HEWLETT-PACKARD

HP·41C

FINANCIAL DECISIONS PAC

INTRODUCTION

Welcome. You are about to step into a field that, ten years ago, was open only to users of large computer systems costing tens or hundreds of thousands of dollars. Today, the HP-41C provides programmed solutions to complex financial problems which, through the use of simple language prompts, can be used by every individual, regardless of their computing background.

Each financial solution in this pac is represented by a programmed set of instructions in the plug-in Application Module and an easy to read description, set of instructions and examples in this manual. We think you will find the combination of power and simplicity a unique and important asset to answering many of your important financial questions.

Before plugging in your Application Module and executing a program please read the next section A Word About Program Usage—Getting Started. This short section will explain how to insert the Application Module without danger of damage to your module or calculator. It will also explain a number of common features that are used in operating the programs.

After reading Getting Started you should familiarize yourself with a program by running it once or twice while following the examples in the manual. An excellent program to begin with is *Days Between Dates*. When you have become familiar with other programs you will find that a program's prompting or the mnemonics on the keyboard overlays will provide the necessary instructions, including which variables are to be input, which keys are to be pressed, and which values will be output. A quick-reference card with a brief description of each program's operating instructions has also been provided for your convenience.

We hope the Financial Decisions Pac will assist you in the solution of numerous problems in your discipline. If you have technical problems with this Pac, refer to your HP-41 owner's handbook for information on Hewlett-Packard "technical support" or "programming assistance."

> **Note:** Application modules are designed to be used in all HP-41 model calculators. The term "HP-41C" is used throughout the rest of this manual, unless otherwise specified, to refer to all HP-41 calculators.

CONTENTS

Solves for any of the five standard compound interest variables N,
I, PV, PMT and FV with either 3 or 4 knowns. Options include BEGIN
(annuity due) or END (ordinary annuity) payments.

Calculates the internal rate of return of a series of up to 46 unequal
cash flows or up to 23 groups of equal cash flows. Each additional
Memory Module can accommodate an additional 64 cash flows or
32 groups of cash flows.

Solves for the internal rate of return using a modified IRR technique.

Discounts a series of cash flows to a single net value.

Calculates the interest and principal portion of each periodic
payment and the remaining balance after the payment has been
made. Options include summarization of accumulated interest and
principal as well as BEGIN (annuity due) payments.

Produces an annual schedule for straight line depreciation with
consideration for partial first year.

Produces an annual schedule for declining balance depreciation
with consideration for partial first year. Automatic crossover to
straight line depreciation is optional.

A WORD ABOUT PROGRAM USAGE

Getting Started

Operating a program in the Financial Decisions Module is a simple five step process which involves: inserting the module, selecting the program, setting the proper memory size, executing the program and then entering the required data values either by responding to simple English prompts or directly by pressing keys labeled with a program overlay. The calculator will do the rest.

Inserting The Module

1. Turn the HP-41C off! Failure to turn the calculator off could damage both the module and the calculator.
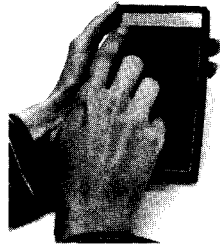
2. Remove the port covers. Remember to save the port covers, they should be inserted into the empty ports when no extensions are inserted.

3. With the application module label facing downward as shown, insert the application module into any port **after** the last memory module presently inserted.
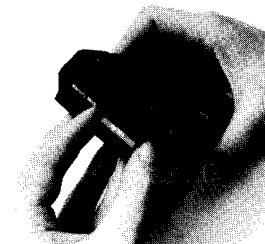
4. If you have additional application modules to insert, plug them into any port after the last memory module. For example, if you have a memory module inserted in port 1, you can insert the Financial Decisions Module in any of ports 2, 3, or 4. *Never insert an application module into a lower numbered port than a memory module.* Be sure to place port covers over unused ports.

5. Turn the calculator on.

Selecting The Program

The table of contents of this Pac lists the titles of the 10 programs contained in the Financial Decisions Module. Beside each title is the program name which is used to execute the program. Program names are also listed on the Quick Reference Card and in the calculator catalog. The calculator extension catalog (■ CATALOG 2) contains the alpha names of all programs contained in any extension plugged into the calculator at the time the catalog is reviewed. Two kinds of Financial Decisions program names appear in the catalog: those needed to execute the programs and those used for subroutines. The subroutine names differ from the basic program names by an * preceeding the name. Only those program names *without* an asterisk are used for normal program operation.

Setting Proper Memory Size

Operating a Financial Decisions Pac program requires that the HP-41C have sufficient storage registers (memory) allocated. This simple procedure involves executing the SIZE function. First, determine the required size by referring to the program documentation or the Quick Reference Guide. Second, execute SIZE followed by the three digit number. For example, to allocate the 18 registers required by the *Days Between Dates* (DAYS) program:

Keystrokes: **Display:**

[XEQ] [ALPHA] SIZE [ALPHA]   *SIZE___*
018

Ideally the calculator should be "sized" to the proper number of registers prior to executing a program. However, if a Financial Decisions Pac program is executed with insufficient memory registers, the program will simply display the error message—*XEQ SIZE XXX.* You may then allocate the proper number of registers and re-execute the program without consequence.

Executing The Program

As mentioned previously, each Financial Decisions program has a name, which is used to execute (start) the program. The following is an example of how to execute the program titled *Days Between Dates* (DAYS).

Keystrokes:	Display:
XEQ ALPHA DAYS ALPHA	*CLR?*

Whenever a program name such as DAYS appears in the text in subsequent pages it will appear in gold type. This indicates that the ALPHA key must be pressed before and after spelling out the name on the calculator keyboard.

Entering Data

In the preceding example, the calculator stopped with the word *CLR?* in the display after the program name was executed. Displays of this kind are called alpha prompts. This particular alpha prompt asked the user whether he/she wishes to clear the storage registers (memories) before the program continues. *CLR?* is always the first prompt displayed when executing Financial Decisions Pac programs. Unless you know that data contained in memory is relevant to the program currently running, it is best to clear the memory. This is done by pressing Y (for yes) followed by a R/S . For expedience a simple R/S is also sufficient to indicate a yes response. At this point, program operation either continues with additional prompts, or halts to be manually executed utilizing a keyboard overlay.

Prompted Operation

Prompts are simply requests for information represented by a word or abbreviated word followed by a question mark. The information requested is either an answer to a question, called an alpha prompt, or a request for numeric data, called a data prompt.

An alpha prompt is denoted by a question mark immediately following the last letter of a word or group of words in the display. *CLR?*, mentioned previously, is an example of an alpha prompt. All alpha prompts in this Pac are requests for a yes or no response. A yes response is signified by pressing the letter Y (for yes) followed by a R/S (a simple R/S is also sufficient). A no is signified by pressing N followed by a R/S .

A data prompt is identified by an equal sign (=) following a word or group of words in the display. The equal sign is followed immediately by either a question mark or a number and a question mark. *DATE1=?* and *LIFE=5?* are two examples of data prompts.

The data prompt *without* a number indicates that the value in memory associated with the prompt has not been retrieved. This occurs when the response to the first program prompt *CLR?* is yes. Not retrieving irrelevant data is a form of pseudo clearing of the memories. The response to any data prompt without an associated value (*DATE1=?*) is to key in the number requested followed by a R/S . The program then proceeds to the next prompt.

A data prompt *with* a value attached indicates that the memory associated with the prompt contains the value displayed. If the value is appropriate for the problem currently being solved, press R/S to acknowledge that the value is

correct and await the next prompt. If the value is not correct, key in the appropriate value and follow it with a $\boxed{\text{R/S}}$. As before, the program then proceeds to the next prompt.

An excellent example of the use of alpha and data prompts (including **CLR**) can be found in the program *Days Between Dates*.

Manual Operation

Although most programs in this Pac function entirely with the aid of user prompts, there are times when faster more efficient operation is desirable. Manual execution utilizes special function keys and a program overlay to provide optimum operation when numerous changes in data values and computation options are required.

The *Bonds* program is an example of a program which works most efficiently with manual operation. A pre-printed overlay is placed on the calculator keyboard to label the operation of the top two rows of keys. When the *Bonds* program is executed these keys become special functions. The blue and gold mnemonics on the overlay label the keys above and below where they are printed. Pressing the key directly above the blue mnemonic executes the function which the mnemonic describes. Pressing the ■ key followed by the key below the gold mnemonic executes the gold function.

Other Helpful Information

To remove an application module:

1. Turn the HP-41C off! Failure to do so could damage both the calculator and the module.

2. Grasp the desired module handle and pull it out as shown.
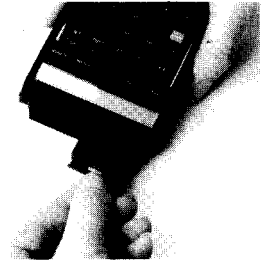
3. Place a port cap into the empty port.

Optional Printer

The Financial Decisions Pac was designed to make optimum use of the plug-in HP 82143A Printer. When the printer is plugged in and *switched to the MAN position* the program will print all data inputs and outputs with appropriate alpha labels. In order to conserve paper it may occasionally be desirable to have a printed record of only the labeled answers while suppressing input printing. This may be accomplished by clearing flag 10 anytime after the alpha

prompt **CLR?** has been displayed. The following is an example of suppressing the printing of data inputs to the program *Days Between Dates* (DAYS).

TRACE
MAN [|||||] NORM

Keystrokes: **Display:**

[XEQ] [ALPHA] DAYS [ALPHA]   **CLR?**

Y [ALPHA] ■ [CF] 10 [R/S]   **DATE1 =?**

Downloading Module Programs

If you wish to trace execution, to modify, to record on magnetic cards, or to print a program in this Applications Module, it must first be copied into the HP-41C's program memory. For information concerning the HP-41C COPY function, see the Owner's Handbook. It is *not* necessary to copy a program in order to run it.

