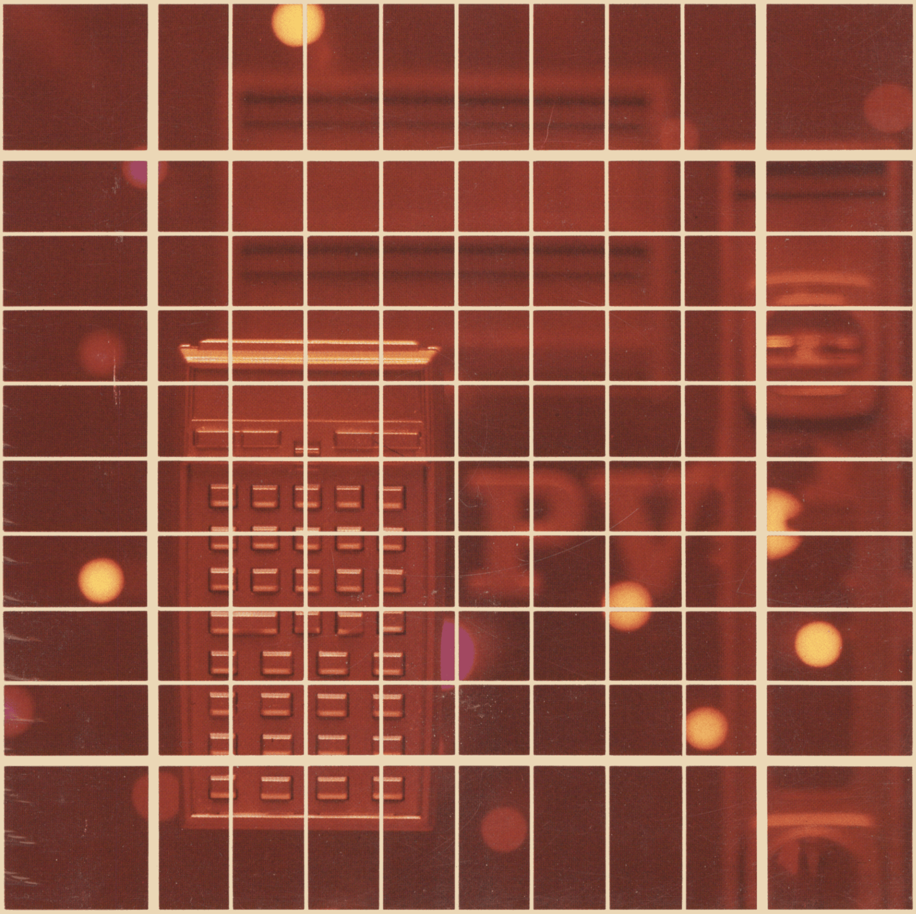
HEWLETT-PACKARD

HP-41C

REAL ESTATE PAC



HEWLETT PACKARD

HEWLETT-PACKARD LISTENS

To provide better calculator support for you, the Application Engineering group needs your help. Your timely inputs enable us to provide higher quality software and improve the existing application pacs for your calculator. Your reply will be extremely helpful in this effort.

1. Pac name ______________________________

2. How important was the availability of this pac in making your decision to buy a Hewlett-Packard calculator?
   ☐ Would not buy without it. ☐ Important ☐ Not important

3. What is the major application area for which you purchased the pac?

____

4. In the list below, please rate the usefulness of the programs in this pac.

PROGRAM NUMBER	ESSENTIAL	IMPORTANT BUT NOT REQUIRED	INFREQUENTLY USED	NEVER USED
1				
2				
3				
4				
5				
6				
7				
8				

PROGRAM NUMBER	ESSENTIAL	IMPORTANT BUT NOT REQUIRED	INFREQUENTLY USED	NEVER USED
9				
10				
11				
12				
13				
14				
15				
16				

5. Did you purchase a printer? ☐ YES ☐ NO
   If you did, is the printing format in this pac useful? ☐ YES ☐ NO

6. What programs would you add to this pac?

____

7. What additional application pacs would you like to see developed?

____

THANK YOU FOR YOUR TIME AND COOPERATION.

____
Name Position

____
Company

____
Address

____
City State

____
Zip Phone

Please fold and staple for mailing.

Additional Comments:

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INTRODUCTION

Each program in this Pac is represented by one program in the Application Module and a section in this manual. The manual provides a description of the program with relevant equations, a set of instructions for using the program, and one or more example problems, each of which includes a list of the keystrokes required for its solution.

Before plugging in your Application Module, **turn your calculator off,** and be sure you understand the section *Inserting and Removing Application Modules.* And before using a particular program, take a few minutes to read *Format of User Instructions* and *A Word About Program Usage.*

You should first familiarize yourself with a program by running it once or twice while following the complete User Instructions in this manual. Thereafter, the program's prompting or the mnemonics on the overlay should 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 been provided for your convenience.

We hope that the Real Estate Pac will assist you in the solution of numerous problems in your discipline. We would appreciate knowing your reactions to the programs in this Pac, and to this end we have provided a questionnaire inside the front cover of this manual. Would you please take a few minutes to give us your comments on these programs? It is from your comments that we learn how to increase the usefulness of our programs.

Acknowledgements:

Hewlett-Packard wishes to thank Gary M. Tenzer for his contributions to the definition of this Pac.

TABLE OF CONTENTS

INSERTING AND REMOVING APPLICATION MODULES

Before you insert an Application Module for the first time, familiarize yourself with the following information.

Up to four Application Modules can be plugged into the ports on the HP-41C. While plugged in, the names of all programs contained in the Module can be displayed by pressing ■ [CATALOG] 2.

> **CAUTION**
>
> Always turn the HP-41C off before inserting or removing any plug-in extension or accessories. Failure to turn the HP-41C off could damage both the calculator and the accessory.

To insert Application Modules:

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. Insert the Application Module with the label facing downward as shown, into any port **after** the last Memory Module. For example, if you have a Memory Module inserted in port 1, you can insert an Application Module in any of ports 2, 3, or 4. (The port numbers are shown on the back of the calculator.) **Never insert an Application Module into a lower numbered port than a Memory Module.**

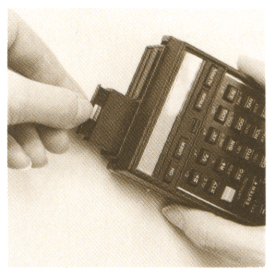
4. If you have additional Application Modules to insert, plug them into any port after the last Memory Module. Be sure to place port covers over unused ports.

5. Turn the calculator on and follow the instructions given in this book for the desired application functions.

To remove Application Modules:

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 ports.

Mixing Memory Modules and Application Modules

Any optional accessories (such as the HP 82104A Card Reader, or the HP 82143A Printer) should be treated in the same manner as Application Modules. That is, they can be plugged into any port after the last Memory Module. Also, the HP-41C should be turned off prior to insertion or removal of these extensions.

The HP-41C allows you to leave gaps in the port sequence when mixing Memory and Application Modules. For example, you can plug a Memory Module into port 1 and an Application Module into port 4, leaving ports 2 and 3 empty.

FORMAT OF USER INSTRUCTIONS

The User Instruction form is composed of five labeled columns. Reading from left to right, the first column, labeled STEP, gives the instruction step number.

The INSTRUCTIONS column gives instructions and comments concerning the operations to be performed.

The INPUT column specifies the input data, the units of data if applicable, or the appropriate alpha response to a prompted question. Data input keys consist of 0 to 9 and the decimal point (the numeric keys), [EEX] (enter exponent), and [CHS] (change sign).

The FUNCTION column specifies the keys to be pressed after keying in the corresponding input data.

The DISPLAY column specifies prompts, intermediate and final answers, and their units, where applicable.

Above the DISPLAY column is a box which specifies the minimum number of data storage registers necessary to execute the program. Refer to the Owner's Handbook for information on how the SIZE function affects storage configuration.

Several of the programs in this Pac use entirely prompted operation, eliminating this form in their explanation.

A WORD ABOUT PROGRAM USAGE

Catalog

When an Application Module is plugged into a port of the HP-41C, the contents of the Module can be reviewed by pressing ■ [CATALOG] 2 (the Extension Catalog). Executing the [CATALOG] function lists the name of each program or function in the Module, as well as functions of any other extensions which might be plugged in.

Overlays

An overlay has been included for one of the programs in this Pac. The mnemonics on the overlay are provided to help you run the program. The program's name is given vertically on the left side. When the calculator is in USER mode, a blue mnemonic identifies the key directly above it. Gold mnemonics are similar to blue mnemonics, except that they are above the appropriate key and the shift (gold) key must be pressed before the re-defined key. Once again, USER mode must be set.

ALPHA and USER Mode Notation

This manual uses a special notation to signify ALPHA mode. Whenever a statement on the User Instruction Form is printed in gold, the [ALPHA] key must be pressed before the statement can be keyed in. After the statement is input, press [ALPHA] again to return the calculator to its normal operating mode, or to begin program execution. For example, [XEQ] $ means press the following keys: [XEQ] [ALPHA] ■ P [ALPHA].

When the calculator is in USER mode, this manual will use the symbols [A]—[J] and ■ [A]—■ [E] to refer to the reassigned keys in the top two rows. These key designations will appear on the User Instruction Form and in the keystroke solutions to sample problems.

Prompted Operation

Prompts are 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 in the display. ***GROUPS?*** is an example of an alpha prompt. Many 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. ***CF 1=?*** and ***CF 1=—1,000.00?*** are two examples of data prompts.

The response to a data prompt without an associated value (***CF 1=?***) 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 press [R/S]. The program then proceeds to the next prompt.

Optional HP 82143A Printer

When the optional printer is plugged into the HP-41C along with the Real Estate Application Module, all results will be printed automatically. You may also want to keep a permanent record of the value input to a certain program. A convenient way to do this is to set the Print Mode switch to NORMAL before running the program. In this mode, all input values and the corresponding keystrokes will be listed on the printer, thus providing a record of the entire operation of the program.

Downloading Module Programs

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

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.

Label Conflicts With Other Application Pacs

Several labels used in the Real Estate Module have the same name as those used in other modules. If you have this module and another module plugged into your HP-41C at the same time, you should make sure that the module whose programs you want to use is in the **lowest-numbered port** to avoid conflicting use of these labels.

Label			Pac
*AMORT	*N	*SOYD	Financial Decisions
*DB	*NPV	AMORT	
*FV	*PMT	IRR	
*IRR	*PV	MIRR	
*MIRR	*SL	NPV	
	*I		Financial Decisions, Home Management
	N		Home Management
	PMT		
	FV		
	DB		Standard
	PV		Circuit Analysis, Home Management
	SIZE?		Stress Analysis, Games, Structural Analysis
	OUT		Petroleum Fluids

In addition, the Real Estate label LIST is also a printer function. The Real Estate LIST option is automatically assigned to ■ [D] when $ is executed. However, when attempting to execute LIST with keystrokes ([XEQ] [ALPHA] LIST [ALPHA]) the printer function will prevail when it is attached.

Assigning Program Names

When the *Compound Interest and Loan Amortization* program is executed ([XEQ] [ALPHA] $ [ALPHA]), 11 global labels within the Real Estate Application Module and 4 main-frame functions are automatically assigned to keys [A]—[J] and ■ [A]—■ [E]. These assignments take priority over any previous user assignments to the keys. And, since key assignments are stored in program memory, registers 55-63 are unavailable for data storage.

To accommodate register 55-63 (without additional Memory Modules), or to use keys [A] — [J] and ■ [A] — ■ [E] when the Real Estate Module is not in the calculator, the 15 functions must be de-assigned. This is accomplished by executing CLK ([XEQ] [ALPHA] CLK [ALPHA]). CLK clears only those assignments made in the $ program. Other user assignments are preserved and must be cleared to obtain the maximum number of storage registers. Refer to Page 63 of the HP-41C Owner's Handbook for a description of how to re-assign a key to its original normal mode function.

COMPOUND INTEREST SOLUTIONS:
The Cash Flow Diagram and Sign Convention

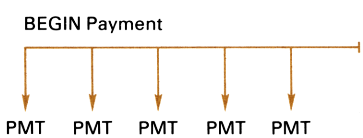
The most universal financial calculations involving money, time and interest rates are the compound interest functions. Although the functions have been known for hundreds of years, their use has been restricted by the need for complicated tables until the advent of high-speed digital computers and hand-held financial calculators.

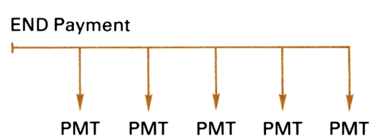
The five variables which have become standard for formatting and describing most compound interest problems can best be explained by referring to a pictorial representation called the cash flow diagram.

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

Exchange of cash is represented with vertical arrows. Cash received is represented by an arrow pointing up (positive) from the point on the time line where the transaction occurred, and cash paid out is represented by an arrow pointing down (negative).

