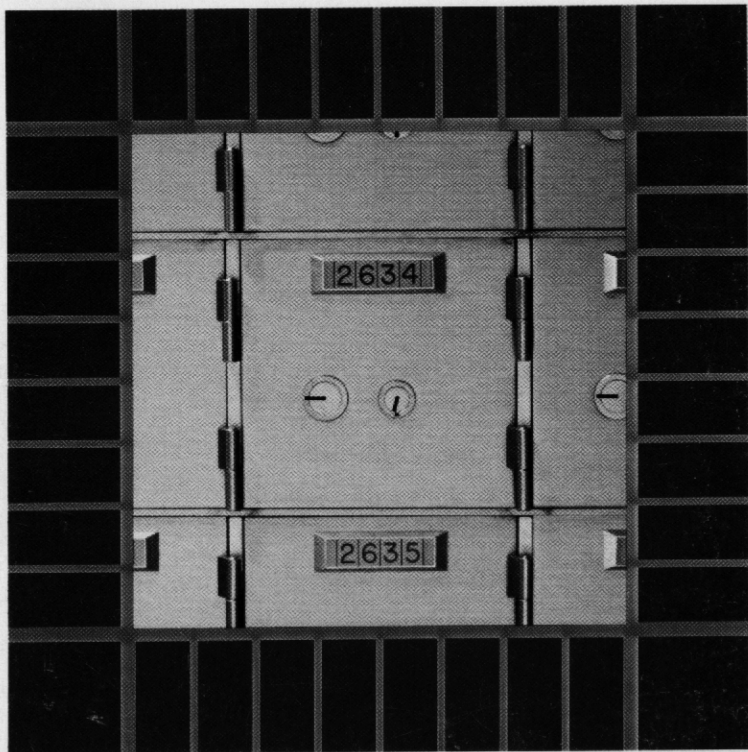


HEWLETT-PACKARD

HP-37E & HP-38E/38C

LENDING, SAVINGS,
AND LEASING
Applications



For Continuous Memory Models

Although this book refers specifically to the HP-37E or HP-38E, the programs and calculations contained herein apply equally well to the HP-38C. The user should note, however, that the display format and data register contents are retained by the calculator even though it has been turned off. It may be desirable to reset or clear these conditions before running programs or making calculations.

NOTICE

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Not For Resale



HP-37E & HP-38E/38C

**Lending, Savings, & Leasing
Applications**

September 1979

00038-90025 Rev. D 9/79

Introduction

This applications book has been designed to supplement the HP-37E and HP-38E *Owners' Handbooks* by providing a collection of applications specifically designed for lending, savings, and leasing institutions. Step by step keystroke procedures, examples, and programs for 19 problem types are explained. Hopefully, this book will provide a reference guide to the majority of your problems, and show you how to redesign our examples to fit your specific needs.

It is sometimes necessary in these keystroke solutions to include operations which involve prefix keys, namely, **f** on the HP-37E and **f** and **g** on the HP-38E. For example, the operation **12x** is performed on the HP-37E as **f 12x** and on the HP-38E as **g 12x**. In such cases, *the keystroke solution omits the prefix key and indicates only the operation* (as here, **12x**). As you work through the example problems, take care to press the appropriate prefix keys (if any) for your calculator.

In addition, it should be noted that certain clearing functions on the two calculators have different key mnemonics. *Clear finance* on the HP-37E is represented as **CL FIN**, and is represented as **FIN** on the HP-38E. *Clear all* is represented as **CL ALL** and **ALL** on the HP-37E and HP-38E respectively. Unless otherwise specified, this book will use the key mnemonics of the HP-37E, although the keystrokes are applicable to both machines.

All results are carried internally to ten significant digits. If intermediate answers are rounded by the user, slightly different final values may be obtained.

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Lending

Annual Percentage Rate Calculations With Fees


Borrowers are sometimes charged fees in connection with the issuance of a mortgage, which effectively raises the interest rate. The actual amount received by the borrower (PV) is reduced, while the periodic payments remain the same. Given the life or term of the mortgage, the interest rate, the mortgage amount, and the basis of the fee charge (how the fee is calculated), the true Annual Percentage Rate may be calculated. Information is entered as follows:

- 1) Set the Payment switch to END and press **CLFN**.
- 2) Calculate and enter the periodic payment amount of the loan.
 - a) Key in the total number of payment periods; press **n**.
 - b) Key in the periodic interest rate; press **i**.
 - c) Key in the mortgage amount; press **PV**.*
 - d) To obtain the periodic payment amount press **PMT**.*
- 3) Calculate and key in the actual net amount dispersed.*
 - a) If fees are stated as a percentage of the mortgage amount (points), recall the mortgage amount (**RCL PV**); key in the fee (percentage) rate; press **% - PV**.
 - b) If fees are stated as a flat charge, recall the mortgage amount (**RCL PV**); key in the fee amount (flat charge); press **- PV**.
 - c) If fees are stated as a percentage of the mortgage amount plus a flat charge, recall the mortgage amount (**RCL PV**); key in the fee (percentage) rate, press **% -**; key in the fee amount (flat charge); press **- PV**.
- 4) Press **i** to obtain the percentage rate per compounding period.
- 5) To obtain the annual nominal percentage rate, key in the number of periods per year, and press **x**.