Assigning Program Names

When a program is executed frequently, it may be easiest to assign the program name to a key. The MONEY overlay shows possible assignment locations for all of the programs in this Pac. Refer to the Owner's Handbook for a complete description of how to assign individual keys.

If either MONEY or BOND is to be executed, be sure to clear previously assigned programs from the top two rows of keys.

Program Interruption

These programs have been designed to operate properly when run from beginning to end, without turning the calculator off (remember, the calculator may turn itself off). If the HP-41C is turned off, it may be necessary to set flag 21 (SF 21) to continue proper execution.

Use of Labels

You should generally avoid writing programs into the calculator memory that use program labels identical to those in your Application Module. In case of a label conflict, the label within program memory has priority over the label within the Application Pac program.

Several labels used in the Financial Decisions Module are also used in other modules. If you have this module and another plugged into your calculator, you should make sure that the module containing the programs you want to use is in the lower numbered port.

You will find a list of all the global labels used in this Application Module at the back of the manual in appendix C, Program Labels. The names of modules or accessories where duplicate labels occur are also listed. Before plugging in two or more modules, check that listing for duplicate label conflicts.

COMPOUND INTEREST SOLUTIONS:
The Cash Flow Diagram and Sign Convention

The most universal financial calculations involving time and interest rates are the compound interest functions. Although the functions have been known for hundreds of years, their use has been restricted by the need for complicated tables until the advent of handheld financial calculators.

The five variables which have become standard for formatting and describing most compound interest problems can best be explained by referring to a pictorial representation called the cash flow diagram.

The diagram begins with a horizontal line called the time line. It represents the duration of a financial problem and is divided into N compounding periods of equal duration (length).

Exchange of cash is represented with vertical arrows. Money received is represented by an arrow pointing up (positive) from the time line where the transaction occured and money paid out is represented by an arrow pointing down (negative).

Payments (PMT) represent a series of cash exchanges of the same direction and amount. In the standard cash flow diagram the payments occur coincidental with the compounding periods and are equal to the number of periods. The first payment can either occur at the beginning of the first period (BEGIN) or at the end of the first period (END).

BEGIN

END
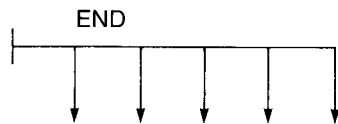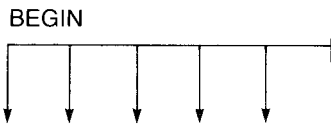
It is always necessary when working compound interest problems involving payments (PMT) to specify which of the two possible payment streams is applicable, BEGIN or END. In the parlance of various industries BEGIN payments are often referred to as annuity due, or first payment in advance. End payments are referred to as ordinary annuity, payment in arrears, or immediate annuity.

A single cash flow at the start of the time line is called the present value (**PV**). A similar single cash flow at the end of the time line is called the future value (**FV**).
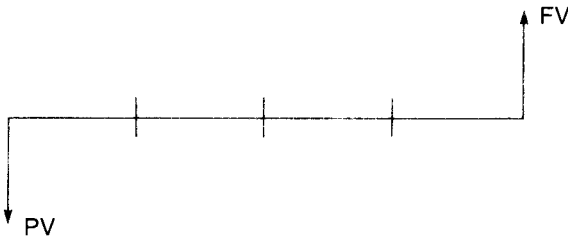
The fifth variable is **I**, the compound interest rate per period.

The following examples demonstrate the five variables **N**, **I**, **PV**, **PMT** and **FV** and their use in the framework of the cash flow diagram to depict common compound interest problems.

Example:

Draw a cash flow diagram to depict the following transaction.

A payment amount of $402.31 is necessary to amortize a mortgage loan of $50,000 over 30 years. Payments are made monthly; interest is compounded monthly at .75% (9% annually) and the first payment is made 1 month after the exchange of the initial loan amount (END).

PV = $50,000
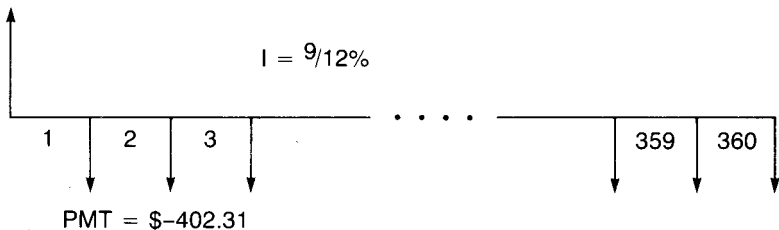
Note: PV is positive (arrow pointing up) because it represents cash received. PMT is negative (arrow pointing down) because it represents cash paid out. The use of positive and negative signs to represent the direction in which cash is exchanged is called the *cash flow sign convention*. It is important in eliminating ambiguity in analyzing various transactions and is used in all current HP financial calculators.

Example:

What will be the balance in a savings account (FV) at the end of 4 years if an initial deposit of $1000 is made followed by 4 annual deposits of $300 (END)? Interest is compounded yearly at 5% (I).

FV = ?

I = 5%

```
        1           2           3           4
```

PMT = $-300

PV = $-1,000
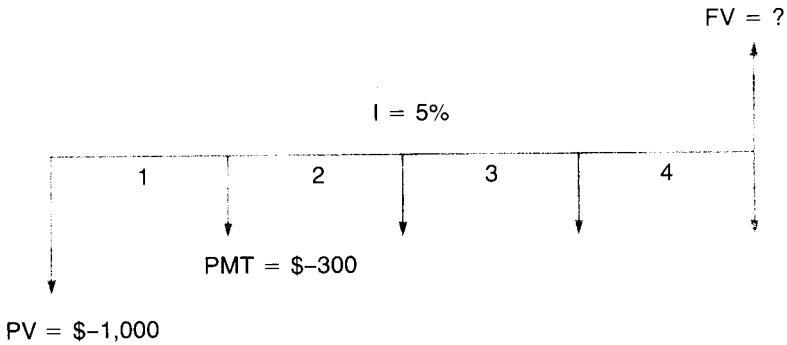
When using the cash flow diagram and the cash flow sign convention to format compound interest problems the following rules always apply.

■ N and I must correspond to the same period of time.

■ *Both* N and I must be present in a problem. Either both values are known, or one is known and the other is to be solved for.

■ A valid financial transaction must always include at least one positive cash flow and one negative cash flow.

The cash flow diagram can be used to describe many variations of compound interest problems. Although the terminology used to describe a particular cash transaction may vary from industry to industry the cash flow diagram remains consistent. In providing a means of describing financial problems without using terminology specific to a particular segment, the cash flow diagram becomes, in a sense, a universal language.

For examples of problem solutions using the cash flow diagram, see the program *Compound Interest Solutions*.

COMPOUND INTEREST SOLUTIONS
MONEY

This program solves for any of the five standard compound interest variables:

N = number of compounding periods (the term)

I = interest rate per period (the rate)

PV = the initial transaction (present value)

PMT = a series of equal annuities coinciding with the compounding periods (payments)

FV = the final transaction (future value)

The five variables can be represented in the following basic cash flow diagram (see Compound Interest Solutions: the Cash Flow Diagram and Sign Convention):
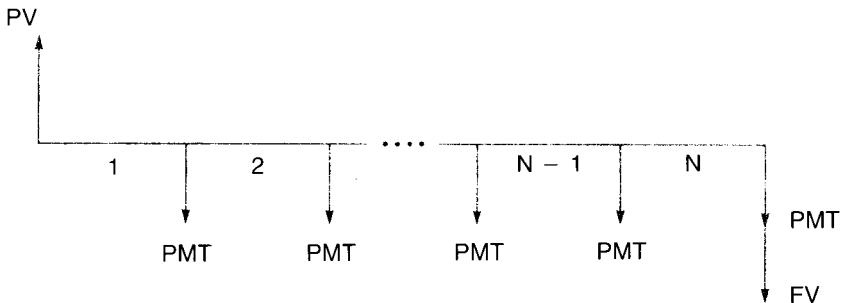
Four variations of the basic diagram are presented below. Under each diagram are listed a number of the more common industry terminology used to describe the represented cash exchange.
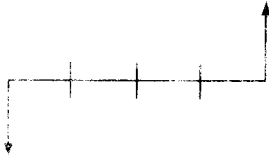
Compound Growth
Savings Account
Appreciation
Reversion Factor
Future Worth of One
Present Worth of One
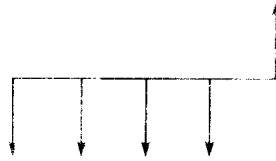
Savings Plan
Sinking Fund
Pension Fund
Annuity (series of payments)
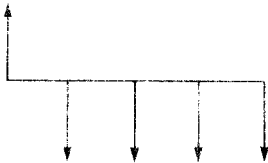
Mortgage
Lease
Direct Reduction (Installment) Loan
Amortization
Annuity
Inwood Coefficient
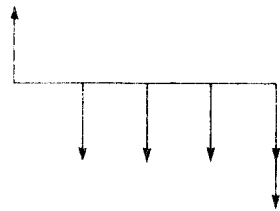
Mortgage w/Balloon (Residual)
Lease w/Buyback
Annuity

(Note that diagrams involving payments may be represented with payments at the beginning (BEGIN) or end (END) of the period.)

Some of the terms you see listed above may be common to your industry and some may not. There also may be diagrams represented that correspond to familiar transactions, but which do not bear familiar names. The important point to remember is that for compound financial calculations, it is the **magnitude** and **timing** of the cash exchanges, represented by the cash flow diagram that are important, not the industry dependent terminology.

Manual Execution

(Minimum size 015)

Before using this program please read *A Word About Program Usage*.