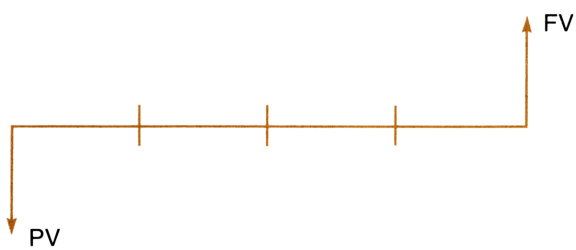
Payments (PMT) represent a series of cash exchanges of the same direction and amount. In the standard cash flow diagram, the payments occur coincidental with the compounding periods and are equal to the number of periods. The payments can either occur at the beginning of the period (***BEGIN***) or at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

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.

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

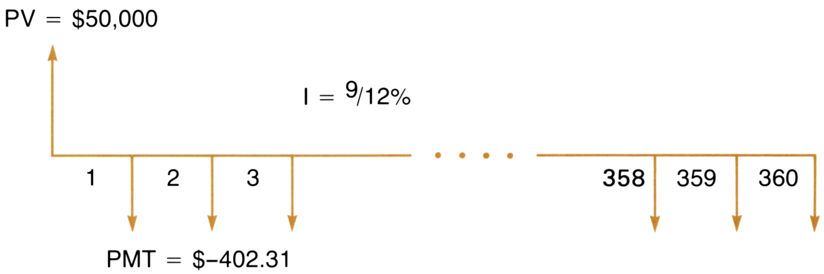
The cash flow diagram provides a means of describing financial problems without using terminology specific to a particular segment of the business community. It is in a sense, a universal financial language.

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.

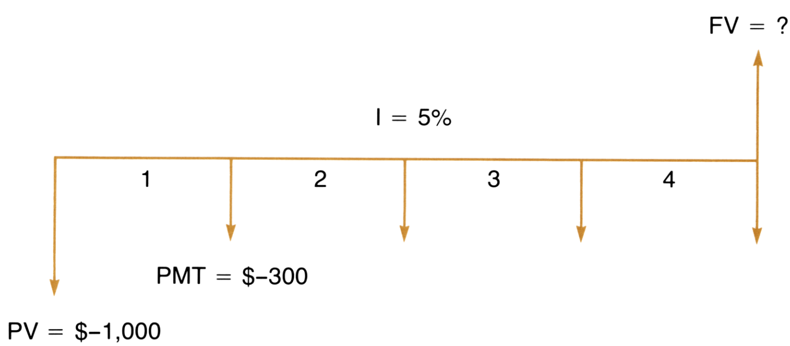
A payment amount of $402.31 is necessary to amortize a mortgage loan of $50,000 over 30 years. Payments are made monthly; interest is compounded monthly at .75% (9% annually) and the first payment is made 1 month after the exchange of the initial loan amount (***END***).



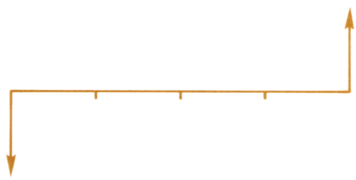
Note: PV is positive (arrow pointing up) because it represents cash received. PMT is negative (arrow pointing down) because it represents cash paid out. The use of positive and negative signs to represent the direction in which cash is exchanged is called the *cash flow sign convention*. It is important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

Example:

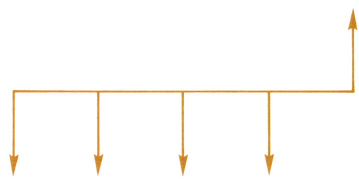
What will be the balance in a savings account (FV) at the end of 4 years if an initial deposit of $1000 is made followed by 4 annual deposits of $300 (***END***)? Interest is compounded yearly at 5% (I).



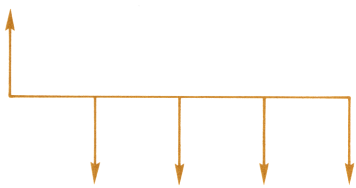
Six variations of the basic diagram are presented below. Under each diagram are listed a number of the more common industry terminology used to describe the represented cash exchange. Note that diagrams involving payments may be represented with payments at the beginning (***BEGIN***) or end (***END***) of the period.



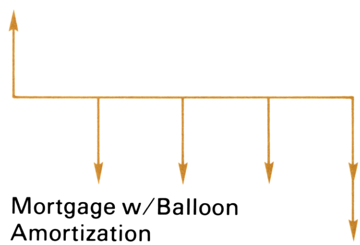
Compound Growth
Savings Account
Appreciation



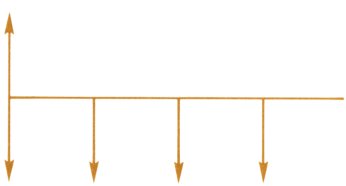
Savings Plan
Pension Fund
Annuity Due



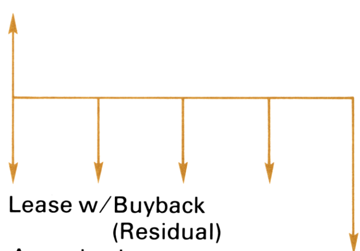
Mortgage
Direct Reduction (Installment) Loan
Amortization
Ordinary Annuity



Mortgage w/Balloon
Amortization
Ordinary Annuity



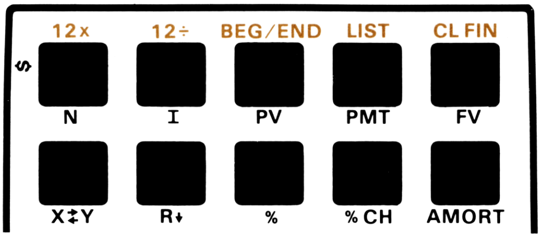
Lease
Amortization
Annuity Due



Lease w/Buyback
(Residual)
Amortization
Annuity Due

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 it is the *magnitude* and *timing* of the cash exchanges, represented by the cash flow diagram that are important, not the industry dependent terminology.

COMPOUND INTEREST AND LOAN AMORTIZATION



This program will allow you to solve a variety of problems involving money, time and interest. The following variables may be inputs or outputs:

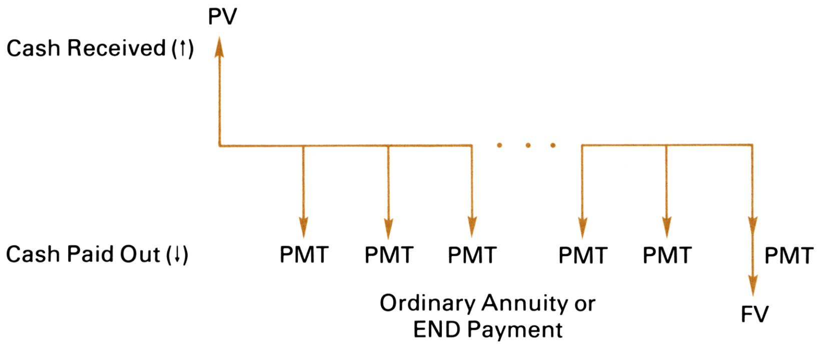
- **N** the number of compounding periods. (For a 30 year loan with monthly payments, N = 12 × 30 = 360.)
- **I** the periodic interest rate expressed as a percent. (For other than annual compounding, divide the annual percentage rate, or APR, by the number of compounding periods per year, i.e., 9% APR compounded monthly equals 9/12 or 0.75%.)
- **PV** the present value; the initial cash flow or the discounted value of a series of future cash flows.
- **PMT** the periodic payment amount.
- **FV** the future value; the final cash flow or the compounded value of a series of cash flows.

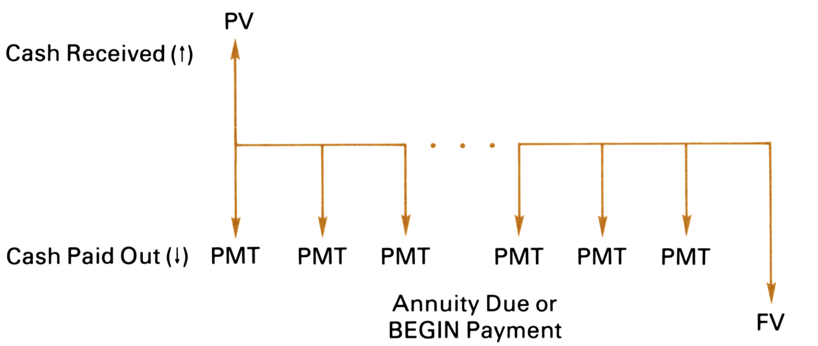
The program accommodates payments which are made at the end of compounding periods (*END* payment) or at the beginning (***BEGIN*** payment). Payments made at the end of compounding periods (ordinary annuity) are common in direct reduction loans and mortgages while payments at the beginning of compounding periods (annuity due) are common in leasing.

When this program is executed ([XEQ] $), global labels within the program are automatically assigned to keys [A]—[J] and ■ [A]—■ [E]. These assignments take priority over any previous user assignments. For a complete explanation, refer to *Assigning Program Names* on page 9 of this manual.

Compound Interest

A cash flow diagram enables you to describe a compound interest problem in terms that the calculator can understand. Once you draw and label your diagram, you simply key in the known data when requested and solve for the unknown value.





(For more information on cash flow diagrams, see *Compound Interest Solutions: the Cash Flow Diagram and Sign Convention).*

Instead of "What is my problem?", ask yourself, "What are the cash flows?"

Solving for any of the values (N, I, PV, PMT, or FV) is easy with your calculator. There are four simple rules to remember—rules that are the same for all compound interest calculations.

1. Given three or four of the financial values (N, I, PV, PMT, or FV), you can solve for the fourth and/or fifth values, as long as N and/or I are known.* Both N and I are involved in all financial calculations. You can enter the values in any order.
2. Use the cash flow sign convention throughout all compound interest calculations (including amortization): *Cash received (arrow pointing up) is represented by a positive value (+). Cash paid out (arrow pointing down) is represented by a negative value (–).*
3. Whenever payments (PMT) are involved, it is always necessary to specify whether the payments are made at the beginning of the payment period (***BEGIN***) or at the end of the payment period (***END***). The label BEG/END denotes a toggled computation option. Pressing ■ [C] causes the HP-41C to display an alpha prompt showing the current status. If you wish to change the status, press ■ [C] again. Flag 0 is displayed (set) in ***BEGIN*** mode, and cleared in ***END*** mode.
4. Remember that N and I must correspond to the same time frame, i.e., the number of compounding periods.

Loan Amortization

Most 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 principal reduction portion and interest portion over the life of a loan is called an amortization schedule.

The program calculates the principal and interest portion of each periodic payment and the remaining balance after the payment has been made, for any series of equal periodic amortization payments from any starting period to any ending period using a specified periodic increment (the increment must be less than 1000).

Periodic payments may be made at the end of the compounding period (***END*** payment) or at the beginning (***BEGIN*** payment). Most loans are ***END*** payment and most leases are ***BEGIN*** payment. Press ■ [C] to select the payment mode. Flag 0 indicates current status. Flag 0 set indicates ***BEGIN*** mode, and Flag 0 cleared indicates ***END*** mode.

* The calculator uses all four variables to solve for the fifth. Previously computed values will be used unless the financial registers are cleared.

The periodic installment schedule generated is valid for loans that have a single large last payment (balloon) as well as for loans which are arranged to be fully amortized. For a loan with a balloon payment, the remaining balance of the last payment period is the balloon payment due. For ***BEGIN*** payment problems (annuity due), any remaining balance or balloon must be compounded for one period since it is due at the *end* of the last payment period.

When using a calculated payment amount in the amortization routine, it is often necessary to round the payment amount to dollars and cents. This is because the calculated amount usually contains fractional cents, even though the display may show only two decimal places. For the greatest accuracy, the calculated payment amount should be appropriately rounded to the actual payment made.

SIZE: 013

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	Place overlay on calculator and initialize program.		[XEQ] $	0.00
2.	The following steps may be performed in any order:			
	• Multiplies the displayed number by 12 and stores in N	n	■ [A]	N=n×12
	• Divides the displayed number by 12 and stores in I	i	■ [B]	I=i/12
	• Toggles between BEGIN and END modes. Flag 0 is displayed (set) in BEGIN mode.		■ [C]	BEGIN or END
	• List values		■ [D]*	
	• Clear financial data		■ [E]	0.00
3.	The following steps may be performed in any order:			
	• Compute or store number of periods†		[A]	N=
	• Compute or store compound interest rate†		[B]	I=
	• Compute or store present value†		[C]	PV=
	• Compute or store payment amount†		[D]	PMT=
	• Compute or store future value†		[E]	FV=
	* Press [R/S] to list successive values if a printer is not being used.			
	† 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.			