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

Example 1:

A borrower is charged 2 points for the issuance of his mortgage. If the mortgage amount is \$50,000 for 30 years, and the interest rate is 9% per year, with monthly payments, what annual percentage rate is the borrower paying? (1 point is equal to 1% of the mortgage amount.)

| Keystrokes | Display | |
|---|------------------|---|
| BEGIN  END | | |
| CL FIN | | |
| 30 12x | 360.00 | Months (into n) |
| 9 12÷ | 0.75 | % monthly interest rate (into i) |
| 50000 PV | 50,000.00 | Loan amount (into PV) |
| PMT | -402.31 | Monthly payment (calculated) |
| RCL PV 2 % - PV | 49,000.00 | Actual amount paid by lender (into PV) |
| i | 0.77 | % monthly interest rate (calculated) |
| 12 x | 9.23 | Annual percentage rate |


For repeated use of this routine, the following HP-38E program could be beneficial:

| KEY ENTRY | DISPLAY |
|--|------------------|
| 9 P/R 9 CL P | 00- |
| PV | 01- 13 |
| 9 R+ | 02- 25 33 |
| 9 12÷ | 03- 25 12 |
| 9 R+ | 04- 25 33 |
| 9 12x | 05- 25 11 |
| PMT | 06- 14 |
| R/S | 07- 74 |
| RCL PV | 08- 22 13 |

| KEY ENTRY | DISPLAY |
|--------------------------------|---------------------|
| X2Y | 09- 33 |
| % | 10- 23 |
| - | 11- 41 |
| 9 PSE | 12- 25 4 |
| PV | 13- 13 |
| i | 14- 12 |
| RCL 9 12÷ | 15- 22,25 12 |
| 9 GTO 00 | 16- 25 7 00 |
| 9 P/R | |


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- 1) Key in the program.
- 2) Set the Payment switch to END and press **f** **FIN**.
- 3) Key in the total number of years; press **ENTER***.
- 4) Key in the annual interest rate; press **ENTER***.
- 5) Key in the mortgage amount and press **R/S** to obtain the monthly payment amount.
- 6) Key in the fee stated as a percentage of the mortgage amount; press **R/S**. The actual net amount dispersed is "paused" on the display, and then the program continues to calculate the annual interest rate.
- 7) For a new case return to step 3.

| Keystrokes | Display | |
|---|------------------|--------------------------------|
| BEGIN  END | | |
| f FIN | | |
| 30 ENTER* | | |
| 9 ENTER* | | |
| 50000 R/S | -402.31 | Monthly payment |
| 2 R/S | 49,000.00 | Actual loan amount (paused) |
| | 9.23 | Annual percentage rate |











Example 2:

Using the same information as given in Example 1, calculate the APR if the mortgage fee is \$150 instead of a percentage.

| Keystrokes | Display | |
|--|------------------|--|
| BEGIN  END | | |
| CL FIN | | |
| 30 12x | 360.00 | Months (into n) |
| 9 12÷ | 0.75 | % monthly interest rate (into i) |
| 50000 PV | 50,000.00 | Loan amount (into PV) |
| PMT | -402.31 | Monthly payment (calculated) |
| RCL PV 150 - PV | 49,850.00 | Effective mortgage amount (new balance into PV) |
| i | 0.75 | Monthly interest rate (calculated) |
| 12 x | 9.03 | Annual percentage rate |

Example 3:

Again using the information given in Example 1, what is the APR if the mortgage fee is stated as 2 points plus \$150?

| Keystrokes | Display | |
|--|------------------|--|
| BEGIN  END | | |
| CL FIN | | |
| 30  | 360.00 | Months (into n) |
| 9  | 0.75 | % monthly interest rate (into i) |
| 50000  | 50,000.00 | Loan amount (into PV) |
| PMT | -402.31 | Monthly payment (calculated) |
| RCL  2   | | |
| 150   | 48,850.00 | Effective mortgage amount (into PV) |
| i | 0.77 | Monthly interest rate (calculated) |
| 12  | 9.26 | Annual percentage rate |

Price of a Mortgage Traded at a Discount/Premium

Mortgages may be bought and/or sold at prices lower (discounted) or higher (at a premium) than the remaining balance of the loan at the time of purchase. Given the amount of the mortgage, the periodic payment, the timing and amount of the balloon or prepayment, and the *desired* yield rate, the price of the mortgage may be found. It should be noted that the balloon payment amount (if it exists) occurs coincident with, and does not include, the last periodic payment amount.