The MONEY overlay supplied with this pac labels 5 special function keys used in the compound interest solutions.
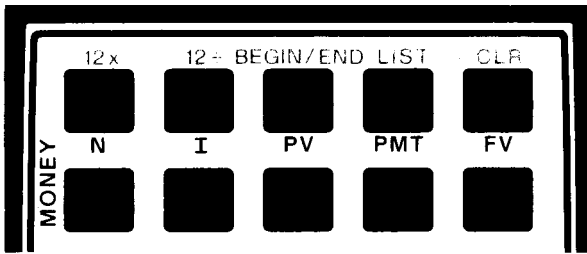
The label BEGIN/END denotes a toggled computation option. Pressing the shift key ■ followed by the key under BEGIN/END causes the 41C to display an alpha prompt showing the current status. If you wish to change the status, press N followed by a [R/S]. If you wish the current status to remain, press Y followed by a [R/S] or simply [R/S] alone.

If **$ERROR** appears during a computation, it indicates that no solution exists.

Note: All values used to represent PV, PMT, and FV utilize the *cash flow sign convention*. Cash received is positive and cash paid out is negative.

				SIZE: 015
STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Execute program name.		[XEQ] MONEY	CLR?
2	Clear data (if desired).	N or Y	[R/S]	END?
3	Select payment status.	N or Y	[R/S]	READY
4	The following steps may be performed in any order:			
	• Multiplies the displayed number by 12 and stores in N.		■[A]	
	• Divides the displayed number by 12 and stores in I.		■[B]	
	• Toggles between BEGIN and END modes.		■[C]	BEGIN? or END?
		N or Y	[R/S]	
	• List values		■[D]	
	• Clear data.		■[E]	0.00

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
5	The following steps may be performed in any order†: • Compute or store number of periods†. • Compute or store compound interest rate†. • Compute or store present value†. • Compute or store payment†. • Compute or store future value†.	%	Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ	%
6	Review stored values.		RCL Ⓐ - Ⓔ	
	†If an A–E key is pressed immediately after keying in a value, the value will be stored. If the key is pressed after previously pressing another A–E key and during which time no digit entry has been made, computation will occur.			

Example 1

What payment is necessary to fully amortize a $75,000 mortgage paid monthly over 25 years at an annual interest rate of 9.75%?

Keystrokes: **Display:**

XEQ ALPHA SIZE ALPHA 015
XEQ ALPHA MONEY ALPHA   *CLR?*
R/S [1]   *END?*
R/S   *END[2]*   *READY*
25■ Ⓐ   *300.00*
9.75▓ Ⓑ   *0.81*
75000 Ⓒ   *75,000.00*
Ⓓ   *PMT=−668.35*

What amount would be necessary to prepay the mortgage (remaining balance) at the end of the 12th year?

PV = $75,000

I = 9.75/12%

1   2   • • • •   143   144

PMT = $−668.35

$−668.35

FV = ?

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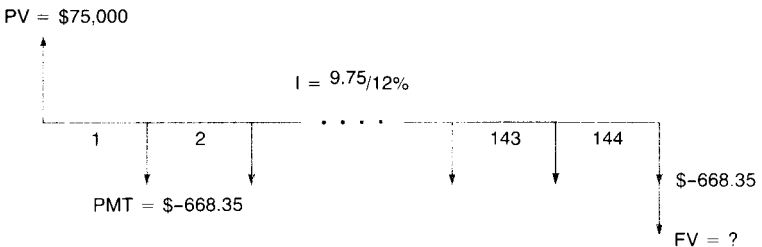
[1] A lone R/S indicates a yes response to an alpha prompt.
[2] Momentary display.

Keystrokes: **Display:**

[XEQ] [ALPHA] RND [ALPHA] [STO] [D]

12 ▮ [A]   *144.00*

[E]   *FV=-58,982.05*

The payment was rounded to two decimal places. Notice that it was not necessary to re-enter the interest rate (*I*) and the present value (*PV*) as they were retained in memory. All values once stored or calculated are retained unless a new value is stored for the same variable, the CLR option is exercised, or another program is executed which interferes with the memory storage registers.

Example 2:

How much money must be set aside in a savings account each month in order to accumulate $4,000 in three years if the account compounds monthly at 6% per year? The deposits "begin" immediately.

Keystrokes:

[XEQ] [ALPHA] MONEY [ALPHA]   *CLR?*

[R/S]   *END?*

N [R/S]   *BEGIN* [3]   *READY*

3 ▮ [A] [4]   *36.00*

6 ▮ [B] [5]   *0.50*

4000 [E]   *4,000.00*

[D]   *PMT=-101.18*

What effective interest rate did the bank pay if the actual amount at the end of the 3 years was $4,025.50?

Keystrokes: **Display:**

4025.50 [E]   *4,025.50*

[B]   *I=0.53*

12 [×]   *6.40*

---

[3] Momentary display.

[4] Convert to months.

[5] Convert to a monthly interest rate.

Example 3:

A $20,000 loan is negotiated which calls for receipt of $5,000 immediately and the remaining $15,000 one year later. Monthly repayment begins immediately upon receipt of the $15,000 balance. The total loan is repaid in 18 monthly payments at an APR of 12.5% compounded monthly. What is the appropriate payment amount?
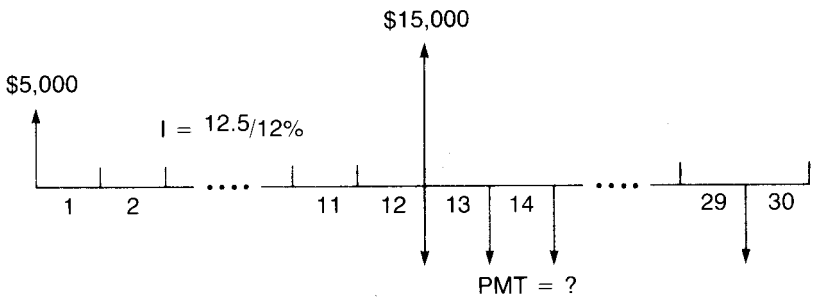
At first glance the cash flow diagram does not appear to conform to the basic diagram. But as the diagrams below demonstrate, the original diagram can be broken into two acceptable diagram variations.
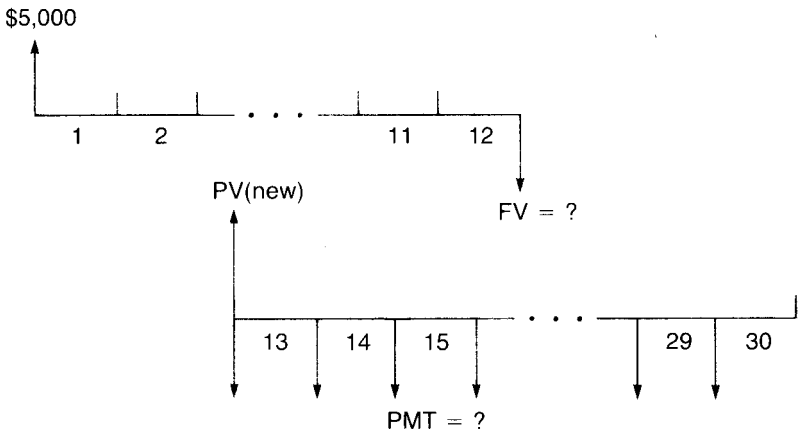
The unknown future value (**FV**) represents the amount of money the borrower would have to pay if repayment occurred at the end of the first year. This value amounts to:

Keystrokes:		Display:
XEQ ALPHA MONEY ALPHA		**CLR?**
R/S		**END?**
N R/S [6]	**BEGIN[7]**	**READY**
12 A		**12.00**
12.5■ B		**1.04**
5000 C		**5,000.00**
E		**FV=-5,662.08**

At the time the balance of the loan is transferred, the borrower owes

CHS 15000 +	**20,662.08**

which becomes the present value (loan amount). The total is entered as the new present value (**PV**)

C	**20,662.08**

It is now possible to solve for **PMT** except for the presence of $-5662.08 in **FV** (remember the memory retention). The existence of the inappropriate value in **FV** can be verified by:

RCL E	**-5,662.08**

Simply rectify the situation by storing zero into FV

0 E	**0.00**

Key in the loan repayment period

18 A	**18.00**

and calculate the correct PMT.

D	**PMT=-1,251.78**

The example demonstrates the value of the cash flow diagram in analyzing and formatting problems for solution with the ⸱⸱ ⸱ program.

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[6] Selection of **BEGIN** or **END** is immaterial if the cash flow does not include a payment stream. In this instance, however, the selection was made in order to have the proper mode selected for the second portion of the calculation.

[7] Momentary display.

INTERNAL RATE OF RETURN
IRR

An Internal Rate of Return is that discount rate at which the net present value of all present and future cash flows equals zero (see *Net Present Value*). This program calculates the IRR of a series of unequal cash flows or groups of equal cash flows. The number of cash flows which can be accommodated depends upon the memory space available. The basic HP-41C without any memory modules can accommodate up to 46 individual cash flows or 23 groups of cash flows. With each additional Memory Module installed, the program can accommodate an additional 64 individual cash flows or 32 groups of cash flows up to a maximum of 239 individual or 119 groups.

One of the important features of the program is the ability to make changes in one or more of the cash flows after the entire series has been entered. This allows the user to ask numerous "what if" questions by altering particular values and noting the effect on the outcome.

The cash flow sign convention is used to enter all cash flows. From the point of view of the user a negative sign represents cash paid out and positive represents cash received. Each time the cash flow changes from a positive value to a negative value or vice versa it is called a sign change. It is necessary to have at least one sign change in a cash flow series for the series to have an IRR solution. Cash flows with more than one sign change, however, can lead to more than one answer and are not recommended for use with this program. While the program may find one of the answers it has no way of finding or indicating other possibilities. For an alternative method of solution for cash flows with multiple sign changes, see *Modified Internal Rate of Return*.

Prompted Operation

(Minimum size 017)[8]

Before using this program, please read *A Word About Program Usage.*

After executing IRR the following user prompts will be displayed. After each response, press [R/S] to continue.