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
4.	Review stored values.		[RCL] [A]—[E]	
5.	To compute an amortization schedule (I, PV, and PMT must already be stored).		[J]	START PER=?
6.	Key in starting period of schedule.	START PER	[R/S]	END PER=?
7.	Key in ending period of schedule.	END PER	[R/S]	INCREMENT=?
8.	Key in increment (the number of periods to be amortized before principal and interest are displayed/printed).	INCREMENT	[R/S]	
9.	Generate period number, interest, principal and remaining balance.		[R/S]* [R/S]* [R/S]*	PERIOD (n) INT= PRN= BAL=
10.	Repeat step 9 until entire schedule is calculated. Then calculate total principal.		[R/S]*	ΣINT=
11.	Calculate total interest.		[R/S]*	ΣPRN=
12.	Calculate remaining balance.		[R/S]*	RBAL=
	* Not necessary when the HP 82143A printer is used.			

Example 1:

A borrower can afford a $450.00 monthly principal and interest payment on a 30 year, 11¼% mortgage. What is the largest such mortgage he can obtain?

Keystrokes	**Display**	
[XEQ] [ALPHA] SIZE [ALPHA] 013		Minimum Size
[XEQ] [ALPHA] $ [ALPHA]	*0.00*	Initialize and clear financial registers
[C]	*END*	Set END mode
450 [CHS] [D]	*PMT=–450.00*	Monthly payment
30 [A]	*N=360.00*	Total term
11.25 [B]	*I=0.94*	Monthly interest rate
[C]	*PV=46,331.50*	Present value

If the mortgage required is only $45,500, what is the monthly payment? (Change the PV and solve for PMT.)

Keystrokes	Display	
45500 [C]	*PV=45,500.00*	Loan amount
[D]	*PMT=–441.92*	Monthly payment

Example 2:

A house which was purchased 3 years ago for $48,000 is currently listed for $65,500. What yearly appreciation rate does this represent?

Keystrokes	Display	
■ [E]	*0.00*	Clear financial registers
■ [C]	*END*	Set END mode
3 [A]	*N=3.00*	Term
48000 [CHS] [C]	*PV=–48,000.00*	Original purchase price
65500 [E]	*FV=65,500.00*	Today's value
[B]	*I=10.92*	Annual appreciation rate

Example 3:

What payment amount is necessary to fully amortize a 30 year, $70,000 mortgage paid monthly with an annual interest rate of 11%?

Keystrokes	Display	
■ [E]	*0.00*	Clear financial registers
■ [C]	*END*	Set END mode
70000 [C]	*PV=70,000.00*	Loan amount
30 ■ [A]	*N=360.00*	Total term
11 ■ [B]	*I=0.92*	Monthly interest rate
[D]	*PMT=–666.63*	Monthly payment

What is the balance on the mortgage at the end of year 5?

Keystrokes	Display	
[XEQ] [ALPHA] RND [ALPHA] [STO] [D]	-666.63	Round the payment to two decimal places and re-store the value
5 [■] [A]	N=60.00	Payments until balloon occurs
[E]	FV=-68,014.96	Remaining balance

Example 4:

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	Display	
[■] [E]	0.00	Clear financial registers
[■] [C]	BEGIN	Set BEGIN mode
3 [■] [A]	N=36.00	Total number of deposits
6 [■] [B]	I=0.50	Monthly interest rate
4000 [E]	FV=4,000.00	Total to accumulate
[D]	PMT=-101.18	Amount to deposit each month

What 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]	*FV=4,025.50*	Total accumulated
[B]	*I=0.53*	Monthly interest rate
12 [×]	*6.40*	Annual interest rate

Example 5:

Generate an amortization schedule for the first two payments of an $80,000 loan with monthly ordinary annuity payments of $658.14 at 9.25% annual interest rate.

Keystrokes	Display	
[XEQ] [ALPHA] $ [ALPHA]	*0.00*	Initialize and clear financial registers
■ [C]	*END*	Set END mode
80000 [C]	*PV=80,000.00*	Loan amount
658.14 [CHS] [D]	*PMT=-658.14*	Monthly payment
9.25 ■ [B]	*I=0.77*	Monthly interest rate
[J]	*START PER=?*	
1 [R/S]	*END PER=?*	
2 [R/S]	*INCREMENT=?*	
1 [R/S]	*PERIOD 1*	
[R/S]	*INT=-616.67*	
[R/S]	*PRN=-41.47*	
[R/S]	*BAL=79,958.53*	
[R/S]	*PERIOD 2*	
[R/S]	*INT=-616.35*	
[R/S]	*PRN=-41.79*	
[R/S]	*BAL=79,916.74*	
[R/S]	*ΣINT=-1,233.02*	
[R/S]	*ΣPRN=-83.26*	
[R/S]	*RBAL=79,916.74*	

Example 6:

Generate a yearly amortization schedule for the first two years of a $25,000 loan at 10%, monthly payments, 10-year term. (End of period payments.)

Keystrokes	Display	
[XEQ] [ALPHA] $ [ALPHA]	*0.00*	
■ [C]	*END*	Set END mode
10 ■ [A]	*N=120.00*	Total term
10 ■ [B]	*I=0.83*	Monthly interest rate
25000 [C]	*PV=25,000.00*	Loan amount
[D]	*PMT=–330.38*	Monthly payment
[XEQ] [ALPHA] RND [ALPHA]		
[STO] [D]	*–330.38*	Round the payment to two decimal places and re-store the value
[J]	*START PER=?*	
1 [R/S]	*END PER=?*	
24 [R/S]	*INCREMENT=?*	
12 [R/S]	*PERIOD 12*	
[R/S]	*INT=–2,430.97*	
[R/S]	*PRN=–1,533.59*	
[R/S]	*BAL=23,466.41*	
[R/S]	*PERIOD 24*	
[R/S]	*INT=–2,270.39*	
[R/S]	*PRN=–1,694.17*	
[R/S]	*BAL=21,772.24*	
[R/S]	*ΣINT=–4,701.36*	
[R/S]	*ΣPRN=–3,227.76*	
[R/S]	*RBAL=21,772.24*	

INTERNAL RATE OF RETURN

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 38 individual cash flows or 19 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 230 individual or 115 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.*

This program was designed for optimum operation when the interest rate being solved for is between 0 and 100%. The program will often solve for interest rates outside this range, but occasionally may halt prematurely with ***DATA ERROR*** in the display. This is an error condition generated by an intermediate calculation, and indicates that the program cannot solve that particular problem.

Prompted Operation

(Minimum size 025)*

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

* Actual size depends on the number of cash flows to be entered: for groups (2 × (number of groups) + 25); for individual cash flows (number of cash flows + 25).

GROUPS?	Are the cash flows to be entered as groups of equal cash flows? Press [R/S] to enter the cash flow in groups, or press N [R/S] if the cash flows are not in groups.
CF (#)=?	What is the amount of the cash flow or group of cash flows in period 0, 1, 2, etc.? Use the cash flow sign convention. If all of the cash flows have been entered, press [R/S] to continue to the next prompt.
NO. CFS (#)=?	How many cash flows are in period 0, 1, 2, etc?
CF CHANGES?	Do you wish to review or change any cash flows? Press [R/S] to make changes, or press N [R/S] if no changes need to be made.

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 number of the group (*GROUP NO.=?*) or cash flow (*CF NO.=?*) to be changed. After responding, the program displays 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 NO.=?* or *CF NO.=?*. 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 annual cash flows are as follows, what is the return on the investment?

Year	Cash Flow ($)
0	−2000
1	−2500
2	−3000
3	−3500
4	−4000
5	25000

Keystrokes	Display
[XEQ] [ALPHA] SIZE [ALPHA] 031	
[XEQ] [ALPHA] IRR [ALPHA]	*GROUPS?*
N [R/S]	*CF 0=?*

Keystrokes	Display	
2000 [CHS] [R/S]	*CF 1=?*	
2500 [CHS] [R/S]	*CF 2=?*	
3000 [CHS] [R/S]	*CF 3=?*	
3500 [CHS] [R/S]	*CF 4=?*	
4000 [CHS] [R/S]	*CF 5=?*	
25000 [R/S]	*CF 6=?*	
[R/S]	*CF CHANGES?*	
N [R/S]	*IRR=19.71*	Annual yield

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

Keystrokes	Display	
[R/S]	*CF NO.=?*	
5 [R/S]	*CF 5=25,000.00?*	
20000 [R/S]	*CF NO.=?*	
[R/S]	*IRR=10.96*	Annual yield

Example 2:

A graduated-payment mortgage calls for the following schedule of increasing monthly mortgage payments on a 30-year, $40,000 loan. What is the actual yearly interest rate (APR)?

Group	Year	Payment
0	0	−40,000.00
1	1	252.01
2	2	264.61
3	3	277.84
4	4	291.73
5	5	306.32
6	6–30	321.64

Keystrokes	Display
[XEQ] [ALPHA] SIZE [ALPHA] 039	
[XEQ] [ALPHA] IRR [ALPHA]	*GROUPS?*
[R/S]	*CF 0=?*
40000 [CHS] [R/S]	*NO. CFS 0=?*
1 [R/S]	*CF 1=?*
252.01 [R/S]	*NO. CFS 1=?*
12 [R/S]	*CF 2=?*
264.61 [R/S]	*NO. CFS 2=?*

Keystrokes	Display	
12 [R/S]	*CF 3=?*	
277.84 [R/S]	*NO. CFS 3=?*	
12 [R/S]	*CF 4=?*	
291.73 [R/S]	*NO. CFS 4=?*	
12 [R/S]	*CF 5=?*	
306.32 [R/S]	*NO. CFS 5=?*	
12 [R/S]	*CF 6=?*	
321.64 [R/S]	*NO. CFS 6=?*	
300 [R/S]	*CF 7=?*	
[R/S]	*CF CHANGES?*	
N [R/S]	*IRR=0.70*	Monthly yield
12 [×]	*8.40*	Annual nominal yield

Note: The effective annual yield may be obtained by doing the following:
1200 [÷] 1 [+] 12 [y^x] 1 [−] 100 [×] → ***8.73***

MODIFIED INTERNAL RATE OF RETURN

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., 10-15%). 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.

The basic HP-41C without any Memory Modules can accommodate up to 38 individual cash flows or 19 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 230 individual or 115 groups.

Prompted Operation

(Minimum size 025)*

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

* Actual size depends on the number of cash flows to be entered: for groups (2 × (number of groups) + 25); for individual cash flows (number of cash flows + 25).

GROUPS? Are the cash flows to be entered as groups of equal cash flows? Press [R/S] to enter the cash flows in groups, or press N [R/S] if the cash flows are not in groups.

CF (#)=? What is the amount of the cash flow or group of cash flows in period 0, 1, 2, etc.? Use the cash flow sign convention. If all of the cash flows have been entered, press [R/S] to continue to the next prompt.

NO. CFS (#)=? How many cash flows are in period 0, 1, 2, etc.?

CF CHANGES? Do you wish to review or change any cash flows? Press [R/S] to make changes, or press N [R/S] if no changes need to be made.

SAFE RATE=? What is the liquid rate of return, in percent?

RISK RATE=? What is the "risky" rate of return, in percent?

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 number of the group (***GROUP NO=?***) or cash flow (***CF NO.=?***) 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.

Example:

An investor has the following unconventional investment opportunity. The cash flows are:

Group	# of Months	Cash Flow ($)
0	1	−180,000
1	5	100,000
2	5	−100,000
3	9	0
4	1	200,000

Calculate the MIRR using a safe rate of 6% and a reinvestment (risk) rate of 10%.

Keystrokes	Display	
[XEQ] [ALPHA] SIZE [ALPHA] 035		
[XEQ] [ALPHA] MIRR [ALPHA]	*GROUPS?*	
[R/S]	*CF 0=?*	
180000 [CHS] [R/S]	*NO. CFS 0=?*	
1 [R/S]	*CF 1=?*	
100000 [R/S]	*NO. CFS 1=?*	
5 [R/S]	*CF 2=?*	
100000 [CHS] [R/S]	*NO. CFS 2=?*	
5 [R/S]	*CF 3=?*	
0 [R/S]	*NO. CFS 3=?*	
9 [R/S]	*CF 4=?*	
200000 [R/S]	*NO. CFS 4=?*	
1 [R/S]	*CF 5=?*	
[R/S]	*CF CHANGES?*	
N [R/S]	*SAFE RATE=?*	
6 [ENTER↑] 12 [÷] [R/S]	*RISK RATE=?*	
10 [ENTER↑] 12 [÷] [R/S]	*MIRR=0.81*	Monthly yield
12 [×]	*9.70*	Annual nominal yield

Note: The effective yield may be obtained by doing the following:
1200 [÷] 1 [+] 12 [y^x] 1 [−] 100 [×] → ***10.14***

NET PRESENT VALUE
(Discounted Cash Flow Analysis)

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 a 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 the return from the investment.