Information is entered as follows:


- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the total number of periods until the balloon payment or prepayment occurs; press **n**.
- 3) Key in the *desired* periodic interest rate (yield) and press **i**.

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- 4) Key in the periodic payment amount; press **PMT** .*
- 5) Key in the balloon payment amount and press **FV** .*
- 6) Press **PV** to obtain the purchase price of the mortgage.


Example 1:

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

| Keystrokes | Display | |
|---|------------------|---------------------------------|
| BEGIN  END | | |
| CL FIN | | |
| 72 n 7.5 12÷ | | |
| 137.17 PMT | | |
| 2000 FV PV | -9,210.48 | Amount necessary to prepay note |

Example 2:

A 9½% mortgage with 28 years remaining may be acquired which has a remaining balance of \$49,350. Determine the price to pay for this mortgage if the desired annual yield is 12%. (Since the payment amount is not given, it must be calculated.)

| Keystrokes | Display | |
|---|-------------------|--|
| BEGIN  END | | |
| CL FIN | | |
| 28 12x | 336.00 | Months (into n) |
| 9.5 12÷ | 0.79 | % monthly interest rate (into i) |
| 49350 CHS PV PMT | 420.40 | Monthly payment to be received |
| 12 12÷ | 1.00 | Desired % monthly interest rate (into i) |
| PV | -40,555.50 | Purchase price to achieve the desired yield (calculated) |

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

Yield of a Mortgage Traded at a Discount/Premium


The annual yield of a mortgage bought at a discount or premium may be calculated, given the original mortgage amount, interest rate, and periodic payment, as well as the number of payment periods per year, the price paid for the mortgage, and the balloon payment amount (if it exists).

Information is entered as follows:

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the total number of periods until the balloon payment occurs and press **n**.
- 3) Key in the periodic payment amount and press **PMT**.*
- 4) Key in the purchase price of the mortgage; press **PV**.*
- 5) Key in the balloon payment amount and press **FV**.*
- 6) Press **i** to obtain the yield per period.
- 7) Key in the number of periods per year and press **x** to obtain the nominal annual yield.

Example 1:

Find the annual yield of a 7%, 21 year mortgage prepaid in full at the end of the 12th year, if the mortgage amount is \$100,000, the purchase price is \$86,000, and equal monthly payments of \$758.47 are received. The remaining balance at the end of the 12th year is \$60,647.67.

| Keystrokes | Display | |
|--|-------------------|---|
| BEGIN  END | | |
| CL FIN | | |
| 12 n | 144.00 | Balloon payment occurs at end of 144 th month (into n) |
| 758.47 PMT | 758.47 | Monthly payment received (into PMT) |
| 86000 CHS PV | -86,000.00 | Amount loaned (into PV) |
| 60647.67 FV | 60,647.67 | Balloon payment (into FV) |
| i | 0.77 | Percent monthly yield (calculated) |
| 12 x | 9.23 | Percent annual yield |

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

Loans With a Constant Amount Paid Towards Principal

This type of loan is structured such that the principal is repaid in equal installments with the interest paid in addition. Therefore each periodic payment has a constant amount applied toward the principal and a varying amount of interest.

Loan Reduction Schedule

If the constant periodic payment to principal, annual interest rate, and loan amount are known, the total payment, interest portion of each payment, and remaining balance for each successive payment may be calculated as follows:

- 1) Key in the constant periodic payment to principal; press **[STO]** 0.
- 2) Key in periodic interest rate and press **[ENTER]** **[ENTER]** **[ENTER]**.
- 3) Key in the loan amount.
If you wish to skip to another time period, press **[ENTER]**.
Then key in the number of payments to be skipped, and press **[RCL]** 0 **[X]** **[=]**.
- 4) Press **[X₂Y]** **[%]** to obtain the interest portion of the payment.
- 5) Press **[RCL]** 0 **[+]** to obtain the total payment.
- 6) Press **[CLX]** **[RCL]** 0 **[=]** to obtain the remaining balance of the loan.
- 7) Return to step 4 for each successive payment.

Example 1:

A \$60,000 land loan at 10% interest calls for equal semi-annual principal payments over a 6-year maturity. What is the loan reduction schedule for the first year? (Constant payment to principal is \$5000 semi-annually.) What is the fourth year's schedule (skip 4 payments)?

