Compute Option: 0	Enter 5.
9.	Enter Payment: 0	Enter 1500.
10.	Enter # Payments: 0	Enter 3.
11.	Enter %Interest: 0	Enter 6.
12.	Enter Pres Val: 0	Accept current value by pressing [ENTER].
13.	End of Period Payments?	Enter Y.
14.	Discount Backward?	Enter N.
15.	Compound Forward?	Enter Y.
16.	Edit?	Enter N.
17.	Future Value= 4784.00	Displays future value. Proceed by pressing [ENTER].
18.	Repeat?	Enter Y.
19.	Enter Compute Option: 5	Enter 6.
20.	Enter Payment: 1500	Accept current value by pressing [ENTER].
21.	Enter # Payments: 3	Accept current value by pressing [ENTER].
22.	Enter %Interest: 6	Accept current value by pressing [ENTER].
23.	Enter Pres Val: 0	Accept current value by pressing [ENTER].
24.	Enter Future Val: 4784.000097	Enter -4784.000097.
25.	End of Period Payments?	Enter Y.
26.	Discount Backward?	Enter Y.
27.	Edit?	Enter N.
28.	Amortize?	Enter Y.
29.	Annual Debt Payment= 1500	Displays annual debt payment. Proceed by pressing [ENTER].

(continued)

100

(continued)

Step	Display	Procedure/Comment
30.	Subtotals?	Enter N.
31.	Cumulative Totals?	Enter N.
32.	Enter First Payment #: 0	Enter 1.
33.	Enter Last Payment #: 0	Enter 3.
34.	**** Payment 1 **** Principal Payment= 1500.00 Interest Payment= .00 Balance= -1500.00 **** Payment 2 **** Principal Payment= 1592.75 Interest Payment= -92.75 Balance= -3092.75 **** Payment 3 **** Final Payment= 1500.01 Principal Payment= 1691.25 Interest Payment= -191.24 Balance= -4784.00	Displays all requested values. Proceed after each output by pressing [ENTER].
35.	Repeat?	Enter Y.
36.	Enter Compute Option: 6	Enter 5.
37.	Enter Payment: 1500	Enter -1500.
38.	Enter # Payments: 3	Accept current value by pressing [ENTER].
39.	Enter %Interest: 6	Accept current value by pressing [ENTER].
40.	Enter Pres Val: 0	Accept current value by pressing [ENTER].
41.	End of Period Payments?	Enter N.
42.	Beginning of Period Payments?	Enter Y.

(continued)

101

(continued)

Step	Display	Procedure/Comment
43.	Discount Backward?	Enter **Y**.
44.	Edit?	Enter **N**.
45.	Future Value= −5079.83	Displays future value. Proceed by pressing **[ENTER]**.
46.	Amortize?	Enter **Y**.
47.	Annual Debt Payment= 1500	Displays annual debt payment. Proceed by pressing **[ENTER]**.
48.	Subtotals?	Enter **N**.
49.	Cumulative Totals?	Enter **N**.
50.	Enter First Payment #: 1	Accept current value by pressing **[ENTER]**.
51.	Enter Last Payment #: 3	Accept current value by pressing **[ENTER]**.
52.	**** Payment 1 ****	Displays all requested values.
	Principal Payment= 1500.00	Proceed after each output by pressing
	Interest Payment= .00	**[ENTER]**.
	Balance= −1500.00	
	**** Payment 2 ****	
	Principal Payment= 1592.75	
	Interest Payment= −92.75	
	Balance= −3092.75	
	**** Payment 3 ****	
	Final Payment= 1500.01	
	Principal Payment= 1691.25	
	Interest Payment= −191.24	
	Balance= −5079.83	
53.	Repeat?	Enter **N**.
54.	Exit program?	Enter **Y**.

Example 2

You are buying an asset for $5000 at 18% nominal interest compounded monthly. You want to make semi-annual payments over three years to pay off the asset's loan. You want to make a final balloon payment of $2,000. Select the ordinary annuity method, compute the payments needed, and calculate an amortization schedule for this project, showing annual subtotals of payments one through six.

Select the Money Evaluator program by entering **RUN "MEVAL"**.