The first cash flow is assumed to occur at time period zero (the present). The discount rate must coincide with the period between cash flows. For example, a 9% yearly discount rate applied to monthly cash flows must be entered as 9/12 or 0.75.

One of the important features of the program is the ability to make changes in one or more of the cash flows or the discount 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 that 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.

The basic HP-41C without any Memory Modules can accommodate up to 38 individual cash flows or 19 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 230 individual or 115 groups.

Prompted Operation

(Minimum size 025)*

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 cash flows? Press [R/S] to enter the cash flows in groups, or press N [R/S] if the cash flows are not in groups.

CF (#)=? What is the amount of the cash flow or group of cash flows in period 0, 1, 2, etc.? Use the cash flow sign convention. If all the cash flows have been entered, press [R/S] to continue to the next prompt.

NO. CFS (#)=? How many cash flows are in period 0, 1, 2, etc.?

CF CHANGES? Do you wish to review or change any cash flows? Press [R/S] to make changes, or press N [R/S] if no changes need to be made.

DSCNT RATE=? Key in the discount rate (in percent). The rate must coincide with the period between 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 number of the group (***GROUP NO.=?***) or cash flow (***CF NO.=?***) 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 NO.=?*** or ***CF NO.=?***. 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.

* Actual size depends on the number of cash flows entered: for groups (2 × (number of groups) + 25); for individual cash flows (number of cash flows + 25).

Example:

An investor has an opportunity to purchase a piece of property for $70,000. If the after-tax cash flows are forecast as follows, should the investor purchase the property if he desires a 15% rate of return?

Group	Cash Flow ($)	Number of Months
0	−70,000	1
1	− 1,000	2
2	800	56
3	87,500	1 (property sold)

Keystrokes	Display
[XEQ] [ALPHA] SIZE [ALPHA] 033	
[XEQ] [ALPHA] NPV [ALPHA]	*GROUPS?*
[R/S]	*CF 0=?*
70000 [CHS] [R/S]	*NO. CFS 0=?*
1 [R/S]	*CF 1=?*
1000 [CHS] [R/S]	*NO. CFS 1=?*
2 [R/S]	*CF 2=?*
800 [R/S]	*NO. CFS 2=?*
56 [R/S]	*CF 3=?*
87500 [R/S]	*NO. CFS 3=?*
1 [R/S]	*CF 4=?*
[R/S]	*CF CHANGES?*
N [R/S]	*DSCNT RATE=?*
15 [ENTER↑] 12 [÷] [R/S]	*NPV=1,373.74*

Since the final NPV is positive, the investment meets the 15% rate of return objective.

Would the 15% rate of return objective be met if the property were projected to sell for $84,000?

Keystrokes	Display
[R/S]	*GROUP NO.=?*
3 [R/S]	*GROUP 3=87,500.00?*
84000 [R/S]	*NO. CFS 3=1.00?*
[R/S]	*GROUP NO.=?*
[R/S]	*DSCNT RATE=1.25?*
[R/S]	*NPV=−308.01*

Since the NPV is negative, the 15% guideline would not have been met.

DEPRECIATION SCHEDULES

In theory, tangible assets such as buildings, machines, tools, trucks, etc. gradually decline in value over time through usage, technological obsolescence, environmental deterioration or a combination of all of these. Depreciation is a method of periodically accounting for the declining value of an asset. Depreciation is an annual deduction from Net Operating Income, before taxable income and income tax liability are calculated, and is an accounting expense item.

The three most commonly used depreciation methods are: Straight Line (SL), Sum-of-the-Years'-Digits (SOYD), and Declining Balance (DB). SOYD and DB are methods of accelerated depreciation whereby higher annual amounts of depreciation are charged during the early years of an asset's life than with the straight line depreciation method, reflecting the fact that many assets decline in value most during the early part of their lives.

The program computes depreciation based on fiscal or calendar year. When the purchase date of an asset does not coincide with the beginning of a year—which is the rule rather than the exception—the amount of depreciation in the first and last years are computed as fractions of a full year's depreciation. The program recognizes this and prompts you to enter the number of months from purchase until the end of the first fiscal or calendar year (***MONS YR 1=?***).

Often a complete depreciation schedule for the asset's entire life is not needed. You are also given prompts to enter the starting and ending periods for which a depreciation schedule is desired.

Calculated results include the amount of depreciation (***DEP***), the remaining depreciable value (**RDV**), and the remaining book value (***RBV***).

Straight Line Depreciation (SL) Method

The annual amount of depreciation using this method is determined by dividing the total depreciable amount (starting book value less salvage value) by the useful life expectancy. This amount is subtracted each year from the previous year's ending book value or ending depreciable value.

Sum-of-the-Years'-Digits (SOYD) Method

The SOYD method is based on the sum of the digits from one year to the number of years in the asset's life. For instance an asset with a 6 year life would have an SOYD total of 21. (6 + 5 + 4 + 3 + 2 + 1 = 21).

Theoretically, 6/21 of the asset's life is used up during the first year, 5/21 during the second year, etc. The annual amount of depreciation for each year is the asset's total depreciable amount multiplied by that year's use factor. Partial first year SOYD depreciation is correctly treated, based on formulas in the back of this book.

Declining Balance (DB) Method

With the DB method, a constant percentage is applied each year to the remaining book value to find the annual amount of depreciation. The salvage value is not subtracted initially but the asset may not be depreciated below this salvage value.

Since income tax regulations currently allow for the use of more than one declining balance percentage rate, you are prompted for the percentage rate you wish to use. A rate of 150% means 150% declining balance, and 200% means double-declining balance. This percentage rate divided by the asset life, in years, gives the constant rate applied each year to the remaining book value. For instance, 150% declining balance applied to an asset with a 6 year life would give a constant rate of 150/6 or 25% each year.

The annual amount of depreciation declines over time and the DB method frequently will not depreciate an asset fully in the asset's lifetime. In these situations, there is an optimum point in the asset's life where a change from the DB method to the straight line method should be used. This is the "crossover point", the first year in which the amount of depreciation by the SL method is greater than if depreciation were continued using the DB method. The annual SL amount of depreciation is determined by dividing the remaining depreciable value by the remaining asset life.

A program prompt will allow you to determine whether or not you want to crossover to the SL method. If you elect to "crossover", the calculated output will give the crossover point, if it occurs in any year up to and including the last year of the printed depreciation schedule.

SIZE: 018

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Initialize the program.		[XEQ] DEPR	DEP AMT=?
2.	Key in the amount to be depreciated.	DEP AMT	[R/S]	LIFE=?
3.	Key in the expected useful life (in years). The life must be an integer.	LIFE	[R/S]	SALVAGE=?
4.	Key in the estimated salvage value.	SALVAGE	[R/S]	MONS YR 1=?
5.	Key in the number of months from acquisition until the end of the first year.	MONS YR 1	[R/S]	START PER=?

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
6.	Key in the first year for which results are desired.	START PER	[R/S]	END PER=?
7.	Key in the last year for which results are desired.	END PER	[R/S]	DEP TYPE?
8.	Key in the depreciation type:			
	Straight line	SL	[R/S]	(Go to 11)
	Sum-of-the-Years'-Digits	SOYD	[R/S]	(Go to 11)
	Declining Balance	DB	[R/S]	DB%=?
9.	Key in the declining balance rate factor (in percent)	DB%	[R/S]	X-OVER?
10.	Accept or decline crossover to straight line:			
	Crossover		[R/S]	
	No crossover	N	[R/S]	
11.	Display the year for which depreciation is to be calculated			YEAR
12.	Calculate the amount of depreciation		[R/S]*	DEP=
13.	Calculate the remaining depreciable value.		[R/S]*	RDV=
14.	Calculate the remaining book value.		[R/S]*	RBV=
15.	Press [R/S] for the next year. Return to step 12.		[R/S]*	YEAR
	* Press [R/S] if you are not using a printer.			

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 11-13.

Keystrokes	Display
[XEQ] [ALPHA] SIZE [ALPHA] 018	
[XEQ] [ALPHA] DEPR [ALPHA]	*DEP AMT=?*
200000 [R/S]	*LIFE=?*
30 [R/S]	*SALVAGE=?*
0 [R/S]	*MONS YR 1=?*
4 [R/S]	*START PER=?*

Keystrokes	Display
11 [R/S]	*END PER=?*
13 [R/S]	*DEP TYPE?*
DB [R/S]	*DB%=?*
150 [R/S]	*X-OVER?*
[R/S]	*YEAR 11*
[R/S]	*DEP=6,197.45*
[R/S]	*RDV=117,751.61*
[R/S]	*RBV=117,751.61*
[R/S]	*YEAR 12*
[R/S]	*DEP=5,987.37*
[R/S]	*RDV=111,764.24*
[R/S]	*RBV=111,764.24*
[R/S]	*YEAR 13*
[R/S]	*DEP=5,987.37*
[R/S]	*RDV=105,776.87*
[R/S]	*RBV=105,776.87*

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

Example 2:

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 (year 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] DEPR [ALPHA]	*DEP AMT=?*
50000 [R/S]	*LIFE=?*
6 [R/S]	*SALVAGE=?*
8000 [R/S]	*MONS YR 1=?*
4 [R/S]	*START PER=?*
2 [R/S]	*END PER=?*
2 [R/S]	*DEP TYPE?*
SOYD [R/S]	*YEAR 2*
[R/S]	*DEP=11,333.33*
[R/S]	*RDV=26,666.67*
[R/S]	*RBV=34,666.67*

INCOME PROPERTY ANALYSIS

This program analyzes the investment potential of income-producing properties, on both a before-tax and after-tax basis. With this program, the user is able to compare investments of similar lifetimes, and to evaluate the effects of alternative methods of financing, depreciation methods, capital improvements, and possible exchanges.

Variables used in this evaluation include: gross income, expenses, mortgage data (interest, term, payment), depreciation, capital expenditures, the investor's income tax and capital gains tax rates, yearly appreciation, yearly escalation (growth) in income, yearly increases in expenses, and the original basis.

The user has the option of obtaining a summary of the performance of the property, or a full schedule for each year of holding. An annual summary of the property's performance includes the following major items: net operating income, taxable income, tax liability, before-tax cash flow, and after-tax cash flow.

Then, at the end of the investment's holding period, a summary is output listing the property's adjusted tax basis, sale price, capital gain realized on sale, taxes (both capital gain taxes and the taxes due when accelerated depreciation has been used), and the after-tax proceeds realized from the sale. The investment's overall equity yield is then determined using an Internal Rate of Return routine.

A full schedule includes all of the above calculations, plus equity yield, for each year of holding. This allows the user to determine the property's optimum holding period.

In either case, when the schedule or summary is complete, the user is able to change the input data, and may re-do the evaluation for a new financing situation.

The program is based on RNMI Form 1-75-F612, and is designed to handle three monthly payment mortgages where the total terms, yearly interest rates, and amounts of each mortgage are known. During execution the mortgages must be entered in decreasing term order (that is, longest term mortgage first). The program prompts for the monthly payment. If the payment is not known, the program will calculate and display the monthly payment necessary to amortize the mortgage. Using this approach, the program can accommodate fully amortized loans, interest-only loans with a balloon payment, and reduced payment loans with a balloon payment.

Two depreciation options are also available—one for the building and one for personal property. The necessary inputs are the depreciable value, the depreciable life, and the depreciation factor.

The basic HP-41C without any Memory Modules can accommodate a projection period of 11 years.* With each additional Memory Module installed, the program can accommodate an additional 64 years.

Prompted Operation

(Minimum size 052)†

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

PROJ PER=?	What is the projected number of holding periods in years (can't exceed the term of the longest mortgage)?
APPREC%=?	What is the annual investment appreciation rate in percent?
GROWTH%=?	What is the annual underlying rate which is applied to the gross income (rents) in percent?
GROSS INC=?	What is the annual gross income?
VACANCY%=?	What is the expected vacancy rate in percent?
INCREASE%=?	What is the annual underlying rate which is applied to the operating expenses and capital improvements in percent?
OP EXP=?	What are the expected annual operating expenses in dollars?
1ST MTG=?	What is the amount of the mortgage with the longest term? Enter a positive, non-zero value.
INT%=?	What is the annual interest rate (in percent) of the first mortgage?
TERM=?	What is the total term (in years) of the first mortgage?
PMT=?	What is the level monthly payment for the first mortgage? Pressing [R/S], with no value entered, results in calculation of a level monthly payment with full amortization. This value is displayed. Press [R/S] to continue if a printer is not being used.
2ND MTG=?	What is the amount of the mortgage with the second longest term? If there is no second mortgage, key in 0; the next seven prompts will then be skipped.