Keystrokes

5000 **[STO]** 0
 10 **[ENTER]** 2 **[+]** **[ENTER]**
[ENTER] **[ENTER]**
 60000 **[X₂Y]** **[%]**
[RCL] 0 **[+]**
[CLX] **[RCL]** 0 **[=]**

Display

5.00
3,000.00
8,000.00
55,000.00

Semi-annual interest rate
 First payment's interest
 Total first payment
 Remaining balance

Keystrokes

Display

x₂y **%**
RCL 0 **+**
CLX **RCL** 0 **-**

2,750.00
7,750.00
50,000.00

Second payment's interest
 Total second payment
 Remaining balance after
 first year

4 **RCL** 0 **x** **-**

x₂y **%**
RCL 0 **+**
CLX **RCL** 0 **-**

1,500.00
6,500.00
25,000.00

Seventh payment's interest
 Total seventh payment
 Remaining balance

x₂y **%**
RCL 0 **+**
CLX **RCL** 0 **-**

1,250.00
6,250.00
20,000.00

Eighth payment's interest
 Total eighth payment
 Remaining balance after
 fourth year

Add-On Interest Rate Converted to APR

An add-on interest rate determines what portion of the principal will be added on for repayment of a loan. This sum is then divided by the number of months in the loan to determine the monthly payment. For example, a 10% add-on rate for 36 months on \$3000 means add one-tenth of \$3000 for 3 years (300×3)—usually called the “finance charge”—for a total of \$3900. The monthly payment is $\$3900/36$.


This keystroke procedure converts an add-on interest rate to an annual percentage rate when the add-on rate and number of months are known.

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the number of months in loan; press **n** **ENTER** **RCL** **12x**.
- 3) Key in the add-on rate; press **x**.
- 4) Key in the amount of loan; press **PV** * **x₂y** **%** **+**.
- 5) Press **x₂y** **=** **CHS** **PMT**.
- 6) Press **i** **12** **x** to obtain the APR.

Example 1:

Calculate the APR and monthly payment of a 5%, \$1000 add-on loan which has a life of 18 months.

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

| Keystrokes | Display | |
|---|-----------------|------------------------|
| BEGIN  END | | |
| CL FIN | | |
| 18 n ENTER \uparrow | | |
| RCL 12x 5 x | | |
| 1000 PV x\divy % + | 1,075.00 | Amount of loan |
| x\divy \div CHS PMT | -59.72 | Monthly payment |
| i 12 x | 9.27 | % annual interest rate |


APR Converted to Add-On Interest Rate

Given the number of months and annual percentage rate, this procedure calculates the corresponding add-on interest rate.

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Enter the following information:
 - a) Key in number of months of loan, press **n**.
 - b) Key in APR, press **12 \div** .
 - c) Key in 100, press **PV** **PMT**.
- 3) Press **RCL** **PV** **RCL** **n** **\div** **+** **CHS** **12** **x** to obtain add-on rate.

Example 1:

What is the equivalent add-on rate for an 18-month loan with an APR of 14%?

| Keystrokes | Display | |
|---|-------------|---------------------|
| BEGIN  END | | |
| CL FIN | | |
| 18 n 14 12\div 100 PV | | |
| PMT RCL PV RCL n | | |
| \div + CHS 12 x | 7.63 | Percent add-on rate |

Add-On Rate Loan With Credit Life

This HP-38E program calculates the monthly payment amount, credit life amount (an optional insurance which cancels any remaining indebtedness at the death of the borrower), total finance charge, and annual percentage rate (APR) for an add-on interest rate loan. The monthly payment is rounded (in the normal manner) to the nearest cent. If other rounding techniques are used, slightly different results may occur.

| KEY ENTRY | DISPLAY |
|---|-----------|
| \boxed{g} $\boxed{P/R}$ \boxed{g} \boxed{CLP} | 00- |
| 1 | 01- 1 |
| \boxed{RCL} 0 | 02- 22 0 |
| 1 | 03- 1 |
| 2 | 04- 2 |
| 0 | 05- 0 |
| 0 | 06- 0 |
| $\boxed{-}$ | 07- 71 |
| \boxed{STO} 4 | 08- 21 4 |
| \boxed{RCL} 2 | 09- 22 2 |
| $\boxed{\times}$ | 10- 61 |
| $\boxed{-}$ | 11- 41 |
| \boxed{g} $\boxed{LAST X}$ | 12- 25 31 |
| \boxed{RCL} 1 | 13- 22 1 |
| $\boxed{\times}$ | 14- 61 |
| \boxed{RCL} 4 | 15- 22 4 |
| $\boxed{\times}$ | 16- 61 |
| $\boxed{-}$ | 17- 41 |
| \boxed{RCL} 4 | 18- 22 4 |
| \boxed{RCL} 1 | 19- 22 1 |
| $\boxed{\times}$ | 20- 61 |
| 1 | 21- 1 |
| $\boxed{+}$ | 22- 51 |
| $\boxed{x\div y}$ | 23- 33 |
| $\boxed{-}$ | 24- 71 |
| \boxed{RCL} 3 | 25- 22 3 |
| $\boxed{\times}$ | 26- 61 |
| \boxed{RCL} 0 | 27- 22 0 |
| $\boxed{-}$ | 28- 71 |

