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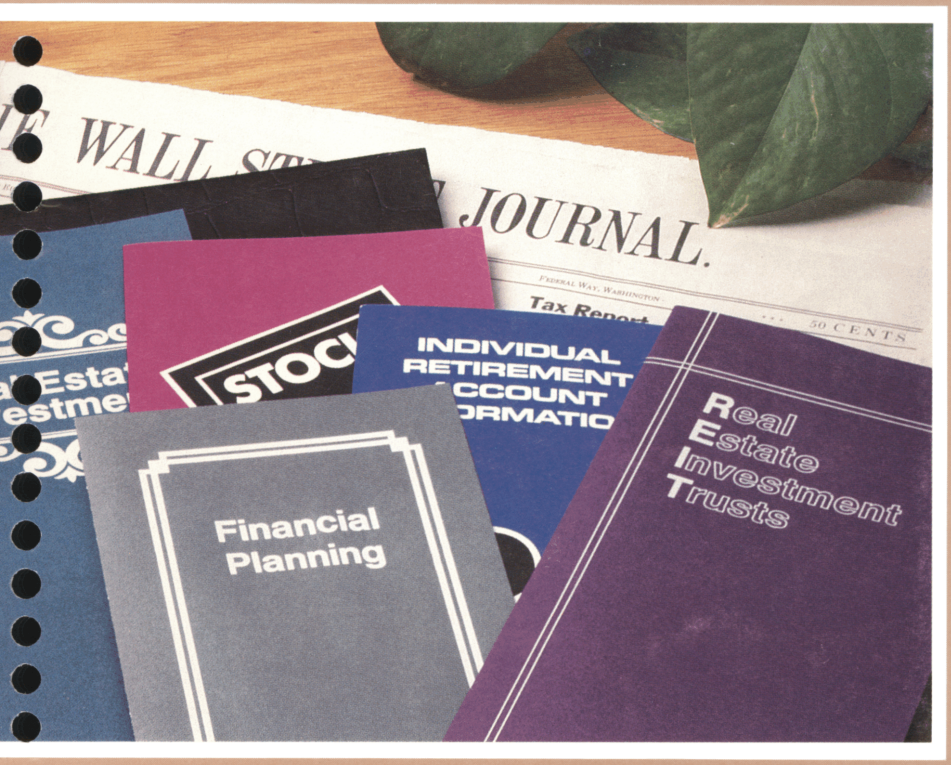
Step-by-Step Solutions
For Your HP Calculator

Personal Investment and Tax Planning



HP-17B
HP-19B
HP-27S

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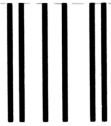

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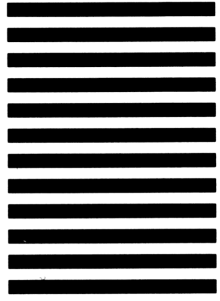

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Personal Investment and Tax Planning

Step-by-Step Solutions for Your HP-17B, HP-19B, or HP-27S Calculator

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Contents

How To Use This Book

The *Personal Investment and Tax Planning* book provides sets of keystrokes and routines to assist you in making decisions related to savings and borrowing, investments, retirement, and taxes. This book is designed to show you how your HP calculator can help in these areas.

Before you use the solutions in this book, you should be familiar with the following concepts from the owner's manual:

- The basics of your calculator – how to do arithmetic calculations, move from menu to menu, and use the menu keys to do calculations.
- The Time Value of Money (TVM) menu and the cash-flow sign convention (cash paid out is entered as a negative number and cash received is entered as a positive number).
- How to enter cash flows in a cash-flow list. (This function is not available on the HP-27S.)
- How to enter and use equations in the Solver.
- How to enter numbers for statistics.

Keys and Menu Selection

A key on the calculator keyboard is represented like this: [EXIT]. A *shifted* function appears with a shift key, like this: ■ [CLEAR DATA]. A menu label is represented like this: [PV] (found in the TVM menu). The arrow keys are represented by [↑] and [↓].

This book can be used with the HP-17B, HP-19B, and HP-27S calculators. Generally, the same keystrokes are used on all three calculators to perform the specific application. However, there are some differences, which are summarized in the following table. Note that the cash-flow menus are available on the HP-27S using a Solver equation.

Keystroke Differences

HP-17B	HP-19B	HP-27S
To display the time value of money (TVM) menu:		
FIN TVM	FIN TVM	■ TVM
To store a Solver equation and its menu:		
SOLVE NEW type the equation INPUT CALC	SOLVE type the equation CALC	■ SOLVE NEW type the equation INPUT CALC
To edit a Solver equation:		
EDIT edit the equation INPUT CALC	EDIT edit the equation CALC	EDIT edit the equation INPUT CALC
To display the cash-flow (CFLO) menu:		
CFLO	CFLO	Solver equations on pages 192 and 196
To display the menu for entering numbers into a sum list:		
SUM	SUM	■ STAT

Display Formats

The examples in this book show numbers displayed to two decimal places. If your display setting is otherwise, the answers in your display will not match exactly what is in this book. Refer to your owner's manual for more information about changing the number of decimal places in the display.

Entering Equations

When entering equations into your HP calculator, follow the Solver instructions in your owner's manual. Here are hints to help you in common error situations:

1. If the calculator displays INVALID EQUATION when you press [CALC], the calculator does not understand something in the equation. When the equation returns to the display, the cursor blinks where the calculator detected the error. Check the equation in the display against the equation in the book. Make sure the parentheses match and that the operators are where they should be.
2. If the calculator accepts the equation but your answer does not match the example, check the values stored in the variables by recalling them (press [RCL], then the menu key). If the values are correct, return to the SOLVE menu and check the equation. (Press [EXIT] to return to the SOLVE menu, and press [EDIT] to view and edit the equation.) Check the equation against the one in this book for accuracy; if you find an error, edit the equation.
3. If the calculator displays INSUFFICIENT MEMORY when you press [INPUT] or [CALC], you must clear portions of memory. Refer to your owner's manual for additional information.

Contributions in the development of this book were provided by Andrew E. Jones, an investment broker in Salem, Oregon.

1

Personal Savings

Basic Savings Calculations

These examples are presented as guidelines for evaluating savings plans when the payment period coincides with the compounding period.* Since the Time Value of Money (TVM) menu is used, remember the cash-flow sign convention when entering dollar amounts (money paid out is entered as a negative number, money received is entered as a positive number).

1. Clear the TVM variables, store the number of payments per year in [P/YR], and set either Begin or End mode.
2. Store values in at least three of the following variables. (Both *N* and *I%YR* must be a part of a problem. Either both values are known, or one is known and the other is to be calculated.)
   - Number of periodic deposits in [N].
   - Annual interest rate in [I%YR].
   - Initial investment in [PV].
   - Periodic deposit in [PMT].
   - Future value in [FV].
3. Press the menu key of the unknown variable to calculate its value.

Example 1: Balance of a Savings Account After Initial Deposit and Regular Deposits. You have just opened a savings account with a $200 deposit. If you deposit $50 a month, and the account earns 5.25% compounded monthly, how much will you have in the account in 3 years?

* If the periodic deposits do not coincide with the compounding periods, the account must be evaluated in another manner. Use the "Compounding Periods Different From Payment Periods" procedure on page 23.

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
3 × 12 N	N=36.00	Stores known values.
5.25 I%YR	I%YR=5.25	
200 +/- PV	PV=-200.00	
50 +/- PMT	PMT=-50.00	
FV	FV=2,178.94	Calculates amount in savings account in 3 years.

Example 2: Number of Deposits or Withdrawals to Reach a Specified Balance. Part 1. Your savings account presently contains $18,000 and earns 5.25% compounded monthly. You wish to withdraw $300 a month until the account is depleted. How long will this take?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
5.25 I%YR	I%YR=5.25	Stores known values.
18000 +/- PV	PV=-18,000.00	
300 PMT	PMT=300.00	
N	N=69.75	Calculates number of months. (The 70th withdrawal will be less than $300.)

Part 2. If you wish to reduce the account to $5,000, how many withdrawals can you make?

5000 [FV]	FV = 5,000.00	Stores remaining balance.
[N]	N = 52.41	Calculates number of monthly withdrawals. (The 53rd withdrawal reduces the account balance to less than $5,000.)

Example 3: Amount to Deposit Today to Have a Certain Future Balance. How much money would you have to invest today if you want $10,000 in 10 years? Assume the interest rate is 9%, compounded annually.

Keys:	Display:	Description:
[TVM]		Displays TVM menu.
■ [CLEAR DATA]		Clears TVM variables.
[OTHER] 1 [P/YR] [END] [EXIT]		Sets 1 payment per year; End mode.
10000 [FV]	FV = 10,000.00	Stores known values.
9 [I%YR]	I%YR = 9.00	
10 [N]	N = 10.00	
[PV]	PV = −4,224.11	Calculates amount to deposit today to have $10,000 in the future.

Example 4: Monthly Deposits to Reach a Future Balance. You plan to replace your car in 3 years, and you want to have $6,000 to help pay for the new one. How much should you save each month, beginning today, to accumulate $6,000 in 3 years? Assume 7.5% interest, compounded monthly.

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA BEG EXIT		Sets 12 payments per year; Begin mode.
3 × 12 N 7.5 I%YR 6000 FV	N = 36.00 I%YR = 7.50 FV = 6,000.00	Stores known values.
PMT	PMT = −148.21	Calculates monthly payment.

Example 5: Periodic Deposits and Withdrawals. Part 1. You are presently depositing $50 at the end of each month into a local savings and loan, earning 5.25% compounded monthly. Your account balance is $1,023.25. How much will you accumulate in 5 months?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
5 N 5.25 I%YR 1023.25 +/− PV 50 +/− PMT	N = 5.00 I%YR = 5.25 PV = −1,023.25 PMT = −50.00	Stores known values.
FV	FV = 1,298.03	Calculates account balance after five months.

Part 2. At the beginning of the sixth month, you withdraw $80. What is the new balance?

[−] 80 [=]	1,218.03	Calculates new balance.

Part 3. At the end of months 6, 7, and 8, you deposit $65. How much will you have in the account at the end of month 8?

[+/−] [PV]	PV = −1,218.03	Stores beginning balance.
65 [+/−] [PMT]	PMT = −65.00	Stores known values.
3 [N]	N = 3.00	
[FV]	FV = 1,429.94	Calculates balance after an additional three months.

Part 4. You decide not to make deposits for the next 2 months. What is the balance in the account after those 2 months?

[+/−] [PV]	PV = −1,429.94	Stores beginning balance.
2 [N]	N = 2.00	Stores known values.
0 [PMT]	PMT = 0.00	
[FV]	FV = 1,442.48	Calculates balance after an additional two months.

Example 6: Deposits Needed for Future Withdrawals. You wish to retire in 25 years with a monthly income of $2,000, continuing for 20 years. How much should you deposit each month into an account that earns 8.5% interest to achieve your retirement objectives?

A two-step solution is appropriate. First, calculate the present value of the desired retirement income. This represents the amount you need in the account when you retire. Then calculate the monthly deposit necessary to accumulate this amount.

Keys:	Display:	Description:
Step 1:		
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
20 × 12 N 8.5 I%YR 2000 PMT	N=240.00 I%YR=8.50 PMT=2,000.00	Stores retirement income values.
PV	PV=−230,461.68	Calculates amount needed in fund at retirement.
+/− FV	FV=230,461.68	Stores retirement fund amount.
Step 2:		
0 PV	PV=0.00	Stores 0 in *PV* as there is no deposit made today.
25 × 12 N	N=300.00	Stores total number of deposits.
PMT	PMT=−223.30	Calculates monthly deposit.

Example 7: Compounding on 365/360-Day Basis. Part 1. Your savings account earns 5.5% interest compounded on a 365/360-day basis. If the account presently contains $1,200, how much will be in the account in 1 year (365 days)? (Use actual number of days for *N*, and use 360 days for number of compounding periods per year).

Keys:	Display:	Description:
[TVM]		Displays TVM menu.
■ [CLEAR DATA]		Clears TVM variables.
[OTHER] 360 [P/YR] [END] [EXIT]		Sets 360 payments per year; End mode.
365 [N] 5.5 [I%YR] 1200 [+/−] [PV]	N=365.00 I%YR=5.50 PV=−1,200.00	Stores known values.
[FV]	FV=1,268.81	Calculates account balance.

Part 2. How does this compare with daily compounding on a 360-day basis?

360 [N]	N=360.00	Stores number of compounding periods.
[FV]	FV=1,267.84	Calculates account balance on 360-day basis.

Savings Account Compounded Daily

The equation below determines the value of a savings account when interest is compounded daily. You can calculate the total amount in the account after a series of transactions on specified dates.

Entering and Using the SAVFV Equation:

1. Enter the *SAVFV* equation into the Solver.*

   SAVFV=(PV+PMT)×SPFV(I%YR÷365:DDAYS (DATE1:DATE2:1))

2. Display the *SAVFV* equation menu.
3. Store five of the following variables:
   - Value of the account on the second date in ≣ SAVFV ≣.
   - Value of the account on the first date in ≣ PV ≣.
   - Payment to the account in ≣ PMT ≣.
   - Annual interest rate as a percentage in ≣ I%YR ≣.
   - First date (in MM.DDYYYY format) in ≣ DATE1 ≣.
   - Second date (in MM.DDYYYY format) in ≣ DATE2 ≣.
4. Press the menu key to calculate the unknown value.

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.

Example. An account earns 5.25%, compounded daily. Calculate the amount in this account after the following transactions:

September 15, 1987	$125.00 deposit
October 9, 1987	$60.00 deposit
October 14, 1987	$70.00 deposit
November 18, 1987	$50.00 withdrawal
December 1, 1987	$175.00 deposit
January 22, 1988	$100.00 withdrawal

Enter the dates in MM.DDYYYY format.

Display the *SAVFV* equation menu.

Keys:	**Display:**	**Description:**
125 [PV]	PV = 125.00	Stores amount deposited on the first date.
0 [PMT]	PMT = 0.00	Stores 0 as the payment amount.
5.25 [I%YR]	I%YR = 5.25	Stores nominal annual interest rate.
9.151987 [DATE1]	DATE1 = 9.15	Stores first date.
10.091987 [DATE2]	DATE2 = 10.09	Stores second date.
[SAVFV]	SAVFV = 125.43	Calculates value of the account on the second date.
[STO] [PV]	PV = 125.43	Stores account balance.
60 [PMT]	PMT = 60.00	Stores amount of deposit.
[RCL] [DATE2] [STO] [DATE1]	DATE2 = 10.09 DATE1 = 10.09	Stores *DATE2* as the first date.
10.141987 [DATE2]	DATE2 = 10.14	Stores second date.
[SAVFV]	SAVFV = 185.57	Calculates value of the account on the second date.

STO PV	PV = 185.57	Stores account balance.
70 PMT	PMT = 70.00	Stores amount of deposit.
RCL DATE2 STO DATE1	DATE2 = 10.14 DATE1 = 10.14	Stores *DATE2* as the first date.
11.181987 DATE2	DATE2 = 11.18	Stores second date.
SAVFV	SAVFV = 256.86	Calculates value of the account on the second date.
STO PV	PV = 256.86	Stores account balance.
50 +/- PMT	PMT = −50.00	Stores amount of withdrawal.
RCL DATE2 STO DATE1	DATE2 = 11.18 DATE1 = 11.18	Stores *DATE2* as the first date.
12.011987 DATE2	DATE2 = 12.01	Stores second date.
SAVFV	SAVFV = 207.24	Calculates value of the account on the second date.
STO PV	PV = 207.24	Stores account balance.
175 PMT	PMT = 175.00	Stores amount of deposit.
RCL DATE2 STO DATE1	DATE2 = 12.01 DATE1 = 12.01	Stores *DATE2* as the first date.
1.221988 DATE2	DATE2 = 1.22	Stores second date.
SAVFV	SAVFV = 385.11	Calculates value of the account on the second date.
− 100 =	285.11	Final amount in the savings account.

Simple Interest

With simple interest, only the principal (the original loan amount) earns interest for the entire life of the transaction. The interest earned, plus the principal, is repaid in one lump sum. The following equations calculate the amount of simple interest on a 360-day basis and a 365-day basis. Once the interest is calculated, the total payment (loan amount plus interest) can also be calculated.

Entering and Using the SINT Equation:

1. Enter the *SINT* equation into the Solver.*

   `SINT=#DYS÷YEAR×LOAN×I%YR÷100`

2. Display the *SINT* equation menu.
3. Store or calculate the following variables:
   - Amount of simple interest in [SINT].
   - Total number of days in [#DYS].
   - Number of days in the calendar year (either 360 or 365) in [YEAR].
   - Loan amount in [LOAN].
   - Annual interest rate in [I%YR].
4. Press [+] [RCL] [LOAN] [=] to calculate the total payment (interest plus principal).

* To key in # on the HP-17B and HP-27S, press [WXYZ] [OTHER] [#].

Example. A friend has requested that you lend him $1,200 for 90 days. You lend him the money at 8% simple annual interest, to be calculated on a 360- day basis. How much interest will he owe you in 90 days? What is the total amount owed?

Display the *SINT* equation menu.

Keys:	Display:	Description:
1200 [LOAN]	LOAN = 1,200.00	Stores known values.
90 [#DYS]	#DYS = 90.00	
8 [I%YR]	I%YR = 8.00	
360 [YEAR]	YEAR = 360.00	
[SINT]	SINT = 24.00	Calculates amount of simple interest.
[+] [RCL] [LOAN]		Calculates total payment
[=]	1,224.00	amount.

Compounding Periods Different From Payment Periods

Note

This keystroke procedure cannot be used on the HP-27S. Refer to page 176 of the *HP-27S Owner's Manual* for the equivalent Solver equations for converting interest rates.

Savings account deposits and withdrawals may not occur at the same time as the bank's compounding periods. The TVM menu, however, assumes these two periods are the same. This procedure shows you how to adjust the interest rate so that you can use the TVM menu in situations when the compounding period is different from the payment period.

When the bank's interest rate is known, adjust the annual interest rate to correspond to the payment period, then use the TVM menu to calculate the unknown value.

1. Display the periodic interest rate conversion menu (≡ ICNV ≡ ≡ PER ≡ on the HP-17B, ≡ ICONV ≡ ≡ PER ≡ on the HP-19B).
2. Store the following variables. The bank provides this information.
   - Nominal annual interest rate in ≡ NOM% ≡.
   - Number of compounding periods per year in ≡ P ≡.
3. Press ≡ EFF% ≡ to calculate the effective annual interest rate.
4. Store the number of payments or withdrawals per year in ≡ P ≡.
5. Press ≡ NOM% ≡ to calculate the nominal annual rate that corresponds to the payment period.
6. Press [EXIT] [EXIT] ≡ TVM ≡ to display the TVM menu.
7. Press [STO] ≡ I%YR ≡ to store the adjusted nominal rate.
8. Store the number of payments per year in ≡ P/YR ≡ and set either Begin or End mode.

9. Store or calculate the following variables. Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.
   - Total number of periodic deposits in [N].
   - Initial deposit in [PV].
   - Amount of periodic deposit or withdrawal in [PMT].
   - Future value in [FV].

When the interest rate is the unknown variable, calculate [I%YR] in the TVM menu (this is the nominal rate that corresponds to the payment period). Then use the interest conversion menu to calculate the nominal annual interest rate corresponding to the compounding period.

Example 1: Balance of a Savings Account. Starting today, you make monthly deposits of $25 into an account paying 5% interest, compounded daily (365-day basis). At the end of 7 years, how much will you receive from the account?

Keys:	Display:	Description:
[ICNV] [PER]		Displays the periodic conversion menu.
5 [NOM%] 365 [P]	NOM% = 5.00 P = 365.00	Stores known values.
[EFF%]	EFF% = 5.13	Calculates effective interest rate for daily compounding.
12 [P]	P = 12.00	Stores number of deposits per year.

NOM%	NOM% = 5.01*	Calculates equivalent nominal interest rate for monthly compounding.
STO 0	NOM% = 5.01	Stores value in register 0.
EXIT EXIT TVM		Displays the TVM menu.
RCL 0 I%YR	I%YR = 5.01	Stores interest rate.
OTHER 12 P/YR BEG EXIT		Sets 12 payments per year; Begin mode.
7 × 12 N 25 +/− PMT 0 PV	N = 84.00 PMT = −25.00 PV = 0.00	Stores known values.
FV	FV = 2,519.61	Calculates value of the account in 7 years.

Example 2: Amount to Deposit Today to Have a Certain Future Balance. You wish to make weekly deposits for eight years into a savings account paying 5.25% interest, compounded quarterly. How much should you deposit each week to accumulate $6,000?

Keys:	Display:	Description:
ICNV PER		Displays the periodic interest conversion menu.
5.25 NOM% 4 P	NOM% = 5.25 P = 4.00	Stores known values.

* Because compounding is less frequent, a higher nominal interest rate is needed to achieve the same effective rate.

EFF%	EFF% = 5.35	Calculates effective rate for quarterly compounding.
52 P	P = 52.00	Stores number of deposits per year.
NOM%	NOM% = 5.22	Calculates equivalent nominal interest rate for weekly compounding.
STO 0	NOM% = 5.22	Stores value in register 0.
EXIT EXIT TVM		Displays the TVM menu.
RCL 0 I%YR	I%YR = 5.22	Stores interest rate.
OTHER 52 P/YR BEG EXIT		Sets 52 payments per year; Begin mode.
8 × 52 N 6000 FV 0 PV	N = 416.00 FV = 6,000.00 PV = 0.00	Stores known values.
PMT	PMT = −11.62	Calculates amount of weekly deposit.

Example 3: Length of Time to Accumulate a Balance. You make weekly deposits of $10 into an account paying 5.25%, compounded daily (365-day basis). How long will it take to accumulate $1,000?

Keys:	Display:	Description:
ICNV PER		Displays the periodic interest conversion menu.
5.25 NOM% 365 P	NOM% = 5.25 P = 365.00	Stores known values.
EFF%	EFF% = 5.39	Calculates effective rate for daily compounding.
52 P	P = 52.00	Stores number of deposits per year.

NOM%	NOM% = 5.25*	Calculates equivalent nominal interest rate for weekly compounding.
STO 0	NOM% = 5.25	Stores value in register 0.
EXIT EXIT TVM		Displays TVM menu.
RCL 0 I%YR	I%YR = 5.25	Stores interest rate.
OTHER 52 P/YR BEG EXIT		Sets 52 payments per year; Begin mode.
10 +/- PMT 1000 FV 0 PV	PMT = −10.00 FV = 1,000.00 PV = 0.00	Stores known values.
N	N = 95.22	Calculates number of weeks. (The 96th deposit places the balance over $1,000.)

Example 4: Calculating Interest Rate. Your bank statement indicates that you earned $4.63 in interest for 1 month. Your beginning balance was $975.46. What interest rate is your bank quoting, assuming daily compounding on a 365-day basis?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.

* To see the difference between the two nominal rates, display more than two decimal places.

OTHER 12 P/YR BEG EXIT		Sets 12 payments per year; Begin mode.
1 N 975.46 +/- PV +/- + 4.63 FV	N = 1.00 PV = −975.46 FV = 980.09	Stores known values.
I%YR	I%YR = 5.70	Calculates periodic interest rate.
STO 0	I%YR = 5.70	Stores value in register 0.
EXIT ICNV PER		Displays periodic interest conversion menu.
RCL 0 NOM%	NOM% = 5.70	Stores nominal interest rate.
12 P	P = 12.00	Stores number of deposits per year.
EFF%	EFF% = 5.85	Calculates effective rate for monthly compounding.
365 P	P = 365.00	Stores number of compounding periods per year.
NOM%	NOM% = 5.68	Calculates nominal annual interest rate quoted by the bank.

Increasing Annuities

These equations calculate the present and future values of an annuity (a series of payments) that increases at a constant rate at equal intervals of time. The first equation (PVINCR) calculates the present value of an increasing annuity. Once the present value has been calculated, the second equation (FVINCR) calculates the future value of the annuity.

The equations assume that payments are made at the end of each period. In addition, the total number of payments (*#YRS* × *P/YR*) divided by the number of periods before payments increase (*#PER*) must be an integer. If this is not so, the calculated results are not meaningful.