---

* To accommodate 55 to 63 storage registers, be sure to de-assign the 15 functions of the *Compound Interest* program ($). This is accomplished by executing CLK ([XEQ] [ALPHA] CLK [ALPHA]). CLK clears only those assignments made in the $ program. Other user assignments are preserved and may need to be cleared to obtain a sufficient number of storage registers. Refer to Page 63 of the HP-41C Owner's Handbook for a description of how to re-assign a key to its original normal mode funtion.

† Actual size is the projection period + 52.

INT%=?	What is the annual interest rate (in percent) of the second mortgage?
TERM=?	What is the total term (in years) of the second mortgage?
PMT=?	What is the level monthly payment on the second mortgage? Pressing [R/S], with no value entered, results in calculation of a level monthly payment with full amortization. This value is displayed. Press [R/S] to continue if a printer is not being used.
3RD MTG=?	What is the amount of the mortgage with the shortest term? If there is no third mortgage, key in 0; the next three prompts will then be skipped.
INT%=?	What is the annual interest rate (in percent) of the third mortgage?
TERM=?	What is the total term (in years) of the third mortgage?
PMT=?	What is the level monthly payment on the third mortgage? Pressing [R/S], with no value entered, results in calculation of a level monthly payment with full amortization. This value is displayed. Press [R/S] to continue if a printer is not being used.
BLD DEP=?	What is the depreciable value of the building?
LIFE=?	What is the depreciable life (in years) of the building?
FACTOR=?	What is the depreciation factor in percent? Enter 100 for straight line depreciation and enter a value greater than 100 (125, 150, etc.) for declining balance depreciation.
PER PROP=?	What is the depreciable value of the personal property? If there is no personal property to depreciate, key in 0; the next two prompts will then be skipped.
LIFE=?	What is the depreciable life (in years) of the personal property?
FACTOR=?	What is the depreciation factor in percent? Enter 100 for straight line depreciation and enter a value greater than 100 (125, 150, etc.) for declining balance depreciation.
PRICE=?	What is the purchase price of the investment?
BASIS=?	What is the original tax basis of the investment?

CAP IMP=?	What are the expected annual capital improvements in dollars?
TAX%=?	What is the investor's marginal income tax rate, as a percent?
CG TAX%=?	What is the investor's capital gains tax rate, as a percent?
FULL SCHED?	Do you wish a full schedule including equity yield for each year? Press [R/S] for a full schedule, or press N [R/S] for a yearly summary.
LIST?	Do you wish to list the values which have been keyed in? Press [R/S] to list the values, or press N [R/S] to proceed.
CHANGE?	Do you wish to review or change any values which have been keyed in? Press [R/S] to make changes, or press N [R/S] if no changes need to be made.
TRANS CST%=?	What are the transaction costs as a percent of the selling price?

When the last result has been calculated (***EQ YLD:***), changes can easily be made in the input data simply by pressing [R/S]. The program responds with ***CHANGE?*** If you wish to make changes, press [R/S]. The program will then display the values currently being used. 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 data input, the computation of a new summary then proceeds automatically.

If you do not wish to make changes, press N [R/S]. The previous computation is repeated.

Example:

You are considering the purchase of a $179,500 multi-use apartment/office space/warehouse complex consisting of nine distinct rentable units. The property is currently generating yearly rental income of $17,580, with a 2% vacancy rate and total yearly operating expenses of $3,620. As conservative estimates, the value of the complex will appreciate 6% per year, the annual rents will grow 5% per year, and expenses (including improvements) will increase 8% per year.

The property is currently financed with an assumable 9.75% mortgage which has a remaining balance of $62,667.17 and a remaining term of 25 years. If this mortgage were assumed, the lender would require a two point increase in the interest rate, thus increasing the rate to 11.75%.

The seller of the property is willing to carry the balance as a second mortgage, with the stipulation that he receive 20% of the asking price as a down payment. The second $80,932.83 would be written at 11%, with monthly payments of $750.00 and a balloon payment occurring at the end of the fourth year for the outstanding balance.

The building is valued at $139,500 and can be depreciated using a 125% declining balance method for a useful life of 20 years. Personal property, valued at $5000, has an expected useful life of 5 years and will be depreciated using the straight line method.

Capital improvements are projected to be $1,500 the first year. Your income tax rate is 50%, and your capital gains tax rate is 30%. When you sell the property, transaction costs are estimated to be 7% of the selling price. The tax basis is $179,500.

Based on this data, analyze the property using an expected holding (projection) period of 5 years. For this analysis, a yearly summary is sufficient.

Keystrokes	**Display**	
[XEQ] [ALPHA] SIZE [ALPHA] 057†		It may be necessary to execute CLK.
[XEQ] [ALPHA] IPA [ALPHA]	*PROJ PER=?*	
5 [R/S]	*APPREC%=?*	
6 [R/S]	*GROWTH%=?*	
5 [R/S]	*GROSS INC=?*	
17580 [R/S]	*VACANCY%=?*	
2 [R/S]	*INCREASE%=?*	
8 [R/S]	*OP EXP=?*	
3620 [R/S]	*1ST MTG=?*	
62667.17 [R/S]	*INT%=?*	
11.75 [R/S]	*TERM=?*	
25 [R/S]	*PMT=?*	
[R/S]	*PMT:648.48*	
[R/S]*	*2ND MTG=?*	
80932.83 [R/S]	*INT%=?*	
11 [R/S]	*TERM=?*	
4 [R/S]	*PMT=?*	
750 [R/S]	*3RD MTG=?*	

† Minimum size is the projection period + 52.

* Press [R/S] if you are not using a printer.

Keystrokes	Display
0 [R/S]	*BLD DEP=?*
139500 [R/S]	*LIFE=?*
20 [R/S]	*FACTOR=?*
125 [R/S]	*PER PROP=?*
5000 [R/S]	*LIFE=?*
5 [R/S]	*FACTOR=?*
100 [R/S]	*PRICE=?*
179500 [R/S]	*BASIS=?*
179500 [R/S]	*CAP IMP=?*
1500 [R/S]	*TAX%=?*
50 [R/S]	*CG TAX%=?*
30 [R/S]	*FULL SCHED?*
N [R/S]	*LIST?*
N [R/S]	*CHANGE?*
N [R/S]	*TRANS CST%=?*
7 [R/S]	

Printout	Description
INIT INV:35,900.00	Initial investment (down payment)
YEAR: 1	
GROSS INC:17,580.00	Gross income
-VAC:351.60	Vacancy
-OP EXP:3,620.00	Operating expenses
=NOI:13,608.40	Net operating income
-INT 1ST:7,340.11	Interest on 1^{st} mortgage
-INT 2ND:8,897.55	Interest on 2^{nd} mortgage
-BLD DEP:8,718.75	Building depreciation
-PER PROP:1,000.00	Personal property depreciation
=TAX INC:-12,348.01	Taxable income
*MTR:50.00	Marginal tax rate
=TAX LIAB:-6,174.01	Tax liability
NOI:13,608.40	Net operating income
-ANN PMTS:16,781.76	Total annual mortgage payments
-CAP IMP:1,500.00	Capital improvements
=BTCF:-4,673.36	Before-tax cash flow
-TAX LIAB:-6,174.01	Tax liability
=ATCF:1,500.65	After-tax cash flow

```
YEAR:2
GROSS INC:18,459.00
-VAC:369.18
-OP EXP:3,909.60
=NOI:14,180.22
-INT 1ST:7,285.33
-INT 2ND:8,885.69
-BLD DEP:8,173.83
-PER PROP:1,000.00
=TAX INC:-11,164.63
*MTR:50.00
=TAX LIAB:-5,582.32

NOI:14,180.22
-ANN PMTS:16,781.76
-CAP IMP:1,620.00
=BTCF:-4,221.54
-TAX LIAB:-5,582.32
=ATCF:1,360.78
```

```
YEAR:3
GROSS INC:19,381.95
-VAC:387.64
-OP EXP:4,222.37
=NOI:14,771.94
-INT 1ST:7,223.75
-INT 2ND:8,872.47
-BLD DEP:7,662.96
-PER PROP:1,000.00
=TAX INC:-9,987.24
*MTR:50.00
=TAX LIAB:-4,993.62

NOI:14,771.94
-ANN PMTS:16,781.76
-CAP IMP:1,749.60
=BTCF:-3,759.42
-TAX LIAB:-4,993.62
=ATCF:1,234.20
```

```
YEAR:4
GROSS INC:20,351.05
-VAC:407.02
-OP EXP:4,560.16
=NOI:15,383.87
-INT 1ST:7,154.53
-INT 2ND:8,857.70
-BLD DEP:7,184.03
-PER PROP:1,000.00
=TAX INC:-8,812.39
*MTR:50.00
=TAX LIAB:-4,406.20

NOI:15,383.87
-ANN PMTS:97,228.00
-CAP IMP:1,889.57
=BTCF:-83,733.70
-TAX LIAB:-4,406.20
=ATCF:-79,327.50
```

Includes balloon payment on second mortgage

```
YEAR:5
GROSS INC:21,368.60
-VAC:427.37
-OP EXP:4,924.97
=NOI:16,016.26
-INT 1ST:7,076.74
-BLD DEP:6,735.03
-PER PROP:1,000.00
=TAX INC:1,204.49
*MTR:50.00
=TAX LIAB:602.25

NOI:16,016.26
-ANN PMTS:7,781.76
-CAP IMP:2,040.73
=BTCF:6,193.77
-TAX LIAB:602.25
=ATCF:5,591.52
```

Second mortgage is paid off

BASIS:179,500.00	Tax basis
+ΣCAP IMP:8,799.90	Total capital improvements
+TRANS COST:16,814.80	Transaction costs
-ΣBLD DEP:38,474.60	Total building depreciation
-ΣPER DEP:5,000.00	Total personal property depreciation
=TAX BASIS:161,640.10	Tax basis

ΣBLD DEP:38,474.60	Total building depreciation
+ΣPER DEP:5,000.00	Total personal property depreciation
-ΣBLD SL:34,875.00	Building depreciation using straight line depreciation
-ΣPER SL:5,000.00	Personal property depreciation using straight line depreciation
=EXCESS:3,599.60	Total excess depreciation
*MTR:50.00	Marginal tax rate
=TAX:1,799.80	Tax on excess depreciation

SALE:240,211.49	Selling price
-TAX BASIS:161,640.10	Tax basis
=GAIN:78,571.39	Gain
-EXCESS:3,599.60	Excess depreciation
=CAP GAIN:74,971.79	Total capital gain
*CGTAX:30.00	Capital gain tax rate
=TAX:22,491.54	Tax on capital gain

SALE:240,211.49	Selling price
-TRANS COST:16,814.80	Transaction costs
-REM BAL:59,838.83	Remaining balance on mortgage(s)
=PROCEEDS:163,557.86	Proceeds
-ΣTAX:24,291.34	Total tax (from excess depreciation and capital gain)
=ATPR:139,266.52	After-tax proceeds
+ATCF:5,591.52	After-tax cash flow (this year)
=ΣATCF:144,858.04	Total after-tax cash flow upon sale
EQTY YLD:11.58	Equity yield (as a percent)

GRADUATED PAYMENT MORTGAGE

The Graduated Payment Mortgage is designed to meet the needs of young homebuyers who currently cannot afford high mortgage payments, but who have the potential of increased earnings in the years to come.

Under the GPM plan, the payments increase by a fixed percentage at the end of each year for a specified number of years. Thereafter, the payment amount remains constant for the remaining life of the mortgage.

The result is that the borrower pays a reduced payment (a payment which is less than a traditional mortgage payment) in the early years, and in the later years makes larger payments than he would with a traditional loan. Over the entire term of the mortgage, the borrower would pay more than he would with conventional financing.

Given the term of the mortgage (in years), the annual interest rate, the loan amount, the number of payments per year, the percentage that the payments increase, and the number of years that the payments increase, this program determines the periodic payments and the remaining balance at the end of each year. The cash flow sign convention is followed.

Prompted Operation

(Minimum size 022)

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

TERM=?	What is the total term of the mortgage (in years)?
INTEREST%=?	What is the annual interest rate (in percent)?
LOAN=?	What is the amount of the loan?
NO. PMT/YR=?	How many payments are made each year?
%INCR=?	How much do the payments increase each year (in percent)?
YRS GRAD=?	How many years do the payments graduate (increase)?

Example 1:

A $45,000, 30-year mortgage at 11¼% interest has monthly payments increasing 5% each year for 5 years after the first year, with a constant payment thereafter. What is the amount of each payment and the remaining balance at the end of each year?