| KEY ENTRY | DISPLAY |
|------------------------------|-------------|
| \boxed{f} \boxed{RND} | 29- 24 14 |
| \boxed{CHS} | 30- 32 |
| \boxed{PMT} | 31- 14 |
| $\boxed{R/S}$ | 32- 74 |
| \boxed{RCL} \boxed{PMT} | 33- 22 14 |
| \boxed{RCL} 0 | 34- 22 0 |
| $\boxed{\times}$ | 35- 61 |
| \boxed{CHS} | 36- 32 |
| \boxed{PV} | 37- 13 |
| \boxed{RCL} \boxed{PV} | 38- 22 13 |
| \boxed{RCL} 2 | 39- 22 2 |
| $\boxed{\%}$ | 40- 23 |
| \boxed{RCL} 0 | 41- 22 0 |
| $\boxed{\times}$ | 42- 61 |
| 1 | 43- 1 |
| 2 | 44- 2 |
| $\boxed{+}$ | 45- 71 |
| \boxed{STO} 5 | 46- 21 5 |
| \boxed{g} \boxed{EEX} | 47- 25 32 |
| 2 | 48- 2 |
| $\boxed{\times}$ | 49- 61 |
| \boxed{g} \boxed{FRAC} | 50- 25 61 |
| \boxed{g} $\boxed{x=0}$ | 51- 25 6 |
| \boxed{g} \boxed{GTO} 60 | 52- 25 7 60 |
| \boxed{RCL} 5 | 53- 22 5 |
| . | 54- 73 |
| 0 | 55- 0 |
| 1 | 56- 1 |
| $\boxed{+}$ | 57- 51 |

| KEY ENTRY | DISPLAY |
|----------------------------|-----------|
| \boxed{f} \boxed{RND} | 58- 24 14 |
| \boxed{STO} 5 | 59- 21 5 |
| \boxed{RCL} 5 | 60- 22 5 |
| $\boxed{R/S}$ | 61- 74 |
| \boxed{RCL} \boxed{PV} | 62- 22 13 |
| $\boxed{x\div y}$ | 63- 33 |
| $\boxed{-}$ | 64- 41 |
| \boxed{RCL} 3 | 65- 22 3 |
| $\boxed{-}$ | 66- 41 |
| \boxed{CHS} | 67- 32 |
| $\boxed{R/S}$ | 68- 74 |


| KEY ENTRY | DISPLAY |
|---|--------------|
| \boxed{RCL} 5 | 69- 22 5 |
| \boxed{RCL} 3 | 70- 22 3 |
| $\boxed{+}$ | 71- 51 |
| \boxed{PV} | 72- 13 |
| \boxed{RCL} 0 | 73- 22 0 |
| \boxed{n} | 74- 11 |
| \boxed{i} | 75- 12 |
| \boxed{RCL} \boxed{g} $\boxed{12-}$ | 76- 22,25 12 |
| \boxed{g} \boxed{GTO} 00 | 77- 25 7 00 |
| \boxed{g} $\boxed{P/R}$ | |
| | |

| REGISTERS | | | |
|--------------|------------|----------|-----------|
| R_0 N | R_1 AIR | R_2 CL | R_3 AMT |
| R_4 N/1200 | R_5 Used | R_6 | R_7 |

- 1) Key in the program.
- 2) Set the payment switch to END and press $\boxed{CL FIN}$.
- 3) Key in the number of monthly payments in the loan; press \boxed{STO} 0.
- 4) Key in the annual add-on interest rate as a percent; press \boxed{STO} 1.
- 5) Key in the credit life as a percent; press \boxed{STO} 2.
- 6) Key in the amount; press \boxed{STO} 3.
- 7) Press $\boxed{R/S}$ to find the monthly payment amount.
- 8) Press $\boxed{R/S}$ to obtain the amount of credit life.
- 9) Press $\boxed{R/S}$ to calculate the total finance charge.
- 10) Press $\boxed{R/S}$ to calculate the annual percentage rate.
- 11) For a new loan return to step 3.