Entering and Using the PVINCR and FVINCR Equations:

1. Enter the PVINCR and FVINCR equations into the Solver.*

   ```
   PVINCR:PMT×USPV(I%YR÷P/YR:#PER)×
   USFV(((1+%INC÷100)÷(1+I%YR÷P/YR÷100)^
   #PER-1)×100:#YRS×P/YR÷#PER)-PVINCR

   FVINCR:SPFV(I%YR÷P/YR:#YRS×P/YR)×
   PVINCR-FVINCR
   ```

2. Display the PVINCR equation menu.

---

* To key in : on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ : ≡.
To key in / on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ MORE ≡ ≡ / ≡.
To key in # on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ # ≡.
To key in ^ on the HP-17B and HP-27S, press ■ [y^x].

3. Store the following variables:
   - Periodic payment amount in ≡ PMT ≡.
   - Annual interest rate as a percentage in ≡ I%YR ≡.
   - Number of payments per year in ≡ P/YR ≡.
   - Number of periods before payments increase in ≡ #PER ≡.
   - Percentage of each increase in ≡ %INC ≡.
   - Total number of years in ≡ #YRS ≡.
4. Press ≡ PVIN ≡ to calculate the present value of the increasing annuity.
5. Once *PVINCR* is calculated, display the FVINCR equation menu and press ≡ FVIN ≡ to calculate the future value of the increasing annuity.*

Example 1. A client has a 20-year annuity that pays $110 per month for the first year. The monthly payment increases 5.5% each year. Assuming a discount rate of 11.5%, what is the present value of the series of payments?

Display the PVINCR equation menu.

Keys:	**Display:**	**Description:**
110 ≡ PMT ≡	PMT = 110.00	Stores known values.
11.5 ≡ I%YR ≡	I%YR = 11.50	
12 ≡ P/YR ≡	P/YR = 12.00	
12 ≡ #PER ≡	#PER = 12.00	
5.5 ≡ %INC ≡	%INC = 5.50	
≡ MORE ≡		Displays second set of menu labels.

* The calculation of *FVINCR* requires that values be stored in ≡ I%YR ≡, ≡ P/YR ≡, ≡ #YRS ≡, and ≡ PVIN ≡.

20 [#YRS]	#YRS = 20.00	Stores number of years.
[PVIN]	PVINCR = 14,793.46	Calculates present value of increasing annuity.

Example 2. Starting at the end of this year, you plan to make yearly deposits into an account that earns 13% interest, compounded annually. Each year you plan to increase the amount of your deposit by 8%. If the first deposit is $1,200, how much will you accumulate over the next 10 years?

Display the PVINCR equation menu.

Keys:	**Display:**	**Description:**
1200 [PMT]	PMT = 1,200.00	Stores known values.
13 [I%YR]	I%YR = 13.00	
1 [P/YR]	P/YR = 1.00	
1 [#PER]	#PER = 1.00	
8 [%INC]	%INCR = 8.00	
[MORE]		Displays second set of menu labels.
10 [#YRS]	#YRS = 10.00	Stores number of years.
[PVIN]	PVINCR = 8,736.14	Calculates present value of increasing annuity.
[EXIT] [↓] [CALC]		Displays FVINCR menu.
[FVIN]	FVINCR = 29,655.42	Calculates future value of increasing annuity.

Example 3. In 30 years you wish to have $250,000 on which to retire. At the end of each month, you plan to deposit a sum into an account that earns 8% interest, compounded monthly. Each year you will increase the amount of the deposit by 3%. How much is your first deposit?

Display the FVINCR equation menu.

Keys:	Display:	Description:
250000 FVIN	FVINCR = 250,000.00	Stores known values.
8 I%YR	I%YR = 8.00	
12 P/YR	P/YR = 12.00	
30 #YRS	#YRS = 30.00	
PVIN	PVINCR = 22,860.84	Calculates present value.
EXIT ↑ CALC		Displays PVINCR menu.
12 #PER	#PER = 12.00	Stores remaining known values.
3 %INC	%INC = 3.00	
PMT	PMT = 125.08	Calculates initial monthly payment.

Deposits Needed To Meet a Future Cash Flow Need

Note

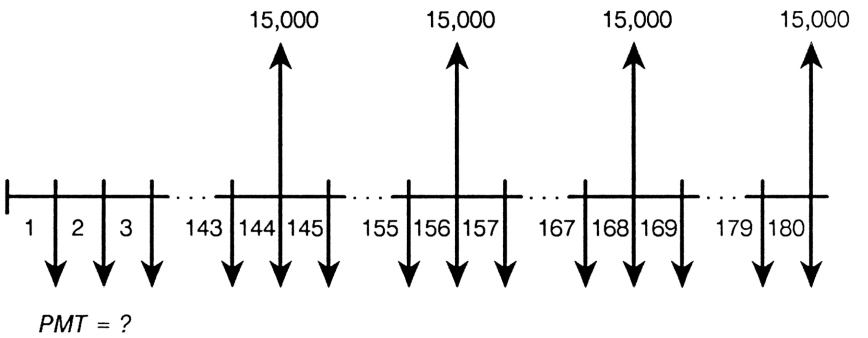
This procedure cannot be used on the HP-27S. For an equation to calculate *NPV* (step 8b below) on the HP-27S, see appendix B, "Net Present Value and Internal Rate of Return on the HP-27S," on page 190.

The procedure in this section helps you determine how much money to save now to accommodate a future series of outflows, such as a college education. To determine how much you need to save each period, you must know when you need the money, how much is needed, and at what interest rate you can invest.

1. Display the CFLO menu.
2. Press ■ [CLEAR DATA] [YES] [YES] to clear the list and its name. (If you don't want to delete the list, name your old list and get a new list.)
3. Store 0 as the initial cash flow.
4. Store 0 as *FLOW(1)*, and the number of payment periods until the withdrawals begin as the number of times.
5. Store the withdrawal amount as *FLOW(2)*. Continue entering cash flows of 0 and withdrawals through the last withdrawal.
6. Press [EXIT] [CALC] to display the CFLO CALC menu.
7. Store the periodic interest rate in [I%].
8. Do **a** and/or **b**:
   - **a.** Press [NUS] to calculate the amount of the periodic payments you need to make (starting at the end of the first period).
   - **b.** Press [NPV] to calculate the lump sum you would need to deposit now.

Example 1: Periodic Deposits. Part 1. Your daughter will be going to college in 12 years and you are starting a fund for her education. She will need $15,000 at the beginning of each year for four years. The fund earns 9%, compounded monthly, and you plan to make monthly deposits, starting at the end of the current month. How much should you deposit each month to meet her educational expenses?

The cash-flow diagram looks like this:



Keys:	Display:	Description:
[CFLO]		Displays CFLO menu.
■ [CLEAR DATA] [YES] [YES] *or* [GET] [*NEW]	FLOW(0)=?*	Clears current list or gets a new one.
0 [INPUT]	FLOW(1)=?*	Stores initial cash flow.
0 [INPUT] 12 [×] 12 [−] 1 [INPUT]	FLOW(2)=?	Stores cash flows until withdrawals begin as *FLOW(1)*.

* On the HP-19B, these prompts are: INIT= and FLOW(1)=.

15000 [INPUT] [INPUT]	FLOW(3) = ?	Stores first withdrawal as *FLOW(2)*.
0 [INPUT] 11 [INPUT]	FLOW(4) = ?	Stores cash flows of zero for the rest of the year as *FLOW(3)*.
15000 [INPUT] [INPUT]	FLOW(5) = ?	Stores second withdrawal as *FLOW(4)*.
0 [INPUT] 11 [INPUT]	FLOW(6) = ?	Stores cash flows of zero for the rest of the year as *FLOW(5)*.
15000 [INPUT] [INPUT]	FLOW(7) = ?	Stores third withdrawal as *FLOW(6)*.
0 [INPUT] 11 [INPUT]	FLOW(8) = ?	Stores cash flows of zero for the rest of the year as *FLOW(7)*.
15000 [INPUT] [INPUT]	FLOW(9) = ?	Stores fourth withdrawal as *FLOW(8)*.

The next step (pressing [EXIT]) is necessary if you have the HP-17B.

[EXIT]

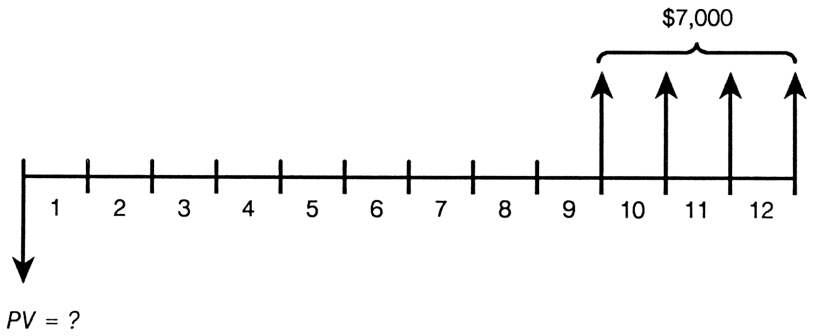
[CALC]		Displays CFLO CALC menu.
9 [÷] 12 [I%]	I% = 0.75	Stores monthly interest rate.
[NUS]	NUS = 182.30	Calculates monthly payment.

Part 2. Alternatively, how much would you need to deposit today in one lump sum to fund her college education?

[NPV]	NPV = 17,973.48	Solves for net present value of the withdrawals.

Example 2: Single Deposit. You wish to put money aside for your daughter's college education. You estimate that when she is of college age, 9 years from now, she will need $7,000 at the beginning of each year for four years to cover college tuition and expenses. You wish to establish a fund that earns 6% annually. How much do you need to deposit in the fund today to meet your daughter's educational expenses?

The cash-flow diagram looks like this:



Keys:	Display:	Description:
[CFLO]		Displays CFLO menu.
■ [CLEAR DATA] [YES] [YES] *or* [GET] [*NEW]	FLOW(0) = ?	Clears current named list or gets a new one.
0 [INPUT]	FLOW(1) = ?	Stores initial cash flow.
0 [INPUT] 8 [INPUT]	FLOW(2) = ?	Stores first through eighth cash flows.
7000 [INPUT] 4 [INPUT]	FLOW(3) = ?	Stores ninth through twelfth cash flows.

The next step (pressing [EXIT]) is necessary if you have the HP-17B.

[EXIT]

[CALC]		Displays the CALC menu.
6 [I%]	I% = 6.00	Stores annual interest rate.
[NPV]	NPV = 15,218.35	Calculates amount of one-time deposit needed for college fund.

Compound Growth Rate

The compound growth rate is often calculated to determine the change in the value of a stock or property. You can use the TVM menu to do the calculation.

To calculate the average periodic compound growth rate when you know the beginning and ending values:

1. Display the TVM menu.
2. Clear the TVM variables and store 1 as the number of payments per year in ≡ P/YR ≡.
3. Store the following variables:
   - Beginning value as a negative number in ≡ PV ≡.
   - Ending value in ≡ FV ≡.
   - Number of periods between beginning and ending values in ≡ N ≡.
4. Press ≡ I%YR ≡ to calculate the average periodic compound growth rate.

To calculate the periodic compound growth rate when you know periodic rates of return:

1. Display the TVM menu.
2. Clear the TVM variables and store the number of payments per year in ≡ P/YR ≡.
3. Store 1 in ≡ PV ≡ to initialize the beginning value.
4. Accumulate the compounded value of the individual rates of return as percentages.
5. Press [+/-] ≡ FV ≡ to store the sum as the future value.
6. Store the number of returns in ≡ N ≡.
7. Press ≡ I%YR ≡ to calculate the average periodic compound growth rate.

Example 1. Twenty-three years ago you purchased a home for $28,000. You have just sold it for $113,000. What is the annual rate of appreciation in the value of the property?

Display the TVM menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears TVM variables.
OTHER 1 P/YR END EXIT		Sets 1 payment per year; End mode.
23 N	N=23.00	Stores number of years.
28000 +/- PV	PV=-28,000.00	Stores beginning value.
113000 FV	FV=113,000.00	Stores ending value.
I%YR	I%YR=6.25	Calculates annual appreciation rate.

Example 2. You read in the financial section that the annual rate of return on a certain stock has fluctuated quite a bit. The following table summarizes the percent rates of return for 7 years.

Year	% Rate of Return
1981	-12
1982	15
1983	27
1984	-8
1985	12
1986	25
1987	5

What is the periodic compound growth rate of the stock?

Display the TVM menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears TVM variables.
OTHER 1 P/YR END EXIT		Sets 1 payment per year; End mode.
1 PV	PV = 1.00	Initializes beginning value.
− 12 % + 15 % + 27 % − 8 % + 12 % + 25 % + 5 % =	1.74	Sums periodic rates of return.
+/− FV	FV = −1.74	Stores sum as future value.
7 N	N = 7.00	Stores number of years.
I%YR	I%YR = 8.22	Calculates periodic compound growth rate.

2

Personal Borrowing

Basic Mortgage Calculations

Many of the techniques illustrated in this book require that you know the five basic components of a mortgage: *N*, *I%YR*, *PV*, *PMT*, and *FV*. For a particular problem, some of these values may not be known. However, if any four elements are known, the remaining unknown value can be calculated.

Storing Financial Data

Menu Label	Value Stored
N	Total number of payments.
I%YR	Annual interest rate as a percent.
PV	Initial loan balance.*
PMT	Periodic payment.*
FV	Future value or balloon payment.*

* Use the cash-flow sign convention (Money paid out is negative, money received is positive).

In addition, the following settings are necessary for the payment frequency and mode.

Setting Frequency and Mode

Menu Label	Value Stored
P/YR	Number of payments per year.
END	Sets End mode.
BEG	Sets Begin mode.

Solving for Values

Unknown Value	Values Required to Solve
N	*I%YR, PV, PMT, FV,* P/YR, End or Begin*
I%YR	*N, PV, PMT, FV,* P/YR, End or Begin*
PV	*N, I%YR, PMT, FV,* P/YR, End or Begin*
PMT	*N, I%YR, PV, FV,* P/YR, End or Begin*
FV	*N, I%YR, PV, PMT, P/YR, End or Begin*

* *FV* is zero if there is no balloon payment.

Example 1: Calculating a Monthly Payment. You are considering a 30-year, $72,500 mortgage at 10.25% interest. What is the monthly payment amount?

Solution. The payment amount is the unknown value. The loan amount, total number of payments, and annual interest rate are known. (The future value is zero.)

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
30 × 12 N	N = 360.00	Stores total number of payments.
72500 PV	PV = 72,500.00	Stores mortgage amount.
10.25 I%YR	I%YR = 10.25	Stores annual interest rate.
PMT	PMT = −649.67	Calculates monthly payment.

Part 2. What is your monthly payment assuming a 15-year mortgage?

15 [×] 12 [N]	N = 180.00	Stores total number of payments.
[PMT]	PMT = −790.21	Calculates monthly payment.

Example 2: Calculating a Maximum Purchase Price. The maximum monthly mortgage payment that you can afford is $750. Interest rates are currently 10.5%, and you can make a $7,000 down payment. With a 30-year mortgage, what is the maximum purchase price you can afford?

Solution. The loan amount is the unknown value. The monthly payment, annual interest rate, and total number of payments are known. (The future value is zero.)

Keys:	Display:	Description:
[TVM]		Displays TVM menu.
■ [CLEAR DATA]		Clears TVM variables.
[OTHER] ■ [CLEAR DATA] [EXIT]		Sets 12 payments per year; End mode.
750 [+/−] [PMT]	PMT = −750.00	Stores monthly payment.
10.5 [I%YR]	I%YR = 10.50	Stores annual interest rate.
30 [×] 12 [N]	N = 360.00	Stores total number of payments.
[PV]	PV = 81,990.57	Calculates loan amount.
[+] 7000 [=]	88,990.57	Calculates maximum purchase price.

Example 3: Calculating an Interest Rate. A property has an existing loan of $100,000 with monthly payments of $1,106.20 for 30 years. What is the annual interest rate of the loan?

Solution. The interest rate is the unknown value. The loan amount, remaining number of payments, and monthly payment are known. (The future value is zero.)

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
30 × 12 N	N = 360.00	Stores total number of payments.
100000 PV	PV = 100,000.00	Stores loan amount.
1106.20 +/− PMT	PMT = −1,106.20	Stores monthly payment. (Remember to use the sign convention.)
I%YR	I%YR = 13.00	Calculates annual interest rate.

Example 4: Calculating a Balloon Payment. What is the balloon payment due at the end of year 10 for a $750,000 loan with monthly payments of $9,483.33 and a 15% annual interest rate?

Solution. The balloon payment is the future value.

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.

10 [×] 12 [N]	N = 120.00	Stores total number of payments.
15 [I%YR]	I%YR = 15.00	Stores annual interest rate.
750000 [PV]	PV = 750,000.00	Stores loan amount.
9483.33 [+/−] [PMT]	PMT = −9,483.33	Stores payment amount.
[FV]	FV = −720,185.74	Calculates amount of balloon payment.*
[+] [RCL] [PMT] [=]	−729,669.07	Calculates final payment.

Example 5: Calculating Payment and Balance. A broker lists a property that has an assumable loan. The original loan amount was $150,000 at 7% annual interest, fully amortized with monthly payments for 25 years. The loan originated 11 years and 8 months ago. What is the estimated loan balance?

Solution. First, calculate the monthly payment, assuming full amortization in 25 years. Then use the four known values (*N*, *I%YR*, *PV*, and *PMT*) to calculate the amount of the balloon payment (*FV*) due after 11 years and 8 months (140 payments).

Keys:	Display:	Description:
[TVM]		Displays TVM menu.
■ [CLEAR DATA]		Clears TVM variables.
[OTHER]		Sets 12 payments per year; End mode.
■ [CLEAR DATA] [EXIT]		
25 [×] 12 [N]	N = 300.00	Stores total number of payments.

* The balloon payment amount occurs coincident with, but does not include, the last periodic payment amount.

7 I%YR	I%YR = 7.00	Stores annual interest rate.
150000 PV	PV = 150,000.00	Stores original loan amount.
PMT	PMT = −1,060.17	Calculates monthly payment amount.
11 × 12 + 8 N	N = 140.00	Calculates and stores number of payments already made.
FV	FV = −110,080.32	Calculates current loan balance.

Example 6: Calculating a Quarterly Payment. Mr. Seller takes a $200,000 mortgage at 12% annual interest with quarterly payments and a $150,000 balloon payment due at the end of 5 years. What is the quarterly payment?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER 4 P/YR END EXIT		Sets 4 payments per year; End mode.
5 × 4 N	N = 20.00	Stores total number of payments.
12 I%YR	I%YR = 12.00	Stores annual interest rate.
200000 PV	PV = 200,000.00	Stores loan amount.
150000 +/− FV	FV = −150,000.00	Stores balloon payment amount.
PMT	PMT = −7,860.79	Calculates quarterly payment amount.

Example 7: Calculating a Loan Term. Your current loan has a balance of $65,000 at 10.25% interest and has a monthly payment of $582.47. If you increase your payment by $75 a month, how long will it take to pay off the loan?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
10.25 I%YR	I%YR = 10.25	Stores annual interest rate.
65000 PV	PV = 65,000.00	Stores loan amount.
582.47 + 75 = +/− PMT	PMT = −657.47	Stores new payment amount.
N	N = 218.79	Calculates total number of payments.
÷ 12 =	18.23	The loan is paid off in the 19th year.

Example 8: Calculating a Balance. A loan at 15% annual interest, with monthly payments of $1,283.62, has a balloon payment of $100,000 due at the end of year 10. What is the remaining balance if the loan is paid in full at the end of the sixth year?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
10 − 6 = × 12 N	N = 48.00	Stores total number of remaining payments.

15 I%YR	I%YR = 15.00	Stores annual interest rate.
1283.62 +/- PMT	PMT = −1,283.62	Stores monthly payment amount.
100000 +/- FV	FV = −100,000.00	Stores amount of balloon payment.
PV	PV = 101,208.02	Calculates loan balance at the end of year 6.

Example 9: Calculating a Current Value. You purchased your home 10 years ago for $47,500. If homes in your area have appreciated 4% per year, how much is your home currently worth? (Use *PV* for the original value and *FV* for the current value.)

Keys:	**Display:**	**Description:**
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER 1 P/YR END EXIT		Sets 1 compounding period per year; End mode.
10 N	N = 10.00	Stores total number of years.
47500 +/- PV	PV = −47,500.00	Stores original purchase price.
4 I%YR	I%YR = 4.00	Stores annual appreciation rate.
FV	FV = 70,311.60	Calculates home value.

Example 10: Calculating an Appreciation Rate. You have accepted an offer to sell your home for $76,900. You originally purchased the house 6 years ago for $48,500. What is the annual rate of appreciation? (Use *PV* for the original value and *FV* for the current value.)

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER 1 P/YR END EXIT		Sets 1 compounding period per year; End mode.
76900 FV	FV = 76,900.00	Stores selling price.
6 N	N = 6.00	Stores number of years.
48500 +/- PV	PV = −48,500	Stores purchase price.
I%YR	I%YR = 7.99	Calculates annual appreciation rate.

Homeowner's Monthly Payment Estimator

When comparison shopping for a mortgage, it is often useful to estimate the monthly payment. This equation calculates the approximate payment for the first month given the purchase price, down payment, interest rate, term of the loan, annual property taxes, and annual homeowner's insurance. (Subsequent monthly payments would be different.) The equation also assumes that mortgage interest and property taxes are allowable deductions on your income tax, so your income tax rate can be stored and the after-tax monthly payment calculated.

The calculation assumes that the assessed value is 100% of the sale price and does not include financing the closing costs.

Entering and Using the MOPMT Equation:

1. Enter the MOPMT equation into the Solver.*

   ```
   MOPMT:IF(S(EPMT):(PRICE-DOWN)÷
   USPV(I%YR÷12:N)+(PTAX+INS)÷12-EPMT:
   EPMT-((PRICE-DOWN)×I%YR÷1200
   +PTAX÷12)×%TAX÷100-ATAX)
   ```

2. Display the MOPMT equation menu.
3. Store values in the following variables:
   - Purchase price in [PRICE].
   - Down payment in [DOWN].
   - Annual mortgage interest rate in [I%YR].
   - Total number of monthly payments in [N].
   - Amount of annual property taxes in [PTAX].
   - Annual homeowner's insurance in [INS].
   - Income tax rate as a percentage in [%TAX].

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

4. Press [EPMT] to calculate the estimated monthly payment, including principal and interest, property taxes, and insurance.
5. Press [ATAX] to calculate the after-tax monthly payment.

Example: Part 1. You are considering a $65,000 house in a neighborhood with a $25 per thousand tax rate. Homeowner's insurance would cost $250 per year. If you put $6,500 down, and receive a 10.75% loan for 30 years, what would be your monthly payment?

Display the MOPMT equation menu.

Keys:	**Display:**	**Description:**
65000 [PRICE]	PRICE = 65,000.00	Stores known values.
6500 [DOWN]	DOWN = 6,500.00	
10.75 [I%YR]	I%YR = 10.75	
30 [×] 12 [N]	N = 360.00	
65 [×] 25 [PTAX]	PTAX = 1,625.00	
[MORE]		
250 [INS]	INS = 250.00	
[EPMT]	EPMT = 702.34	Calculates estimated monthly payment.

Part 2. If your tax rate is 20%, what is your actual monthly payment?

20 [%TAX]	%TAX = 20.00	Stores income tax rate.
[ATAX]	ATAX = 570.44	Calculates after-tax monthly payment.

APR of a Loan With Fees

The *annual percentage rate*, APR, incorporates fees usually charged when a mortgage is issued, which raises the interest rate. The actual amount received by the borrower (*PV*) is reduced, while the periodic payments remain the same. You can calculate the annual percentage rate (APR) if you know the life or term of the mortgage, the interest rate, the mortgage amount, and the basis of the fee charged (how the fee is calculated).

Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

1. Display the TVM menu.
2. Clear the TVM variables, store the number of payments per year in [P/YR], and set the payment mode (Begin or End).
3. Store the total number of payments in [N].
4. Store the payment amount in [PMT].
5. Store the balloon payment plus any prepayment penalties in [FV].
6. Subtract any origination fees from the loan amount and store the result (the net proceeds) in [PV].
7. Press [I%YR] to calculate the annual percentage rate.