GROUPS?	Are the cash flows to be entered as groups of equal flows?
TOTL GROUPS=?	How many groups are to be entered?
TOTL CFS=?	How many individual cash flows are to be entered? This prompt occurs if the response to **GROUPS?** is no.

---

[8] Actual size depends on the number of cash flows to be entered: for groups (2 × (number of groups) + 17); for individual cash flows (cash flows + 17).

GROUP(#) or CF(#)   Momentary display. No response necessary.

CF AMT=?   What is the amount of the first (second etc.) cash flow or group of cash flows? Use the cash flow sign convention.

NO. CFS=?   How many cash flows are in the first (second etc.) group?

CF CHANGES?   Do you wish to review or change any cash flows?

When the result has been calculated and displayed, changes can easily be made in the cash flows or number of cash flows simply by pressing ⌐R/S⌐. The program responds by prompting for the group number (**GROUP=?**) or cash flows (**CF=?**) to be changed. After responding the program displays the current values. Values are either changed by entering the new value followed by a ⌐R/S⌐ or not changed by responding with a lone ⌐R/S⌐.

After the last group or cash flow change, the correction routine is terminated by pressing ⌐R/S⌐ with no data entry in response to the prompt **GROUP=?** or **CF=?**. The computation of the new IRR is then computed and displayed.

Example 1:

An investment proposal calls for an increasing outlay of cash for each of 5 years and then a substantial payoff. If the financials show the following dollar values, what would be the investment return?

Year	Cash Flow($)
1	−2000
2	−2500
3	−3000
4	−3500
5	−4000
6	25000

Keystrokes:		Display:
⌐XEO⌐ ⌐ALPHA⌐ SIZE ⌐ALPHA⌐ 023		
⌐XEO⌐ ⌐ALPHA⌐ IRR ⌐ALPHA⌐		**CLR?**
⌐R/S⌐ [9]		**GROUPS?**
N ⌐R/S⌐		**TOTL CFS=?**
6 ⌐R/S⌐	**CF 1**[10]	**CF AMT=?**
2000 ⌐CHS⌐ ⌐R/S⌐	**CF 2**	**CF AMT=?**
2500 ⌐CHS⌐ ⌐R/S⌐	**CF 3**	**CF AMT=?**
3000 ⌐CHS⌐ ⌐R/S⌐	**CF 4**	**CF AMT=?**

---

[9] A lone ⌐R/S⌐ indicates a yes response to an alpha prompt.
[10] Momentary display.

Keystrokes:		Display:
3500 [CHS] [R/S]	**CF 5**	**CF AMT=?**
4000 [CHS] [R/S]	**CF 6**	**CF AMT=?**
25000 [R/S]		**CF CHANGES?**
N [R/S]		**IRR=19.71%**

If the payoff were only $20,000, what would the IRR be?

[R/S]		**CF=?**
6 [R/S]	**CF 6**	**CF AMT=25,000.00?**
20000 [R/S]		**CF=?**
[R/S][11]		**IRR=10.96%**

Example 2:

A 3%—10 year Graduated Payment Mortgage Plan calls for the following schedule of increasing mortgage payments on a 30 year, $35,000 loan. What is the actual yearly interest rate (APR)?

GROUP	YEAR	PAYMENT
1	0	−35000
2	1	223
3	2	230
4	3	237
5	4	244
6	5	251
7	6	258
8	7	266
9	8	274
10	9	282
11	10	291
12	11–30	300

Keystrokes:		Display:
[XEQ] [ALPHA] SIZE [ALPHA] 041		
[XEQ] [ALPHA] IRR [ALPHA]		**CLR?**
[R/S][12]		**GROUPS?**
[R/S]		**TOTL GROUPS=?**
12 [R/S]	**GROUP 1**[13]	**CF AMT=?**
35000 [CHS] [R/S]		**NO. CFS=?**
1 [R/S]	**GROUP 2**	**CF AMT=?**
223 [R/S]		**NO. CFS=?**

---

[11] Terminate changes.
[12] A lone [R/S] indicates a yes response to an alpha prompt.
[13] Momentary display.

Keystrokes:		Display:
12 R/S	*GROUP 3*	*CF AMT=?*
230 R/S		*NO. CFS=?*
12 R/S	*GROUP 4*	*CF AMT=?*
237 R/S		*NO. CFS=?*
12 R/S	*GROUP 5*	*CF AMT=?*
244 R/S		*NO. CFS=?*
12 R/S	*GROUP 6*	*CF AMT=?*
251 R/S		*NO. CFS=?*
12 R/S	*GROUP 7*	*CF AMT=?*
258 R/S		*NO. CFS=?*
12 R/S	*GROUP 8*	*CF AMT=?*
266 R/S		*NO. CFS=?*
12 R/S	*GROUP 9*	*CF AMT=?*
274 R/S		*NO. CFS=?*
12 R/S	*GROUP 10*	*CF AMT=?*
282 R/S		*NO. CFS=?*
12 R/S	*GROUP 11*	*CF AMT=?*
291 R/S		*NO. CFS=?*
12 R/S	*GROUP 12*	*CF AMT=?*
300 R/S		*NO. CFS=?*
240 R/S		*CF CHANGES?*
N R/S		*IRR=0.71%*
12 ×		*8.51*

MODIFIED INTERNAL RATE OF RETURN (FMRR)
MIRR

The traditional IRR technique has several drawbacks which hamper its usefulness in some investment applications. The technique implicitly assumes that all cash flows are either reinvested or discounted at the computed yield rate. This assumption is financially reasonable as long as the rate is within a realistic borrowing and lending range (e.g., 5–15%). When the IRR becomes significantly greater or smaller, the assumption becomes less valid and the resulting value less sound as an investment measure.

IRR also is limited by the number of times the sign of the cash flow changes (positive to negative or vice versa). For every change of sign the IRR solution has the potential for an additional answer. The cash flow sequence in the following example has three sign changes and hence up to three potential internal rates of return. This particular example has three positive real answers: 1.86, 14.35 and 29. Although mathematically sound, the multiple answers are meaningless as an investment measure.

The *Modified Internal Rate of Return** program is one of several IRR alternatives which avoids the drawbacks of the traditional IRR technique. The program eliminates the sign change problem and the reinvestment (or discounting) assumption by utilizing user stipulated reinvestment and borrowing rates.

Negative cash flows are discounted at a rate (**SAFE RATE**) that reflects the return on an investment in a liquid account. The figure generally used is a short-term security (T-Bill) or bank passbook rate.

Positive cash flows are reinvested at a rate which reflects the return on an investment of comparable risk (**RISK RATE**). An average return rate on recent market investments might be used.

---

* Also called Financial Management Rate of Return (FMRR).

Prompted Operation

(Minimum size 017)†

Before using this program, please read *A Word About Program Usage*.

After executing MIRR the following user prompts will be displayed. After each response, press [R/S] to continue.

GROUPS?	Are the cash flows to be entered as groups of equal flows?
TOTL GROUPS=?	How many groups are to be entered?
TOTL CFS=?	How many individual cash flows are to be entered? This prompt occurs if the response to GROUPS? is no.
GROUP(#) or CF(#)	Momentary display. No response necessary.
CF AMT=?	What is the amount of the first (second etc.) cash flow or group of cash flows? Use the cash flow sign convention.
NO. CFS=?	How many cash flows are in the first (second etc.) group?
SAFE RATE=?	What is the liquid rate of return, in percent?
RISK RATE=?	What is the "risky" rate of return, in percent?
CF CHANGES?	Do you wish to review or change any cash flows?

When the result has been calculated and displayed, changes can easily be made in the cash flows, number of cash flows and rates, simply by pressing [R/S]. The program responds by prompting for the group number (*GROUP=?*) or cash flow (*CF=?*) to be changed. After responding, the program displays the current values. Values are either changed by entering the new value followed by a [R/S] or not changed by responding with a lone [R/S].

After the last group or cash flow change, the correction routine is terminated by pressing [R/S] with no data entry in response to the prompt *GROUP=?* or *CF=?*. The safe rate (*SAFE RATE*) and risk rate (*RISK RATE*) are then displayed and any changes made. The computation of a new MIRR then proceeds automatically.

---

† Actual size depends on the number of cash flows entered: for groups (2 × (number of groups) + 17); for individual cash flows (cash flows + 17).

Example:

The following monthly cash flows do not have a meaningful IRR but they do have a MIRR. Calculate the MIRR using an annual safe rate of 6% and an annual reinvestment (risk) rate of 10%. Use the *cash flow sign convention* for keying in values.

Group #	Months	Cash Flow($)	Number of Cash Flows
1	0	−180,000	1
2	1–5	100,000	5
3	6–10	−100,000	5
4	11–19	0	9
5	20	200,000	1

Keystrokes:		**Display:**
[XEO] [ALPHA] SIZE [ALPHA] 027		
[XEO] [ALPHA] MIRR [ALPHA]		*CLR?*
[R/S] [14]		*GROUPS?*
[R/S]		*TOTL GROUPS=?*
5 [R/S]	*GROUP 1* [15]	*CF AMT=?*
180000 [CHS] [R/S]		*NO. CFS=?*
1 [R/S]	*GROUP 2*	*CF AMT=?*
100000 [R/S]		*NO. CFS=?*
5 [R/S]	*GROUP 3*	*CF AMT=?*
100000 [CHS] [R/S]		*NO. CFS=?*
5 [R/S]	*GROUP 4*	*CF AMT=?*
0 [R/S]		*NO. CFS=?*
9 [R/S]	*GROUP 5*	*CF AMT=?*
200000 [R/S]		*NO. CFS=?*
1 [R/S]		*CF CHANGES?*
N [R/S]		*RISK RATE=?*
10 [ENTER↑] 12 [÷] [R/S]		*SAFE RATE=?*
6 [ENTER↑] 12 [÷] [R/S]		*MIRR=0.81*
12 [×]		*9.70*

---

[14] A lone [R/S] indicates a yes response to an alpha prompt.

[15] Momentary display.