Example 1:

You wish to quote a loan on a \$3100 balance, payable over 36 months at an add-on rate of 6.75%. Credit life is 1%. What are the monthly payment amount, credit life amount, total finance charge, and APR?

| Keystrokes | Display | |
|---|----------------|-----------------|
| BEGIN  END | | |
| CL FIN | | |
| 36 STO 0 | | |
| 6.75 STO 1 | | |
| 1 STO 2 | | |
| 3100 STO 3 | | |
| R/S | -107.42 | Monthly payment |
| R/S | 116.02 | Credit life |
| R/S | -651.10 | Finance charge |
| R/S | 12.39 | APR |

Interest Rebate—Rule of 78's

This procedure finds the unearned interest rebate, as well as the remaining principal balance due for a prepaid consumer loan using the Rule of 78's. The known values are the current installment number, the total number of installments for which the loan was written, and the total finance charge (amount of interest). The information is entered as follows:

- 1) Key in number of months in the loan; press **STO** 1.
- 2) Key in payment number when prepayment occurs; press **-** **STO** 2 **1** **+**.
- 3) Key in total finance charge; press **x** **RCL** 1 **ENTER** **x** **RCL** 1 **+** **-** **RCL** 2 **x** to obtain the unearned interest (rebate).
- 4) Key in periodic payment amount; press **RCL** 2 **x** **x₂y** **-** to obtain the amount of principal outstanding.

Example 1:

A 30 month, \$1,000 loan having a finance charge of \$180, is being repaid at \$39.33 per month. What is the rebate and balance due after the 25th regular payment?

Keystrokes

Display

30 **STO** 125 **-** **STO** 21 **+** 180 **x****RCL** 1 **ENTER*****x** **RCL** 1 **+****-** **RCL** 2 **x**39.33 **RCL** 2 **x****x₂y** **-**

5.81

Rebate

190.84

Outstanding principal

This HP-38E program can be used to evaluate the previous example:

| KEY ENTRY | DISPLAY | KEY ENTRY | DISPLAY |
|--|-----------|------------------------|-------------|
| 9 P/R 9 CL P | 00- | ENTER * | 14- 31 |
| STO 0 | 01- 21 0 | x | 15- 61 |
| 9 R+ | 02- 25 33 | RCL 1 | 16- 22 1 |
| STO 2 | 03- 21 2 | + | 17- 51 |
| 9 R+ | 04- 25 33 | - | 18- 71 |
| STO 1 | 05- 21 1 | RCL 2 | 19- 22 2 |
| RCL 2 | 06- 22 2 | x | 20- 61 |
| - | 07- 41 | R/S | 21- 74 |
| STO 2 | 08- 21 2 | RCL 2 | 22- 22 2 |
| 1 | 09- 1 | x | 23- 61 |
| + | 10- 51 | x₂y | 24- 33 |
| RCL 0 | 11- 22 0 | - | 25- 41 |
| x | 12- 61 | 9 GTO 00 | 26- 25 7 00 |
| RCL 1 | 13- 22 1 | 9 P/R | |

REGISTERS

| | | | |
|-------------------|--------------------------|------------------------|----------------|
| R ₀ FC | R ₁ Payment # | R ₂ Total n | R ₃ |
| R ₄ | R ₅ | R ₆ | R ₇ |

- 1) Key in the program.
- 2) Key in the number of months in the loan; press **ENTER**.
- 3) Key in the payment number when prepayment occurs; press **ENTER**.
- 4) Key in the total finance charge; press **R/S** to obtain the unearned interest (rebate).
- 5) Key in the periodic payment amount; press **R/S** to find the amount of principal outstanding.
- 6) For a new case return to step 2.

Keystrokes**Display**30 **ENTER**25 **ENTER**180 **R/S**39.33 **R/S****5.81****190.84**

Rebate

Outstanding principal

Savings

An annual effective rate demonstrates the effect of compounding for a full year of compounding periods at a particular periodic interest rate. The periodic interest rate to be used is determined by dividing the number of compounding periods in a year into the stated nominal interest rate. The effect is such that if the nominal rate is held constant, as the number of compounding periods per year is increased, the annual effective interest rate will increase. The ultimate or upper limit in this process is to have an infinite number of compounding periods in a year, commonly called continuous compounding.

Nominal Rate Converted to Effective Rate

Given a nominal interest rate and the number of compounding periods per year, this keystroke procedure computes the effective annual interest rate.

- 1) Press **CLFIN**.
- 2) Key in the nominal rate; press **ENTER**.
- 3) Key in the number of compounding periods per year; press **n** **÷** **i**.
- 4) Key in 100; press **CHS** **ENTER** **PV**.
- 5) Press **FV** **+** to obtain the effective annual interest rate.