Example 1: Loan With Points. A borrower is charged a fee of two points for the issuance of a mortgage. (One point is equal to 1% of the mortgage amount.) If the mortgage amount is $60,000 for 30 years and the interest rate is 11.5%, with monthly payments, what APR is the borrower paying?

Keys:	Display:	Description:
[TVM]		Displays TVM menu.
■ [CLEAR DATA]		Clears TVM variables.
[OTHER]		Sets 12 payments per year; End mode.
■ [CLEAR DATA] [EXIT]		

30 [×] 12 [N]	N = 360.00	Stores number of payments.
11.5 [I%YR]	I%YR = 11.50	Stores annual interest rate.
60000 [PV]	PV = 60,000.00	Stores loan amount.
[PMT]	PMT = −594.17	Calculates monthly payment.
[RCL] [PV] [−] 2 [%] [PV]	PV = 58,800.00	Stores actual amount received by borrower.
[I%YR]	I%YR = 11.76	Calculates annual percentage rate.

Example 2: Loan With a Flat Fee. Using the information given in example 1, calculate the APR if the mortgage fee is stated as $150 instead of as a percentage.

Keys:	Display:	Description:
[TVM]		Displays TVM menu.
■ [CLEAR DATA]		Clears TVM variables.
[OTHER] ■ [CLEAR DATA] [EXIT]		Sets 12 payments per year; End mode.
30 [×] 12 [N]	N = 360.00	Stores number of payments.
11.5 [I%YR]	I%YR = 11.50	Restores annual interest rate.
60000 [PV]	PV = 60,000.00	Restores loan amount.
[PMT]	PMT = −594.17	Calculates monthly payment.
[RCL] [PV] [−] 150 [PV]	PV = 59,850.00	Stores actual amount received.
[I%YR]	I%YR = 11.53	Calculates APR.

Example 3: Loan With Points and a Fee. Using the information given in example 1 again, what is the APR if the mortgage fee is stated as 2 points plus $150?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
30 × 12 N	N=360.00	Stores number of payments.
11.5 I%YR	I%YR=11.50	Restores annual interest rate.
60000 PV	PV=60,000.00	Restores loan amount.
PMT	PMT=−594.17	Calculates monthly payment.
RCL PV − 2 % − 150 PV	PV=58,650.00	Stores actual amount borrowed.
I%YR	I%YR=11.80	Calculates APR.

Example 4: Loan With a Balloon. A 30-year, $50,000 loan at 15% interest has fees of 2 points plus $150. Assuming that monthly payments are made and that the loan is paid in full at the end of the seventh year, what is the APR?

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
30 × 12 N	N=360.00	Stores number of payments.
15 I%YR	I%YR=15.00	Restores annual interest rate.
50000 PV	PV=50,000.00	Restores loan amount.
PMT	PMT=−632.22	Calculates monthly payment.
7 × 12 N	N=84.00	Stores number of payments until balloon.
FV	FV=−48,937.43	Calculates balloon payment.
RCL PV − 2 % − 150 PV	PV=48,850.00	Stores actual amount borrowed.
I%YR	I%YR=15.54	Calculates APR.

Example 5: Interest-Only Loan With Points. A $1,000,000, 10-year, 12% interest-only loan has an origination fee of 3 points. What is the yield to the lender? Assume that monthly payments are made. (The monthly payment amount must first be calculated. The balloon payment is the entire loan amount, $1,000,000.)

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
10 × 12 N	N = 120.00	Stores number of payments.
12 I%YR	I%YR = 12.00	Stores interest rate.
1000000 FV	FV = 1,000,000.00	Stores balloon payment.
+/− PV	PV = −1,000,000.00	Stores loan amount.
PMT	PMT = 10,000.00	Calculates monthly payment.
RCL PV −		Calculates and stores
3 % PV	PV = −970,000.00	actual amount borrowed.
I%YR	I%YR = 12.53	Calculates APR.

Adjustable-Rate Mortgages

Note

Steps 8 and 9 of this procedure (calculating the APR of an adjustable-rate mortgage) cannot be used on the HP-27S. For an equation to calculate *NPV* and *IRR%* on the HP-27S, see "Net Present Value and Internal Rate of Return on the HP-27S," on page 190.

An *adjustable-rate mortgage* is a mortgage loan that provides for the adjustment of its interest rate as market interest rates change. As the interest rate changes, the amount of the periodic payment changes to reflect the new interest rate.

Given the terms of the original mortgage, the changes in the interest rate, and the time frame in which the changes occur, this procedure calculates the amount of each periodic payment. Once each payment is known, the annual percentage rate (APR) of the entire transaction can be calculated.

Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

1. Display the TVM menu.
2. Clear the TVM variables, store the number of payments per year in [P/YR], and set the payment mode (Begin or End).
3. Calculate the amount of the initial monthly payment.
4. Calculate the loan balance (*FV*) just before payments increase the first time, change the sign, and store the result in [PV].
5. Change the interest rate, adjust the term, store 0 in [FV], and recalculate the monthly payment.
6. Calculate the loan balance before payments increase the next time, change the sign, and store the result in [PV].
7. Repeat steps 5 and 6 until all payments have been calculated.

8. Use [IRR%] in the CALC menu for CFLO lists to calculate the periodic *IRR%*. (The CFLO menu does not exist on the HP-27S.)
9. Multiply by the number of payment periods per year to calculate the annual interest rate.

Example 1. A $50,000, 30-year, adjustable-rate mortgage has the following terms:

12% interest in the first year.
13% interest in the second and third years.
15% interest for the remaining term.

What are the monthly payments? (Assume the borrower's point of view.)

Keys:	Display:	Description:
[TVM]		Displays TVM menu.
■ [CLEAR DATA]		Clears TVM variables.
[OTHER] ■ [CLEAR DATA] [EXIT]		Sets 12 payments per year; End mode.
30 [×] 12 [N]	N=360.00	Stores total number of payments.
12 [I%YR]	I%YR=12.00	Stores initial annual interest rate.
50000 [PV]	PV=50,000.00	Stores loan amount.
[PMT] [STO] 1*	PMT=−514.31	Calculates and stores payment amount in first year.
12 [N]	N=12.00	Stores number of payments at initial interest rate.

* Up to 10 storage registers, 0 through 9, are available.

FV	FV = −49,818.56	Calculates loan balance after 12 payments.
+/− PV	PV = 49,818.56	Stores remaining balance as new loan amount.
29 × 12 N	N = 348.00	Stores remaining number of payments.
13 I%YR	I%YR = 13.00	Stores new interest rate.
0 FV	FV = 0.00	Sets loan balance to zero.
PMT STO 2	PMT = −552.70	Calculates and stores payment in second and third years.
24 N	N = 24.00	Stores number of payments at new interest rate.
FV	FV = −49,464.37	Calculates remaining balance after the next 24 payments.
+/− PV	PV = 49,464.37	Stores remaining balance as new loan amount.
27 × 12 N	N = 324.00	Stores remaining number of payments.
15 I%YR	I%YR = 15.00	Stores new annual interest rate.
0 FV	FV = 0.00	Sets loan balance to zero.
PMT STO 3	PMT = −629.55	Calculates and stores payment for remaining term.

Example 2. Given the payments in example 1, calculate the APR.

Keys:	Display:	Description:
[EXIT] [CFLO]		Displays the CFLO menu.
■ [CLEAR DATA] [YES] [YES] *or* [GET] [*NEW]	FLOW(0) = ?*	Clears current named list or gets a new one.
50000 [INPUT]	FLOW(1) = ?*	Stores initial cash flow.
[RCL] 1 [INPUT] 12 [INPUT]	FLOW(2) = ?	Stores first cash flow group.
[RCL] 2 [INPUT] 24 [INPUT]	FLOW(3) = ?	Stores second cash flow group.
[RCL] 3 [INPUT] 27 [×] 12 [INPUT]	FLOW(4) = ?	Stores third cash flow group.

The next step (pressing [EXIT]) is necessary if you have the HP-17B.

[EXIT]

[CALC]		Displays the CALC menu.
[IRR%]	IRR% = 1.18	Calculates monthly IRR%.
[×] 12 [=]	14.13	Calculates APR.

* On the HP-19B, these prompts are: INIT = and FLOW(1) =.

Graduated-Payment Mortgages

A *graduated-payment mortgage* is designed to meet the needs of home-buyers who currently cannot afford high mortgage payments, but who have the potential of increased earnings in the years to come.

Under a graduated-payment mortgage 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. The result is that in the early years the borrower makes a payment that is less than a traditional mortgage payment at the same interest rate, but in the later years makes larger payments than he would have with a traditional loan.

The equations below calculate the first year's monthly payment and payments for subsequent years given the total number of payments, the annual interest rate, the loan amount, the annual percentage that the payments increase, and the number of years that the payments increase. The *GPMT* equation can be modified to accommodate other than monthly payments by changing the constant 12 to the number of payments per year.

Entering and Using the GPMT and PMT Equations:

1. Enter the *GPMT* and *PMT* equations into the Solver.*

```
GPMT=PV÷(USPV(I%YR÷12:12)×USFV
(((1+%INC÷100)÷(1+I%YR÷1200)^12)
-1)×100:#YRS)+((USPV(I%YR÷12:
N-12×#YRS)×(1+%INC÷100)^#YRS)÷SPFV
(I%YR÷12:12×#YRS)))

PMT=RND(GPMT:2)×(1+%INC÷100)^
(MIN(YR#:#YRS+1)-1)
```

* To key in : on the HP-17B and HP-27S, press ▒ WXYZ ▒ ▒ OTHER ▒ ▒ : ▒.
To key in ^ on the HP-17B and HP-27S, press ■ [y^x].
To key in # on the HP-17B and HP-27S, press ▒ WXYZ ▒ ▒ OTHER ▒ ▒ # ▒.

2. Display the *GPMT* equation menu.
3. Store values in the following variables:
   - Loan amount in [PV].
   - Annual interest rate (as a percentage) in [I%YR].
   - Annual percentage increase in the monthly payment in [%INC].
   - Number of years during which payments increase in [#YRS].
   - Total number of payments in [N].
4. Press [GPMT] to calculate the monthly payment amount for the first year.
5. Display the *PMT* equation menu.
6. Store the year number in [YR#].
7. Press [PMT] to calculate the monthly payment amount in the specified year.*

Example. A couple purchased a new house with a graduated-payment mortgage. The loan is for $50,000 over a period of 30 years at an initial annual interest rate of 12.5%. The monthly payments will be graduating at an annual rate of 5% for each of the first 5 years and then will be level for the remaining 25 years. What is the amount of the monthly payment in the first year? How much are the monthly payments in each subsequent year?

Display the *GPMT* equation menu.

Keys:	Display:	Description:
50000 [PV]	PV=50,000.00	Stores known values.
30 [×] 12 [N]	N=360.00	
12.5 [I%YR]	I%YR=12.50	
5 [%INC]	%INC=5.00	

* The *PMT* equation shares variables with the *GPMT* equation. You must store variables in the *GPMT* equation and calculate the amount of the monthly graduated-payment before calculating subsequent payments with the *PMT* equation.

5 [#YRS]	#YRS = 5.00	
[GPMT]	GPMT = 448.88	Calculates monthly payment in first year.
[EXIT] [↓] [CALC]		Displays menu for the *PMT* equation.
2 [YR#] [PMT]	PMT = 471.32	Calculates monthly payment for year 2.
3 [YR#] [PMT]	PMT = 494.89	Calculates monthly payment for year 3.
4 [YR#] [PMT]	PMT = 519.63	Calculates monthly payment for year 4.
5 [YR#] [PMT]	PMT = 545.62	Calculates monthly payment for year 5.
6 [YR#] [PMT]	PMT = 572.90	Calculates monthly payment for years 6 to 30.

Amortization Schedule With Unequal Payments

It is possible to generate an amortization schedule in situations where either the periodic payment amount or the annual interest rate, or both, change. You must know the amount of the loan, the interest rates, the amount of each payment, and the number of payments at each interest rate.

Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

To calculate an amortization schedule with unequal payments:

1. Display the TVM menu.
2. Clear the TVM variables, store the number of payments per year in ≣ P/YR ≣, and set the payment mode (Begin or End).
3. Store the initial loan information (the loan amount, annual interest rate, and periodic payment amount) in the TVM menu. (If the payment amount is not known, it can be calculated by also storing the total number of payments in ≣ N ≣ and then pressing ≣ PMT ≣.)
4. Press ≣ OTHER ≣ ≣ AMRT ≣ to display the amortization menu.
5. Key in the number of payments to amortize and press ≣ #P ≣. Press ≣ INT ≣ and ≣ BAL ≣ to display the interest and remaining balance. Repeat this step until all payments at this amount and interest rate are amortized.
6. With the remaining balance in the calculator line, press [EXIT] [EXIT] [STO] ≣ PV ≣ to store the remaining balance as the new loan amount in the TVM menu.
7. Store the adjusted annual interest rate in ≣ I%YR ≣ and the new periodic payment amount in ≣ PMT ≣.
8. Repeat steps 4–7 until the schedule is complete.

Example 1. A $50,000, 30-year, adjustable-rate mortgage has the following terms:

12 payments at 12% interest; PMT = $514.31.
24 payments at 13% interest; PMT = $552.70.
324 payments at 15% interest; PMT = $629.55.

Generate a yearly amortization schedule for the first three years. (Assume the borrower's point of view.)

Keys:	Display:	Description:
TVM		Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
12 I%YR 50000 PV 514.31 +/− PMT	I%YR = 12.00 PV = 50,000.00 PMT = −514.31	Stores initial loan information.
OTHER AMRT		Displays amortization menu.
12 #P	#P = 12 PMTS:1 − 12	Stores number of payments to amortize.

The next step (pressing INT) is necessary if you have the HP-17B or HP-27S.

INT	INTEREST = −5,990.23	
BAL	BALANCE = 49,818.51	
EXIT EXIT		Returns to TVM menu.
STO PV	PV = 49,818.51	Stores remaining balance as new loan amount.
13 I%YR 552.70 +/− PMT	I%YR = 13.00 PMT = −552.70	Stores adjusted interest rate and payment amount.

OTHER AMRT		Displays amortization menu.
12 #P	#P = 12 PMTS:1 – 12	Stores number of payments to amortize.

The next step (pressing INT) is necessary if you have the HP-17B or HP-27S.

INT	INTEREST = –6,466.76
BAL	BALANCE = 49,652.87
12 #P	#P = 12 PMTS:13 – 24
INT	INTEREST = –6,443.90
BAL	BALANCE = 49,464.37

Loan With Extra Annual Payments

You may choose to make extra annual payments on a loan. The equation below helps you determine how an extra payment made at the end of the year affects the term of the loan or changes the monthly payments.

Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

Entering and Using the XTRAPMT Equation:

1. Enter the XTRAPMT equation into the Solver.*

   ```
   XTRAPMT:N×I%YR×PV×0+PMT=(-PV÷USPV
   (I%YR÷12:N))-(XPMT÷USFV(I%YR÷12:12))
   ```

2. Display the XTRAPMT equation menu.
3. Store or calculate the following variables:
   - Number of monthly payment periods in [N].
   - Annual interest rate as a percentage in [I%YR].
   - Loan amount in [PV].
   - Monthly payment amount in [PMT].
   - Extra annual payment amount in [XPMT].

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

Example: Part 1. Your bank will loan $100,000 for 30 years at 10%. The regular monthly payment is $877.57. Calculate the monthly payment if you make an additional payment of $1,500 at the end of each year.

Display the XTRAPMT equation menu.

Keys:	Display:	Description:
30 [×] 12 [N]	N = 360.00	Stores term.
10 [I%YR]	I%YR = 10.00	Stores interest rate.
100000 [PV]	PV = 100,000.00	Stores loan amount.
1500 [+/−] [XPMT]	XPMT = −1,500.00	Stores extra payment amount.
[PMT]	PMT = −758.20	Calculates new monthly payment amount.

Part 2. If the extra payment of $1,500 is made at the end of each year in addition to the regular monthly payment of $877.57, how long would it take to pay off the mortgage?

877.57 [+/−] [PMT]	PMT = −877.57	Stores payment amount.
[N]	N = 217.77*	Calculates new term in months.

* The Solver searches for an iterative solution and displays intermediate estimates.

Add-On Interest Rates and APR

The add-on interest rate determines what portion of the principal will be added on as the finance charge for a loan. This sum is then divided by the number of months in the loan to determine the monthly payment. For example, a $6,000, 10% add-on rate for one year means that you add 10% of $6,000 on to the amount of the loan. This amount is usually called the "finance charge." The loan amount plus interest is $6,600, and the monthly payment is $550 (6,600 ÷ 12). If the loan were for two years, the finance charge would be $1,200 (600 × 2), with a monthly payment of $300 (7,200 ÷ 24).

The following equation converts an add-on interest rate (*RATE*) to an APR (*I%YR*), or converts an APR to an add-on rate. The equation can be modified to accommodate other than monthly payments by changing the constant 12 to the number of payments per year. In that case, *#MO* would reflect the total number of payments.

Entering and Using the ADDON Equation:

1. Enter the ADDON equation into the Solver.*

   ```
   ADDON:#MO÷(1+(#MO÷12)×(RATE÷100))=
   USPV(I%YR÷12:#MO)
   ```

2. Display the ADDON equation menu.
3. Store or calculate the following variables:
   - Total number of months in the loan in [#MO].
   - Add-on interest rate as a percentage in [RATE].
   - Annual interest rate as a percentage in [I%YR].

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].
To key in # on the HP-17B and HP-27S, press [WXYZ] [OTHER] [#].

Example 1. What is the equivalent add-on rate for a 24-month loan with an APR of 13.5%?

Display the ADDON equation menu.

Keys:	Display:	Description:
24 [#MO]	#MO = 24.00	Stores known values.
13.5 [I%YR]	I%YR = 13.50	
[RATE]	RATE = 7.33	Calculates add-on rate.

Example 2: Part 1. A $15,000 loan with 36 monthly payments is quoted at an add-on rate of 9.5%. Calculate the APR.

Display the ADDON equation menu.

Keys:	Display:	Description:
36 [#MO]	#MO = 36.00	Stores known values.
9.5 [RATE]	RATE = 9.50	
[I%YR]	I%YR = 17.08*	Calculates APR.
[STO] 0	I%YR = 17.08	Stores value in register 0.

* The Solver searches for an iterative solution and displays intermediate estimates.

Part 2. Calculate the monthly payment.

TVM	17.08	Displays TVM menu.
■ CLEAR DATA		Clears TVM variables.
OTHER ■ CLEAR DATA EXIT		Sets 12 payments per year; End mode.
RCL 0 I%YR	I%YR = 17.08	Stores known values.
36 N	N = 36.00	
15000 PV	PV = 15,000.00	
PMT	PMT = −535.42	Calculates monthly payment.

Rent or Buy Decision

The question of whether to rent or buy a house is not always easy to answer, especially when the time period over which you would rent or own is short. The equation in this section helps you analyze from a financial standpoint whether it is in your best financial interest to rent or buy.

The analysis is based on the following assumptions:

- You have a conventional mortgage with fixed interest monthly payments.
- Interest on the mortgage and property taxes are tax deductible.
- You own the home for several years and then sell it.

To use the equations, you must know the following:

- Rental costs
  - Monthly rent
  - Refundable deposit
- House costs
  - Down payment
  - Closing costs
  - Monthly loan payment
  - Property taxes
  - Additional annual maintenance costs
  - Loan amount
  - Annual appreciation rate in property values
  - Selling commission rate
  - Annual interest rate on loan
  - Years between purchase and sale of home
- Other factors
  - Income tax rate
  - Required rate of return on investments

The RENT.OR.BUY equation calculates the net present value of a house purchase investment. If the net present value is positive, you prefer buying

over renting. If the net present value is negative, you prefer renting. In general, if you increase rent, buying becomes more attractive. The results of this equation are approximate, to be used for planning only. For more information, consult a tax accountant or a qualified tax or financial advisor.

Entering and Using the RENT.OR.BUY Equation:

Note

To enter and use this equation, you must have at least 1100 bytes of available memory. To check available memory, press ■ MEM.

1. Enter the RENT.OR.BUY equation into the Solver.*

```
RENT.OR.BUY:-DOWN-CLOSE+DEPST-(PMT×12
×(1-((PMT×YRS×12-(LOAN-(LOAN×SPFV(I%YR
÷12:YRS×12)-PMT×USFV(I%YR÷12:YRS×12))))
÷(PMT×YRS×12))×ITAX%÷100)+MNTC+PTAX×(1-
ITAX%÷100)-RENT×12)×USPV(IRR%:YRS)+
((LOAN+DOWN)×SPFV(APP%:YRS)×(1-COM%
÷100)-DEPST-(LOAN-PMT×USPV(I%YR÷12:
YRS×12))×SPFV(I%YR÷12:YRS×12))×SPPV
(IRR%:YRS)=NPV
```

2. Display the RENT.OR.BUY equation menu.
3. Store the following variables:
   - Down payment if you purchase the home in ≣ DOWN ≣.
   - Closing costs if you purchase the home in ≣ CLOSE ≣.
   - Refundable deposit if you rent in ≣ DEPST ≣.
   - Monthly mortgage payment in ≣ PMT ≣.

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.

- Number of years between purchase and sale of the home in [YRS].
- Loan amount in [LOAN].
- Annual interest rate on the loan in [I%YR].
- Income tax rate as a percentage in [ITAX%].
- Annual maintenance costs on the purchased home not incurred when renting in [MNTC].
- Annual property taxes in [PTAX].
- Monthly rent in [RENT].
- Required rate of return on investments in [IRR%].
- Annual appreciation rate of the home as a percentage in [APP%].
- Selling commission rate as a percentage in [COM%].

4. Press [NPV] to calculate the net present value of the investment of buying rather than renting.

Example: Part 1. If you buy a house, you pay $7,000 down, $2,000 at closing, and $1,800 in property taxes each year. You expect the house to appreciate at a rate of 3.5% each year. When you sell the house in 10 years, you expect to pay a 6% commission.

The annual interest rate on the $75,000 loan is 11.5%. The monthly payments are $742.72. The yearly maintenance costs above what you would pay if renting are $750.

If you rent, you pay a refundable deposit of $500 and $575 rent per month.

Your tax bracket is 28% and your required rate of return is 8%. Calculate the net present value of the investment in the house.

Display the RENT.OR.BUY equation menu.

7000 DOWN	DOWN = 7,000.00	Stores down payment.
2000 CLOSE	CLOSE = 2,000.00	Stores closing costs.
500 DEPST	DEPST = 500.00	Stores rental deposit.
742.72 PMT	PMT = 742.72	Stores monthly mortgage payment.
10 YRS	YRS = 10.00	Stores number of years.
MORE		
75000 LOAN	LOAN = 75,000.00	Stores loan amount.
11.5 I%YR	I%YR = 11.50	Stores interest rate.
28 ITAX%	ITAX% = 28.00	Stores income tax rate.
750 MNTC	MNTC = 750.00	Stores annual maintenance costs.
1800 PTAX	PTAX = 1,800.00	Stores property taxes.
MORE		
575 RENT	RENT = 575.00	Stores monthly rent.
8 IRR%	IRR% = 8.00	Stores required return on investments.
3.5 APP%	APP% = 3.50	Stores appreciation amount.
6 COM%	COM% = 6.00	Stores commission rate on sale.
NPV	NPV = −2,122.81	Calculates net present value.

Part 2. At what monthly rent are the two alternatives equivalent?

0 NPV	NPV = 0.00	Stores zero net present value.
RENT	RENT = 601.36	Calculates rent at which two alternatives are equal.

If the monthly rent is higher than $601.36 per month, you prefer to buy. If the rent is less, you prefer to rent.

3

Life Insurance

Universal Whole Life Insurance

Universal life insurance, a form of whole life insurance, combines insurance protection with an accumulation account that generally builds throughout the life of the insured. The benefit of the policy can be realized in two ways: the policy can be canceled and any cash value distributed to the policy owner (which may have negative tax implications), or, when the insured dies, an estate benefit is paid to the beneficiary of the policy.