Step	Display	Procedure/Comment
1.	MONEY EVALUATOR	Program name.
2.	Use Printer?	Enter **N**.
3.	Nominal Interest?	Enter **Y**.
4.	Enter Compounding Prds/Yr: 0	Enter **12**.
5.	Enter # Pmts/Yr: 0	Enter **2**.
6.	0=Menu 1=Payment 2=# Payments	Displays Menu.
	3=Interest 4=Present Value	
	5=Future Value 6=Amortize	
7.	Enter Compute Option: 0	Enter **1**.
8.	Enter # Payments: 0	Enter **6**.
9.	Enter %Interest: 0	Enter **18**.
10.	Enter Pres Val: 0	Enter **5000**.
11.	Enter Future Val: 0	Enter **2000**.
12.	End of Period Payments?	Enter **Y**.
13.	Discount Backward?	Enter **Y**.
14.	Edit?	Enter **N**.
15.	Payment= 862.53	Displays payment. Proceed by pressing **[ENTER]**.
16.	Amortize?	Enter **Y**.
17.	Annual Debt Payment= 1725.06	Displays annual debt payment. Proceed by pressing **[ENTER]**.

Step	Display		Procedure/Comment
18.	Subtotals?		Enter Y.
19.	Enter Pmts/Subtotal: 1		Enter 2.
20.	Cumulative Totals?		Enter Y.
21.	Enter First Payment #: 0		Enter 1.
22.	Enter Last Payment #: 0		Enter 6.
23.	**** Payment 2 ****		Displays all requested values.
	Subtotal Principal=	827.56	Proceed after each output by pressing
	Subtotal Interest=	897.50	[ENTER].
	Total Principal=	827.56	
	Total Interest=	897.50	
	Balance=	4172.44	
	**** Payment 4 ****		
	Subtotal Principal=	989.45	
	Subtotal Interest=	735.61	
	Total Principal=	1817.01	
	Total Interest=	1633.11	
	Balance=	3182.99	
	**** Payment 6 ****		
	Final Payment=	862.51	
	Subtotal Principal=	1182.99	
	Subtotal Interest=	542.05	
	Total Principal=	3000.00	
	Total Interest=	2175.16	
	Balance=	2000.00	
24.	Repeat?		Enter N.
25.	Exit Program?		Enter Y.

Appendix—Subprograms

Many of the routines used in the programs of this library are developed as independent subprograms. These subprograms may be accessed for use in developing your own BASIC programs by calling the subprogram with its assigned arguments. Refer to the *Compact Computer User's Guide* for details on the restrictions and requirements for use of subprograms.

The special format used for presentation of subprograms in this appendix provides all of the information necessary for you to select and run the subprograms which you need in your own BASIC program. There are three possible sections within the discussion of each subprogram: Description; Format; and Example. To insure proper execution of the subprograms, these sections should be read thoroughly before running the subprograms.

Description   briefly describes the routine which the subprogram performs.
Format   illustrates the format necessary for calling the subprogram and identifies the requirements, restrictions, and purpose of each element in the argument list.
Example   provides the procedure and comments for actual execution of the subprogram.

AK

Description

Input and edit a one dimensional array.

Format

CALL AK(PROMPT$,ARRAY( ),FIRST,LAST,DEVICE)

PROMPT$	Pass in the name or description of the array to be displayed preceding the subscript.
ARRAY( )	Pass in the array name used in the program with no arguments.
FIRST	Pass in the first array element to be entered.
LAST	Pass in the last array element to be entered.
DEVICE	Pass in the device number of the output device. If DEVICE = 0, output is not printed; otherwise, output is printed on DEVICE.

After inputting all array elements, this subprogram asks if you wish to edit the array. If you do not, this subprogram passes control back to the calling program. If you do, this subprogram allows editing of only the elements previously entered with the option of editing any or all of them.

Example

CALL AK("NUMBER",A( ),1,5,PN)

1. Inputs into the array A( ) from elements 1 through 5 inclusive with the following prompt.

    Enter NUMBER(X):

    where X goes from 1 to 5.

2. After entry, you are prompted for editing by

    Edit?

    An **N** response returns control to the calling program.

    A **Y** response prompts

    Edit All Data?

    A **Y** response allows reentry of all previously entered elements. Execution then returns to step 2.

    An **N** response continues at step 3.

3. The subprogram now prompts

    Enter Element Number:

    Enter the specific element number to be edited. It must also be one of the array elements previously entered. After editing the element, the subprogram prompts

    Edit More Elements?

    A **Y** response continues execution at step 3.

    An **N** response returns control to the calling program.

DT

Description

Extract and validate date.

Format

CALL DT(DATE$,MONTH,DATE,YEAR,FACTOR)

DATE$	Pass in date to be validated in MMDD.YYYY format.
MONTH	Returns month of the year (1-12).
DATE	Returns date number (1-31 or 1-29 for Feb.).
YEAR	Returns year (Must be after 1582).
FACTOR	Returns a factor such that the difference between any two factors is the number of days between the two dates. A FACTOR of zero signals an invalid date.