Keystrokes	Display
[XEQ] [ALPHA] SIZE [ALPHA] 022	
[XEQ] [ALPHA] GPMT [ALPHA]	TERM=?
30 [R/S]	INTEREST%=?
11.25 [R/S]	LOAN=?
45000 [R/S]	NO. PMT/YR=?
12 [R/S]	%INCR=?
5 [R/S]	YRS GRAD=?
5 [R/S]	PMT1=-365.76
[R/S]	BAL1=-45,709.21
[R/S]	PMT2=-384.05
[R/S]	BAL2=-46,271.29
[R/S]	PMT3=-403.25
[R/S]	BAL3=-46,657.31
[R/S]	PMT4=-423.41
[R/S]	BAL4=-46,834.28
[R/S]	PMT5=-444.58
[R/S]	BAL5=-46,764.66
[R/S]	PMT6=-466.81
[R/S]	BAL6=-46,405.84

WRAP-AROUND MORTGAGE

A wrap-around mortgage is essentially the same as a refinancing mortgage, except that the new mortgage is granted by a different lender, who assumes the payments on the existing mortgage, which remains in full force. The new (second) mortgage is thus "wrapped around" the existing mortgage. The "wrap-around" lender advances the net difference between the new (second) mortgage and the balance on the existing mortgage in cash to the borrower, and receives as net cash flow the difference between the debt service on the new (second) mortgage and the debt service on the existing mortgage.

The wrap-around mortgage is implemented when one lender (often a seller) uses the positive leverage from an existing loan by another lender, to create a higher yielding loan. It is also used when it is impractical to alter existing financing, or when the seller does not want a second or third mortgage at current interest rates. Using a wrap-around mortgage can provide measurable benefit to both the buyer and the seller.

Given the particulars of the original mortgage (remaining balance, remaining term, periodic payment or periodic interest, and balloon payment), and the particulars of the wrap-around mortgage (amount of the wrap-around, term, periodic interest, balloon payment, and any points (fees) which may be charged), this program calculates the periodic yield to the lender of a wrap-around mortgage. Then, if this yield is not acceptable, a desired periodic yield can be input, and the necessary payment to achieve this yield is calculated.* The quoted interest rate on the wrap-around mortgage (the interest rate which the borrower is charged) is then displayed. An option is also available to summarize the net cash flows in the entire transaction ([XEQ] SUMMARY).

This program assumes that the term of the original mortgage does not exceed the term of the wrap-around mortgage. The sign convention is not used.

*There is more than one way to adjust the wrap-around mortgage to achieve a desired yield. In this program, the wrap-around balloon payment initially input remains intact, while the periodic payment changes. If this is not the case for your particular mortgage, then the calculated wrap-around payment and interest rate should be used only as a guideline. WRAP must be repeated, with new wrap-around mortgage data, until the desired yield is achieved.

Prompted Operation

(Minimum size 035)

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

PV 1ST=?	What is the remaining balance of the underlying mortgage?
TERM 1ST=?	What is the total remaining term of the underlying mortgage?
PMT 1ST=?	What is the periodic payment of the underlying mortgage? Press [R/S] if the payment is not known.
INT 1ST=?	What is the periodic interest rate of the underlying mortgage? This prompt occurs if a payment amount was not keyed in.
BAL 1ST=?	What is the balloon payment of the underlying mortgage?
WRAP AMT=?	What is the amount of the wrap-around mortgage?
WRAP TERM=?	What is the term of the wrap-around mortgage?
INT WRAP=?	What is the periodic interest rate of the wrap-around mortgage?
BAL WRAP=?	What is the balloon payment of the wrap-around mortgage?
NO. POINTS=?	How many points are charged on the wrap-around mortgage?
YIELD=?	What is your desired yield on the entire transaction?

Example 1:

A mortgage loan on an income property currently has a remaining balance of $150,681.54. When the loan originated 8 years ago, it had a 20-year term with full amortization in level monthly payments at 8% interest.

A lender has agreed to "wrap" a $250,000 second mortgage at 11%, with full amortization in level monthly payments over 12 years. What is the yield (IRR) to the lender on net cash advanced, assuming that no points are charged?

Keystrokes	Display	
[XEQ] [ALPHA] SIZE [ALPHA] 035		Minimum size
[XEQ] [ALPHA] WRAP [ALPHA]	*PV 1ST=?*	
150681.54 [R/S]	*TERM 1ST=?*	
144 [R/S]	*PMT 1ST=?*	

Keystrokes	Display	
[R/S]	INT 1ST=?	Since the payment wasn't entered, what is the periodic interest rate?
8 [ENTER↑] 12 [÷] [R/S]	BAL 1ST=?	
0 [R/S]	WRAP AMT=?	
250000 [R/S]	WRAP TERM=?	
144 [R/S]	INT WRAP=?	
11 [ENTER↑] 12 [÷] [R/S]	BAL WRAP=?	
0 [R/S]	NO. POINTS=?	
0 [R/S]	YIELD=1.27	Periodic yield to the lender
12 [×]	15.19	Annual yield to lender

What monthly payment must be received to achieve a 17% overall yield? What interest rate is the borrower paying?

Keystrokes	Display	
[R/S]	YIELD=?	
17 [ENTER↑] 12 [÷] [R/S]	WPMT=3,251.86	Payment on wrap-around
[R/S]	INT WRAP=0.98	Periodic interest on wrap-around
12 [×]	11.79	Annual wrap-around interest rate

Summarize the entire transaction.

Keystrokes	Display	
[XEQ] [ALPHA] SUMMARY		
[ALPHA]	NEW$=99,318.46	Net cash advanced
[R/S]	TERM1=144.00	
[R/S]	PMT1=1,620.80	Net cash flow received
[R/S]	BAL1=0.00	
[R/S]	YIELD=1.42	Annual yield is 17%

Example 2:

A customer has an existing mortgage with a balance of $64,531.63, a remaining term of 10 years, and a $716.43 monthly payment. He wishes to obtain a $125,000, 11½% wrap-around with monthly payments and a balloon payment at the end of the 180th month of $75,000. If you, as a lender, accept the proposal and charge 2 points on the wrap-around mortgage, what is your rate of return?

Keystrokes	Display	
[XEQ] [ALPHA] WRAP [ALPHA]	*PV 1ST=?*	
64531.63 [R/S]	*TERM 1ST=?*	
10 [ENTER↑] 12 [×] [R/S]	*PMT 1ST=?*	
716.43 [R/S]	*BAL 1ST=?*	
0 [R/S]	*WRAP AMT=?*	
125000 [R/S]	*WRAP TERM=?*	
180 [R/S]	*INT WRAP=?*	
11.5 [ENTER↑] 12 [÷] [R/S]	*BAL WRAP=?*	
75000 [R/S]	*NO. POINTS=?*	
2 [R/S]	*YIELD=1.22*	Monthly yield
12 [×]	*14.69*	Annual yield

HOME OWNER'S EQUITY ANALYSIS

This program is designed to provide the home owner or purchaser of real estate with useful information on future monthly payments, accumulated equity, and tax deductions. The user keys in the purchase price, the down payment, the interest rate and the term of the mortgage. The program calculates and displays the basic monthly mortgage payment.

Further inputs include the expected percent appreciation or depreciation in value per year, the number of months remaining in the first year of analysis, the amount of property taxes (in dollars), and the anticipated yearly percentage increase in taxes.

The program then calculates, for each year of ownership, the estimated monthly payment (covering mortgage payments and taxes), the total accumulated equity in the property, and the tax deduction due to interest and property taxes for the year.

				SIZE: 021
STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	Initialize the program.		[XEQ] EQ	PRICE=?
2.	Key in the price of the home.	Price	[R/S]	DOWN PMT=?
3.	Key in the amount of the down payment (in dollars).	Down Payment	[R/S]	% INT=?
4.	Key in the mortgage interest rate (% per year).	Int (%)	[R/S]	TERM=?
5.	Key in the term of the mortgage (in years). The monthly payment to amortize the mortgage is displayed.	Term	[R/S]	PMT=
6.	Key in the anticipated yearly appreciation in the value of the house (as a %).		[R/S]*	% APPREC=?
		Apprec (%)	[R/S]	MONS YR 1=?
7.	Key in the number of months remaining in the first tax year.	# Months	[R/S]	TAXES=?
8.	Key in the current property taxes.	Taxes	[R/S]	% INCREASE=?
9.	Key in the expected percent increase or decrease in taxes each year.	Increase (%)		
	* Press [R/S] if you are not using a printer.			

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
10.	Calculate the following information for each year:		[R/S]	YEAR 1
	Monthly payment		[R/S]*	ΣPMT=
	Total equity		[R/S]*	ΣEQ=
	Total tax deductions		[R/S]*	ΣDED=
	Appreciated value of the property		[R/S]*	VAL=
11.	For succeeding years, go to step 10.			
12.	For a new case, go to step 1.			
	* Press [R/S] if you are not using a printer.			

Example:

A family is contemplating purchase of a new home priced at $62,500. They will be able to pay $12,500 as a down payment and can obtain a 30 year mortgage for the balance at 13.25%. Property values in the area have been appreciating at about 10% per year. Property taxes for the current year are $1437.50 and have been increasing at the rate of about 8% per year. The buyer will take possession of the house with 10 months remaining in the tax year. What is the basic mortgage payment? Calculate the expected total monthly payments, total equity in the property and income tax deductions for years 1 through 3 of the mortgage.

Keystrokes	**Display**
[XEQ] [ALPHA] SIZE [ALPHA] 021	
[XEQ] [ALPHA] EQ [ALPHA]	*PRICE=?*
62500 [R/S]	*DOWN PMT=?*
12500 [R/S]	*%INT=?*
13.25 [R/S]	*TERM=?*
30 [R/S]	*PMT=562.89*
[R/S]	*%APPREC=?*
10 [R/S]	*MONS YR 1=?*
10 [R/S]	*TAXES=?*
1437.50 [R/S]	*%INCREASE=?*
8 [R/S]	*YEAR 1*
[R/S]	*ΣPMT=682.68*
[R/S]	*ΣEQ=17,821.93*
[R/S]	*ΣDED=6,713.22*

Keystrokes	Display
[R/S]	VAL=67,708.33
[R/S]	YEAR 2
[R/S]	ΣPMT=692.27
[R/S]	ΣEQ=24,746.62
[R/S]	ΣDED=8,153.33
[R/S]	VAL=74,479.17
[R/S]	YEAR 3
[R/S]	ΣPMT=702.62
[R/S]	ΣEQ=32,370.06
[R/S]	ΣDED=8,255.86
[R/S]	VAL=81,927.08

THE RENT OR BUY DECISION

The question of whether to rent or purchase a residence is not always easy to answer, especially when the time period over which you would own or rent the house is short. This program performs an analysis which could be helpful in reaching a decision. In essence, it calculates a yield or rate of return on the proposed investment and its estimated resale value, and compares this yield with that which could be obtained by renting a residence and investing the down payment and monthly payment differences in a savings account or other investment opportunity. The program takes into account the tax advantages obtained by a home owner on property taxes and mortgage interest.

The user keys in the price of the house, the down payment, the mortgage data, the holding period, the expected rate of appreciation of the house, the real estate costs, the total marginal income tax rate,* the monthly property taxes, the estimated monthly maintenance expenses, the rent which would have to be paid for a satisfactory alternative residence, and the percentage interest which could be obtained on an alternative investment (in a bank).

The program then calculates the monthly mortgage payment, the anticipated market value, the Net Cash Proceeds upon Resale (***NCPR***),† the annual yield on the investment in the house, and the actual cash gain or loss on the investment in the house. In addition, the user may calculate the actual market value, the annual appreciation which would be necessary to equal the proceeds of the alternate investment, and the amount of rent to "break-even". At the "break-even" rent, the yield on the investment is equal to the bank's interest rate, and the gain is zero.

At the end of the calculation, the user is able to change the input data, and may re-do the computation for a different situation. The sign convention is not used.

* The user should key in the total marginal income tax rate—federal plus state—to obtain calculations which reflect the tax advantages of home ownership. Because of the complexities of tax laws and different financial and tax considerations for each individual, this program should only serve as a guide in considering an investment of this type. For more specific, detailed information, consult a tax accountant or qualified tax advisor.

† The Net Cash Proceeds upon Resale (NCPR=sales price-commission-mortgage balance), is the pre-tax proceeds. The program assumes that the buyer reinvests in like property and is then not subject to capital gains tax.