Comparison of policies is often made by calculating the internal rate of return (IRR%) of the policies under consideration. The calculation uses the premiums as the cash invested, and the realized benefit (either estate or accumulated cash value) as the cash received. The equation below recognizes that the premium payment period may be less than the policy term being considered, as is typical in vanishing premium types of policies.

Entering and Using the ULIFE Equation:

1. Enter the ULIFE equation into the Solver.*

   ```
   ULIFE:PREM×(1+USPV(IRR%:IF(#P>#YRS:
   #YRS-1:#P-1)))-VAL×SPPV(IRR%:#YRS)
   ```

2. Display the ULIFE equation menu.
3. Store or calculate the following variables:
   - Annual premium of the policy in [PREM]. The first premium is paid today.
   - Annual internal rate of return of the policy as a percentage in [IRR%].
   - Number of premiums to be paid in [#P]. If premiums are to be paid for life, store an integer greater than or equal to *#YRS*.

---

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].
To key in # on the HP-17B and HP-27S, press [WXYZ] [OTHER] [#].
To key in > on the HP-17B and HP-27S, press [WXYZ] [OTHER] [>].

- Number of years to analyze the policy in [#YRS].
- Accumulated value or estate benefit at the end of *#YRS* in [VAL].

Note

#P and *#YRS* are not the age of the insured. If the policy is issued at age 30 and you want to know the accumulated value at age 55, then *#YRS* is 25.

Example. You are offered a life insurance policy that includes an accumulation account feature. The annual premium of $1,300 is to be paid for 10 years. If the balance in the accumulation account is projected to be $44,840 at the end of 20 years, what is the internal rate of return of the policy?

Display the ULIFE equation menu.

Keys:	Display:	Description:
1300 [PREM]	PREM=1,300.00	Stores annual premium.
10 [#P]	#P=10.00	Stores number of premiums to be paid.
20 [#YRS]	#YRS=20.00	Stores number of years to analyze policy.
44840 [VAL]	VAL=44,840.00	Stores accumulated value.
[IRR%]	IRR%=8.14*	Calculates internal rate of return.

* The Solver searches for an iterative solution and displays intermediate estimates.

Term Life Insurance

Note

This procedure cannot be done on the HP-27S. For an equation to calculate *NPV* and *IRR%* on the HP-27S, see appendix B, "Net Present Value and Internal Rate of Return on the HP-27S," on page 190.

Term life insurance policies provide life insurance protection without an accumulation account built into the policy.

You can compare term life insurance policies having equal amounts of protection by calculating the net present value of each policy. Use the CFLO menu to make this calculation. Because premiums for life insurance policies are paid at the beginning of each year, enter the first premium as the initial cash flow.

To calculate the net present value of term life insurance premiums:

1. Display the CFLO menu.
2. Press ■ CLEAR DATA YES to clear the list. (If you don't want to delete the list, name your old list and get a new list.)
3. Enter the first year premium as the initial cash flow.
4. Enter subsequent premiums and the number of times they occur.
5. In the CFLO CALC menu, store the annual savings rate as a percentage in I%.
6. Press NPV to calculate the net present value of the insurance premiums.

Example. You are offered a term life policy with the following premiums for 15 years:

Years	Annual Premium
1 (initial flow)	$390
2 – 5	$390
6 – 10	$650
11 – 15	$1,260

If the low risk savings rate is 6% annually, what is the net present value of the 15 premiums?

Display the CFLO menu.

Keys:	Display:	Description:
■ CLEAR DATA YES YES *or* GET *NEW	FLOW(0) = ?*	Clears current list or gets a new one.
390 INPUT	FLOW(1) = ?*	Stores cash flow for year 1.
INPUT 4 INPUT	FLOW(2) = ?	Stores cash flows for years 2 – 5.
650 INPUT 5 INPUT	FLOW(3) = ?	Stores cash flows for years 6 – 10.
1260 INPUT 5 INPUT	FLOW(4) = ?	Stores cash flows for years 11 – 15.

* On the HP-19B, these prompts are: INIT = and FLOW(1) =.

Skip the next step (pressing [EXIT]) if you have the HP-19B.

[EXIT]		
[CALC]		
6 [I%]	I% = 6.00	Stores annual savings rate.
[NPV]	NPV = 7,051.72	Calculates net present value of life insurance premiums.

4

Tax Deferral and Planning for Retirement

Equivalent Contribution

When analyzing retirement plans, one factor you should consider is whether contributions by you, or made on your behalf, are tax-deferred. Tax-deferred payments are actually greater than a similar investment in a non-deferred program. Any total return computation would be reduced by an amount equal to the taxes incurred on a payment received as ordinary income.

The following equation calculates the after-tax payment that would be equivalent to a tax-deferred payment.

Entering and Using the EQUIV Equation:

1. Enter the EQUIV equation into the Solver.*

   `EQUIV: BPMT×(1−MTX%÷100)=APMT`

2. Display the EQUIV equation menu.
3. Store or calculate the following variables:
   - Tax-deferred payment (before-tax contribution) in [BPMT].
   - Marginal income tax rate in [MTX%].
   - After-tax payment in [APMT].

Example. You have the option to contribute $1,500 into a tax-deferred compensation plan offered by your employer. You are in the 28% tax bracket. What would be the equivalent after-tax contribution to a non-tax deferred plan?

* To key in : on the HP-17B and HP 27S, press [WXYZ] [OTHER] [:].

Display the EQUIV equation menu.

Keys:	Display:	Description:
1500 BPMT	BPMT = 1,500.00	Stores before-tax payment amount.
28 MTX%	MTX% = 28.00	Stores marginal tax bracket.
APMT	APMT = 1,080.00	Calculates after-tax equivalent payment.

Value of Tax-Deferred and Non-Tax-Deferred Accounts at Retirement

The procedures in this section calculate the amount and the purchasing power of a tax-deferred account and of a non-tax- deferred account.

Value of Tax-Deferred Account

Use the TVM menu to calculate the amount in your account at retirement. Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

To calculate the value in a tax-deferred account:

1. Display the TVM menu.
2. Clear the TVM variables, store the number of payments per year in ≡ P/YR ≡, and set the payment mode (Begin or End).
3. Store the following variables:
   - Number of payments until you retire in ≡ N ≡.
   - Annual dividend rate in ≡ I%YR ≡.
   - Payment amount in ≡ PMT ≡.
4. Press ≡ FV ≡ to calculate the amount in the account at retirement.

Example: Part 1. Assume a 35-year investment period with a dividend rate of 8.175%. If you invest $2,000 at the beginning of each year in an IRA, how much will you have at retirement?

Display the TVM menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears TVM variables.
≡ OTHER ≡ 1 ≡ P/YR ≡ ≡ BEG ≡ EXIT		Sets 1 payment per year; Begin mode.

35 [N]	N = 35.00	Stores number of years until retirement.
8.175 [I%YR]	I%YR = 8.18	Stores dividend rate.
2000 [+/-] [PMT]	PMT = −2,000.00	Stores payment amount.
[FV]	FV = 387,640.45	Calculates amount in IRA at retirement.

Part 2. How much have you paid into the IRA?

[RCL] [PMT] [×]	−2,000.00×	Recalls payment amount.
[RCL] [N] [=]	−70,000.00	Total amount paid in.

Part 3. How much interest have you earned?

[+] [RCL] [FV] [=]	317,640.45	Calculates interest earned (difference between what you paid in and future value of the account).

Part 4. After retirement, you estimate that you will be taxed at 20%. What is the after-tax value?

[RCL] [FV] [−] 20 [%] [=]	310,112.36	Calculates value of account after taxes are paid at 20%.

Part 5. What is the purchasing power of that amount, in today's dollars, assuming 5% annual inflation?

[FV]	FV = 310,112.36	Stores future value of account.

0 PMT	PMT = 0.00	Stores zero payment.
5 I%YR	I%YR = 5.00	Stores inflation rate.
PV	PV = −56,220.36*	Calculates value of account after inflation.

Value of a Non-Tax-Deferred Account

You can also use the TVM menu to calculate the value of a non-tax-deferred account. Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

To calculate the value in a non-tax-deferred account:

1. Display the TVM menu.
2. Clear the TVM variables, store the number of payments per year in P/YR, and set the payment mode (Begin or End).
3. Store the following variables:
   - Number of payments until you retire in N.
   - Annual interest rate multiplied by (1 − (tax rate%÷100)) in I%YR.
   - Payment amount in PMT.
4. Press FV to calculate the future value of a taxed investment.

Example: Part 1. If you invest $2,000 at the beginning of each year, with dividends or interest taxed as ordinary income, how much will you have in the account at retirement? Assume a dividend rate of 8.175%, a tax rate of 28%, and an investment period of 35 years.

Display the TVM menu.

---

* Ignore the sign convention when analyzing the result.

Keys:	Display:	Description:
■ CLEAR DATA		Clears TVM variables.
OTHER 1 P/YR BEG EXIT		Sets 1 payment per year; Begin mode.
35 N	N=35.00	Stores number of years until retirement.
8.175 × (1 − 28 % I%YR	I%YR=5.89	Stores interest rate adjusted for taxes.
2000 +/− PMT	PMT=−2,000.00	Stores payment amount.
FV	FV=230,337.07	Calculates future value of a taxed account.

Part 2. What is the purchasing power of that amount in today's dollars, assuming 5% annual inflation?

0 PMT	PMT=0.00	Stores zero payment.
5 I%YR	I%YR=5.00	Stores inflation rate.
PV	PV=−41,757.87*	Calculates value of account after inflation.

* Ignore the sign convention when analyzing the result.

5

Certificates of Deposit

Introduction

A certificate of deposit (CD) is generally a short-term obligation offered by banks and savings institutions. A variety of maturities, ranging from seven days to ten years, are usually available.

When analyzing a CD, be sure to consider the following:

- Nominal interest rate.
- Compounding period.
- Compounding method.
- Effective yield.
- Penalty imposed for early withdrawal.

The applications in this chapter show you how to calculate the time to maturity, maximum term given date constraints, and penalty and yield on early withdrawal.

Time to Maturity and Maximum Term

The built-in TIME CALC menu can calculate the maturity date of a CD with a specified term. It can also calculate the maximum term, given a desired maturity date.

To calculate the maturity date or maximum term of a CD:

1. Display the TIME CALC menu.
2. Store the purchase date of the CD (in MM.DDYYYY format) in DATE1.
3. Store or calculate the following variables:
   - Number of days to maturity in DAYS.
   - Maturity date (in MM.DDYYYY format) in DATE2.

Example 1: CD Maturity Date. On August 4, 1988, you purchased a CD from your local savings institution. If the term of the CD is 180 days, when will your certificate mature?

Display the TIME CALC menu.

Keys:	Display:	Description:
8.041988 DATE1	DATE1=08/04/1988 THU	Stores purchase date.
180 DAYS	ACTUAL DAYS= 180.00	Stores days to maturity.
DATE2	DATE2=01/31/1989 TUE	Calculates maturity date.

Example 2: Desired Term. You receive your tax refund on March 14, 1988 and want to invest in a CD until you need the money on December 15. What is the maximum term you should consider?

Display the TIME CALC menu.

Keys:	Display:	Description:
3.141988 DATE1	DATE1 = 03/14/1988 MON	Stores purchase date.
12.151988 DATE2	DATE2 = 12/15/1988 THU	Stores latest maturity date.
DAYS	ACTUAL DAYS = 276.00	Calculates maximum term.

Penalty and Yield on Early Withdrawal

The equations in this section calculate the amount of the interest penalty for early withdrawal of a CD, and the yield once the penalty is known. The penalty equation in this section assumes that the interest penalty on the CD is stated as a number of days interest at simple interest. The number of penalty days must not exceed one year. The yield equation assumes simple interest is earned during any period less than one year.

To use these equations, you must know whether your CD uses an actual, 365-, or 360-day calendar. The three calendars are explained in the chapter on the TIME menus in the calculator owner's manual. Ask your financial institution which calendar applies to your CD.

This calculation is limited to the transaction between the original purchaser and the issuing financial institution. The equation does not calculate the yield of a CD that is bought or sold in a secondary market.

The variables in the PENALTY equation are shared with CDYIELD, so if you first calculate the penalty, you don't have to reenter values for *FACE*, *I%*, *P*, *DY/YR*, and *PNLT* in the CDYIELD equation.

Entering and Using the PENALTY and CDYIELD Equations:

1. Enter the PENALTY and CDYIELD equations into the Solver.*

```
PENALTY:FACE×((1+I%÷100÷P)^P-1)×
DAYS÷DY/YR=PNLT
```

```
CDYIELD:FACE=((FACE×(1+((1+I%÷100÷P)
^P-1)×FP(DDAYS(ISSUE:REDM:CAL)÷DY/YR))
×(1+I%÷100÷P)^P^IP(DDAYS(ISSUE:REDM:CAL)
÷DY/YR))-PNLT)÷(1+YLD%÷100×FP(DDAYS
(ISSUE:REDM:CAL)÷DY/YR))÷(1+YLD%÷100)
^IP(DDAYS(ISSUE:REDM:CAL)÷DY/YR)
```

---

* To key in : on the HP-17B and HP-27S, press ▒WXYZ▒ ▒OTHER▒ ▒:▒.
To key in ^ on the HP-17B and HP-27S, press ■ [y^x].
To key in / on the HP-17B and HP-27S, press ▒WXYZ▒ ▒OTHER▒ ▒MORE▒ ▒/▒.

2. If you need to calculate the penalty, display the PENALTY equation menu. Store the following variables:
   - Face amount of the CD in ≣ FACE ≣.
   - Nominal annual interest rate as a percentage in ≣ I% ≣.
   - Number of compounding periods per year in ≣ P ≣.
   - Number of days penalty for early withdrawal in ≣ DAYS ≣.
   - Number of days in a year in ≣ DY/YR ≣.

   Press ≣ PNLT ≣ to calculate the dollar amount of the penalty.
3. Display the CDYIELD equation menu. If you did not just calculate *PNLT*, store *FACE*, *I%*, *P*, and *DY/YR* as described in step 2. Also store *PNLT*. Then store the following variables:
   - Date the CD was issued (in MM.DDYYYY format) in ≣ ISSUE ≣.
   - Date the CD was redeemed (in MM.DDYYYY format) in ≣ REDM ≣.
   - Calendar identification number in ≣ CAL ≣:
     - 1 for the actual calendar
     - 2 for the 365-day calendar
     - 3 for the 30-day month, 360-day year financial calendar

   Press ≣ YLD% ≣ to calculate the annual yield on the CD.

Example: Part 1. A $3,000 CD you purchased earns interest at 7.125% annually, compounded monthly. It carries a penalty of 90 days of interest earnings if it is redeemed prior to maturity. What is the penalty if the financial institution uses a 365-day calendar?

Display the PENALTY equation menu.

Keys:	Display:	Description:
3000 ≣ FACE ≣	FACE=3,000.00	Stores CD amount.
7.125 ≣ I% ≣	I%=7.13	Stores interest rate.

12 [P]	P = 12.00	Stores compounding periods per year.
90 [DAYS]	DAYS = 90.00	Stores penalty days.
365 [DY/YR]	DY/YR = 365.00	Stores days in the year.
[PNLT]	PNLT = 54.46	Calculates penalty amount.

Part 2. You purchased the CD on April 25, 1988 and are surrendering the CD for early withdrawal on November 10, 1988. The financial institution uses the actual calendar. Calculate the yield over the period you have held the CD.

Display the CDYIELD equation menu.

4.251988 [ISSUE]	ISSUE = 4.25	Stores issue date.
11.101988 [REDM]	REDM = 11.10	Stores redemption date.
[MORE]		
1 [CAL]	CAL = 1.00	Stores actual calendar code.
[YLD%]	YLD% = 4.03*	Calculates effective annual yield.

* The Solver searches for an iterative solution and displays intermediate estimates.

6

Bonds

Introduction

The HP-17B and the HP-19B include a built-in BOND menu that calculates bond yield and bond price for a wide variety of bonds issued in the United States. For more information, read the appropriate section in the calculator owner's manual. For more information about bonds that can and cannot be solved using the BOND menu, see appendix C, "Bonds," in this book.

To do bond calculations, you must know:

- When the interest (coupon) payments are made, either semi-annually or annually.
- Which calendar the bond issuer uses, either the actual calendar (A/A), or the 30-day month, 360-day year (30/360) calendar. These two calendars are used in the BOND menu. Appendix C, on page 200 in this manual, will help you determine which calendar to use and which bonds you can solve. Check with your broker or dealer for information about the calendar for your bond.

To calculate the price and yield on interest at maturity notes and discounted notes, see chapter 7, "Notes."

Bond Price and Yield

Note

This procedure cannot be done on the HP-27S.

The calculation of bond price and yield is detailed in the calculator owner's manual. This section provides additional BOND menu examples for calculating price, yield to maturity, and yield to call.

To calculate the price or yield of a bond:

1. Display the BOND menu.
2. Press ■ [CLEAR DATA] to clear the bond variables and to set *CALL* = 100.
3. Define the type of bond by pressing [TYPE], followed by the appropriate calendar and coupon interval. Press [EXIT] to restore the BOND menu.
4. Store the following variables:
   - Settlement date in [SETT].
   - Maturity date or call date in [MAT]. When you calculate yield to call, the call date must be a coupon date.
   - Annual coupon rate as a percentage in [CPN%].
   - If you are calculating yield to call, call value in [CALL].
5. Do **a** and/or **b** and/or **c**:
   a. To calculate the price, store the yield to maturity in [YLD%]. Press [PRICE].
   b. To calculate the yield, store the price in [PRICE]. Press [YLD%].
   c. To calculate the accrued interest, press [ACCRU]. The *total* amount owed the seller is *PRICE* + *ACCRU*.

Example 1: Yield to Maturity. On June 3, 1988, you pay $113 per $100 of par value for a U.S. Treasury Bond with an 11.5% coupon rate. If the bond matures on December 15, 1998, what is the yield to maturity? The calendar basis is actual/actual with semi-annual coupon payments. Use the *MM.DDYYYY* date format.

Display the BOND menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears BOND variables.
TYPE A/A SEMI EXIT	A/A SEMIANNUAL	Sets bond type.
6.031988 SETT	SETT=06/03/1988 FRI	Stores settlement date.
12.151998 MAT	MAT=12/15/1998 TUE	Stores maturity date.
11.5 CPN%	CPN%=11.50	Stores annual coupon rate.
MORE		
113 PRICE	PRICE=113.00	Stores price per $100.
YLD%	YLD%=9.52	Calculates yield to maturity.

Example 2: Price. On February 28, 1989, you purchase an 8.5% U.S. Treasury Note that matures on September 16, 1996. If you require a yield to maturity of 9%, what price per $100 of par value would you be willing to pay? The calendar basis is actual/actual and the coupon payments are semi-annual. Use the *MM.DDYYYY* date format.

Display the BOND menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears BOND variables.

TYPE A/A SEMI EXIT	A/A SEMIANNUAL	Sets bond type.
2.281989 SETT	SETT=02/28/1989 TUE	Stores settlement date.
9.161996 MAT	MAT=09/16/1996 MON	Stores maturity date.
8.5 CPN%	CPN%=8.50	Stores annual coupon rate.
MORE		
9 YLD%	YLD%=9.00	Stores current yield.
PRICE	PRICE=97.30	Calculates price per $100 of face value.
+ ACCRU	97.30+3.87	Adds accrued interest owed the seller.
=	101.17	Calculates net price.

Example 3: Yield to Call. On September 8, 1988, you purchase a 9.75% corporate bond. The purchase price of the bond is $105 per $100 of par value. The bond matures on August 20, 2013 but a call provision allows the company to prepay the bond on February 20, 1998, a coupon payment date, at $102. The calendar basis is 30/360 and the coupon payments are made semi-annually. What is the yield to call? Use the *MM.DDYYYY* date format.

Display the BOND menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears BOND variables.
TYPE 360 SEMI EXIT	30/360 SEMI ANNUAL	Sets bond type.
9.081988 SETT	SETT=09/08/1988 THU	Stores settlement date.

2.201998 [MAT]	MAT=02/20/1998 FRI	Stores call date.
9.75 [CPN%]	CPN%=9.75	Stores annual coupon rate.
102 [CALL]	CALL=102.00	Stores call value.
[MORE]		
105 [PRICE]	PRICE=105.00	Stores price.
[YLD%]	YLD%= 9.09	Calculates yield to call.

Example 4: Yield of a Zero-Coupon Bond. You purchase a zero-coupon, semi-annual bond on April 4, 1988. The bond matures on June 22, 2010. The price is $11.50. The calendar basis is 30/360. Calculate the yield of the bond. Use the *MM.DDYYYY* date format.

Display the BOND menu.

Keys:	**Display:**	**Description:**
■ [CLEAR DATA]		Clears BOND variables; sets *CALL* to 100.
[TYPE] [360] [SEMI] [EXIT]	30/360 SEMI ANNUAL	Sets bond type.
4.041988 [SETT]	SETT=04/04/1988 MON	Stores settlement date.
6.222010 [MAT]	MAT=06/22/2010 TUE	Stores maturity date.
[MORE]		
11.5 [PRICE]	PRICE=11.50	Stores price.
[YLD%]	YLD%= 9.98	Calculates yield.

Current Yield

The current yield of a bond is often quoted. If you calculate the current yield of both taxable and tax-exempt bonds, you can compare these yields. The following equation helps you compare the before-tax and after-tax current yield of bonds.

Entering and Using the CYIELD Equation:

1. Enter the CYIELD equation into the Solver.*

```
CYIELD:IF(S(CYLD%):CPN%÷PRICE×100
-CYLD%:IF(S(ATAX%):CYLD%×(1-TAX%÷100)
-ATAX%:CYLD%÷(1-TAX%÷100)-BTAX%))
```

2. Display the CYIELD equation menu.
3. Store the following variables:
   - Coupon rate as a percentage in [CPN%].
   - Bond price per $100 par value in [PRICE].
4. Press [CYLD%] to calculate the current yield.
5. To calculate the before- or after-tax current yield:
   - Store or calculate current yield in [CYLD%].
   - Store the marginal tax rate as a percentage in [TAX%].
6. Press [ATAX%] to calculate the after-tax current yield.
7. Press [BTAX%] to calculate the before-tax current yield.

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

Example 1. Your broker tells you of a new debt issue with a coupon rate of 8.5%. If the current price is 103.99, what is the current yield?

Display the CYIELD equation menu.

Keys:	Display:	Description:
8.5 CPN%	CPN% = 8.50	Stores coupon rate.
103.99 PRICE	PRICE = 103.99	Stores current price.
CYLD%	CYLD% = 8.17	Calculates current yield.

Example 2. A corporate bond priced at 101.86 has a coupon of 10.95%. Your marginal income tax rate is 28%. Calculate the after-tax current yield on the corporate bond.

Display the CYIELD equation menu.

Keys:	Display:	Description:
10.95 CPN%	CPN% = 10.95	Stores coupon rate.
101.86 PRICE	PRICE = 101.86	Stores bond price.
CYLD%	CYLD% = 10.75	Calculates current yield.
28 TAX%	TAX% = 28.00	Stores tax rate.
ATAX%	ATAX% = 7.74	Calculates after-tax current yield.

Example 3. A municipal issue has a current yield of 7.1%. What yield for a taxable bond is equivalent to the 7.1% tax-exempt yield? Your tax rate is 28%.

Display the CYIELD equation menu.

Keys:	Display:	Description:
7.1 CYLD%	CYLD% = 7.10	Stores municipal bond current yield.
28 TAX%	TAX% = 28.00	Stores tax rate.
BTAX%	BTAX% = 9.86	Calculates before-tax equivalent yield.

Bond Premium Amortization

In some cases, tax regulations permit you to amortize the bond purchase premium or discount over the life of the bond. This amortization can be calculated using the built-in AMRT menu.

The procedure below assumes that the purchase date is a coupon date. When the purchase date is not a coupon date, the method gives a close approximation. The procedure also assumes that the bond price is the price per $100 face value and that the bond has semi-annual coupons.

Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

To amortize the bond premium:

1. Display the TVM menu.
2. Clear the TVM variables, store 2 as the number of payments per year in ≣ P/YR ≣, and select End mode.
3. Store the following variables:
   - Remaining number of coupon payments in ≣ N ≣.
   - Bond purchase price in ≣ PV ≣.
   - One-half of the coupon rate in ≣ PMT ≣.
   - One hundred in ≣ FV ≣.
4. Press ≣ I%YR ≣ to calculate the yield to maturity.
5. Display the AMRT menu.
6. Store 1 in ≣ #P ≣.
7. Press ≣ INT ≣ to calculate the amount of taxable income for that coupon period.
8. To calculate the amortized premium or discount, subtract the semi-annual coupon amount.
9. Press ≣ BAL ≣ to calculate the total book value of the bond.
10. To calculate the remaining unamortized premium or discount, subtract 100.
11. Press ≣ NEXT ≣ to calculate the next coupon period.

Example: Part 1. You are considering buying a bond at 108. The coupon rate is 14%. There are 30 coupon payments until maturity. The bond premium is to be amortized over the remaining coupon periods and taxed as ordinary income. Calculate the amount that will be reported as income during the first two coupon payment periods.

Display the TVM menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears TVM variables.
OTHER 2 P/YR END EXIT		Sets 2 payments per year; End mode.
30 N	N = 30.00	Stores number of coupon payments.
14 ÷ 2 PMT	PMT = 7.00	Stores semi-annual coupon amount.
108 +/− PV	PV = −108.00	Stores bond price.
100 FV	FV = 100.00	Stores bond redemption value.
I%YR	I%YR = 12.79	Calculates yield to maturity.
OTHER AMRT		Displays amortization menu.
1 #P	#P = 1 PMTS: 1 − 1	Stores period number.

The next step (pressing INT) is necessary if you have the HP-17B or HP-27S.

INT	INTEREST = 6.91	Calculates taxable income for period 1.
NEXT INT	INTEREST = 6.90	Calculates taxable income for period 2.

Part 2. Calculate the remaining unamortized bond premium.

BAL + 100 =	−7.81	Calculates unamortized purchase premium at the end of period 2.

After-Tax Bond Yield

Tax law changes have complicated the calculation of after-tax bond yield because bond purchase discount or premium can be handled in several ways. This section provides solutions for three methods.

- Capital gain method – the discount or premium is taxed as capital gain, the coupon payment is taxed as regular income.
- Actuarial amortization method – the discount or premium is amortized on an actuarial basis over the remaining coupon payment periods at an interest rate that is the before-tax bond yield. To calculate the amount that is amortized each period, see "Bond Premium Amortization" on page 107.
- Straight-line amortization method – the discount or premium is amortized on a straight-line basis over the remaining coupon payment periods.

The procedures in this section assume that the bond is purchased on a coupon date and that periodic coupon payments are treated as regular income.

Capital Gain Method

When using the capital gain method, after-tax bond yield can be calculated using the TVM menu. If you do this calculation often, you may want to use the Solver equation on page 112.

This method reduces the coupon payment by the income tax on the coupon payment and adjusts the redemption value. If the bond is purchased at a discount, the capital gains tax reduces the redemption value. If purchased at a premium, the tax savings is added to the redemption value.

TVM Solution. Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

To calculate the after-tax bond yield using the capital gain method:

1. Display the TVM menu.

2. Clear the TVM variables, store 2 as the number of payments per year in [P/YR], and select End mode.
3. Store the number of coupon payments in [N].
4. Store the bond purchase price in [PV].
5. Calculate the after-tax coupon payment by dividing the annual coupon payment by 2, then multiplying by (1 − decimal tax rate). Store it in [PMT].
6. Calculate the net redemption amount by subtracting the purchase price from 100, then multiplying by the capital gains tax rate. If you purchased the bond at a discount, subtract the result from 100; if you purchased at a premium, add it to 100. Store the result in [FV].
7. Press [I%YR] to calculate the after-tax bond yield.

Example. You pay 96 for a bond with a 10% coupon rate and 20 coupon payments. Your income tax rate is 28%. The coupon payments are taxed as regular income; the bond discount is taxed as a capital gain at one-half your tax rate. Calculate the estimate of the after-tax bond yield.

Display the TVM menu.

Keys:	Display:	Description:
■ [CLEAR DATA]		Clears TVM variables.
[OTHER] 2 [P/YR] [END] [EXIT]		Sets 2 payments per year; End mode.
20 [N]	N=20.00	Stores number of coupon payments.
96 [+/−] [PV]	PV=−96.00	Stores bond price.
10 [÷] 2 [×]	5.00×	Calculates coupon payment amount.
[(] 1 [−] .28 [PMT]	PMT=3.60	Stores after-tax coupon payment amount.
100 [−] 96 [=]	4.00	Calculates difference between purchase price and 100.

[×] .28 [÷] 2 [=]	0.56	Calculates capital gains tax on bond purchase discount.
[+/−] [+] 100 [FV]	FV = 99.44	Calculates and stores net cash received at maturity.
[I%YR]	I%YR = 7.74	Calculates after-tax bond yield.

Solver Equation. If you often calculate after-tax bond yield using the capital gain method, you may prefer to use the following equation.

Entering and Using the CGYIELD Equation:

1. Enter the CGYIELD equation into the Solver.*

```
CGYIELD:IF(S(ATY%):0×N×CPN%−PRICE
+0×BTY%+(1−TAX%÷100)×CPN%÷2×USPV
(ATY%÷2:N)+(100−(100−PRICE)×CGT%
÷100)×SPPV(ATY%÷2:N):USPV(BTY%÷2:N)
×CPN%÷2+100×SPPV(BTY%÷2:N)−PRICE)
```

2. Display the CGYIELD equation menu.
3. Store or calculate the following variables:
   - Number of coupon payments to maturity in [N].
   - Annual coupon rate as a percentage in [CPN%].
   - Bond purchase price in [PRICE].
   - Before-tax bond yield as a percentage in [BTY%].
4. Store the following variables:
   - Income tax rate as a percentage in [TAX%].
   - Capital gains tax rate as a percentage in [CGT%].
5. Press [ATY%] to calculate the after-tax bond yield.

---

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

Example: Part 1. You pay 96 for a bond with a 10% coupon rate and 20 coupon payments. Calculate the estimate of the before-tax bond yield.

Display the CGYIELD menu.

Keys:	Display:	Description:
20 [N]	N = 20.00	Stores number of coupon payments.
10 [CPN%]	CPN% = 10.00	Stores annual coupon rate.
96 [PRICE]	PRICE = 96.00	Stores bond price.
[BTY%]	BTY% = 10.66*	Calculates before-tax yield.

Part 2. Continuing from part 1, your income tax rate is 28%. The coupon payments are taxed as regular income; the bond discount is taxed as a capital gain at one-half your tax rate. Calculate the estimate of the after-tax bond yield.

28 [TAX%]	TAX% = 28.00	Stores income tax rate.
[MORE]		
14 [CGT%]	CGT% = 14.00	Stores capital gains tax rate.
[ATY%]	ATY% = 7.74*	Calculates after-tax bond yield.

* The Solver searches for an iterative solution and displays intermediate estimates.

Actuarial Amortization Method

In some situations, current tax regulations permit bond premiums to be amortized over the life of the bond at the before-tax yield rate. "Bond Premium Amortization" on page 107 shows how to calculate the amount of the premium or discount that is accrued each coupon payment period. To estimate the after-tax bond yield using the actuarial amortization method, use the following equation.

Entering and Using the ACTYIELD Equation:

1. Enter the ACTYIELD equation into the Solver.*

```
ACTYIELD:IF(S(ATY%):0×N×CPN%-PRICE+0
×BTY%+(1-TAX%÷100)×((PRICE×BTY%÷200-
CPN%÷2)×(1÷(1+ATY%÷200)-SPFV(BTY%÷
2:N)÷SPFV(ATY%÷2:N+1))÷(1-(1+BTY%÷
200)÷(1+ATY%÷200))+CPN%÷2×USPV(ATY%÷
2:N))+100×SPPV(ATY%÷2:N):USPV(BTY%÷
2:N)×CPN%÷2+100×SPPV(BTY%÷2:N)-PRICE)
```

2. Display the ACTYIELD equation menu.
3. Store or calculate the following variables:
   - Number of coupon payments to maturity in [N].
   - Annual coupon rate as a percentage in [CPN%].
   - Bond purchase price in [PRICE].
   - Before-tax bond yield as a percentage in [BTY%].
4. Store income tax rate as a percentage in [TAX%].
5. Press [ATY%] to calculate the after-tax bond yield.

---

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

Example. You pay 108 for a bond with a 14% coupon rate and 30 coupon payments. Your income tax rate is 28%. The bond premium is to be amortized over the remaining coupon payment periods and taxed as ordinary income. Calculate the estimate of the before-tax and after-tax bond yields.

Display the ACTYIELD menu.

Keys:	Display:	Description:
30 N	N=30.00	Stores number of coupon payments.
14 CPN%	CPN%=14.00	Stores annual coupon rate.
108 PRICE	PRICE=108.00	Stores bond price.
BTY%	BTY%=12.79*	Calculates before-tax yield.
28 TAX%	TAX%=28.00	Stores income tax rate.
ATY%	ATY%=8.79*	Calculates after-tax bond yield.

Straight-Line Amortization Method

In this amortization method, you accrue an equal part of the discount or premium each coupon period using straight-line amortization.

The bond purchase discount or premium is treated as ordinary income and you can use the TVM menu to calculate the after-tax bond yield. If you do this calculation often, you may want to enter the Solver equation on page 118.

---

* The Solver searches for an iterative solution and displays intermediate estimates.

TVM Solution. Remember to use the cash-flow sign convention: Money paid out is negative, money received is positive.

To calculate the after-tax bond yield using the straight-line method:

1. Display the TVM menu.
2. Clear the TVM variables, store 2 as the number of payments per year in [P/YR], and select End mode.
3. Store the number of coupon payments to maturity in [N].
4. Store the bond purchase price in [PV].
5. Calculate the semi-annual after-tax cash payment:
   - Divide the bond purchase discount or premium by the total number of coupon payments to calculate the periodic straight-line amortization of the discount or premium.
   - Divide the annual coupon payment by 2 to calculate the semi-annual coupon payment.
   - If the bond is purchased at a discount, add the amortization amount to the semi-annual coupon payment to calculate the before-tax semi-annual cash payment.
   - If the bond is purchased at a premium, subtract the amortization of the premium from the semi-annual coupon payment to calculate the before-tax semi-annual cash payment.
   - Store the result in [PMT].
6. Store 100 as the redemption value in [FV].
7. Press [I%YR] to calculate the after-tax bond yield.

Example. You pay 96 for a bond with a 10% coupon rate and 20 coupon payments. Your income tax rate is 28%. The coupon payments are taxed as regular income; the bond discount is amortized on a straight-line basis and taxed as regular income. Calculate the estimate of the after-tax bond yield.

Display the TVM menu.

Keys:	Display:	Description:
■ CLEAR DATA		Clears TVM variables.
OTHER 2 P/YR END EXIT		Sets 2 payments per year; End mode.
20 N	N = 20.00	Stores number of coupon payments.
96 +/− PV	PV = −96.00	Stores bond price.
10 ÷ 2 = STO 0	5.00	Calculates and stores coupon payment amount.
100 − 96 =	4.00	Calculates bond purchase discount.
÷ 20 =	0.20	Calculates straight-line amortization of bond purchase discount.
+ RCL 0 =	5.20	Calculates amortized bond discount plus coupon payment.
× (1 − .28 PMT	PMT = 3.74	Stores after-tax coupon payment amount.
100 FV	FV = 100.00	Stores redemption value.
I%YR	I%YR = 8.08	Calculates after-tax bond yield.

Solve Equation. If you often calculate after-tax bond yield using the straight-line method, you may prefer to use the following equation.

Entering and Using the SLYIELD Equation:

1. Enter the SLYIELD equation into the Solver.*

```
SLYIELD:IF(S(ATY%):0×N×CPN%−PRICE
+0×BTY%+(1−TAX%÷100)×(CPN%÷2+(100−
PRICE)÷N)×USPV(ATY%÷2:N)+100×SPPV
(ATY%÷2:N):USPV(BTY%÷2:N)×CPN%÷2
+100×SPPV(BTY%÷2:N)−PRICE)
```

2. Display the SLYIELD equation menu.
3. Store or calculate the following variables:
   - Number of coupon payments to maturity in [N].
   - Annual coupon rate as a percentage in [CPN%].
   - Bond purchase price in [PRICE].
   - Before-tax bond yield as a percentage in [BTY%].
4. Store the income tax rate as a percentage in [TAX%].
5. Press [ATY%] to calculate the after-tax bond yield.

Example: Part 1. You pay 96 for a bond with a 10% coupon rate and 20 coupon payments. Calculate the estimate of the before-tax bond yield.

Display the SLYIELD menu.

Keys:	Display:	Description:
20 [N]	N=20.00	Stores number of coupon payments.

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

10 CPN%	CPN% = 10.00	Stores annual coupon rate.
96 PRICE	PRICE = 96.00	Stores bond price.
BTY%	BTY% = 10.66*	Calculates before-tax yield.

Part 2. Continuing from part 1, your income tax rate is 28%. The coupon payments are taxed as regular income. Calculate the estimate of the after-tax bond yield.

28 TAX%	TAX% = 28.00	Stores income tax rate.
ATY%	ATY% = 8.08*	Calculates after-tax bond yield.

* The Solver searches for an iterative solution and displays intermediate estimates.

Convertible Bonds

Convertible bonds, also called *convertible debentures* or simply *convertibles*, let you convert a bond into shares of the issuer's common stock.

The evaluation of convertibles, as with any marketable security, is far from an exact science. The yield to maturity and yield to call calculations presented earlier in this chapter also apply to convertible bonds. You should also consider the value of the underlying common stock if you were to convert the bond and the premium you will pay for the conversion privilege.

The CVTBND equation calculates the theoretical stock value and conversion premium for a convertible bond.

Entering and Using the CVTBND Equation:

1. Enter the CVTBND equation into the Solver.*

   ```
   CVTBND:IF(S(SVAL):#SH×STK$-SVAL:
   100×BND$÷(100+CVPR%)-SVAL)
   ```

2. Display the CVTBND equation menu.
3. To calculate the stock value of one bond:
   - Store the number of shares each bond can be converted to in [#SH].
   - Store the current market price per share of common stock in [STK$].
   - Press [SVAL] to calculate the stock value of one bond.

---

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].
To key in # on the HP-17B and HP-27S, press [WXYZ] [OTHER] [#].
To key in $ on the HP-17B and HP-27S, press [WXYZ] [OTHER] [MORE] [$].

4. To calculate the conversion premium percentage:
   - Store or calculate the stock value of one bond in SVAL.
   - Store the purchase price of one bond in BND$.
   - Press CVPR% to calculate the conversion premium percentage.

Example: Part 1. You purchase a convertible bond that allows you to convert to the underlying stock at the rate of 24 shares of common stock per bond. If the current market price of the stock is $43 a share, what is the theoretical stock value of the convertible bond?

Display the CVTBND equation menu.

Keys:	Display:	Description:
24 #SH	#SH=24.00	Stores number of shares per bond.
43 STK$	STK$=43.00	Stores price per share.
SVAL	SVAL=1,032.00	Calculates stock value of a convertible bond.

Part 2. Continuing from part 1, if the current purchase price of the convertible bond is $1,240, what is the conversion premium as a percentage?

1240 BND$	BND$=1,240.00	Stores purchase price of bond.
CVPR%	CVPR%=20.16	Calculates percentage premium paid in excess of stock value.

Duration of a Bond

The duration of a bond is the average time that elapses until the various cash flows (coupons and redemption value) are received. In other words, the duration is a weighted average of the number of periods until the payments occur. For coupon-bearing bonds, the duration is always shorter than the term to maturity. For zero-coupon bonds, duration is equal to maturity. (The DURATION equation assumes semi-annual coupon payments.)

Entering and Using the DURATION Equation:

1. Enter the DURATION equation into the Solver.*

```
DURATION: ($CPN×(SPFV(YLD%÷2:N+1)-
(1+YLD%÷200)-YLD%÷200×N)÷(YLD%
÷200)^2÷SPFV(YLD%÷2:N)+RDV×N÷SPFV
(YLD%÷2:N))=(USPV(YLD%÷2:N)×$CPN+SPPV
(YLD%÷2:N)×RDV)×DUR×2
```

2. Display the DURATION equation menu.
3. Store the following variables:
   - Dollar amount of each coupon in [$CPN].
   - Annual yield to maturity as a percentage in [YLD%].
   - Total number of coupons in [N].
   - Redemption value in [RDV].
4. Press [DUR] to calculate the number of periods in the duration.

---

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].
To key in $ on the HP-17B and HP-27S, press [WXYZ] [OTHER] [MORE] [$].
To key in ^ on the HP-17B and HP-27S, press ■ [y^x].

Example. A bond pays a semi-annual coupon of $60 for five years. The redemption value of the bond is $1,000 and the annual yield is 13.5%. Calculate the duration.

Display the DURATION equation menu.

Keys:	Display:	Description:
60 $\boxed{\text{\$CPN}}$	$CPN = 60.00	Stores amount of each coupon.
13.5 $\boxed{\text{YLD\%}}$	YLD% = 13.50	Stores annual yield.
5 $\boxed{\times}$ 2 $\boxed{\text{N}}$	N = 10.00	Stores total number of coupons.
1000 $\boxed{\text{RDV}}$	RDV = 1,000.00	Stores redemption value.
$\boxed{\text{DUR}}$	DUR = 3.87	Calculates duration in years.

Reference: Jess H. Chua, *A Closed-Form Formula for Calculating Bond Duration*, Financial Analysts Journal, May-June 1984.

7

Notes

Interest at Maturity Notes

A *note* is a written agreement to pay a sum of money, plus interest, at a certain date. Notes do not have periodic coupons, since all interest is paid at maturity.

The price and yield of a note can be calculated using the following equations. The price is stated per 100 face value of the note. Three calendar options are available: 30/360, actual/360, and actual/actual.

Entering and Using the Note Equations:

1. Enter the 360NOTE and/or 365NOTE equations into the Solver.*
   - For notes on a 30/360 day basis:

     ```
     360NOTE:(DDAYS(ISSUE:SETT:3)+0×MAT)÷
     360×I%+PRICE=(1+(DDAYS(ISSUE:MAT:3)÷
     360)×I%÷100)÷(1+(DDAYS(SETT:MAT:3)÷
     360)×YLD%÷100)×100
     ```

   - For notes on an actual/360 or actual/actual day basis:

     ```
     365NOTE:(DDAYS(ISSUE:SETT:1)+0×MAT)÷
     BASIS×I%+PRICE=(1+(DDAYS(ISSUE:MAT:1)÷
     BASIS)×I%÷100)÷(1+(DDAYS(SETT:MAT:1)÷
     BASIS)×YLD%÷100)×100
     ```

2. Display the menu for the appropriate equation.

* To key in : on the HP-17B and HP-27S, press ▒ WXYZ ▒ ▒ OTHER ▒ ▒ : ▒.

3. Store the following variables:
   - Issue date (in MM.DDYYYY format) in [ISSUE].
   - Settlement date (in MM.DDYYYY format) in [SETT].
   - Maturity date (in MM.DDYYYY format) in [MAT].
   - If you are using the 365NOTE equation, store the number of days in a calendar year (either 360 or 365) in [BASIS].
   - Annual interest rate as a percentage in [I%].
4. Do **a** or **b**.
   a. To calculate the price, store the annual yield as a percentage in [YLD%] and press [PRICE].
   b. To calculate the annual yield, store the purchase price in [PRICE] and press [YLD%].

Example: Part 1. Price of Tax Exempt Note. Calculate the price of the following tax exempt note. The note uses a 30/360 day calendar.

Issue date: January 4, 1988
Settlement date: March 21, 1988
Maturity date: July 5, 1988
Interest: 5%
Yield: 6.2%

Display the 360NOTE equation menu.

Keys:	Display:	Description:
1.041988 [ISSUE]	ISSUE = 1.04	Stores known values.
3.211988 [SETT]	SETT = 3.21	
7.051988 [MAT]	MAT = 7.05	
5 [I%]	I% = 5.00	
6.2 [YLD%]	YLD% = 6.20	
[PRICE]	PRICE = 99.64	Calculates note price.

Part 2: Yield of Tax Exempt Note. If the note was purchased for 99.5, what is the yield?

99.5 PRICE	PRICE = 99.50	Stores purchase price.
YLD%	YLD% = 6.69	Calculates note yield.

Example 2. Repurchase Agreement. Calculate the price of the following repurchase agreement that uses an actual/360 calendar.

Issue date: March 1, 1988
Settlement date: March 23, 1988
Maturity date: September 1, 1988
Interest: 6%
Yield: 6.5%

Display the 365NOTE equation menu.

Keys:	Display:	Description:
3.011988 ISSUE	ISSUE = 3.01	Stores known values.
3.231988 SETT	SETT = 3.23	
9.011988 MAT	MAT = 9.01	
360 BASIS	BASIS = 360.00	
6 I%	I% = 6.00	
MORE		
6.5 YLD%	YLD% = 6.50	
PRICE	PRICE = 99.77	Calculates note price.

Discounted Notes

A *discounted note* is a note that has no stated interest rate. These notes are purchased at a discount and the face value of the note is paid at maturity. The difference between the discount price and the maturity value is the interest earned.

The following equation calculates the price and/or yield of a discounted note. The equation assumes that the calendar basis is actual/360.

Entering and Using the DISC.NOTE Equation:

1. Enter the DISC.NOTE equation into the Solver.*

   ```
   DISC.NOTE:IF(S(PRICE):RV-DISC×RV×
   DDAYS(SETT:MAT:1)÷36000-PRICE:(RV-
   PRICE)÷PRICE×36000÷DDAYS(SETT:
   MAT:1)-YLD%)
   ```

2. Display the DISC.NOTE equation menu.
3. Store the following variables:
   - Redemption value per $100 in ≣ RV ≣.
   - Discount rate as a percentage in ≣ DISC ≣.
   - Settlement date (in MM.DDYYYY format) in ≣ SETT ≣.
   - Maturity date (in MM.DDYYYY format) in ≣ MAT ≣.
4. Press ≣ PRICE ≣ to calculate the purchase price. If you know the price, store it if you want to calculate yield.
5. Press ≣ YLD% ≣ to calculate the yield.

---

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.

Example 1: Treasury Bill. Calculate the price and yield of the following U.S. Treasury Bill: settlement date October 14, 1987; maturity date March 17, 1988; discount rate 8.7%.

Display the DISC.NOTE equation menu.

Keys:	Display:	Description:
10.141987 SETT	SETT = 10.14	Stores known values.
3.171988 MAT	MAT = 3.17	
8.7 DISC	DISC = 8.70	
100 RV	RV = 100.00	
PRICE	PRICE = 96.25	Calculates price.
YLD%	YLD% = 9.04	Calculates yield.

Example 2: Discounted Note. Determine the yield of the following discounted note: settlement date June 25, 1987; maturity date September 10, 1987; price 99.45; redemption value 101.33.

Display the DISC.NOTE equation menu.

Keys:	Display:	Description:
6.251987 SETT	SETT = 6.25	Stores known values.
9.101987 MAT	MAT = 9.10	
99.45 PRICE	PRICE = 99.45	
101.33 RV	RV = 101.33	
YLD%	YLD% = 8.84	Calculates yield.

8

Common Stock

Simple Earnings Valuation Model

The simple earnings valuation model is used to determine the yield of a stock based on its earnings and market price.

Entering and Using the YLD% Equation:

1. Enter the *YLD%* equation into the Solver.

   YLD%=EPS÷PPS×100

2. Display the *YLD%* equation menu.
3. Store or calculate the following variables:
   - Stock earnings yield as a percentage in ≣ YLD% ≣.
   - Current earnings per share of common stock in ≣ EPS ≣.
   - Current price per share of common stock in ≣ PPS ≣.

Example. A stock you are considering costs $50 per share. If the earnings per share is $2.50, what is the earnings yield?

Display the *YLD%* equation menu.

Keys:	Display:	Description:
50 ≣ PPS ≣	PPS=50.00	Stores current price per share.
2.5 ≣ EPS ≣	EPS=2.50	Stores current earnings per share.
≣ YLD% ≣	YLD%=5.00	Calculates earnings yield per share.

Dividend Valuation Model

The dividend valuation model bases the value of a share of common stock on the dividends paid over time. It is a useful tool for comparing the stock in companies that have comparable dividend policies.