Example 1:

What is the effective annual rate of interest if the annual nominal rate of 5¼% is compounded quarterly?

| Keystrokes | Display | |
|---------------------------------------|-------------|---------------------------|
| CLFIN | | |
| 5.25 ENTER 4 n ÷ | | |
| i | 1.31 | % quarterly interest rate |
| 100 CHS ENTER PV | | |
| FV + | 5.35 | % effective interest rate |

For repeated calculations the following HP-38E program can be used:

| KEY ENTRY | DISPLAY | KEY ENTRY | DISPLAY |
|--|-----------|------------------------|-------------|
| g P/R g CL P | 00- | CHS | 08- 32 |
| f FIN | 01- 24 32 | ENTER ▶ | 09- 31 |
| n | 02- 11 | PV | 10- 13 |
| ± | 03- 71 | FV | 11- 15 |
| i | 04- 12 | + | 12- 51 |
| 1 | 05- 1 | g GTO 00 | 13- 25 7 00 |
| 0 | 06- 0 | g P/R | |
| 0 | 07- 0 | | |

- 1) Key in the program.
- 2) Key in the nominal rate; press **ENTER** **▶**.
- 3) Key in the number of compounding periods; press **R/S** to obtain the effective annual interest rate.
- 4) For a new case return to step 2.

Example 2:

What is the effective annual rate of interest if the annual nominal rate of 5¼% is compounded monthly?

Keystrokes

5.25 **ENTER** **▶**

12 **R/S**

Display

5.38

% effective interest rate

Effective Rate Converted to Nominal Rate

Given an effective interest rate and the number of compounding periods per year, this routine calculates the nominal interest rate.

- 1) Press **CL FIN**.
- 2) Key in the number of periods per year; press **n**.
- 3) Key in 100; press **ENTER** **▶** **PV**.
- 4) Key in the effective annual rate; press **+** **CHS** **FV** **i**.
- 5) Press **RCL** **n** **x** to obtain the nominal rate.

Example 1:

Find the nominal rate if the effective annual rate is 5.35% compounded quarterly.

| Keystrokes | Display |
|---------------------------------------|-------------------------------------|
| CL FIN | |
| 4 n 100 ENTER PV | |
| 5.35 + CHS | |
| FV i | |
| RCL n x | 5.25 % nominal interest rate |

Nominal Rate Converted to Continuous Effective Rate

This procedure converts a nominal annual interest rate to the continuous effective rate.

- 1) Key in 1; press **ENTER**.
- 2) Key in the nominal rate; press **%**.
- 3) Press **e^x** **Δ%** to obtain the continuous effective rate.

Example 1:

What is the effective rate resulting from a 5¼% passbook rate with continuous compounding?

| Keystrokes | Display |
|---|-------------------------------|
| 1 ENTER 5.25 % e^x | |
| Δ% | 5.39 % continuous rate |

This section gives keystroke procedures to evaluate frequently encountered savings problems. Also included is a generalized routine to evaluate a savings plan when deposits and withdrawals are made at irregular intervals.

Initial Deposit With Periodic Deposits


Given an initial deposit into a savings account, and a series of periodic deposits coincident with the compounding period, the future value (or accumulated amount) may be calculated as follows:

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the initial investment and press **CHS** **PV**.
- 3) Key in the number of additional periodic deposits and press **n**.
- 4) Key in the periodic interest rate and press **i**.
- 5) Key in the periodic deposit and press **CHS** **PMT**.
- 6) Press **FV** to determine the value of the account at the end of the time period.

Example 1:

You have just opened a savings account with a \$200 deposit. If you deposit \$50 a month, and the account earns 5¼% compounded monthly, how much will you have in 3 years?

Keystrokes

BEGIN  END

CL FIN

200 **CHS** **PV** 3 **12x**

5.25 **12÷**

50 **CHS** **PMT** **FV**

Display

2,178.94

Value of the account

Note: If the periodic deposits do not coincide with the compounding periods, the account must be evaluated in another manner. First, find the future value of the initial deposit and store it. Then use the procedure for Compounding Periods Different from Payment Periods to calculate the future value of the periodic deposits. Recall the future value of the initial deposit and add to obtain the value of the account.

Number of Periods to Deplete a Savings Account or to Reach a Specified Balance

Given the current value of a savings account, the periodic interest rate, the amount of the periodic withdrawal, and a specified balance, this

procedure determines the number of periods to reach that balance (the balance is zero if the account is depleted.)

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the value of the savings account and press **CHS** **PV**.
- 3) Key in the periodic interest rate and press **i**.
- 4) Key in the amount of the periodic withdrawal and press **PMT**.
- 5) Key in the amount remaining in the account and press **FV**. This step may be omitted if the account is depleted ($FV = 0$).
- 6) Press **n** to determine the number of periods to reach the desired balance.

Example 1:

Your savings account presently contains \$18,000 and earns $5\frac{1}{2}\%$ compounded monthly. You wish to withdraw \$300 a month until the account is depleted. How long will this take? If you wish to reduce the account to \$5,000, how many withdrawals can you make?