				SIZE: 029
STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	Initialize the program.		[XEQ] RENT	PRICE=?
2.	Key in the price of the house.	Price	[R/S]	DOWN PMT=?
3.	Key in the amount of the down payment.	Down Payment	[R/S]	% INT=?
4.	Key in the mortgage interest rate (% per year).	Int (%)	[R/S]	TERM=?
5.	Key in the term of the mortgage (in years).	Term	[R/S]	NO. YEARS=?
6.	Key in the number of years you intend to occupy the house.	Years	[R/S]	% APPREC=?
7.	Key in the expected appreciation in value of the house (% annually).	Apprec (%)	[R/S]	% COMM=?
8.	Key in the percentage commission charged to sell the house.	Comm (%)	[R/S]	CLOSE COST=?
9.	Key in the closing costs paid on the purchase of the house.	Costs	[R/S]	TAX RATE=?
10.	Key in the marginal income tax rate (in percent).	% Tax	[R/S]	TAXES=?
11.	Key in the anticipated monthly property taxes.	Taxes	[R/S]	MAINT=?
12.	Key in the anticipated monthly cost of maintenance and insurance.	Maint.	[R/S]	RENT=?
13.	Key in the monthly rent for an acceptable alternative residence.	Rent	[R/S]	BANK % INT=?
14.	Key in the annual rate of interest (as %) available if you were to invest the money in some form of savings.	Bank % Int	[R/S]	CHANGE?
15.	To change data, press [R/S]. Otherwise, press N [R/S] to calculate the monthly payment to amortize the mortgage.			PMT=
16.	Calculate the anticipated resale value at the end of occupancy.		[R/S]*	VAL=
17.	Calculate the total real estate commission.		[R/S]*	−COMM:
18.	Calculate the mortgage balance.		[R/S]*	−RBAL:
19.	Calculate the Net Cash Proceeds upon Resale.		[R/S]*	NCPR=
20.	Calculate the annual rate of return on the investment in the house.		[R/S]*	YLD=
	*Press [R/S] if you are not using a printer.			

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
21.	Calculate the total dollar gain (if positive) or loss (if negative) from buying a house as compared to renting.		[R/S]*	$GAIN=
22.	Calculate the market value of the house at which you would obtain the same annual return as on the investment at step 14.		[R/S]	VAL=
23.	Calculate the yearly percent appreciation at which you would obtain this value.		[R/S]*	% APPREC=
24.	Calculate the monthly rent to break-even.		[R/S]	B-E RENT=
25.	To change data and repeat the calculation, respond to the prompt by pressing [R/S]. Otherwise, press N [R/S].		[R/S] [R/S]	CHANGE? PRICE=
	* Press [R/S] if you are not using a printer.			

Example:

You are being transferred for 2 years to a distant city and are faced with the decision of whether to rent or buy a house. A quick survey of the housing market indicates that you can purchase an acceptable house for $65,000 with a $13,000 down payment on a 30 year mortgage at 13% interest. The closing costs would be about $950 and a real estate agency would charge a 6% commission on resale. Houses in the area are appreciating at 10% per year. Property taxes would be about $110 per month, and you estimate that maintenance would cost an additional $70 per month.

An alternative would be to rent a similar dwelling at $550 per month and invest the difference between purchase costs and rent at 7.75% interest.

Your marginal income tax rate is 25% federal and 5% state. Which alternative is more financially attractive?

Keystrokes	Display
[XEQ] [ALPHA] SIZE [ALPHA] 029	
[XEQ] [ALPHA] RENT [ALPHA]	*PRICE=?*
65000 [R/S]	*DOWN PMT=?*
13000 [R/S]	*%INT=?*
13 [R/S]	*TERM=?*

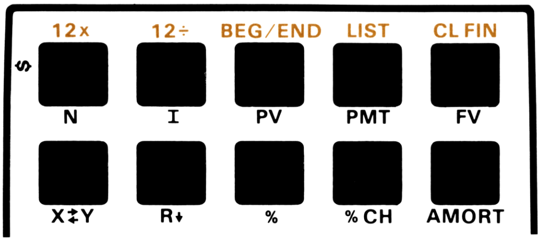
Keystrokes	Display
30 [R/S]	NO. YEARS=?
2 [R/S]	%APPREC=?
10 [R/S]	%COMM=?
6 [R/S]	CLOSE COST=?
950 [R/S]	TAX RATE=?
30 [R/S]	TAXES=?
110 [R/S]	MAINT=?
70 [R/S]	RENT=?
550 [R/S]	BANK %INT=?
7.75 [R/S]	CHANGE?
N [R/S]	PMT=575.22
[R/S]	VAL=78,650.00
[R/S]	-COMM:4,719.00
[R/S]	-RBAL:51,676.19
[R/S]	NCPR=22,254.81
[R/S]	YLD=18.63
[R/S]	$GAIN=4,119.73

By purchasing the house, you would gain $4,119.73 over an alternate investment at 7.75% interest.

Keystrokes	Display
[R/S]	VAL=74,267.31
[R/S]	$ APPREC=6.89
[R/S]	B-E RENT=390.75

To obtain the same return as the alternate investment, the house would have to appreciate 6.89% or obtain a market value of $74,267.31. The amount of rent to "break-even" is $390.75.

PRICE AND YIELD OF A MORTGAGE TRADED AT A DISCOUNT/PREMIUM



Mortgages may be bought and/or sold at prices lower (discounted) or higher (at a premium) than the remaining balance of the loan at the time of purchase. Given the remaining term of the mortgage, the periodic payment, the amount of the balloon payment, and either the desired yield or the purchase price, the remaining variable may be calculated using the *Compound Interest* program.

There are many possible combinations of discounted mortgage problems, so it is important for you to ask yourself "What are the cash flows?" You might wish to review the section *Compound Interest Solutions: The Cash Flow Diagram and Sign Convention.*

Example 1:

A lender wants to induce the borrower to prepay a low interest rate loan. The interest rate is 5% with 6 years (72 payments) remaining of $137.17 and a balloon payment at the end of the sixth year of $2000. If the lender is willing to discount the future payments 7½%, how much would the borrower need to prepay the note?

Keystrokes	Display	
[XEQ] [ALPHA] SIZE [ALPHA] 013		
[XEQ] [ALPHA] $ [ALPHA]	*0.00*	Clear "financial" registers
■ [C]	*END*	Optional step to clear flag 0 and set END mode
72 [A]	*N=72.00*	Months
7.5 ■ [B]	*I=0.63*	Monthly interest

Keystrokes	Display	
137.17 [D]	*PMT=137.17*	Monthly payment received by lender
2000 [E]	*FV=2,000.00*	Balloon payment received
[C]	*PV=-9,210.48*	Amount necessary to prepay the note

Example 2:

A 9½% mortgage with 28 years remaining may be acquired which has a remaining balance of $49,350. Determine the price to pay for this mortgage if the desired annual yield is 15%. (Since the payment amount is not given, it must be calculated.)

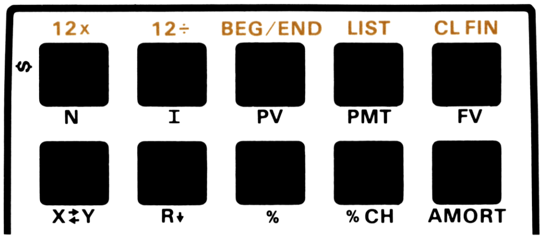
Keystrokes	Display	
■ [E]	*0.00*	Clear "financial" registers
■ [C]	*END*	Set END mode
28 ■ [A]	*N=336.00*	Months
9.5 ■ [B]	*I=0.79*	Monthly interest rate (%)
49350 [CHS] [C]	*PV=-49,350.00*	
[D]	*PMT=420.40*	Monthly payment to be received
15 ■ [B]	*I=1.25*	Desired monthly interest rate (%)
[C]	*PV=-33,114.65*	Purchase price to achieve a 15% annual yield

Example 3:

Find the annual yield of a 7%, 20 year, $95,000 mortgage purchased for $75,000. Monthly payments are being made.

Keystrokes	Display	
■ [E]	*0.00*	Clear "financial" registers.
■ [C]	*END*	Set END mode
20 ■ [A]	*N=240.00*	Total term
7 ■ [B]	*I=0.58*	
95000 [CHS] [C]	*PV=–95,000.00*	Loan amount
[D]	*PMT=736.53*	Monthly payment
75000 [CHS] [C]	*PV=–75,000.00*	Purchase price
[B]	*I=0.85*	Monthly yield (%)
12 [×]	*10.26*	Annual yield (%)

APR OF A LOAN WITH FEES



Borrowers are often charged fees in connection with the issuance of a mortgage, which effectively raises the effective yield on the mortgage to the lender. The actual amount received by the borrower (PV) is reduced, while the periodic payments remain the same. Given the term or life of the mortgage, the interest rate, the mortgage amount, and the basis of the fee charge (how the fee is calculated), the true Annual Percentage Rate may be calculated using the *Compound Interest* program.

Since there are several possible combinations of mortgages with fees, it is important to understand what the cash flows are, and when they occur. You might wish to review the section *Compound Interest Solutions: The Cash Flow Sign Convention.*

Example 1:

A borrower is charged 2 points for the issuance of his mortgage. If the mortgage amount is $50,000 for 30 years, and the interest rate is 11.5% per year, with monthly payments, what annual percentage rate is the borrower paying? (1 point is equal to 1% of the mortgage amount.)

Keystrokes	**Display**	
[XEQ] [ALPHA] SIZE [ALPHA] 013		
[XEQ] [ALPHA] $ [ALPHA]		
■ [E]	*0.00*	Clear "financial" registers
■ [C]	*END*	Set END mode
30 ■ [A]	*N=360.00*	Total term (months)
11.5 ■ [B]	*I=0.96*	Monthly interest rate (%)
50000 [C]	*PV=50,000.00*	Loan amount

Keystrokes	Display	
[D]	*PMT=–495.15*	Monthly payment
[RCL] [C] 2 [%]* [–] [C]	*PV=49,000.00*	Actual amount received by borrower
[B]	*I=0.98*	Monthly interest rate (%)
12 [×]	*11.76*	Annual percentage rate

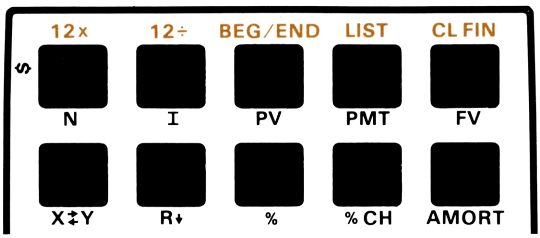
Example 2:

Assuming Example 1 has just been done, calculate the APR if the mortgage fee is $750 instead of a percentage.

Keystrokes	Display	
50000 [ENTER↑] 750 [–] [C]	*PV=49,250.00*	Effective mortgage amount
[B]	*I=0.97*	Monthly interest rate (%)
12 [×]	*11.70*	Annual percentage rate

* [%] is calculated by pressing [H].

PRESENT VALUE OF AN INCREASING/DECREASING ANNUITY



The majority of real estate financing arrangements deal with equal periodic payments. It is possible however to consider a payment stream where the payment amounts change, such as income, repair costs or price changes reflecting inflation or deflation. The present worth of such a payment stream may easily be calculated by summing the present value of each individual payment. A quicker and easier way to sum the payments is possible using the *Compound Interest* program and the following keystrokes:

1. Clear the "financial" registers (■ [E]) and set to ***END*** mode (■ [C]).
2. Key in the total number of payment periods; press [A].
3. Key in the payment's percentage increase per period expressed as one plus the decimal interest rate; press [ENTER↑]. If there is a percentage decrease, express it as one minus the decimal interest rate.
4. Key in the discount (interest) rate per period expressed as one plus the decimal interest rate; press [% CH] [B].
5. Press ■ [CLx/A].
6. Key in the starting payment; press [x⇌y] [÷] [D].*
7. Press [C] to obtain the present value of the payment stream.*

Note: This procedure assumes that payments occur at the end of the period.

* Positive for cash received; negative for cash paid out.

Example 1:

You are appraising a piece of income property which is providing increasing rents. Assuming a 7% rate of increase over the next 5 years, what is the present value of the income stream? Your discount rate is 12%, and the rent for the first year is expected to be $8,500.

Keystrokes	Display	
[XEQ] [ALPHA] SIZE [ALPHA] 013		
[XEQ] [ALPHA] $ [ALPHA]		
■ [E]	*0.00*	Clear "financial" registers
■ [C]	*END*	Set END mode
5 [A]	*N=5.00*	Years
1.07 [ENTER↑]	*1.07*	Periodic increase factor (1+.07)
1.12 [%CH] [B]	*I=4.67*	Adjust i for interest rate
■ [CL*x*/A] 8500 [x⇌y] [÷] [D]	*PMT=7,943.93*	Adjusted starting payment
[C]	*PV=-34,706.26*	Present value of payments

When the payment amounts change by a constant amount instead of by a constant ratio, as in the previous problem, the following keystrokes will give the present value:

1. Clear the "financial" registers (■ [E]) and set to ***END*** mode (■ [C]).
2. Key in the periodic discount (interest) rate as a percent; press [B].
3. Key in the starting payment; press [ENTER↑].
4. Key in the amount that the payment increases each period; press [ENTER↑].
5. Key in the periodic discount (interest) rate as a decimal; press [÷] [STO] 10 [+] [D].
6. Key in the total number of payment periods; press [ENTER↑] [A] [RCL] 10 [×] [CHS] [STO] [E].
7. Press [C] to obtain the present value of the payments.