Entering and Using the DIV Equation:

1. Enter the *DIV* equation into the Solver.

   `DIV=PPS×YLD%÷100`

2. Display the *DIV* equation menu.
3. Store or calculate the following variables:
   - Current annual dividend per share of common stock in ≣ DIV ≣.
   - Current price per share of common stock in ≣ PPS ≣.
   - Dividend yield per share of common stock in ≣ YLD% ≣.

Example. You are considering the purchase of stock at $30 per share. The company pays a quarterly dividend of $0.3125 per share. What is the annual dividend yield?

Display the *DIV* equation menu.

Keys:	Display:	Description:
30 ≣ PPS ≣	PPS=30.00	Stores current price per share.
.3125 × 4 ≣ DIV ≣	DIV=1.25	Stores current annual dividend per share.
≣ YLD% ≣	YLD%=4.17	Calculates dividend yield per share.

Price/Earnings Ratio Model

The price/earnings ratio, or P/E ratio, is perhaps the most common ratio for basic stock analysis. It measures the price the market is willing to pay for each dollar of earnings that a stock is generating.

Entering and Using the PE Equation:

1. Enter the *PE* equation into the Solver.

   PE=PPS÷EPS

2. Display the *PE* equation menu.
3. Store or calculate the following variables:
   - Price/earnings ratio for a share of common stock in ≣ PE ≣.
   - Current price per share of common stock in ≣ PPS ≣.
   - Current earnings per share of common stock in ≣ EPS ≣.

Example. The current market price of a stock is $25 per share. If the earnings are $1.75 per share annually, what is the P/E ratio?

Display the *PE* equation menu.

Keys:	Display:	Description:
25 ≣ PPS ≣	PPS=25.00	Stores current price per share.
1.75 ≣ EPS ≣	EPS=1.75	Stores current earnings per share.
≣ PE ≣	PE=14.29	Calculates P/E ratio.

Beta Coefficient

The beta coefficient is a measure of the risk of a stock. When the beta coefficient equals 0, the return is said to be riskless. When beta equals 1.00, the risk equals the risk of an investment in a diversified portfolio of stocks. In general, the higher the beta, the greater the risk.

Typically, two components from the financial marketplace are used to establish risk levels:

- Rate of return for a totally risk-free investment, usually indicated by the return on 91-day Treasury Bills.
- Rate of return for a hypothetical diversified portfolio of equity-oriented securities, usually measured by the Standard & Poor's 500.

The difference between the risk-free yield in the equation and the estimated total return on a hypothetical portfolio of stocks represents the premium paid to the individual who is willing to accept the risk.

Estimating the Beta of a Stock

The following equation calculates an estimate of the beta coefficient for a stock.

Entering and Using the Beta Equation:

1. Enter the *BETA* equation into the Solver.

   `BETA=(STK%-TBIL%)÷(MKT%-TBIL%)`

2. Display the *BETA* equation menu.
3. Store or calculate the following variables:
   - Estimated annual return for stock in ≣ STK% ≣.
   - Current yield on 91-day Treasury Bills in ≣ TBIL% ≣.
   - Estimated annual return for hypothetical market in ≣ MKT% ≣.
   - Beta coefficient of the stock in ≣ BETA ≣.
4. To calculate the premium paid for the risk, subtract the T-bill yield from the estimated market return.

Example: Part 1. The anticipated annual return of a stock is 15%. If the current risk-free yield on a 91-day Treasury Bill is 5.52%, and the estimated total return on the Standard & Poor's 500 is 13.25%, what is the beta coefficient of this stock?

Display the *BETA* equation menu.

Keys:	Display:	Description:
15 STK%	STK% = 15.00	Stores annual return on stock.
5.52 TBIL%	TBIL% = 5.52	Stores T-bill yield.
13.25 MKT%	MKT% = 13.25	Stores return for hypothetical market.
BETA	BETA = 1.23	Calculates beta coefficient for the stock.

Part 2. What is the premium paid for the risk?

RCL MKT%	MKT% = 13.25	Recalls previously stored values.
− RCL TBIL%	13.25 − 5.52	
=	7.73	Calculates premium.

Estimating the Beta of a Stock Portfolio

To calculate the estimated beta coefficient of a portfolio of several stocks, you must know for each stock, the number of shares owned, the current market price per share, and a fairly accurate estimate of the anticipated return. You must also know an estimate of the total return of a market portfolio of equities, and the annual return of a riskless investment.

To use the PBETA equation, you must first store your stock portfolio data into SUM lists (STAT lists, for the HP-27S). Be sure to enter information in each list in the same order.

Entering and Using the PBETA Equation:

1. Display the SUM menu (the STAT menu on the HP-27S).
   - Enter the number of shares of each stock into a list and name it *#SHR*.
   - Enter the current market price of each stock into a list and name it *$SHR*.
   - Enter the estimate of the annual return on each stock into a list and name it *R%*.
2. Enter the PBETA equation into the Solver.*

```
PBETA:0×TBIL%×MKT%+IF(S(VALUE):Σ
(J:1:SIZES(#SHR):1:ITEM(#SHR:J)×
ITEM($SHR:J))-VALUE:IF(S(PBETA):
(Σ(K:1:SIZES(#SHR):1:ITEM(#SHR:K)
×ITEM($SHR:K)×(ITEM(R%:K)-TBIL%)
÷(MKT%-TBIL%)))÷VALUE-PBETA:0))
```

3. Display the PBETA equation menu.
4. Store the following variables:
   - Estimated return of a riskless security in ≣ TBIL% ≣.
   - Estimated market return in ≣ MKT% ≣.
5. Press ≣ VALUE ≣ to calculate the value of the portfolio.
6. Press ≣ PBETA ≣ to calculate the beta coefficient of the portfolio.

---

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.
To key in Σ on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ MORE ≣ ≣ Σ ≣.
To key in # on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ # ≣.
To key in $ on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ MORE ≣ ≣ $ ≣.

Example. The following table represents your current stock portfolio. If the current risk-free yield on a 91-day Treasury Bill is 7.23%, and the estimated total return on the Standard & Poor's 500 for the same period is 14.96%, what is the estimated beta coefficient of your portfolio?

Issue	Number of Shares *#SHR*	Market Value Per Share *$SHR*	Estimated Total Return *R%*
1	300	$20.00	16.74%
2	200	$25.00	19.68%
3	100	$40.00	21.69%
4	85	$58.82	13.72%
5	250	$32.00	11.71%
6	40	$50.00	17.74%

The solution below assumes that you have the numbers above in the appropriate SUM or STAT lists. As a check, your list totals should be as follows:

- *#SHR* = 975.00.
- *$SHR* = 225.82.
- *R%* = 101.28.

Display the PBETA equation menu.

Keys:	Display:	Description:
7.23 TBIL%	TBIL% = 7.23	Stores annual T-bill yield.
14.96 MKT%	MKT% = 14.96	Stores estimated annual market return.
VALUE	VALUE = 29,999.70	Calculates current value of your portfolio.
PBETA	PBETA = 1.15	Calculates beta coefficient.

Price Targeting

The following equation is a method to calculate the price at which to sell a stock to achieve a particular yield.

Entering and Using the STOCKPRICE Equation:

1. Enter the STOCKPRICE equation into the Solver.*

   ```
   STOCKPRICE:#SHR×BPRC+BCOM=
   (#SHR×SPRC−SCOM)×SPPV(YLD%:#YRS)
   ```

2. Display the STOCKPRICE equation menu.
3. Store or calculate the following variables:
   - Number of shares of stock to be bought in ≣ #SHR ≣.
   - Buying price per share in ≣ BPRC ≣.
   - Buying commission in ≣ BCOM ≣.
   - Selling price per share in ≣ SPRC ≣.
   - Selling commission in ≣ SCOM ≣.
   - Annual yield desired as a percentage in ≣ YLD% ≣.
   - Number of years that stock is held in ≣ #YRS ≣.

Example. You purchased 100 shares of common stock at $20 per share. The commission on the buy was $40, and it will cost you an additional $40 to sell the stock. You want to sell the stock in one year and receive an annual yield of 15%. What price must the stock reach to achieve your target yield?

---

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.
To key in # on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ # ≣.

Display the STOCKPRICE equation menu.

Keys:	Display:	Description:
100 #SHR	#SHR = 100.00	Stores number of shares.
20 BPRC	BPRC = 20.00	Stores buying price.
40 BCOM	BCOM = 40.00	Stores buying commission.
40 SCOM	SCOM = 40.00	Stores selling commission.
MORE		
15 YLD%	YLD% = 15.00	Stores required yield.
1 #YRS	#YRS = 1.00	Stores number of years.
MORE		
SPRC	SPRC = 23.86	Calculates target selling price per share.

9

Options and Margins

Options

An option is a contract granting the right to buy or sell a security at a given price during a specified period. Stock options typically are for lots of 100 shares. This convention is used here.

There are two types of options:

- *Call options* give the option buyer the right to buy (call away) stock from the option writer at a certain market value known as the *strike price* or *exercise price*.
- *Put options* give the buyer the right to sell (put) the stock to the option writer at the strike price.

The following equations calculate the results of call and put option transactions. Commissions are not included in the equations.

Buying a Call Option

A call option gives the buyer the right to call away, or buy, 100 shares of a particular stock at a contracted price. The equation below calculates the estimated profit or loss from buying a call option.

Entering and Using the BUY.CALL Equation:

1. Enter the BUY.CALL equation into the Solver.*

   ```
   BUY.CALL:IF(PRC>=EXP:PRC-EXP
   -PREM:-PREM)=PROF÷100
   ```

2. Display the BUY.CALL equation menu.

---

* To key in : on the HP-17B and HP-27S, press ▒ WXYZ ▒ ▒ OTHER ▒ ▒ : ▒.
To key in > on the HP-17B and HP-27S, press ▒ WXYZ ▒ ▒ OTHER ▒ ▒ > ▒.

3. Store or calculate the following variables:
   - Current price per share in PRC.
   - Option exercise (or strike) price in EXP.
   - Premium paid per share for the option in PREM.
   - Profit or loss to the option buyer in PROF.

Example. A call option to purchase 100 shares of a stock at $45 per share costs $2.50 per share. If you buy the option and the price of the stock moves to $52 per share, what is your profit?

Display the BUY.CALL equation menu.

Keys:	Display:	Description:
52 PRC	PRC = 52.00	Stores current price per share.
45 EXP	EXP = 45.00	Stores option exercise price.
2.5 PREM	PREM = 2.50	Stores premium paid per share for the option.
PROF	PROF = 450.00	Calculates estimated profit.

Writing a Call Option

In writing a call option, the option writer (seller) gives the buyer the right to purchase 100 shares of a stock at a given price. There are two types of call options the seller can write:

- *Naked call options*, or options covering stocks you don't own. Because you are contracting to provide a stock that you don't own, potential losses are theoretically unlimited.
- *Covered call options*, or options for stock that you do own.

The following equation helps you estimate the profit or loss from writing naked and covered call options.

Entering and Using the SELL.CALL Equation:

1. Enter the SELL.CALL equation into the Solver.*

   ```
   SELL.CALL:IF(PRC>=EXP:EXP
   -PRC+PREM:PREM)=PROF÷100
   ```

2. Display the SELL.CALL equation menu.
3. Store or calculate the following variables:
   - Current price per share in [PRC].
   - Option exercise price in [EXP].
   - Premium received in selling the option in [PREM].
   - Profit or loss to the option writer in [PROF].

Example 1: Naked Call Options. You wrote a naked call option for 100 shares of stock at $20 per share. The price of the stock moved from $20 to $23 per share by the exercise date. If you receive a premium of $1 per share for writing the option, calculate your profit or loss.

Display the SELL.CALL equation menu.

Keys:	Display:	Description:
23 [PRC]	PRC=23.00	Stores current price per share.
20 [EXP]	EXP=20.00	Stores option exercise price.
1 [PREM]	PREM=1.00	Stores premium received per share for the option.
[PROF]	PROF=−200.00	Calculates estimated loss.

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].
To key in > on the HP-17B and HP-27S, press [WXYZ] [OTHER] [>].

Example 2: Covered Call Options. Part 1. You write a covered call option that allows the buyer to call 100 shares at $70 per share. Your original price per share was $65. If you received a premium of $2 for writing the option and the price subsequently rises above the strike price, calculate your profit or loss on the option.

Display the SELL.CALL equation menu.

Keys:	Display:	Description:
65 [PRC]	PRC=65.00	Stores price per share.
70 [EXP]	EXP=70.00	Stores option exercise price.
2 [PREM]	PREM=2.00	Stores premium received per share for the option.
[PROF]	PROF=200.00	Calculates estimated profit on the option.

Part 2. If the option is exercised, calculate your maximum profit.

Keys:	Display:	Description:
70 [−] 65 [=]	5.00	Calculates difference between purchase and option price.
[×] 100 [=]	500.00	Calculates gain from exercised call of the 100 shares of stock.
[+] [RCL] [PROF] [=]	700.00	Calculates total estimated profit.

Buying a Put Option

The put option investor purchases the right to sell 100 shares of a stock at a predetermined price stated in the put option contract. The equation below helps you estimate the profit or loss from buying a put option.

Entering and Using the BUY.PUT Equation:

1. Enter the BUY.PUT equation into the Solver.*

   ```
   BUY.PUT:IF(PRC<=EXP:EXP-PRC
   -PREM:-PREM)=PROF÷100
   ```

2. Display the BUY.PUT equation menu.
3. Store or calculate the following variables:
   - Current price per share in ≣ PRC ≣.
   - Option exercise price in ≣ EXP ≣.
   - Premium paid per share for the option in ≣ PREM ≣.
   - Profit or loss to the option buyer in ≣ PROF ≣.

Example. A put option that gives you the right to put, or sell, 100 shares of a stock at $85 per share costs $3.50 per share. If you buy the option and the price of the stock declines to $76.50 per share, what is your profit?

Display the BUY.PUT equation menu.

Keys:	Display:	Description:
76.5 ≣ PRC ≣	PRC=76.50	Stores current price per share.
85 ≣ EXP ≣	EXP=85.00	Stores option exercise price.

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.
To key in < on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ < ≣.

3.5 PREM	PREM = 3.50	Stores premium paid per share for the option.
PROF	PROF = 500.00	Calculates estimated profit.

Writing a Put Option

The put option writer receives a premium for the obligation to purchase 100 shares of a particular stock at a specific price. If exercised, the seller of put options must pay the contracted, or strike price, regardless of the current market price. The equation below helps you estimate the profit or loss from writing a put option.

Entering and Using the SELL.PUT Equation:

1. Enter the SELL.PUT equation into the Solver.*

   ```
   SELL.PUT:IF(PRC<=EXP:PRC-EXP
   +PREM:PREM)=PROF÷100
   ```

2. Display the SELL.PUT equation menu.
3. Store or calculate the following variables:
   - Current price per share in PRC.
   - Option exercise price in EXP.
   - Premium received per share for the option in PREM.
   - Profit or loss to the option writer in PROF.

---

* To key in : on the HP-17B and HP-27S, press WXYZ OTHER :.
To key in < on the HP-17B and HP-27S, press WXYZ OTHER <.

Example. With the price of a stock at $97.50 per share, you write a put option that can be exercised at $90 per share. For this obligation, you receive a premium of $2 per share. If the price per share of the underlying stock falls to $69, what is your profit or loss?

Display the SELL.PUT equation menu.

Keys:	Display:	Description:
69 PRC	PRC=69.00	Stores current price per share.
90 EXP	EXP=90.00	Stores option exercise price.
2 PREM	PREM=2.00	Stores premium received per share for the option.
PROF	PROF=−1,900.00	Calculates estimated loss.

Margin Accounts

Investors who use margin accounts when purchasing securities employ *leverage*. Leverage is the ability to control a larger asset with a smaller one. Margin requirements for securities are set by the Federal Reserve Board. Because margin accounts represent a form of lending, investors using such an account are normally charged interest by the brokerage firms on the leveraged portion of their holdings.

The following equation calculates the dollar amount of equity required to maintain a margin account, the loan amount, and the total purchase amount. The equation can also be used to calculate the margin call, which is the amount of the loan that needs to be redeemed if the price of the security goes down.

Entering and Using the MARGIN Equation:

1. Enter the MARGIN equation into the Solver.*

   ```
   MARGIN:IF(S(LOAN):(1-MAR%÷100)×#SHR
   ×$PS+0×EQTY-LOAN:IF(S(TOTAL):#SHR×$PS
   -TOTAL:#SHR×$PS×MAR%÷100-EQTY))
   ```

2. Display the MARGIN equation menu.
3. Store or calculate the following variables:
   - Margin requirement as a percentage in ≣ MAR% ≣.
   - Number of shares to be purchased in ≣ #SHR ≣.
   - Current price per share in ≣ $PS ≣.
   - Dollar amount of equity required to maintain margin account in ≣ EQTY ≣.

---

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.
To key in # on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ # ≣.
To key in $ on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ MORE ≣ ≣ $ ≣.

4. To calculate the margin loan amount, press LOAN.
5. To calculate the total amount of the purchase, press TOTAL.

Example 1: Dollar Amount of Margin Requirement. Part 1. Your brokerage firm has a margin requirement of 60%. How much equity must you have in your account to purchase 400 shares of a stock having a market value of $36 per share?

Display the MARGIN equation menu.

Keys:	Display:	Description:
60 MAR%	MAR% = 60.00	Stores margin requirement.
400 #SHR	#SHR = 400.00	Stores number of shares.
36 $PS	$PS = 36.00	Stores price per share.
EQTY	EQTY = 8,640.00	Calculates dollar equity required.

Part 2. Calculate the amount loaned.

LOAN	LOAN = 5,760.00	Calculates dollar amount loaned.

Part 3. Calculate the total amount of the purchase.

TOTAL	TOTAL = 14,400.00	Calculates total purchase.

Example 2: Margin Calls. The market value of a stock you purchased on margin has declined from $43 per share to $36. If you own 300 shares and your brokerage firm has a 60% margin requirement, what is the amount of your margin call?

Display the MARGIN equation menu.

Keys:	Display:	Description:
60 MAR%	MAR% = 60.00	Stores margin requirement.
300 #SHR	#SHR = 300.00	Stores number of shares.
36 $PS	$PS = 36.00	Stores current price.
LOAN	LOAN = 4,320.00	Calculates margin loan at current price.
STO 0		Stores margin loan amount.
43 $PS	$PS = 43.00	Stores original price.
LOAN	LOAN = 5,160.00	Calculates margin loan at original price.
− RCL 0 =	840.00	Calculates amount of margin call.

Leveraged Rates of Return

Leveraging securities is used by investors to enhance the return of their portfolios. The equation below evaluates the relationship between the rate of return for margin accounts and fluctuating market values.

The equation ignores dividends and commissions. It does include the interest charged to use a margin. A calendar of 360 days has been used, so that you can easily store the number of days or months over which price changes occur. Enter the number of days as if there were 30 days in each month.

Entering and Using the MARGIN.ROR Equation:

1. Enter the MARGIN.ROR equation into the Solver.*

   ```
   MARGIN.ROR:(CPRC-PRC-I%÷100×DAYS
   ÷360×(1-MAR%÷100)×PRC)÷(MAR%
   ÷100×PRC)÷DAYS×360=ROR%÷100
   ```

2. Display the MARGIN.ROR equation menu.
3. Store or calculate the following variables:
   - Current price per share in [CPRC].
   - Original price per share in [PRC].
   - Annual interest rate charged for margin account in [I%].
   - Number of days the security has been held in [DAYS]. Assume 30 days per month.
   - Margin requirement as a percentage in [MAR%].
   - Annual rate of return as a percentage in [ROR%].

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

Example: Part 1. You purchase a stock at $39 per share. The brokerage firm's margin requirement is 55% and annual interest on the margin loan is 10.5%. If, after a month and a half, the price rises to $40 per share, what is your rate of return?

Display the MARGIN.ROR equation menu.

Keys:	Display:	Description:
40 [CPRC]	CPRC=40.00	Stores current price.
39 [PRC]	PRC=39.00	Stores original price.
10.5 [I%]	I%=10.50	Stores annual interest rate.
1.5 [×] 30 [DAYS]	DAYS=45.00	Stores number of days.
55 [MAR%]	MAR%=55.00	Stores margin requirement.
[ROR%]	ROR%=28.71	Calculates annual rate of return.

Part 2. What is the return if the margin requirement drops to 50%?

50 [MAR%]	MAR%=50.00	Stores margin requirement.
[ROR%]	ROR%=30.53	Calculates annual rate of return.

Part 3. What is the return if the margin requirement is 50% and the price declines to $38.50 per share?

38.5 [CPRC]	CPRC=38.50	Stores current price.
[ROR%]	ROR%=−31.01	Calculates annual rate of return.

10

Mutual Funds

Introduction

A mutual fund is a diversified portfolio of securities. The individual securities are purchased by a fund manager using the pooled dollars from numerous investors (share-holders). Each mutual fund share-holder has a proportional share of a diversified portfolio. Generally, all investment decisions concerning the portfolio are made by the fund manager(s).

The investor who buys mutual funds can choose between the following two broad categories of funds:

- Load funds – a fee is charged when the shares are purchased.
- No-load fund – no fee is charged, either at purchase or liquidation of the shares.

The applications in this section show you how to calculate the charge on a load fund, and help you compare the return on a load fund to a no-load fund.

Load Mutual Funds

Note

To do this calculation on the HP-27S, first enter the equations on page 157 into the Solver. The equations are built into the BUS menu of the HP-17B and HP-19B.

The sales charge on a fund is based on the net asset value of the fund and its public offering price. The net asset value is the total value of the fund's portfolio divided by the total number of shares outstanding. The public offering price is the net asset value plus the applicable sales load.

The built-in markup menus in the HP-17B and HP-19B can be used to calculate the sales charges.

To calculate the sales charge as a percentage of the public offering price:

1. Display the MU%P menu.
2. Store the following variables:
   - Net asset value in COST.
   - Public offering price in PRICE.
3. Press M%P to calculate the sales charge as a percentage of the public offering price.

To calculate the sales charge as a percentage of the net asset value:

1. Display the MU%C menu.
2. Store the following variables:
   - Net asset value in COST.
   - Public offering price in PRICE.
3. Press M%C to calculate the sales charge as a percentage of the net asset value.

Example: Part 1. Your broker tells you about a fund with a public offering price of $11.11. If the net asset value of the fund is $10.67, what is the sales charge as a percentage of the public offering price?

Display the MU%P menu.

Keys:	Display:	Description:
10.67 [COST]	COST = 10.67	Stores net asset value.
11.11 [PRICE]	PRICE = 11.11	Stores public offering price.
[M%P]	MARKUP%P = 3.96	Calculates sales charge as a percentage of public offering price.

Part 2. Calculate the sales charge as a percentage of the net asset value.

[EXIT] [MU%C]		Displays MU%C menu.
[M%C]	MARKUP%C = 4.12	Calculates sales charge as a percentage of net asset value.

Equations for the HP-27S

If you have an HP-27S, you can do markup calculations by entering the following equations into the Solver.

Entering and Using the MU%P and MU%C Equations:

1. Enter the MU%P equation into the Solver.*

   `MU%P:M%P=(1-COST÷PRICE)×100`

2. Enter the MU%C equation into the Solver.*

   `MU%C:M%C=(PRICE÷COST-1)×100`

3. Display the MU%P or MU%C equation menu.
4. Store the values you know by keying in the number and pressing the appropriate menu key.
5. Press the menu key for the value you want to calculate.

---

* To key in :, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ : ≡.

Comparing Load and No-Load Mutual Funds

Yield comparisons between load and no-load funds are complicated since the returns for load funds often do not reflect sales charges.

The following equation calculates the no-load fund yield equivalent to a load fund. The equation allows for a redemption fee as well as the load percent at purchase.

Entering and Using the LOAD.YLD Equation:

1. Enter the LOAD.YLD equation into the Solver.*

   ```
   LOAD.YLD:0×YRS+SPFV(NLY%:YRS)=
   SPFV(LY%:YRS)×(1-LFEE%÷100)-RFEE%÷100
   ```

2. Display the LOAD.YLD equation menu.
3. Store or calculate the following variables:
   - Number of years for the comparison in [YRS].
   - Estimated or historic return on a no-load fund in [NLY%].
   - Estimated or historic return on a load fund in [LY%].
   - Load percentage imposed at purchase in [LFEE%].
   - Redemption percentage imposed at liquidation in [RFEE%].