NET PRESENT VALUE
Discounted Cash Flows
NPV

The Net Present Value procedure reduces a series of cash flows which occur at different times in the future to a single net value at one point in time, the present. The technique that makes this transformation possible is called discounting. If one dollar were invested at the present in an investment which yielded 10% a year it would grow to $1.10 in one year. The $1.10 is referred to as the future value (FV) of $1 invested at 10% for one year. Conversely the opportunity to realize $1.10 a year from now would be equivalent to having one dollar now (PV) with 10% investment opportunity. The technique of comparing a future value to its equivalent present value is called discounting and the investment rate is called the discount rate.

This program produces a net present value (**NPV**) for a number of future cash flows or groups of equal future cash flows when given a discounting rate (**DSCNT RATE**). The cash flows which must occur at equal intervals are represented using the cash flow sign convention. Negative cash flows represent invested money and positive cash flows represent return from the investment.

The first cash flow is assumed to occur at time zero. The discount rate must coincide with period between cash flows. For example a 9% yearly discount rate applied to monthly cash flows must be entered as 9/12 or .75.

One of the important features of the program is the ability to make changes in one or more of the cash flows or discounted rate after the entire series has been entered. This allows the user to ask numerous "what if" questions by altering particular values and noting the effect on the outcome.

If the Net Present Value of all future positive and negative cash flows has a positive sign it means the net return rate of the investment exceeds the discounting rate. If the final Net Present Value is negative, the investment did not return the discounting rate. If the Net Present Value is zero, the discounting rate and the investment return rate are equal.

Prompted Operation

(Minimum size 017)†

Before using this program, please read *A Word About Program Usage*.

After executing NPV the following user prompts will be displayed. After each response, press [R/S] to continue.

GROUPS?   Are the cash flows to be entered as groups of equal flows?

---

† Actual size depends on the number of cash flows entered; for groups (2 × (number of groups) + 17); for individual cash flows (cash flows + 17).

TOTL GROUPS=?	How many groups are to be entered?
TOTL CFS=?	How many individual cash flows are to be entered? This prompt occurs if the response to **GROUPS?** is no.
GROUP(#) or CF(#)	Momentary display. No response necessary.
CF AMT=?	What is the amount of the first (second etc.) cash flow or group or cash flows? Use the cash flow sign convention.
NO. CFS=?	How many cash flows are in the first (second etc.) group?
DSCNT RATE=?	Input the discount rate (in percent). The rate must coincide in time with the period between cash flows.
CF CHANGES?	Do you wish to review or change any cash flows?

When the result has been calculated and displayed, changes can easily be made in the cash flows, number of cash flows or the discount rate, simply by pressing [R/S] . The program responds by prompting for the group number (**GROUP=?**) or cash flow (**CF=?**) to be changed. After responding the program displays the current values. Values are either changed by entering the new value followed by a [R/S] or not changed by responding with a lone [R/S] .

After the last group or cash flow change, the correction routine is terminated by pressing [R/S] with no data entry in response to the prompt **GROUP=?** or **CF=?**. The discount rate (**DSCNT=?**) is then displayed and may be changed. After a response has been made the new Net Present Value is calculated and displayed.

Example:
A new piece of manufacturing equipment is being considered as a replacement for a currently owned machine. Financial projection of the benefits yields a series of net monthly cash flow savings over the anticipated operating life of the equipment. If the finance manager demands a net return of 10% on all new projects, will the machine realize the criterion? The initial net purchase cash flow is $180,000.

Groups	Cash Flow ($)	Number of Months	Comment
1	−180,000	1	initial investment
2	− 3,000	1	installation
3	− 800	1	
4	2,000	3	
5	4,000	23	
6	− 28,000	1	overhaul
7	3,000	59	
8	30,000	1	salvage value

Keystrokes:		Display:
[XEQ] [ALPHA] SIZE [ALPHA] 033		
[XEQ] [ALPHA] NPV [ALPHA]		*CLR?*
[R/S] [16]		*GROUPS?*
[R/S]		*TOTL GROUPS=?*
8 [R/S]	*GROUP 1* [17]	*CF AMT=?*
180000 [CHS] [R/S]		*NO. CFS=?*
1 [R/S]	*GROUP 2*	*CF AMT=?*
3000 [CHS] [R/S]		*NO. CFS=?*
1 [R/S]	*GROUP 3*	*CF AMT=?*
800 [CHS] [R/S]		*NO. CFS=?*
1 [R/S]	*GROUP 4*	*CF AMT=?*
2000 [R/S]		*NO. CFS=?*
3 [R/S]	*GROUP 5*	*CF AMT=?*
4000 [R/S]		*NO. CFS=?*
23 [R/S]	*GROUP 6*	*CF AMT=?*
28000 [CHS] [R/S]		*NO. CFS=?*
1 [R/S]	*GROUP 7*	*CF AMT=?*
3000 [R/S]		*NO. CFS=?*
59 [R/S]	*GROUP 8*	*CF AMT=?*
30000 [R/S]		*NO. CFS=?*
1 [R/S]		*CF CHANGES?*
N [R/S]		*DSCNT RATE=?*
10 [ENTER↑] 12 [÷] [18] [R/S]		*NPV=3,942.15*

Would the acquisition have failed to meet the 10% guideline if the equipment salvage estimate were only $20,000?

[R/S]		*GROUP=?*
8 [R/S]	*GROUP 8*	*CF AMT=30,000?*
20000 [R/S]		*NO. CFS=1?*
[R/S]		*GROUP=?*
[R/S] [19]		*DSCNT RATE=0.83?*
[R/S]		*NPV=-835.70*

Since the NPV is negative, the 10% guideline would not have been met.

---

[16] A lone [R/S] indicates a yes response to an alpha prompt.

[17] Momentary display.

[18] Convert annual rate to a per cash flow (monthly) rate.

[19] [R/S] without digit entry terminates change prompts.

LOAN AMORTIZATION SCHEDULES
AMORT

Most simple mortgages and installment loans are called direct reduction loans. The debt is discharged by equal periodic payments paid at equal intervals. As each payment is received by the note holder, interest is calculated on the outstanding balance since the last payment, subtracted from the payment amount and the remainder applied to the balance. As the balance drops with each payment so does the interest. With a smaller portion of each payment being deducted for interest the amount remaining to pay off the balance increases. The breakdown of each payment into the interest portion and principal reduction portion over the life of a loan is called an amortization schedule.

This program calculates the interest (**INT**) and principal portion (**PRN**) of each periodic payment (**PMT**), and the remaining balance (**BAL**) after the payment has been made for any series of equal periodic amortization payments from any beginning payment (**P1**) to any ending payment (**P2**).

The periodic installment schedule generated is valid for loans that have a single large final payment (balloon) as well as for loans which are arranged to be fully amortized. For a loan with a balloon payment, the remaining balance at the end of the last payment period is the balloon payment due.

For tax purposes and certain financial analyses, payments to principal and interest are desirable on an accumulated yearly basis rather than on an individual payment basis. The amortization program therefore provides accumulated interest (Σ**INT**) and accumulated principal (Σ**PRN**) from payment **P1** to payment **P2**.

The words **BEGIN** and **END** are used to describe the occurrance in time of the first payment, either at the beginning of the first time period (coincident with the present value) or at the end of the first period. Most loans have END payments (ordinary annuity or payment in arrears) while most leases have BEGIN payments (annuity due or payment in advance). This program accommodates both BEGIN and END payments.

When using a calculated payment (MONEY) in the amortization program it is often necessary to change the payment amount to a whole number of dollars or cents. This is because the calculated amount usually contains fractional cents. Even though the display may show only two decimal places, all numbers are calculated to tenth place accuracy. The calculated payment amount must therefore be altered to a whole number of dollars or cents to be equivalent to the actual payment made.

Although there is no standardization in the manner in which the payment must be altered, banks usually round up to the nearest cent or nearest dollar. The effect of the rounded payment on the amortization schedule is to reduce the amount of the last payment. Whenever this situation occurs, the amount of the final payment (**LST PMT**) is displayed.

Prompted Operation

(Minimum size 013)

Before using this program please read *A Word About Program Usage*.

After executing AMORT many of the following user prompts will be displayed. After each response press R/S to continue.

I=?	What is the periodic interest rate (in percent)? The rate must correspond to the payment period. A 6% annual rate for a monthly amortization payment must be keyed in as 6 divided by 12 or .5.
PV=?	What is the amortized loan amount? Use of the *cash flow convention* is optional. (See *The Cash Flow Diagram*.)
PMT=?	What is the payment amount? Use of the *cash flow sign convention* is optional. (See *The Cash Flow Diagram*.)
END?	Does the first payment occur one period after the exchange of PV?
BEGIN?	Does the first payment occur coincident with the exchange of PV?
P1=?	What is the number of the first payment for which the schedule or summary is to be calculated?
P2=?	What is the number of the last payment for which the schedule or summary is to be calculated? *P1* equals *P2* if a single payment calculation is desired.
SCHEDULE?	Do you wish to have a schedule and a summary calculated? A no response (N) will produce *only the final summary:* accumulated interest and accumulated principal from *P1* to *P2* and remaining balance at *P2*.

In order to provide for maximum flexibility, the values keyed in may use the *cash flow sign convention* or may be keyed in as positive values. In either case, the printed results are always positive.

Example 1:

Generate an amortization schedule for the first two payments of an $80,000 loan (PV) with monthly ordinary annuity payments (END) of $1297.30 (PMT) at 9.25% annual interest rate (I).