Example 2:

If the rents in the previous example increase by $500 each year, what is the present value of the payment stream?

Keystrokes	Display	
■ [E]	0.00	Clear "financial" registers
■ [C]	END	Set END mode
12 [B]	I=12.00	Periodic discount (interest rate)
8500 [ENTER↑]	8,500.00	Starting payment
500 [ENTER↑]	500.00	Periodic payment increase
.12 [÷] [STO] 10 [+] [D]	PMT=12,666.67	Adjusted payment
5 [ENTER↑] [A] [RCL] 10 [×] [CHS] [STO] [E]	-20,833.33	Adjusted FV
[C]	PV=-33,839.11	Present value of the payments

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

Amortization Schedules

$INT_j = RND\,[BAL_{j-1} \cdot i] \times (\text{sign of } PMT)$

$PRN_j = PMT_j - INT_j$

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

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

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

For BEGIN payments

$INT_1 = 0$

where:

INT_j = interest portion of j^{th} payment

PRN_j = principal portion of j^{th} payment

BAL_j = remaining balance after the j^{th} payment

PMT = payment amount

i = interest rate (as a decimal)

ΣINT = accumulated interest from P1 to P2 inclusive

ΣPRN = accumulated principal from P1 to P2 inclusive

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)

Modified Internal Rate of Return

$$MIRR = \left[\left(\frac{NFV\,(\text{pos. CFs})}{-NPV\,(\text{neg. CFs})} \right)^{1/n} - 1 \right] 100$$

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-Years'-Digits Depreciation

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

where:

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

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

For Partial First Year

$$\mathrm{Dep}_1 = d_1 \left(\frac{Y_1}{12}\right)$$

$$\mathrm{Dep}_{n+1} = d_n - x_n$$

Declining Balance Depreciation

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

For Partial First Year

$$\mathrm{Dep}_1 = A \left(\frac{R}{N(100)}\right) \left(\frac{Y_1}{12}\right)$$

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)

Income Property Analysis

$$\text{Net Operating Income} = \text{Gross Income}\,(1+G)^{N-1}\left(1-\frac{\text{Vacancy}}{100}\right) - \text{Operating Expenses}\,(1+G)^{N-1}$$

$$\text{Taxable Income} = \text{Net Operating Income} - \text{Yearly Mortgage Interest} - \text{Yearly Depreciation}$$

$$\text{Tax Liability} = (\text{Taxable Income})\,(\text{Marginal Tax Rate})$$

$$\text{Before Tax Cash Flow} = \text{Net Operating Income} - \text{Total Yearly Mortgage Payments} - \text{Capital Improvements}\,(1+G)^{N-1}$$

$$\text{After Tax Cash Flow} = \text{Before Tax Cash Flow} - \text{Tax Liability}$$

$$\text{Tax Basis} = \text{Basis} + \text{Capital Improvements}\left[\frac{(1+G)^{N-1}-1}{G}\right] + \text{Purchase Price}\,(1+A)^{N}\left(\frac{\text{Transaction Costs}}{100}\right) - \text{Total Depreciation}$$

$$\text{Excess Depreciation} = \text{Total Depreciation} - \text{Straight Line Depreciation}$$

$$\text{Capital Gain} = \text{Purchase Price}\,(1+A)^{N} - \text{Tax Basis} - \text{Excess Depreciation}$$

$$\text{Before Tax Proceeds} = \text{Purchase Price}\,(1+A)^{N}\left[1-\frac{\text{Transaction Costs}}{100}\right] - \text{Remaining Balance Mortgage(s)}$$

$$\text{After Tax Proceeds} = \text{Before Tax Proceeds} - \text{Excess Depreciation}\left(\frac{\text{Marginal Tax Rate}}{100}\right) - \text{Capital Gain}\left(\frac{\text{Capital Gain Tax}}{100}\right)$$

where:

G = Growth rate (as decimal)

A = Appreciation rate (as decimal)

N = Current year

Wrap-Around Mortgage

$$PV_2 - PV_1 = \frac{PMT_2[1-(1+I)^{-n_2}]}{I} - \frac{PMT_1[1-(1+I)^{-n_1}]}{I} + FV_2(1+I)^{-n_2} - FV_1(1+I)^{-n_1}$$

where:

I = yield (as decimal)

Graduated Payment Mortgage

$$PV = PMT_1 \left\{ \left[\frac{1-(1+I)^{-A}}{I}\right]\left[\frac{(1+Q)^B-1}{Q}\right] + \frac{(1+C)^B\left[\frac{1-(1+I)^{-(n-AB)}}{I}\right]}{(1+I)^{AB}} \right\}$$

where:

$Q = \frac{1+C}{(1+I)^A} - 1$

A = number of payments per year

B = number of years that payments increase

C = percent increase in periodic payment (as decimal)

PMT_1 = amount of first payment

Home Owner's Equity Analysis

ΣPMT = PMT + Taxes/month

ΣEQ = DOWN PMT + Accumulated Principal + Appreciation

ΣDED = Interest + Taxes/year

where:

ΣPMT = monthly payment

PMT = mortgage payment

ΣEQ = total equity

ΣDED = total tax deductions

DOWN PMT = down payment

The Rent or Buy Decision

Market Value = PRICE $(1 + i)^n$

where:

i = appreciation per year (as decimal)

n = number of years

Net Cash Proceeds on Resale = Market Value − Mortgage Balance − Commission

The interest rate is obtained by solving the financial (compound interest) equation for I using:

N = number of years house is owned

PV = down payment + closing costs

PMT = mortgage payment + taxes + maintenance + investment interest − rent − (% tax) (interest + taxes + investment interest)

FV = net cash proceeds on resale

Annual interest rate = $12 \times I$

At the break-even rent, I = bank's interest rate.

PROGRAM DATA

Program	# Regs. to COPY	Data Registers	Flags	Display Format
$	111	00-12	00-Begin	Fix 2
			05-Used in I*	
			21-Printer	
			27-USER mode	
*AMORT	44	00-12	00-BEGIN	Fix 0/Fix 2
			05-Used	
IRR, MIRR, NPV	96	06-08	01-Groups	Fix 0/Fix 2
*IRR	27	18-24	05-IRR	
*MIRR	38	25	06-MIRR	
		⋮	07-Changes	
			08-2nd pass	
			21-Printer	
DEPR	97	06-10	01-Cross-over	Fix 2
		12-17	06-Partial 1st year	
			07-X-over occurred	
			21-Printer	
IPA	100	00-52	01-List & change	Fix 2
CALC	104	⋮	02-Change	
SALE	83		04-Bld. depr.	

Program	# Regs. to COPY	Data Registers	Flags	Display Format
Y	13		05-Prop. depr./1st mtg. paid 06-2nd mtg. paid 07-Used 08-Used 09-Calc. PMT 10-Full sched. 16-Used 17-3rd mtg. paid 21-Printer	
GPMT	38	00-21	CF 00 21-Printer	Fix 0/Fix 2
WRAP	66	00-17 18-19 25-34	CF 00 CF 01 05-Used	Fix 2
EQ	48	00-20	CF 00 05-1st year	Fix 2
RENT	81	00-28	CF 00 02-Change	Fix 2
SIZE?	4		25	

SUBROUTINES

This table provides the information necessary to use various portions of the Real Estate Application Module as subroutines.

Subroutine	Description	Initial Registers	Registers Used	Flags
*N	Calculates N and stores result in R_{01}.	R_{00} 0(END)/1(BEGIN) R_{01} N	R_{00}-R_{09}	SF 00-BEGIN CF 00-END
I*	Calculates I and stores result in R_{02}.	R_{02} I (as %) R_{03} PV		05-used by I*
*PV	Calculates PV and stores result in R_{03}.	R_{04} PMT R_{05} FV		
*PMT	Calculates PMT and stores result in R_{04}.			
*FV	Calculates FV and stores result in R_{05}.			
*AMT	Calculates interest, principal, and remaining balance for specified period and leaves results in stack registers X, Y, and Z.	R_{00} 0(END)/1(BEGIN) R_{02} I (as %) R_{03} PV R_{04} PMT R_{06} 0 (for ΣINT) R_{07} 0 (for ΣPRN) R_{09} Increment/1000 R_{10} Remaining Balance	R_{00}-R_{05} R_{06}-ΣINT R_{07}-ΣPRN R_{08}-INT R_{09}-Increment/1000 R_{10}-RBAL R_{11}-PRN R_{12}-Start + End/1000	SF 00-BEGIN SF 05-BEGIN (1st period only

Subroutine	Description	Initial Registers	Registers Used	Flags
*NPV	Assuming cash flows and discount rate are already stored, calculates NPV and stores result in X-register.	R_{18} #CFs or #groups R_{19} $24 + R_{18}$ contents or $25 + 2$ (#groups) R_{20} discount/100 R_{25} CF 0 R_{26} N_0 or CF 1 R_{27} CF 1 or CF 2 R_{28} N_1 or CF 3 ⋮	R_{18}-R_{23} R_{25} ⋮	SF 01-Groups
*IRR	Assuming cash flows are already stored, calculates IRR and leaves result in X-register and R_{20}. Also calls *NPV. Fix 2 is set.	R_{18} #CFs or #groups R_{19} $24 + R_{18}$ contents or $25 + 2$ (#groups) R_{25} CF 0 R_{26} N_0 or CF 1 R_{27} CF 1 or CF 2 R_{28} N_1 or CF 3	R_{18}-R_{20} R_{25} ⋮	SF 01-Groups
*MIRR	Assuming cash flows, safe rate and risk rate are stored, calculates MIRR and stores result in X-register.	R_{18} #CFs or #groups R_{19} $24 + R_{18}$ contents or $25 + 2$ (#groups) R_{20} risk rate (decimal) R_{21} safe rate (decimal)	R_{06}-R_{08} R_{18}-R_{21} R_{22}-Σneg CFs R_{23}-Σpos CFs R_{25} ⋮	SF 01-Groups

Subroutine	Description	Initial Registers	Registers Used	Flags
*SL, *DB, *SOYD	Use program on next page as an example of how to use the depreciation routines.	R_{12} Start + (End/1000) R_{13} Dep. amount R_{14} Life R_{15} Salvage R_{16} # mons year 1 R_{17} Factor (as %)	R_{06}-R_{10} R_{12}-R_{17}	SF 06-Partial 1st year SF 01-Cross-over to SL SF 07-Cross-over occurred

Straight line and Stop?

```
 01♦LBL "SL"
0  STO 06

 04♦LBL 00
CLD  1  ST+ 06
XEQ "*SL"  RCL 12  INT
RCL 06  X<Y?  GTO 00
XEQ 10  X=Y?  STOP
GTO 00

 18♦LBL 10
XEQ 02  RCL 06  RCL 12
FRC  1 E3  *  RTN
```

Output routine

```
 26♦LBL 02
ADV  "YEAR"  RCL 06
CF 29  FIX 0  "├"
ARCL X  SF 21  AVIEW
FIX 2  SF 29  "DEP"
RCL 09  XEQ "OUT"
RCL 10  RCL 15  -  "RDV"
XEQ "OUT"  RCL 10  "RBV"
XEQ "OUT"  RTN
```

Declining balance

```
 50♦LBL "DB"
0  STO 06

 53♦LBL 07
CLD  1  ST+ 06
XEQ "*DB"  RCL 12  INT
RCL 06  X<Y?  GTO 07
XEQ 10  X=Y?  STOP
GTO 07
```

Sum-of-the-years'-digits

```
 67♦LBL "SOYD"
0  STO 06

 70♦LBL 04
CLD  1  ST+ 06
XEQ "*SOYD"  RCL 12  INT
RCL 06  X<Y?  GTO 04
XEQ 10  X=Y?  STOP
GTO 04  .END.
```

SIZE? Displays machine size necessary to execute the program. To call this routine, place the necessary SIZE in the X-register prior to the call. The calling sequence must never be in a subroutine. The calling sequence for a SIZE of 20 is:

```
 01 20
 02 XROM "SI
ZE?"
 03 FC?C 25
 04 PROMPT
```

OUT Formats and prints, or displays, the value in the X-register. Flag 21 is set in this routine.

```
 01♦LBL "OUT
"
 02 SF 21
 03 "⊢="
 04 ARCL X
 05 AVIEW
 06 RTN
```

START START is a micro-coded function which assigns 11 global labels and 4 mainframe functions to the top 2 rows of keys. This function cannot be copied into program memory.

CLK CLK is a micro-coded function which de-assigns the functions assigned by START. This function cannot be copied into program memory.

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00041-90353 Rev. B

Printed in U.S.A. 3/82