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

Example. You are considering a no-load mutual fund with an anticipated average annual rate of return of 12% over the next 10 years and want to compare it to a load fund with a sales load of 4.75%. Calculate the rate of return that the load fund must provide to equal the return of the no-load fund. There is no redemption fee.

Keys:	Display:	Description:
10 [YRS]	YRS = 10.00	Stores number of years.
12 [NLY%]	NLY% = 12.00	Stores return on no-load fund.
4.75 [LFEE%]	LFEE% = 4.75	Stores load percentage.
0 [RFEE%]	RFEE% = 0.00	Stores redemption fee.
[LY%]	LY% = 12.55*	Calculates equivalent return required on a load fund.

* The Solver searches for an iterative solution and displays intermediate estimates.

11

Personal Income Taxes

Introduction

This chapter summarizes calculator solutions for a number of the major changes resulting from the United States Tax Reform Act of 1986 (TRA-86). No attempt is made to address or solve all income tax reporting issues – this is best left to professionals in the tax field. The procedures and equations are designed to assist in eliminating some of the more tedious and time-consuming calculations you may encounter when figuring your taxes.

The equations in this chapter can be used independently or together. Many of the variables are shared. Each equation is relatively simple and can be calculated without the equation. However, if you have several alternative tax situations that you want to calculate, you may find the equations useful.

If you choose to use all of the equations in this chapter and to follow the examples from first to last, enter all the equations first. Then work through the explanations and examples. The equations are listed below to to make it easier if you want to enter them all now.*

- Adjustments – page 163

  ```
  AGI=GROS-ADJ
  ```

- Medical Deductions – page 165

  ```
  MEDD=IF(MED$>=AGI×IRS%÷100:
  MED$-AGI×IRS%÷100:0)
  ```

- Miscellaneous Expense Deductions – page 166

  ```
  MISD=IF(MIS$>=AGI×IRS%÷100:
  MIS$-AGI×IRS%÷100:0)
  ```

---

* To key in $ on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ MORE ≡ ≡ $ ≡.
To key in > on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ > ≡.
To key in : on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ : ≡.
To key in # on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ # ≡.

- Consumer Interest Deduction – page 167

```
INTD=CON$×IRS%÷100
```

- Total Itemized Deductions – page 168

```
ITEM=MEDD+MISD+INTD+OTHER
```

- Taxable Income – page 171

```
TAXI=AGI-IF(ITEM>=STD:
ITEM:STD)-#PE×PE$
```

- Tax Liability for Incomes Below Surcharge – page 174

```
$DUE=IF(TAXI>=LR$:(TAXI-LR$)×UP%
÷100+LOW%÷100×LR$:TAXI×LOW%÷100)
```

- Upper Income Surcharges – page 176

```
STAX1=IF(TAXI>S1BEG:MIN(TAXI
-S1BEG:S1END-S1BEG):0)×SR%÷100
```

```
STAX2=IF(TAXI>=S1END:MIN((TAXI
-S1END)×SR%:#PE×PE$×UP%):0)÷100
```

- Total Tax Liability – page 179

```
TTL=$DUE+STAX1+STAX2-CR
```

Adjustments

Several adjustments to gross income were eliminated or modified by TRA-86:

- Working spouse adjustment was eliminated.
- Employee business expense adjustment was eliminated. You may be able to declare these expenses if you itemize deductions.
- Individual retirement account adjustment was modified.

After the total amount of adjustments has been determined, the adjusted gross income can be calculated. Although the equation below is simple, *AGI* is shared with equations later in this chapter.

Entering and Using the AGI Equation:

1. Enter the *AGI* equation into the Solver.

   `AGI=GROS-ADJ`

2. Display the *AGI* equation menu.
3. Store the following variables:
   - Gross income for the household in GROS.
   - Total adjustments to income in ADJ.
4. Press AGI to calculate the adjusted gross income.

Example 1. In 1988, you have a gross income of $55,000. If your adjustments to income are $4,000, what is your adjusted gross income?

Display the *AGI* equation menu.

Keys:	Display:	Description:
55000 GROS	GROS=55,000.00	Stores gross income.
4000 ADJ	ADJ=4,000.00	Stores adjustments to income.
AGI	AGI=51,000.00	Calculates adjusted gross income.

Deductions

Many of the deductions taken by taxpayers who itemize have been retained, including the following:

- State and local taxes.
- Real estate and personal property taxes.
- Mortgage interest on first and second homes.
- Theft and casualty losses.
- Contributions to charity. (Taxpayers who do not itemize deductions can no longer deduct charitable contributions.)

Other deductions have been revised, including medical expenses and miscellaneous deductions. Still other deductions were reduced or eliminated, including interest on consumer credit and state sales tax.

The equations in this section help you estimate the total itemized deductions that you are allowed under TRA-86.

Medical Expense Deductions

Beginning in the 1987 tax year, only medical expenses in excess of 7.5% of the adjusted gross income are allowed as deductions. The following equation calculates your medical expense deduction based on adjusted gross income and total medical expenses.

Entering and Using the MEDD Equation:

1. Enter the *MEDD* equation into the Solver.*

```
MEDD=IF(MED$>=AGI×IRS%÷100:
MED$-AGI×IRS%÷100:0)
```

2. Display the *MEDD* equation menu.
3. Store the following variables:
   - Total medical expenses for the tax year in ≡ MED$ ≡.
   - Adjusted gross income in ≡ AGI ≡.
   - Percentage in excess of adjusted gross income allowed in ≡ IRS% ≡.
4. Press ≡ MEDD ≡ to calculate the allowed medical expense deduction.

Example 2. Your adjusted gross income is $51,000. The percentage above adjusted gross income allowed for medical deductions is 7.5%. Your medical expenses are $4,300. How much can you deduct?

Display the *MEDD* equation menu.

Keys:	Display:	Description:
51000 ≡ AGI ≡	AGI = 51,000.00	Stores *AGI*.
4300 ≡ MED$ ≡	MED$ = 4,300.00	Stores medical expenses.
7.5 ≡ IRS% ≡	IRS% = 7.50	Stores percentage allowed.
≡ MEDD ≡	MEDD = 475.00	Calculates medical expense deduction.

* To key in $ on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ MORE ≡ ≡ $ ≡.
To key in > on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ > ≡.
To key in : on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ : ≡.

Miscellaneous Expense Deductions

Deductions allowed for miscellaneous expenses such as union dues, professional journals, fees paid for investment and accounting services, and employee business expenses (formerly an adjustment) have also been revised. Only expenses that exceed 2% of the adjusted gross income are deductible under the new law.

The equation below calculates your miscellaneous expense deduction based on adjusted gross income and the percentage allowed by the IRS.

Entering and Using the MISD Equation:

1. Enter the *MISD* equation into the Solver.*

   ```
   MISD=IF(MIS$>=AGI×IRS%÷100:
   MIS$-AGI×IRS%÷100:0)
   ```

2. Display the *MISD* equation menu.
3. Store the following variables:
   - Total miscellaneous expenses for the tax year in ≣ MIS$ ≣.
   - Adjusted gross income in ≣ AGI ≣.
   - Percentage in excess of adjusted gross income allowed in ≣ IRS% ≣.
4. Press ≣ MISD ≣ to calculate the allowed miscellaneous expense deduction.

Example 3. During the last tax year, you paid $1,200 in investment advisory fees and $791 for various accounting services. If the allowable percentage requirement is 2%, what is your allowable deduction for miscellaneous expenses? If your adjusted gross income of $51,000 is still stored in *AGI*, you don't have to store it again.

---

* To key in $ on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ MORE ≣ ≣ $ ≣.
To key in > on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ > ≣.
To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.

Display the *MISD* equation menu.

Keys:	Display:	Description:
51000 ≣ AGI ≣	AGI = 51,000.00	Stores adjusted gross income.
1200 + 791 ≣ MIS$ ≣	MIS$ = 1,991.00	Stores total miscellaneous expenses.
2 ≣ IRS% ≣	IRS% = 2.00	Stores percentage allowed.
≣ MISD ≣	MISD = 971.00	Calculates miscellaneous expenses allowed.

Consumer Interest Deduction

The consumer interest deduction will be phased out over a five-year period so that it does not unfairly penalize those who financed items when the tax code encouraged credit purchases. A deduction of 65% of the total interest is allowed in 1987, 40% in 1988, 20% in 1989, 10% in 1990, followed by total elimination in 1991.

The equation below calculates the consumer interest deduction allowed based on the expenses for the year and the allowed deduction percentage.

Entering and Using the INTD Equation:

1. Enter the *INTD* equation into the Solver.*

   `INTD=CON$×IRS%÷100`

2. Display the *INTD* equation menu.

---

* To key in $ on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ MORE ≣ ≣ $ ≣.

3. Store the following variables:
   - Total consumer interest expenses for the tax year in CON$.
   - Percentage allowed in IRS%.
4. Press INTD to calculate the allowed consumer interest deduction.

Example 4. The interest portion of your automobile payments for 1988 is $2,385. The allowable percentage is 40%. How much of the total interest can you deduct in 1988?

Display the *INTD* equation menu.

Keys:	Display:	Description:
2385 CON$	CON$=2,385.00	Stores total consumer interest expenses.
40 IRS%	IRS%=40.00	Stores percentage allowed.
INTD	INTD=954.00	Calculates consumer interest expenses allowed.

Total Itemized Deductions

This equation sums the medical, miscellaneous, and consumer interest deductions calculated in the *MEDD*, *MISD*, and *INTD* equations plus other deductible items to calculate the total itemized deductions.

Entering and Using the ITEM Equation:

1. Enter the *ITEM* equation into the Solver.

   ```
   ITEM=MEDD+MISD+INTD+OTHER
   ```

2. Display the *ITEM* equation menu.

3. Store the following variables:
   - Medical deduction in [MEDD].
   - Miscellaneous deduction in [MISD].
   - Consumer interest deduction in [INTD].
   - Total of all other deductible items in [OTHER].
4. Press [ITEM] to calculate the total itemized deductions.

Example 5. During the year you paid $1,000 in state income taxes, $800 in property taxes, and $3,200 in mortgage interest. You also donated $1,400 to a charitable organization. Your medical deduction is $475, your miscellaneous deduction is $971, and your consumer interest deduction is $954, as calculated in earlier examples. If these values are still stored in *MEDD*, *MISD*, and *INTD*, you don't have to store them again. Calculate your total itemized deductions.

Display the *ITEM* equation menu.

Keys:	Display:	Description:
475 [MEDD]	MEDD=475.00	Stores medical deduction.
971 [MISD]	MISD=971.00	Stores miscellaneous deduction.
954 [INTD]	INTD=954.00	Stores consumer interest deduction.
1000 [+] 800 [+] 3200 [+] 1400 [OTHER]	OTHER=6,400.00	Stores total other deductions.
[ITEM]	ITEM=8,800.00	Calculates total itemized deductions.

Taxable Income

The equation in this section calculates the net taxable income, based on the calculations performed earlier for adjusted gross income and itemized deductions, and includes the standard deduction and personal exemption.

The standard deduction is now an automatic reduction in taxable income, with the amount based on filing status. The following table shows the reduction.

Filing Status	1988
Married, Filing Jointly	$5,000
Married, Filing Separately	$2,500
Single	$3,000
Head of Household	$4,400

The personal exemption reduces the net income that is subject to federal income tax. The following table shows the exemption.

Year	Personal Exemption
1986	$1,080
1987	$1,900
1988	$1,950
1989	$2,000
1990	Indexed to inflation

Exemptions for the elderly and the blind have been replaced by a tax credit, and are included in the *TTL* equation in the next section, "Total Tax Liability."

Entering and Using the TAXI Equation:

1. Enter the *TAXI* equation into the Solver.*

   ```
   TAXI=AGI-IF(ITEM>=STD:
   ITEM:STD)-#PE×PE$
   ```

2. Display the *TAXI* equation menu.
3. Store the following variables:
   - Adjusted gross income in ≣ AGI ≣.
   - Total itemized deductions in ≣ ITEM ≣.
   - Standard deduction allowed in ≣ STD ≣.
   - Number of personal exemptions in ≣ #PE ≣.
   - Personal exemption amount in ≣ PE$ ≣.
4. Press ≣ TAXI ≣ to calculate the estimated taxable income.

Example 6. You have an adjusted gross income of $51,000 and total allowable itemized deductions of $8,800. You are married, filing jointly, so you are allowed a standard deduction of $5,000 in 1988. You have three dependent children. Calculate your taxable income for 1988. If the adjusted gross income and itemized deductions are still stored in *AGI* and *ITEM*, you don't have to store them again.

---

* To key in > on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ > ≣.
To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.
To key in # on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ # ≣.
To key in $ on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ MORE ≣ ≣ $ ≣.

Display the *TAXI* equation menu.

Keys:	Display:	Description:
51000 [AGI]	AGI = 51,000.00	Stores adjusted gross income.
8800 [ITEM]	ITEM = 8,800.00	Stores itemized deductions.
5000 [STD]	STD = 5,000.00	Stores standard deduction.
5 [#PE]	#PE = 5.00	Stores number of personal exemptions.
1950 [PE$]	PE$ = 1,950.00	Stores personal exemption amount.
[TAXI]	TAXI = 32,450.00	Calculates taxable income for 1988.

Total Tax Liability

TRA-86 created a simple two-tiered marginal tax rate structure. The lower bracket is taxed at 15% and the upper bracket at 28%. The table below shows the top of the lower tax bracket for each filing status, starting in 1988.

Filing Status	Top of Lower Tax Bracket
Married, Filing Jointly	$29,750
Married, Filing Separately	$14,875
Single	$17,850
Head of Household	$23,900

Most taxpayers will be able to use the two-rate structure of the new tax code. However, upper-income taxpayers whose taxable incomes exceed a certain level will be subject to a surtax in addition to the tax calculated in the *$DUE* equation on the next page. To determine if you need to pay a surtax and how much that tax will be, see "Upper Income Surtaxes" on page 175.

For many taxpayers, the actual tax liability is determined using a tax table. The tax liability can be estimated using the equations in this section.

Tax Liability

The equation below calculates the estimated taxes due based on your income and the two tax rates. If your income is such that you also must pay a surtax, first calculate your tax using this equation, then calculate the surtax.

Entering and Using the $DUE Equation:

1. Enter the *$DUE* equation into the Solver.*

   ```
   $DUE=IF(TAXI>=LR$:(TAXI-LR$)×UP%
   ÷100+LOW%÷100×LR$:TAXI×LOW%÷100)
   ```

2. Display the *$DUE* equation menu.
3. Store the following variables:
   - Net taxable income in [TAXI].
   - Maximum income level that qualifies for lower tax rate in [LR$].
   - Upper marginal tax rate in [UP%].
   - Lower marginal tax rate in [LOW%].
4. Press [$DUE] to calculate estimated Federal income taxes due.

Example 7. You have an estimated taxable income of $32,450. Assuming you are married, filing jointly, what is the estimated Federal income taxes you owe for 1988? If the estimated taxable income is still stored in *TAXI*, you don't have to store it again.

Display the *$DUE* equation menu.

---

* To key in $ on the HP-17B and HP-27S, press [WXYZ] [OTHER] [MORE] [$].
To key in > on the HP-17B and HP-27S, press [WXYZ] [OTHER] [>].
To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].

Keys:	Display:	Description:
32450 [TAXI]	TAXI = 32,450.00	Stores taxable income.
29750 [LR$]	LR$ = 29,750.00	Stores top of income bracket subject to lower tax rate.
28 [UP%]	UP% = 28.00	Stores upper tax rate.
15 [LOW%]	LOW% = 15.00	Stores lower tax rate.
[$DUE]	$DUE = 5,218.50	Calculates estimate of Federal income tax due.

Upper Income Surtaxes

The first provision of the surtax phases out the 15% marginal tax bracket. The second provision phases out the benefits of the increased personal exemption. Each is achieved through a 5% surtax.

The table below shows the two surtaxes and the income levels to which they apply. Surtax #1 is the phase-out of the 15% bracket; surtax #2 is the phase-out of personal exemptions.

Filing Status	Surtax #1 Begins At	Surtax #2 Begins At
Married, Filing Jointly	$71,900	$149,250
Married, Filing Separately	$35,950	$113,300
Single	$43,150	$89,560
Head of Household	$61,500	$123,790

Each surtax has an equation. Use these equations only if your income is higher than the appropriate amount listed in the table. The first equation, *STAX1*, calculates the surtax for the phase-out of the 15% marginal bracket. The second equation, *STAX2*, calculates the second surtax for the phase-out of increased personal exemptions.

Entering and Using the STAX1 and STAX2 Equations:

1. Enter the *STAX1* equation into the Solver.*

```
STAX1=IF(TAXI>S1BEG:MIN(TAXI
-S1BEG:S1END-S1BEG):0)×SR%÷100
```

2. Enter the *STAX2* equation into the Solver.*

```
STAX2=IF(TAXI>=S1END:MIN((TAXI
-S1END)×SR%:#PE×PE$×UP%):0)÷100
```

3. To calculate the surtax due to the phase-out of the 15% bracket, display the *STAX1* equation menu.
   - Store net taxable income in ≡ TAXI ≡.
   - Store income level at which initial surtax is levied in ≡ S1BEG ≡.
   - Store maximum income level at which initial surtax no longer applies in ≡ S1END ≡.
   - Store surtax rate as a percentage in ≡ SR% ≡.
   - Press ≡ STAX1 ≡ to calculate the initial surtax.
4. To calculate the surtax due to the phase-out of the increased personal exemption, display the *STAX2* equation menu.
   - Store net taxable income in ≡ TAXI ≡.
   - Store top marginal tax rate in ≡ UP% ≡.
   - Store maximum income level at which initial surtax no longer applies in ≡ S1END ≡.
   - Store surtax rate as a percentage in ≡ SR% ≡.
   - Store number of personal exemptions in ≡ #PE ≡.
   - Store personal exemption amount in ≡ PE$ ≡.
   - Press ≡ STAX2 ≡ to calculate the secondary surtax.

---

* To key in > on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ > ≡.
To key in $ on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ MORE ≡ ≡ $ ≡.
To key in : on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ : ≡.
To key in # on the HP-17B and HP-27S, press ≡ WXYZ ≡ ≡ OTHER ≡ ≡ # ≡.

Example 8: Part 1. After adjustments and itemized deductions, your net taxable income is $160,000. You are married, filing jointly, with five personal exemptions. Using the Federal tax information provided in the preceding tables, what is your preliminary Federal income tax liability?

Display the *$DUE* equation menu.

Keys:	Display:	Description:
160000 [TAXI]	TAXI = 160,000.00	Stores taxable income.
29750 [LR$]	LR$ = 29,750.00	Stores top of income bracket subject to lower tax rate.
28 [UP%]	UP% = 28.00	Stores upper tax rate.
15 [LOW%]	LOW% = 15.00	Stores lower tax rate.
[$DUE]	$DUE = 40,932.50	Calculates estimated Federal income tax due.

Part 2. Calculate the initial surtax due to the phase-out of the 15% bracket.

Display the *STAX1* equation menu.

160000 [TAXI]	TAXI = 160,000.00	Stores taxable income.
71900 [S1BEG]	S1BEG = 71,900.00	Stores beginning income level subject to initial surtax.
149250 [S1END]	S1END = 149,250.00	Stores maximum income level subject to initial surtax.
5 [SR%]	SR% = 5.00	Stores surtax percentage.
[STAX1]	STAX1 = 3,867.50	Calculates initial surtax.

Part 3. Calculate the secondary surtax due to phase-out of personal exemptions. If taxable income, maximum income level subject to initial surtax, and surtax percentage are still stored in *TAXI*, *S1END*, and *SR%*, you don't have to store them again.

Display the *STAX2* equation menu.

160000 [TAXI]	TAXI = 160,000.00	Stores taxable income.
149250 [S1END]	S1END = 149,250.00	Stores maximum income level subject to initial surtax.
5 [SR%]	SR% = 5.00	Stores surtax percentage.
5 [#PE]	#PE = 5.00	Stores number of personal exemptions.
[MORE]		
1950 [PE$]	PE$ = 1,950.00	Stores personal exemption amount.
28 [UP%]	UP% = 28.00	Stores upper tax rate.
[MORE]		
[STAX2]	STAX2 = 537.50	Calculates secondary surtax.

Total Tax Liability

The *TTL* equation in this section combines the taxes calculated in the *$DUE* equation with the surtaxes and any tax credits to estimate your total tax liability. Tax credits for the elderly and the blind range from $600 for married qualified individuals to $750 for single qualifiers.

Entering and Using the TTL Equation:

1. Enter the *TTL* equation into the Solver.*

   TTL=$DUE+STAX1+STAX2−CR

2. Display the *TTL* equation menu.
3. Store the following variables:
   - Estimated Federal income tax due in [$DUE].
   - Initial surtax in [STAX1].
   - Secondary surtax in [STAX2].
   - Tax credits in [CR].
4. Press [TTL] to calculate the estimated total tax liability.

Part 4. You calculated your estimated Federal income tax due as $40,932.50, and your surtaxes as $3,867.50 and $537.50. You have no tax credits. Calculate the total tax liability. If the estimated taxes and the surtaxes are still stored in *$DUE*, *STAX1*, and *STAX2*, you don't have to store them again.

Display the *TTL* equation menu.

40932.5 [$DUE]	$DUE = 40,932.50	Stores estimated income tax.
3867.5 [STAX1]	STAX1 = 3,867.50	Stores initial surtax.
537.5 [STAX2]	STAX2 = 537.50	Stores secondary surtax.
[TTL]	TTL = 45,337.50	Calculates estimate of tax liability.

* To key in $ on the HP-17B and HP-27S, press [WXYZ] [OTHER] [MORE] [$].

Average Rate of Taxation

Note

To do this calculation on the HP-27S, first enter the equation on page 181 into the Solver. The equation is built into the BUS menu of HP-17B and HP-19B.

Once you have determined your total tax liability for the year, you can determine your average rate of taxation.

To calculate the average rate of taxation:

1. Display the %TOTL menu.
2. Store the following variables:
   - Total estimated Federal income tax liability in [PART].
   - Net taxable income in [TOTAL].
3. Press [%T] to calculate the average rate of taxation.

Example. Your net taxable income is $160,000. The total Federal income tax liability is $45,337.50. Calculate the average rate of taxation.

Display the %TOTL menu.

Keys:	**Display:**	**Description:**
45,337.5 [PART]	PART = 45,337.50	Stores income tax liability.
160000 [TOTAL]	TOTAL = 160,000.00	Stores taxable income.
[%T]	%TOTAL = 28.34	Calculates average rate of taxation.

%TOTL Equation for the HP-27S

If you have an HP-27S, you can calculate %TOTL by entering the following equation into the Solver.

Entering and Using the %TOTL Equation:

1. Enter the %TOTL equation into the Solver.*

   `%TOTL: %T=PART÷TOTAL×100`

2. Display the %TOTL equation menu.
3. Store the values you know by keying in the number and pressing the appropriate menu key.
4. Press the menu key for the value you want to calculate.

---

* To key in : on the HP-27S, press ⇧ WXYZ ⇧ OTHER ⇧ : ⇧.

Tax and Inflation Breakeven Point

Using your average tax rate, you can calculate the minimum investment yield after taxes and inflation for your portfolio to break even. The breakeven point can help you assess the viability of your portfolio in obtaining your financial objectives.

Entering and Using the BREAKPT Equation:

1. Enter the BREAKPT equation into the Solver.*

   `BREAKPT: IN%÷(100−T%)=BRKP÷100`

2. Display the BREAKPT equation menu.
3. Store or calculate the following variables:
   - Projected rate of inflation in ≣ IN% ≣.
   - Average rate of taxation in ≣ T% ≣.
   - Breakeven point as a percentage in ≣ BRKP ≣.

Example. The projected inflation rate for next year is 6%. If your average rate of taxation is 28%, what is your tax and inflation breakeven point?

Display the BREAKPT equation menu.