Keystrokes: **Display:**

[XEQ] [ALPHA] SIZE [ALPHA] 013

[XEQ] [ALPHA] AMORT [ALPHA]   *CLR?*

[R/S] [20]   *I=?*

9.25 [ENTER♦] 12[÷] [21] [R/S]   *PV=?*

80000 [R/S]   *PMT=?*

1297.30 [R/S]   *P1=?*

1 [R/S]   *P2=?*

2 [R/S]   *END?*

[R/S] [20]   *END* [22]   *SCHEDULE?*

[R/S] [20]   *PER 1*

[R/S] [23]   *INT=616.67*

[R/S] [23]   *PRN=680.63*

[R/S] [23]   *BAL=79,319.37*

[R/S] [23]   *PER 2*

[R/S] [23]   *INT=611.42*

[R/S] [23]   *PRN=685.88*

[R/S] [23]   *BAL=78,633.49*

[R/S] [23]   *ΣINT=1,228.09*

[R/S] [23]   *ΣPRN=1,366.51*

[R/S] [23]   *BAL=78,633.49*

What is the accumulated interest, accumulated principal and remaining balance over the first 12 months?

[XEQ] [ALPHA] AMORT [ALPHA]   *CLR?*

N [24] [R/S]   *I=0.77?*

[R/S]   *PV=80,000.00?*

[R/S]   *PMT=1,297.30?*

[R/S]   *P1=1?*

[R/S]   *P2=2?*

12 [25] [R/S]   *END?*

[R/S]   *END* [22]   *SCHEDULE?*

N [26] [R/S]   *ΣINT=7,044.68*

[R/S] [23]   *ΣPRN=8,522.92*

[R/S] [23]   *BAL=71,477.08*

---

[20] A lone [R/S] indicates a yes response to an alpha prompt.

[21] Convert 9.25 to a per payment interest rate.

[22] Momentary display.

[23] Not necessary when the HP-82143A printer is used.

[24] Since most of the previous data is applicable, it should not be cleared.

[25] Change P2 from 2 to 12.

[26] A full schedule is not necessary.

Example 2:

Calculate the balloon (remaining balance) after five years on a proposed loan of $175,000 at 8% where monthly payments are based on a 25 year amortization. Payments are ordinary annuity (END).

The first step is to calculate the value of the monthly payment using the MONEY program.

Keystrokes:		Display:
[XEQ] [ALPHA] MONEY [ALPHA]		**CLR?**
[R/S]		**END?**
[R/S]	END [27]	**READY**
25 ■ [28] [A]		**300.00**
8 ■ [29] [B]		**0.67**
175000 [C]		**175,000.00**
[D]		**PMT=-1,350.68**

Then proceed with executing AMORT.

[XEQ] [ALPHA] AMORT [ALPHA]		**CLR?**
N [30] [R/S]		**I=0.67?**
[R/S]		**PV=175,000.00?**
[R/S]		**PMT=-1,350.68?**
[XEQ] [ALPHA] RND [ALPHA] [32]		**-1350.68**
[R/S]		**P1=0?**
1 [R/S]		**P2=130?** [31]
60 [R/S]		**END?**
[R/S]	END	**SCHEDULE?**
N [R/S]		**ΣINT=67,520.07**
[R/S] [33]		**ΣPRN=13,520.73**
[R/S] [33]		**BAL=161,479.27**

---

[27] Momentary display.

[28] ■ [A] automatically converts years to months and stores in N. See MONEY.

[29] ■ [B] converts a yearly rate to monthly rate and stores in I.

[30] The values stored and computed by MONEY can be used by AMORT and are therefore not cleared.

[31] This value results from using MONEY program, and should be changed to the correct value.

[32] Although the value in the display shows a payment rounded to a whole number of cents, the actual value in memory was computed to a full 10 digits. As described in the program introduction, it is necessary to round this figure and restore it.

[33] Not necessary when the HP-82143A printer is used.

STRAIGHT LINE DEPRECIATION
SL

Tangible assets such as buildings, machines, trucks, tools, etc. decline in value with usage or the passing of time. To account periodically for the wasting value of an asset, a number of different mathematical procedures have been developed. This program provides a solution for one of the three most commonly used procedures: straight line depreciation.

For both income tax purposes and financial analyses, it is valuable to calculate depreciation based on a calendar or fiscal accounting year. When the acquisition date of an asset does not coincide with the start of the year—which is the rule rather than the exception—the amounts of depreciation in the first and last years are computed as fractions of a full year's depreciation. The program accounts for this requirement by prompting for the number of months from acquisition until the end of the first calendar or accounting year (**MONS YR1**).

Calculated results include the depreciated amount per period (**DEP**), the remaining book value (**RBV**) or cost (starting book value) minus accumulated depreciation and the remaining depreciable value (**RDV**) or remaining book value less the salvage value. When the salvage value is zero, the remaining book value equals the remaining depreciable value. In this case, only the remaining book value is displayed.

Prompted Operation

(Minimum size 015)

Before using this program please read *A Word About Program Usage*.

After executing SL the following user prompts will be displayed. After each response, press ⌈R/S⌉ to continue.

DEP AMT=?   What is the beginning depreciable amount (also called basis, starting book value or cost)?

LIFE=?   What is the expected useful life (in years) over which the asset is depreciated?

SAL=?   What is the estimated salvage value (or residual value) at the end of the asset's life?

MONS YR1=?   How many months are there from the beginning of the depreciable life (acquisition) until the end of the first calendar or accounting year?

P1=?   What is the first year for which calculated results are desired?

P2=?   What is the last year for which results are desired?

Example:

A new die for a metal stamping press is to be purchased for $1,000 on July 1. It is expected to last for 4 years at which time it will be scrapped for an estimated $200. Produce a depreciation schedule for the life of the asset. Note in this example, if the asset is depreciated using an accounting year starting Jan. 1, that a complete schedule will involve 5 years—2 half years (6 months) and 3 full years.

Keystrokes:	Display:
[XEQ] [ALPHA] SIZE [ALPHA] 015	
[XEQ] [ALPHA] SL [ALPHA]	**CLR?**
[R/S]	**DEP AMT=?**
1000 [R/S]	**LIFE=?**
4 [R/S]	**SAL=?**
200 [R/S]	**MONS YR1=?**
6 [R/S]	**P1=?**
1 [R/S]	**P2=?**
5 [R/S]	**YR 1**
[R/S] [34]	**DEP=100.00**
[R/S] [34]	**RDV=700.00**
[R/S] [34]	**RBV=900.00**
[R/S] [34]	**YR 2**
[R/S] [34]	**DEP=200.00**
[R/S] [34]	**RDV=500.00**
[R/S] [34]	**RBV=700.00**
[R/S] [34]	**YR 3**
[R/S] [34]	**DEP=200.00**
[R/S] [34]	**RDV=300.00**
[R/S] [34]	**RBV=500.00**
[R/S] [34]	**YR 4**
[R/S] [34]	**DEP=200.00**
[R/S] [34]	**RDV=100.00**
[R/S] [34]	**RBV=300.00**
[R/S] [34]	**YR 5**
[R/S] [34]	**DEP=100.00**
[R/S] [34]	**RDV=0.00**
[R/S] [34]	**RBV=200.00**

---

[34] Not necessary when the HP-82143A printer is used.

Tangible assets such as buildings, machines, trucks, tools, etc. decline in value with usage or the passing of time. To account periodically for the wasting value of an asset, a number of different mathematical procedures have been developed. This program provides a solution for one of the three most commonly used procedures: declining balance depreciation.

When calculating declining balance depreciation it is often advantageous for tax purposes to switch from declining balance to straight line depreciation at some point. The program calculates the optimum crossover point (*X-OVER*) and automatically switches to straight line depreciation at the appropriate time.

For both income tax purposes and financial analyses, it is valuable to calculate depreciation based on a calendar or fiscal accounting year. When the acquisition date of an asset does not coincide with the start of the year—which is the rule rather than the exception—the amounts of depreciation in the first and last years are computed as fractions of a full year's depreciation. The program accounts for this requirement by prompting for the number of months from acquisition until the end of the first calendar or accounting year (*MONS YR1*).

Calculated results include the depreciated amount per period (*DEP*), the remaining book value (*RBV*) or cost (starting book value) minus accumulated depreciation and the remaining depreciable value (*RDV*) or remaining book value less the salvage value. When the salvage value is zero, only the remaining book value is displayed.

Prompted Operation

(Minimum size 015)

Before using this program please read *A Word About Program Usage*.

After executing DB the following user prompts will be displayed. After each response, press ⟨R/S⟩ to continue.

DEP AMT=?	What is the beginning depreciable amount (also called basis, starting book value or cost)?
LIFE=?	What is the expected useful life (in years) over which the asset is depreciated?
SAL=?	What is the estimated salvage value (or residual value) at the end of the asset's life?

MONS YR1 =?	How many months are there from the beginning of the depreciable life (acquisition) until the end of the first calendar or accounting year?
P1 =?	What is the first year for which calculated results are desired?
P2 =?	What is the last year for which results are desired?
DB% =?	What is the declining balance rate factor (in percent)?
X-OVER?	Is crossover from declining balance depreciation to straight line depreciation desired?

Example 1:

A property has been acquired for $250,000. The purchase price is allocated to $50,000 for land (non-depreciable) and $200,000 for improvements (building, etc.). The remaining useful life of the building is determined to be 30 years with no estimated salvage value. If the property was acquired on September 1, calculate the 150% declining balance depreciation with crossover for years 10–13.

Keystrokes: **Display:**

Keystrokes	Display
[XEQ] [ALPHA] SIZE [ALPHA] 015	
[XEQ] [ALPHA] DB [ALPHA]	**CLR?**
[R/S]	**DEP AMT =?**
200000 [R/S]	**LIFE =?**
30 [R/S]	**SAL =?**
0 [R/S]	**MONS YR1 =?**
4 [R/S]	**P1 =?**
10 [R/S]	**P2 =?**
13 [R/S]	**DB% =?**
150 [R/S]	**X-OVER?**
[R/S]	**YR 10**
[R/S] [35]	**DEP =6,523.64**
[R/S] [35]	**RBV =123,949.06**
[R/S] [35]	**YR 11**
[R/S] [35]	**DEP =6,197.45**
[R/S] [35]	**RBV =117,751.61**
[R/S] [35]	**YR 12**
[R/S] [35]	**DEP =5,987.37**
[R/S] [35]	**RBV =111,764.24**
[R/S] [35]	**YR 13**
[R/S] [35]	**DEP =5,987.37**
[R/S] [35]	**RBV =105,776.87**

---

[35] Not necessary when the HP-82143A printer is used.