Example

CALL DT (0428.1958,MTH,DY,YR,FAC)

1. The subprogram sets MTH = 4, DY = 28, and YR = 1958.

2. The extracted date is then checked for validity. This means that the month is from 1-12, the date is 1-31 and the year is after 1582. If the date is found to be invalid by these criteria, FAC is set to 0 and control is returned to the calling program.

3. A valid date causes a factor unique to the date to be computed. The difference in factors is the number of days between the two dates on a 365 day calendar. FAC is set equal to 715262 and control returns to the calling program.

FIX

Description

Fix (round) a number to two decimal places.

Format

CALL FIX(NUMBER)

    NUMBER   Pass in number to be rounded. Rounded number is returned in NUMBER.

Example

CALL FIX(LMK)

If LMK = 2533.52791, then LMK is rounded to 2533.53 and control returns to the calling program.

IR

Description

Input a real (floating point) number.

Format

CALL IR(PROMPT$,VARIABLE,DEVICE)

PROMPT$ Pass in a prompt describing the variable being asked for.

VARIABLE Returns the value entered.

DEVICE   Pass in the output device number. An output device number less than zero causes the entered value to be printed with the IMAGE of "####.####". This is useful when using dates as input.

Example

CALL IR("Future Value",FV,PN)

1. The subprogram asks for input with the prompt

    Enter Future Value: X

    where X is the current value of FV.

2. After input, the value of PN is checked. If it is 0, control returns to the calling program. If PN > 0, the prompt, along with the entered number are printed on device #PN. If PN < 0, the prompt, along with the entered number, are printed using the IMAGE "####.####" on device ABS(PN). i.e. with PN = −1 and FV = 428.1958 the following is printed on device #1.

    Future Value= 428.1958

In both cases, control returns to the calling program.

109

RC

Description

Range check input numbers.

Format

CALL RC(LOW,HIGH,VARIABLE,CHECK,FLAG)

LOW	Pass in lowest value allowed.
HIGH	Pass in highest value allowed.
VARIABLE	Pass in number to be validated.
CHECK	Pass in one or the sum of any of the following numbers indicating which check(s) are to be made as follows.

    1   VARIABLE must be an integer

    2   VARIABLE > LOW and VARIABLE < HIGH

    4   VARIABLE ≥ LOW and VARIABLE ≤ HIGH

    8   VARIABLE > LOW

  16 VARIABLE > LOW

  32 VARIABLE < HIGH

  64 VARIABLE ≤ HIGH

128 VARIABLE <> LOW

256 VARIABLE = LOW

FLAG	Returns a flag indicating if VARIABLE has failed a check by setting FLAG = −1 and passed by setting FLAG = 0.

Example

CNT = 12
CALL RC(0,10,CNT,49,F)

Since CHECK is 49, the subprogram verifies that CNT is an integer (1), greater than or equal to zero (16), and less than 10 (32). If it fails, an appropriate error message is displayed and F is set to −1.

If CNT passes the tests, F = 0. In either case, control is then returned to the calling program.

UP

Description

Ask to use printer.

Format

CALL UP(NAME$,DEVICE)

NAME$	Pass in the name of the program to be displayed for 3 seconds.
DEVICE	Returns the device number of the opened output device. A device number of 0 indicates output will appear on the display, while a device number of 1 indicates the requested output device was opened as device #1.

Example

CALL UP("DATA FORECASTING",PN)

1. The name DATA FORECASTING appears in the display for three seconds.

2. The subprogram then prompts

    Use Printer?

An N response exits the subprogram with PN = 0.

A Y response causes the subprogram to prompt

    Enter Device Name:

The entered device is opened under device number 1, setting PN = 1. The subprogram returns control to the calling program.

YN

Description
Ask yes/no question.

Format
CALL YN(QUESTION$,ANSWER,DEVICE)

    QUESTION$ Pass in the question to be asked with no question mark.

    ANSWER   Returns ANSWER = 0 when N is chosen, or returns ANSWER = -1 when Y is chosen.

    DEVICE   Pass in device number. If device number is zero, nothing is printed; otherwise, QUESTION$ is printed on DEVICE.

Example
CALL YN("Edit",D,PN)

The question Edit? is displayed.

A Y response sets D = -1 and prints the question, less the question mark, on device #PN.

An N response sets D = 0. Control is then passed back to the calling program.

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NOTES

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