Keys:	Display:	Description:
6 ≣ IN% ≣	IN% = 6.00	Stores estimated inflation rate.
28 ≣ T% ≣	T% = 28.00	Stores average tax rate.
≣ BRKP ≣	BRKP = 8.33	Calculates yield you must earn to break even.

* To key in : on the HP-17B and HP-27S, press ≣ WXYZ ≣ ≣ OTHER ≣ ≣ : ≣.

Appendixes

A

Black-Scholes Options Valuation

The equation in this appendix uses the theoretical model developed by Fisher Black and Myron Scholes to estimate the value of options to buy or sell financial assets.*

The BLK.SCHLS equation estimates the value of a call or put option. One of the variables in this equation is the standard deviation of the rates of return of the stock. This number is not commonly available. However, you may be able to use one of the following to estimate the value:

- A source that publishes Beta statistics for a stock may also publish the standard deviation (or variance, which is the standard deviation squared) of the stock.
- If you know a sequence of stock prices at uniform time intervals, you can use the SD.ROR equation, later in this appendix, to calculate the sample standard deviation of the rates of return.

* Fisher Black and Myron Scholes, "The Pricing of Options and Corporate Liabilities," The Journal of Political Economy, May-June, 1973, pp 644.

Entering and Using the BLK.SCHLS Equation:

Note

You need approximately 2500 bytes of calculator memory to enter the BLK.SCHLS equation. Once it's entered correctly, you need only 1500 bytes to use it.

1. Enter the BLK.SCHLS equation into the Solver.*

```
BLK.SCHLS:IF(S(PUTV):-PS+PE×EXP(-RF%×T
÷100)+0×S+CALLV-PUTV:0×L(D5:(LN
(PS÷PE)+(RF%÷100+S^2÷2)×T)÷S÷SQRT
(T))×L(D6:(LN(PS÷PE)+(RF%÷100-S^2÷2)
×T)÷S÷SQRT(T))×L(D3:IF(G(D5)<0:0:-1))
×L(D4:IF(G(D6)<0:0:-1))×L(D1:ABS(G(D5)))
×L(D2:ABS(G(D6)))+(PS×ABS(G(D3)+1÷
(1+.196854×G(D1)+.115194×G(D1)^2+.000344
×G(D1)^3+.019527×G(D1)^4)^4÷2)-PE
×EXP(-RF%×T÷100)×ABS(G(D4)+1÷
(1+.196854×G(D2)+.115194×G(D2)^2+.000344
×G(D2)^3+.019527×G(D2)^4)^4÷2))-CALLV)
```

2. Display the BLK.SCHLS equation menu.
3. Store the following variables:
   - Stock price per share in [PS].
   - Exercise price of option in [PE].
   - Periodic risk free rate of return as a percentage in [RF%].
   - Number of periods until expiration in [T].
   - Standard deviation, as a decimal, of the periodic returns of the stock in [S].

---

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].
To key in ^ on the HP-17B and HP-27S, press ■ [y^x].
To key in SQRT, press ■ [$\sqrt{x}$].

- Press [CALLV] to calculate the call option value per share of stock.
- Press [PUTV] to calculate the put option value per share of stock.

Note

The time units for *RF%*, *T*, and *S* must be the same. For example, if *S* (the standard deviation) is based on monthly rates of return, then *RF%* and *T* (the risk-free rate and the time until expiration) must also be in months.

Example. A call option on a stock has an exercise price of 45 and a current price of 52. The standard deviation of monthly rates of return for the stock is .2054, and the monthly T-Bill rate is .5%. The option expires in 6 months. What is the estimated value of the call?

Display the BLK.SCHLS equation menu.

Keys:	Display:	Description:
52 [PS]	PS=52.00	Stores current stock price.
45 [PE]	PE=45.00	Stores exercise price.
.5 [RF%]	RF%=0.50	Stores risk free rate of return.
6 [T]	T=6.00	Store time period.
.2054 [S]	S=0.21	Stores standard deviation of stock rates of return.
[MORE]		
[CALLV]	CALLV=14.24	Calculates value of call option per share of stock.
[PUTV]	PUTV=5.91	Calculates value of put option per share of stock.

Standard Deviation of Rates of Return

The variable *S* in the BLK.SCHLS equation is the standard deviation of the periodic rates of return of the stock. If you know a sequence of stock prices at uniform time intervals, you can use the SD.ROR equation below to calculate the sample standard deviation of the rates of return.

The equation does not include dividends, which is appropriate if the stock pays either a constant dividend or zero dividend over the time that prices are measured.

Entering and Using the SD.ROR Equation:

1. Enter the SD.ROR equation into the Solver.*

```
SD.ROR:S=0×L(M:Σ(J:1:SIZES(PRICE)-1:
1:ITEM(PRICE:J+1)÷ITEM(PRICE:J)-1)÷
(SIZES(PRICE)-1))+SQRT(Σ(K:1:SIZES
(PRICE)-1:1:(ITEM(PRICE:K+1)÷
ITEM(PRICE:K)-1-G(M))^2)÷
(SIZES(PRICE)-2))
```

2. Enter the stock prices into a SUM (STAT in the HP-27S) list and name the list PRICE.
3. Display the SD.ROR equation menu.
4. Press [S] to calculate the standard deviation of the rates of return of the stock. (You may have to press [S] twice, since the first time you press it, the machine may store the value in the display. Pressing [S] a second time will begin the solve calculation.)

---

* To key in : on the HP-17B and HP-27S, press [WXYZ] [OTHER] [:].
To key in Σ on the HP-17B and HP-27S, press [WXYZ] [OTHER] [MORE] [Σ].
To key in SQRT, press ■ [√x].
To key in ^ on the HP-17B and HP-27S, press ■ [y^x].

Example. You have tracked the monthly closing stock prices a corporation for 61 months. Calculate the sample standard deviation of returns for this set of prices.

Mo.	Price	Mo.	Price	Mo.	Price
1	42.000	21	57.875	41	78.250
2	39.875	22	63.750	42	75.125
3	39.750	23	67.125	43	82.375
4	37.875	24	68.250	44	87.500
5	37.375	25	64.875	45	90.500
6	37.875	26	61.750	46	99.500
7	41.750	27	63.000	47	117.000
8	43.125	28	63.000	48	115.000
9	40.375	29	65.125	49	118.125
10	42.750	30	56.875	50	113.875
11	46.625	31	57.000	51	116.375
12	47.625	32	52.375	52	114.375
13	50.125	33	49.375	53	114.625
14	55.000	34	52.000	54	116.125
15	49.125	35	57.750	55	125.875
16	54.875	36	60.625	56	120.125
17	62.750	37	61.250	57	136.125
18	61.500	38	64.875	58	123.625
19	63.875	39	67.000	59	129.125
20	62.625	40	75.000	60	124.250
				61	129.250

The solution below assumes that you have the numbers above in a SUM or STAT list named PRICE. As a check, the total of the list should be 4,512.88.

Display the SD.ROR equation menu.

Keys:	Display:	Description:
[SUM] [S] [SUM] [S]	S=0.07	Calculates sample standard deviation of the numbers in the SUM list named PRICE.
■ [SHOW]	6.59623655232E-2	Shows result to full precision.

B

Net Present Value and Internal Rate of Return on the HP-27S

A common decision in business is choosing between two alternative investments. One way of evaluating investment alternatives is to use *net present value* or *internal rate of return*.

Included in this section are two equations for calculating net present value or internal rate of return on a series of cash flows occurring at regular intervals for a given interest (discount) rate. One equation is for cash flows (money paid out or received) that do not repeat. These are called *ungrouped cash flows*. The second equation is for cash flows that do repeat. These are called *grouped cash flows*.

The internal rate of return is the interest (discount) rate at which the net present value of the cash flows equals zero. You calculate the internal rate of return by storing 0 as the net present value (*NPV*) and then solving for the interest rate (*I%*).

The cash flows are stored in a STAT list. Money paid out is stored as a negative number; money received is stored as a positive number. (For more information about cash flows and sign conventions, refer to the TVM menu discussion in your HP-27S owner's manual.) Be sure to name the STAT list with the same name used in the Solver equation. The examples in this section use FLOWS as the list name. You can change the name in the equation to something other than FLOWS, if you wish.

To create a cash-flow list, be sure your cash flows are occurring at regular intervals and at the end of each period. * If a period is skipped, enter zero for its cash flow.

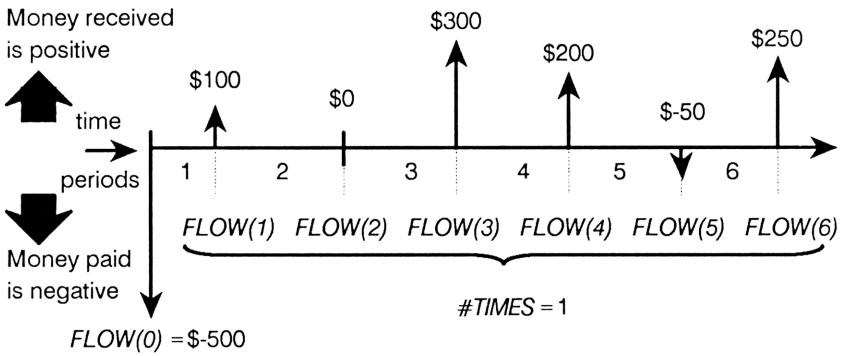
If your cash flows are ungrouped, use the UNGROUPED equation, and store the cash flows in ungrouped format in a STAT list. The initial cash flow is stored in *ITEM(1)*, the second cash flow is stored in *ITEM(2)*, the third cash flow is stored in *ITEM(3)*, and so on.

If your cash flows are grouped, use the GROUPED equation, and store the cash flows in pairs, or grouped format, in a STAT list. The data for each group is stored by entering two numbers. The first number is the cash flow amount, and the second is the number of cash flows in that group. *ITEM(1)* contains the cash flow amount for the initial group, *ITEM(2)* contains the number of consecutive times it occurs, *ITEM(3)* contains the cash flow amount for the next group, *ITEM(4)* contains the number of consecutive times it occurs, and so on.

* If the cash flows occur at the beginning of each period, then combine the first flow with the initial flow (which can increase or decrease the flow), and move each cash flow up one period. Remember, a payment made at the beginning of period 2 is equivalent to the same payment made at the end of period 1, and so on.

Ungrouped Cash Flows

In a series of ungrouped cash flows, each flow is different from the one before it. Each flow occurs one time.



The horizontal timeline is divided into equal compounding periods. The vertical lines represent the cash flows. For money received, the line points up (positive); for money paid out, the line points down (negative). In the previous illustration, the investor has invested $500. This investment has generated a series of cash flows, starting at the end of the first period. Notice that there is no cash flow (a cash flow of zero) for period two, and that the investor pays a small amount in period five.

Entering and Using the UNGROUPED Equation:

1. Enter the UNGROUPED equation into the Solver.* FLOWS is the name of the STAT list in which you will store the cash flows.

   ```
   UNGROUPED:Σ(J:1:SIZES(FLOWS):1:
   ITEM(FLOWS:J)×SPPV(I%:J-1))=NPV
   ```

2. Enter all the cash flows into a STAT list. Name the list FLOWS, the same name used in the Solver equation.
3. Display the UNGROUPED equation menu.

---

* To key in :, press [WXYZ] [OTHER] [:].
To key in Σ, press [WXYZ] [OTHER] [MORE] [Σ].

4. To calculate net present value (*NPV*):
   - Store the periodic interest rate in [I%].
   - Press [NPV] to calculate the net present value.
5. To calculate internal rate of return (*I%*):
   - Store zero in [NPV].
   - Press [I%] to calculate the internal rate of return.

Example 1. You want to purchase a punch press machine. Machine A requires the larger initial investment. However, it has lower upkeep expenses and a positive salvage value. Machine B, on the other hand, costs less initially, but upkeep is more costly, and the salvage value is negative. You want to compare the two equipment options.

The following table lists the projected costs for the two machines over their five-year lives, summarizing the initial flows, the cash flows during the five years, and the difference between the two options (net cash flows).

	A	B	A-B
Initial Investment	$-250,000	$-170,000	$-80,000
Cost in year 1	-12,000	-17,000	5,000
Cost in year 2	-35,000	-39,500	4,500
Cost in year 3	-45,000	-50,500	5,500
Cost in year 4	-12,000	-16,000	4,000
Cost in year 5	100,000	-15,000	115,000

The column headed A-B is treated as the investment in a net present value or internal rate of return calculation. If the investment is attractive (*NPV* is positive, or *IRR%* is greater than required), it is better to spend the additional $80,000 on machine A and get the benefit of the lower maintenance costs and the salvage value. If the investment is not attractive (*NPV* is negative or *IRR%* is less than required), it is better to buy machine B and to bear the higher maintenance costs each year.

Enter the data into the STAT list. Name the list FLOWS. Then use the UNGROUPED equation to calculate the NPV and IRR% to determine which machine should be purchased. (Note that this is a conventional series of cash flows, which means that the cash flows change sign only once.) The required rate of return is 10.5%.

Display the STAT menu.

Keys:	**Display:**	**Description:**
■ MODES ≣ FIX ≣ 2 INPUT		Sets display to two places.
■ CLEAR DATA ≣ YES ≣ ≣ YES ≣		Clears current named list or gets a new one.
or		
≣ GET ≣ ≣ *NEW ≣	ITEM(1) = ?	
80000 +/- INPUT	ITEM(2) = ?	Stores initial cash flow.
5000 INPUT	ITEM(3) = ?	Stores cash flow for year 1
4500 INPUT	ITEM(4) = ?	Stores cash flow for year 2.
5500 INPUT	ITEM(5) = ?	Stores cash flow for year 3.
4000 INPUT	ITEM(6) = ?	Stores cash flow for year 4.
115000 INPUT	ITEM(7) = ? TOTAL = 54,000.00	Stores cash flow for year 5.
EXIT ≣ NAME ≣ FLOWS INPUT		Names the list.

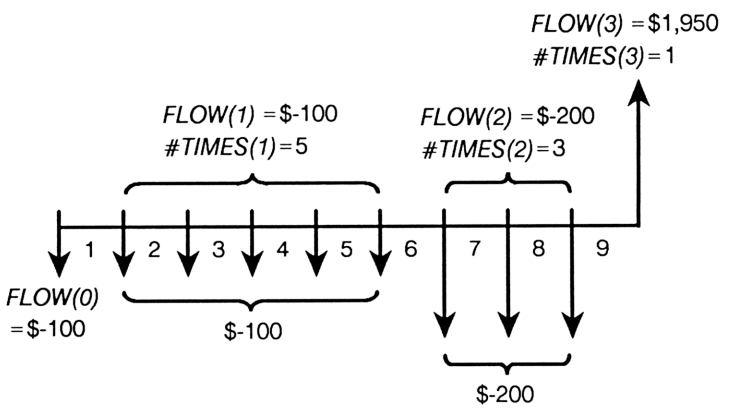
Display the UNGROUPED equation menu.

Keys:	Display:	Description:
0 NPV	NPV = 0.00	Stores net present value.
I%	I% = 11.93*	Calculates internal rate of return.
10.5 I%	I% = 10.50	Stores required return.
NPV	NPV = 4,774.63	Calculates net present value.

Option A is the better choice because *NPV* is positive. The *I%* calculation tells you the same thing – that because *I%* is more than the required 10%, option A is the better choice.

Grouped Cash Flows

Consecutive, equal cash flows are called grouped cash flows. The series shown in the following illustration is grouped into two sets of consecutive, equal cash flows:



* The Solver searches for an iterative solution and displays intermediate estimates.

After an initial payment of $100, the investor pays $100 at the end of periods one through five, and $200 at the end of periods six through eight. The investment returns $1950 at the end of period nine.

Entering and Using the GROUPED Equation:

1. Enter the GROUPED equation into the Solver.* FLOWS is the name of the STAT list in which you will store the cash flows.

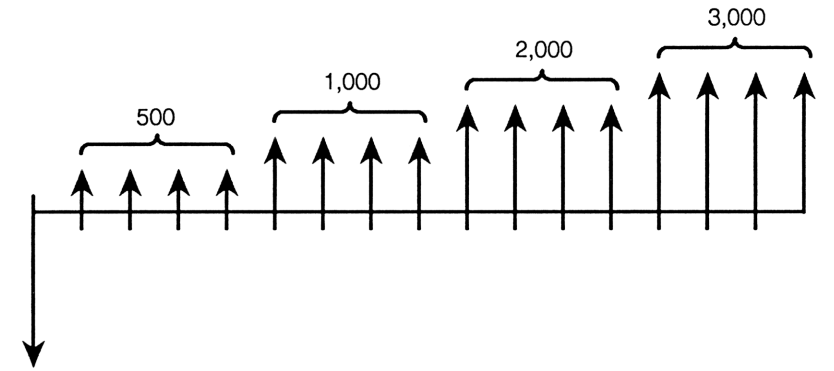
```
GROUPED:Σ(J:2:SIZES(FLOWS):2:
ITEM(FLOWS:J-1)×USPV(I%:ITEM
(FLOWS:J))×SPPV(I%:Σ(L:2:J-2:2:
ITEM(FLOWS:L))-1))=NPV
```

2. Enter all the cash flows into a STAT list. For each cash flow group, enter the cash flow amount as one item, then the number of cash flows in that group as the next item. Name the list FLOWS, the name used in the Solver equation.
3. Display the GROUPED equation menu.
4. To calculate net present value (*NPV*):
   - Store the periodic interest rate in [I%].
   - Press [NPV] to calculate the net present value.
5. To calculate internal rate of return (*I%*):
   - Store zero in [NPV].
   - Press [I%] to calculate the internal rate of return.

---

* To key in :, press [WXYZ] [OTHER] [:].
To key in Σ, press [WXYZ] [OTHER] [MORE] [Σ].

Example 2. You have an opportunity to invest $20,000. In return, you receive the following quarterly cash flows: 4 at $500, 4 at $1,000, 4 at $2,000, and 4 at $3,000.



Enter the data into the STAT list as cash flow groups. Name the list FLOWS. Then use the GROUPED equation to calculate the annual internal rate of return for this investment ($I\%\times4$).

Display the STAT menu.

Keys:	**Display:**	**Description:**
■ [MODES] [FIX] 2 [INPUT]		Sets display to two places.
■ [CLEAR DATA] [YES] [YES]		Clears current named list or gets a new one.
or		
[GET] [*NEW]	ITEM(1) =?	
20000 [+/−] [INPUT]	ITEM(2) =?	Stores initial cash flow.
1 [INPUT]	ITEM(3) =?	Stores number of times initial cash flow occurs.
500 [INPUT]	ITEM(4) =?	Stores first grouped cash flow.
4 [INPUT]	ITEM(5) =?	Stores number of times cash flow occurs.

1000 [INPUT]	ITEM(6) = ?	Stores second grouped cash flow.
4 [INPUT]	ITEM(7) = ?	Stores number of times cash flow occurs.
2000 [INPUT]	ITEM(8) = ?	Stores third grouped cash flow.
4 [INPUT]	ITEM(9) = ?	Stores number of times cash flow occurs.
3000 [INPUT]	ITEM(10) = ?	Stores fourth grouped cash flow.
4 [INPUT]	ITEM(11) = ? TOTAL = −13,483.00	Stores number of times cash flow occurs.
[EXIT] [NAME] FLOWS [INPUT]		Names the list FLOWS.

Display the GROUPED equation menu.

Keys:	Display:	Description:
0 [NPV]	NPV = 0.00	Stores net present value.
[I%]	I% = 2.43*	Calculates quarterly internal rate of return.
[×] 4 [=]	9.72	Calculates annual internal rate of return.

Notes on Internal Rate of Return Calculations

When calculating the internal rate of return, the Solver searches iteratively for a solution. This process may take a relatively long time, sometimes several minutes. To interrupt the calculation, press any key.

Storing guesses can help the Solver find the desired solution more quickly. To store two guesses, key in the first guess and press [I%]. Key in the

* The Solver searches for an iterative solution and displays intermediate estimates.

second guess and press [I%], and then press [I%] again to calculate the result.

For a "conventional investment," only one solution exists. A conventional investment means that the sequence of cash flows begins with negative cash flows, changes sign only once, and the sum of the cash flows is positive.

Calculation using cash flows that do not meet the conventional investment criteria can be more complex because there may be more than one mathematical solution to the problem, or there may be no solution. In these situations, storing initial guesses is important.

C

Bonds

This appendix includes two sections. The first section lists some of the bonds commonly available in the United States that can be solved with the BOND menu. The second section lists bonds that cannot be solved using the BOND menu. Neither section is all inclusive.

Bonds Solved on the HP-17B and HP-19B

This section is divided into two groups: 30/360 bonds and actual/actual bonds. This tells you which calendar to use in the BOND menu.

30/360 Bonds, Semi-Annual Coupon Payments

- State/Municipal/Local Government
  - Zero-coupon bonds
  - Tax supported bonds
  - Revenue bonds
  - Revenue supported bonds
  - Assessment supported bonds
  - Special supported bonds
- Corporate bonds*

* A common convention in calculating price and yield of corporate bonds in the United States is that if the coupon percent equals the yield percent, then the price of the bond is set to 100, whether the settlement date is a coupon date or not. In this convention, if the price is 100, the yield is set to the coupon rate. The BOND menu does not use this convention.

- Certificates of deposit with periodic interest
- Inter-American Development Bank bonds
- International Bank for Reconstruction and Development (World Bank) bonds
- Federal agency instruments
  - Commodity Credit Corporation (CCC) bonds
  - Export-Import Bank participation (Ex-Im) certificates
  - Federal Home Loan Bank (FHLB) bonds and notes
  - Federal Intermediate Credit Bank (FICB) debentures if coupon interest is paid periodically
  - Federal Land Bank (FLB) bonds
  - Federal National Mortgage Association (FNMA) debentures
  - General National Mortgage Association (GNMA) bonds and participation certificates
  - New Communities Act debentures
  - U.S. Postal Service bonds
  - Tennessee Valley Authority (TVA) bonds
  - Merchant Marine bonds

Actual/Actual, Semi-Annual Coupon Payments

- U.S. Treasury Bonds and Notes
- Federal Agency Issues
  - Farmers Home Administration (FHDA) insured notes
  - Federal Housing Administration (FHA) debentures

Bonds Not Solved on the HP-17B and HP-19B

Note

This list is not all inclusive.

- Interest at Maturity Notes
  - Commercial paper
  - Tax supported notes or warrants
  - Revenue supported notes or warrants
  - Assessment supported notes or warrants
  - Special supported notes or warrants
  - Repurchase agreements (Repos)
  - Banks for Cooperatives (Co-ops) debentures
  - Federal Intermediate Credit Bank (FICB) debentures, if interest at maturity
- Discounted Notes
  - Bankers acceptances
  - U.S. Treasury Bills
  - U.S. Tax-Anticipation Bills (TABS)
  - Commercial paper
  - U.S. Treasury certificates of indebtedness
  - Federal National Mortgage Association (FNMA) short term notes
  - Tennessee Valley Authority (TVA) Notes
- Other bonds and notes
  - Issued dated bonds if the issue date is not a coupon date anniversary
  - Stepped coupon bonds

- Federal Funds (Fed Funds)
- Callable bonds if the call date is not a coupon date anniversary
- Many non-U.S. bonds and notes.

More Step-by-Step Solutions for Your HP-17B, HP-19B, or HP-27S Calculator

These additional books offer a variety of examples and keystroke procedures to help set up your calculations the way *you* need them.

Practical routines show you how to use the built-in menus to solve problems more effectively, while easy-to-follow instructions help you create personalized menus.

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- Use the TVM menu for real estate, banking, and leasing calculations.
- Calculate the annual percentage rate of a loan with fees.
- Calculate discounted, adjustable-rate, and bi-weekly mortgages.
- Develop menus for graduated-payment and wrap-around mortgages.
- Estimate monthly payments and mortgage insurance.
- Use menus to calculate Rule of 78s, add-on loans, constant payment loans, loans with odd first periods, and leases with multiple payments in advance.
- Work with a variety of methods to evaluate savings plans.

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- Perform financial statement, production, and inventory analyses.
- Forecast sales and units to manufacture.

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Step-by-Step Solutions for Your HP-17B, HP-19B, or HP-27S Calculator

This book contains examples, equations, and keystrokes to help you with your personal investment and tax planning decisions.

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