Note that while the depreciable amounts in years 10 and 11 differ, the amounts in years 12 and 13 are the same. Crossover from declining balance to straight line occurs in year 12.

Example 2:

Having just calculated the answer in example 1, calculate the remaining book value for year 15 with crossover.

Keystrokes:	**Display:**
[XEQ] [ALPHA] DB [ALPHA]	*CLR?*
N [R/S] [37]	*DEP AMT=200,000.00?*
[R/S]	*LIFE=30.00?*
[R/S]	*SAL=0.00?*
[R/S]	*MONS YR1=4?*
[R/S]	*P1=10?*
15 [R/S]	*P2=13?*
15 [R/S]	*DB%=150.00?*
[R/S]	*X-OVER?*
[R/S]	*YR 15*
[R/S] [36]	*DEP=5,987.37*
[R/S] [36]	*RBV=93,802.13*

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[36] Not necessary when the HP-82143A printer is used.

[37] All initial values remain the same so memory is not cleared.

Tangible assets such as buildings, machines, trucks, tools, etc. decline in value with usage or the passing of time. To account periodically for the wasting value of an asset, a number of different mathematical procedures have been developed. This program provides a solution for one of the three most commonly used procedures: sum-of-the-years'-digits depreciation.

For both income tax purposes and financial analyses, it is valuable to calculate depreciation based on a calendar or fiscal accounting year. When the acquisition date of an asset does not coincide with the start of the year—which is the rule rather than the exception—the amounts of depreciation in the first and last years are computed as fractions of a full year's depreciation. The program accounts for this requirement by prompting for the number of months from acquisition until the end of the first calendar or accounting year (**MONS YR1**).

Calculated results include the depreciated amount per period (**DEP**), the remaining book value (**RBV**) or cost (starting book value) minus accumulated depreciation and the remaining depreciable value (**RDV**) or remaining book value less the salvage value. When the salvage value is zero, the remaining book value equals the remaining depreciable value. In this case only the remaining book value is displayed.

Prompted Operation

(Minimum size 015)

Before using this program please read *A Word About Program Usage.*

After executing   the following user prompts will be displayed. After each response, press [R/S] to continue.

DEP AMT=?	What is the beginning depreciable amount (also called basis, starting book value or cost)?
LIFE=?	What is the expected useful life (in years) over which the asset is depreciated?
SAL=?	What is the estimated salvage value (or residual value) at the end of the asset's life?
MONS YR1=?	How many months are there from the beginning of the depreciable life (acquisition) until the end of the first calendar or accounting year?
P1=?	What is the first year for which calculated results are desired?
P2=?	What is the last year for which results are desired?

Example:

An electron beam welder which costs $50,000 is purchased 4 months before the end of the accounting year. What will the depreciation be during the first full accounting year (P2=2) if the welder has a 6 year depreciable life, a salvage value of $8,000 and is depreciated using the sum-of-the-years'-digits method?

Keystrokes:	**Display:**
[XEQ] [ALPHA] SIZE [ALPHA] 015	
[XEQ] [ALPHA] SOYD [ALPHA]	*CLR?*
[R/S]	*DEP AMT=?*
50000 [R/S]	*LIFE=?*
6 [R/S]	*SAL=?*
8000 [R/S]	*MONS YR1=?*
4 [R/S]	*P1=?*
2 [R/S]	*P2=?*
2 [R/S]	*YR 2*
[R/S] [38]	*DEP=11,333.33*
[R/S] [38]	*RDV=26,666.67*
[R/S] [38]	*RBV=34,666.67*

---

[38] Not necessary when the HP-82143A printer is used.

BONDS

In the securities market there are numerous interest bearing obligations: bills, notes, bonds, certificates, debentures, warrants, certificates of deposit, etc. Each of these instruments can be divided into one of three categories according to the procedure by which interest is paid to the investor. Interest is either paid periodically (annually or semiannually), at maturity, or as a result of discounting the purchase price.

This program computes either yield (**YLD**) or price (**PRICE**)† and accrued interest (**AI**) of a security obligation which pays interest (coupons) either semiannually or annually. Since the most common obligation of this kind is often called a bond the term will be used in that context. Note however that in the securities market there are periodic interest only obligations which are not called bonds and there are bonds which do not pay interest periodically.

Program options available for the price and yield computation include annual (**ANN**) or semiannual (**SEMI**) coupons, redemption at maturity (**MAT**) or at call (**CALL**), before tax (**BTAX**) or after tax (**ATAX**), and 30/360 (**360**) or Actual/365 (**365**) calendar basis.

The last option, calendar basis, can often be difficult to determine. There is seldom any indication from an obligation name what the appropriate calendar basis is. For this reason, the following guide has been included. It lists the most common U.S. bonds and the appropriate calendar basis.

Semiannual Coupon, 30/360 Basis

Examples:

Corporate Bonds, Commodity Credit Corporation, Export-Import Bank Certificates, Federal Home Loan Bank, Federal National Mortgage Association Debentures (FNMA), Federal Land Bank Bonds, U.S. Postal Service Bonds, TVA Bonds, State and Local Government Issues, Certificate of Deposit, Inter-American Development Bank Bonds, International Bank for Reconstruction and Development, Merchant Marine Bonds, New Communities Act Debentures.
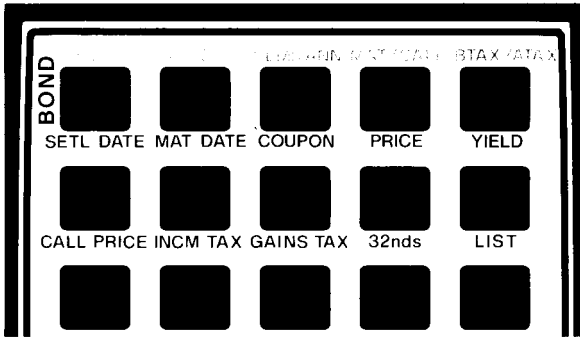
Semiannual Coupon, Actual/365 Basis

Examples:

U.S. Treasury Bonds and Notes, Farmers Home Administration Insured Notes (FHDA), Federal Housing Administration Debentures (FHA), Foreign Bonds.

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† Bond price (**PRICE**) is quoted as a percent of par value ($100).

Manual Operation

(Minimum size 025)

Before using this program please read *A Word About Program Usage*.

When placed over the keyboard, this overlay labels 10 special function keys used in the bond price and yield computations. Each of the keys A - J , is used either to enter data or to change computation options (toggles).

The after-tax calculation only applies when the time to redemption is greater than 1 coupon period.

				SIZE: 025
STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	Execute program name.		[XEQ] BOND	CLR?
2.	Clear data (if desired).	N or Y	[R/S]	READY
3.	The following steps may be performed in any order:			
	• Clear data		■[A]	0.00
	• Select calendar basis (Toggle)		■[B]	360? or 365?
	• Select coupon period (Toggle)		■[C]	ANN? or SEMI?
	• Select redemption time (Toggle)		■[D]	CALL? or MAT?
	• Select tax basis (Toggle)		■[E]	BTAX? or ATAX?
	• Key in settlement date	MM.DDYYYY²	[A]	
	• Key in maturity (or call) date	MM.DDYYYY²	[B]	
	• Key in coupon rate	%	[C]	

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
4.	The following steps need only be performed if applicable:			
	• Key in price	$	☐D	
	• Key in yield	%	☐E	
	• Key in call price	$	☐F	
	• Key in marginal income tax rate	%	☐G	
	• Key in capital gains tax rate	%	☐H	
	• Convert price using decimal 32^{nds} to price using decimal cents and store in price	$.32^{nds}$	☐I	$.cents
5.	Calculate			
	• Price[1] and accrued interest		☐D	PRICE=
	or		☐R/S	AI=
	• Yield[1]		☐E	YIELD=
6.	Review:			
	• Any entered value (except price with 32^{nds})		☐RCL ☐A–☐H	
	• Toggle status		☐J	
	• Data values with alpha labels. Press ☐J , wait until the toggle review has ended, then press ☐R/S . (Use only with the HP-82143A printer.)		☐J ☐R/S	
	[1] If ☐D or ☐E is pressed following keys ☐A–☐J or ■☐A–☐E and during which no digit entry has been made, computation will occur. See example for clarification.			
	[2] Dates are entered using European format (DD.MMYYYY) whenever the European display mode is used (i.e., flag 28 is clear).			

Example:

What is the before tax yield of a corporate bond offered for $88 3/32 on August 10, 1977, paying 6¾% and callable on May 1, 1992 at 102?

Keystrokes: **Display:**

☐XEQ ☐ALPHA SIZE ☐ALPHA 025

☐XEQ ☐ALPHA BOND ☐ALPHA   *CLR?*

☐R/S [39]   *READY*

■☐B   *360?*

☐R/S [39]   *360*

■☐C   *SEMI?*

☐R/S [39]   *SEMI*

---

[39] A lone ☐R/S indicates a yes response to an alpha prompt.

Keystrokes: **Display:**

■ D	**MAT?**
N R/S	**CALL**
■ E	**BTAX?**
R/S [40]	**BTAX**
8.101977 A	**8.101977**
5.011992 B	**5.011992**
6.75 C	**6.75**
88.03[41] I	**88.09**
102 F	**102.00**
E	**YIELD=8.23**

What is the after tax yield if the marginal income tax rate is 50% and the effective capital gains tax is 25%?

■ E	**BTAX?**
N R/S	**ATAX**
50 G	**50.00**
25 H	**25.00**
E	**YIELD=4.41**

What is the purchase price necessary for an after tax yield of 4.75%?

| 4.75 E | **4.75** |
| D | **PRICE=84.34** |

---

[40] A lone R/S indicates a yes response to an alpha prompt.

[41] When using the 32^{nds} key, key in the price with the two digits after the decimal representing 32^{nds}. 88$^3/_{32}$ is keyed in as 88.03. If there is an extra 64th it is keyed in as a 5 in the third decimal place. 88$^3/_{32}$ + $^1/_{64}$ is keyed in as 88.035.

DAYS BETWEEN DATES
DAYS

Financial problem solving is heavily influenced by the concept of elapsed time. This program calculates the number of days between two dates (**DAYS**). The computation is based on either the actual number of calendar days between two dates (including applicable leap days)* or the hypothetical "bank calendar" with thirty day months and 360 day years.

Prompted Operation

(Minimum size 018)

Before using this program please read *A Word About Program Usage*.

After executing DAYS some of the following user prompts will be displayed. After each response, press [R/S] to continue.

DATE1=?   What is the earliest date? Enter dates using the format MM.DDYYYY.[42] See example.

DATE2=?   What is the latest date?

365?   Do you wish to calculate the interval between DATE1 and DATE2 on an actual day month 365 day year?

360?   Do you wish to calculate the interval between DATE1 and DATE2 on a 30 day month 360 day year?

Example 1:

How many days are there between May 1, 1975 and November 12, 1980 based on a 365 day year? A 360 day year?

Keystrokes:		Display:
[XEQ] [ALPHA] SIZE [ALPHA] 018		
[XEQ] [ALPHA] DAYS [ALPHA]		**CLR?**
[R/S] [43]		**DATE1=?**
5.011975 [R/S]		**DATE2=?**
11.121980 [R/S]		**365?**
[R/S] [43]	**365**	**DAYS=2022**

---

* Effective from January 1, 1901 to December 31, 2099.

[42] Dates are entered using European format (DD.MMYYYY) whenever the European display mode is used (i.e. flag 28 is clear).

[43] A lone [R/S] indicates a yes response to an alpha prompt.

Keystrokes:		**Display:**
[XEQ] [ALPHA] DAYS [ALPHA]		*CLR?*
N[44] [R/S]		*DATE1=5.011975?*
[R/S]		*DATE2=11.121980?*
[R/S]		*365?*
N [R/S]	*360*	*DAYS=1991*

---

[44] Most of the data currently stored will be re-used, therefore, it should not be cleared.

APPENDIX A
FINANCIAL FORMULAS

Compound Interest Solutions

$$0 = PV + (1 + Is)\, PMT \left[\frac{1 - (1 + I)^{-n}}{I} \right] + FV(1 + I)^{-n}$$

where

$s = 1$ given BEGIN
$s = 0$ given END

Internal Rate of Return
Solve for IRR

$$0 = \sum_{j=1}^{k} CF_j \left[\frac{1 - (1 + IRR)^{-n_j}}{IRR} \right] \left[(1 + IRR)^{-\sum_{\ell < j}^{n} \ell} \right] - CF_0$$

where:

n = number of cash flows
CF_j = j^{th} cash flow

Net Present Value

$$NPV_k = CF_0 + \sum_{k=1}^{n} \frac{CF_k}{(1 + i)^k}$$

where:

CF_k = k^{th} cash flow
i = discount rate (as a decimal)

Amortization Schedules

$$INT_j = \left| RND \left[BAL_{j-1} \cdot i \right] \right|$$

$$PRN_j = \left| PMT_j \right| - INT_j$$

$$BAL_j = BAL_{j-1} - PRN_j$$

$$\Sigma INT = \sum_{j=P1}^{P2} INT_j$$

$$\Sigma PRN = \sum_{j=P1}^{P2} PRN_j$$

For BEGIN payments

$$INT_1 = 0$$

where:

$INT_j =$ interest portion of jth payment

$PRN_j =$ principal portion of jth payment

$BAL_j =$ remaining balance after the jth payment

$PMT =$ payment amount

$i =$ interest rate (as a decimal)

$\Sigma INT =$ accumulated interest from P1 to P2 inclusive

$\Sigma PRN =$ accumulated principal from P1 to P2 inclusive

Straight Line Depreciation

$$Dep_n = \frac{A - S}{N}$$

For Partial First Year

$$Dep_1 = \frac{A - S}{N} \cdot \left(\frac{Y_1}{12}\right)$$

$$Dep_{N+1} = B_N$$

Sum-of-the-Digits Depreciation

$$Dep_n = (d_{n-1} - x_{n-1}) + d_n \left(\frac{Y_1}{12} \right)$$

where
$$x_n = d_n \left(\frac{Y_1}{12} \right)$$

$$d_n = \frac{N - n + 1}{(INT\ (N) + 1)\left(N - \frac{INT\ (N)}{2} \right)} \cdot (A - S)$$

For Partial First Year

$$Dep_1 = d_1 \left(\frac{Y_1}{12} \right)$$

$$Dep_{N+1} = d_N - x_N$$

Declining Balance Depreciation

$$Dep_n = B_{n-1} \left(\frac{R}{N\ (100)} \right)$$

For Partial First Year

$$Dep_1 = A \left(\frac{R}{N\ (100)} \right) \left(\frac{Y_1}{12} \right)$$

where:

n = year number

N = useful life

S = salvage value

A = starting book value

B_n = remaining depreciable amount

Y_1 = number of months in partial first year

R = declining balance rate (in percent)

Bonds

For na/b > 1

$$\text{Price} = \frac{RV\left(1 + \frac{i}{a}\right)^{-na/b}(1 - T_C)}{1 - T_C\left(1 + \frac{i}{a}\right)^{-na/b}}$$

$$+ \frac{(1 - T_I)\frac{CR}{i}\left[\left(1 + \frac{i}{a}\right)^j - \left(1 + \frac{i}{a}\right)^{-na/b}\right] - \frac{CR \cdot j \cdot (1 - T_I)}{a}}{1 - T_C\left(1 + \frac{i}{a}\right)^{-na/b}}$$

For na/b ≤ 1

$$\text{Price} = \frac{RV + \left(\frac{CR}{a}\right)}{1 + \left(\frac{i}{a}\right)\left(\frac{na}{b}\right)} - \left(\frac{CR}{a}\right) \cdot j$$

where:

a = number of coupons per year (1 or 2)

b = day basis (360 or 365)

i = yield as a decimal

CR = coupon rate in percent

RV = redemption value

n = life of bond in days

$j = 1 - \text{FRAC}\left(\frac{n \cdot a}{b}\right)$

T_C = capital gains tax as a decimal

T_I = income tax as a decimal

Days Between Dates

Actual

$$\text{Days} = f(D_2) - f(D_1)$$

where:

$$f(D_n) = 365\,(YYYY) + 31\,(mm - 1) + dd + \text{Int}\left(\frac{z}{4}\right) - x$$

$$\left.\begin{array}{l} x = 0 \\ z = (YYYY) - 1 \end{array}\right\} \text{given } mm \leq 2$$

$$\left.\begin{array}{l} x = \text{INT}\,(.4\,mm + 2.3) \\ z = (YYYY) \end{array}\right\} \text{given } mm > 2$$

30/360

$$\text{Days} = f(D_2) - f(D_1)$$

$$f(D_n) = 360\,(YYYY) + 30\,mm + z$$

where:

for $f(D_1)$

$z = 30$ given $dd_1 = 31$
$z = dd_1$ given $dd_1 \neq 31$

for $f(D_2)$

$z = 30$ given $dd_2 = 31$ and $dd_1 = 30$ or 31
$z = dd_2$ given $dd_2 = 31$ and $dd_1 < 30$
$z = dd_2$ given $dd_2 < 31$

PROGRAM DATA

Program	#Regs. to COPY	Data Registers	Flags	Display Format
Compound Interest Solutions (MONEY)	33	02, 08, 09, 11, 12, 14	01, 02, 09, 21, 22, 27, 55	FIX 2
*N, *I, *PV, *PMT, *FV	54	01-08 10, 13, 14	03	FIX 2
Internal Rate of Return (NPV, MIRR, IRR, *IRR, *NPV, *MIRR)	96	01-16	01-06 10, 21, 22, 29, 55	FIX 2
Loan Amortization Schedules (AMORT, *AMORT)	38	01-12	01-05 09, 29	FIX 2
Depreciation (SL, DB, SOYD, *SL, *DB, *SOYD)	78	01-12	01-09 29	FIX 2
Bonds (BOND)	60	01, 04, 09 11-14 16, 17, 21, 22	00, 01, 02, 04, 09, 10, 21, 22, 27, 55	FIX 2
*PRC, *YLD	35	03-09 11-15 18-21 23, 24	00, 01, 03, 05	

Program	#Regs. to COPY	Data Registers	Flags	Display Format
Days Between Dates (DAYS, *DAYS)	38	01, 02, 09, 11-17	02, 09, 28, 29	FIX 0
*BGN	14	00	00-08 10, 12, 21, 55	
*SIZE	7	—	25, 29	FIX 2
*DATA *DATA 1	11	00, 11, 12	00, 10, 55	
*OUT	5	—	55	
*TGL *TGL 1	20	10	01, 09, 10, 21, 55	
*Y/N	6	—	01	
$ENG	83	—	—	

PROGRAM LABELS

Label			Duplicate Label In
*AMORT	*N	*SOYD	Real Estate Pac
*DB	*NPV	AMORT	
*FV	*PMT	IRR	
*IRR	*PV	MIRR	
*MIRR	*SL	NPV	
*OUT			Machine Design Pac
DB			Standard Applications
I			Home Management Pac, Real Estate Pac
*BGN	*SIZE	DAYS	No Label conflicts
*DATA	*TGL	MONEY	
*DATA1	*TGL1	SL	
*DAYS	*YLD	SOYD	
*ENG	*Y/N		
*PRC	BOND		

The labels in this list are not in the same order as they appear in the catalog listing for the module.