Keystrokes

BEGIN  END

CL FIN

18000 **CHS** **PV**

5.5 **12** \div

300 **PMT** **n**

12 \div

5000 **FV** **n**

12 \div

Display

70.32

5.86

52.95

4.41

Months

Years to deplete account

Months

Years to reduce account to
\$5,000

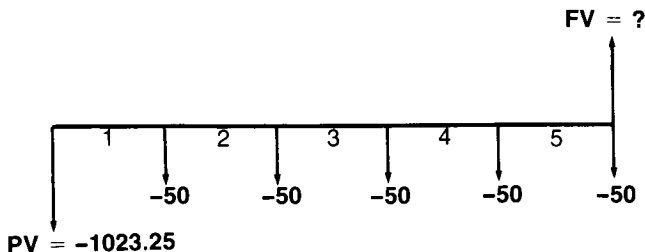
Periodic Deposits and Withdrawals

This section is presented as a guideline for evaluating a savings plan when deposits and withdrawals occur at irregular intervals. One problem is given, and a step-by-step method for setting-up and solving the problem is presented.

Problem

You are presently depositing \$50 at the end of each month into a local savings and loan, earning $5\frac{1}{2}\%$ compounded monthly. Your current balance is \$1023.25. How much will you have accumulated in 5 months?

The cash flow diagram looks like this:








The keystrokes are:

Keystrokes**Display**

BEGIN  END



50   5.5 

1023.25  

5  

1,299.22

Amount in account

Now suppose that at the beginning of the 6th month you withdraw \$80. What is the new balance?

Keystrokes**Display**

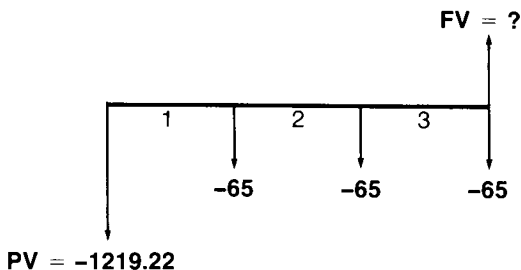
80 

1,219.22

New balance

You increase your monthly deposit to \$65. How much will you have in 3 months?

The cash flow diagram now looks like this:



Keystrokes

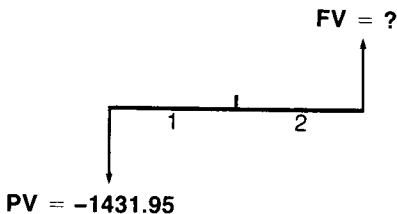
[CHS] [PV] 65 [CHS] [PMT]
3 [n] [FV]

Display

1,431.95

Account balance

Suppose that for 2 months you decide not to make a periodic deposit. What is the balance in the account?



Keystrokes

[CHS] [PV] 2 [n]
0 [PMT] [FV]

Display

1,445.11

Account balance

This type of procedure may be continued for any length of time, and may be modified to meet the user's particular needs.

Savings Account Compounded Daily

This HP-38E program determines the value of a savings account when interest is compounded daily, based on a 365 day year. The user is able to calculate the total amount remaining in the account after a series of transactions on specified dates.

| KEY ENTRY | DISPLAY |
|---|-----------|
| g P/R g CLP | 00- |
| CHS | 01- 32 |
| PV | 02- 13 |
| g R+ | 03- 25 33 |
| 3 | 04- 3 |
| 6 | 05- 6 |
| 5 | 06- 5 |
| - | 07- 71 |
| I | 08- 12 |
| g R+ | 09- 25 33 |
| STO 0 | 10- 21 0 |
| RCL PV | 11- 22 13 |
| CHS | 12- 32 |
| R/S | 13- 74 |
| STO 2 | 14- 21 2 |
| g R+ | 15- 25 33 |
| STO 1 | 16- 21 1 |
| RCL 0 | 17- 22 0 |
| RCL 1 | 18- 22 1 |
| f ΔDAYS | 19- 24 41 |

| KEY ENTRY | DISPLAY |
|------------------------|-------------|
| n | 20- 11 |
| FV | 21- 15 |
| f RND | 22- 24 14 |
| FV | 23- 15 |
| ENTER* | 24- 31 |
| RCL PV | 25- 22 13 |
| + | 26- 51 |
| STO + 3 | 27- 21 51 3 |
| RCL FV | 28- 22 15 |
| RCL 2 | 29- 22 2 |
| + | 30- 51 |
| CHS | 31- 32 |
| PV | 32- 13 |
| RCL 1 | 33- 22 1 |
| STO 0 | 34- 21 0 |
| RCL PV | 35- 22 13 |
| CHS | 36- 32 |
| g GTO 13 | 37- 25 7 13 |
| g P/R | |
| | |

REGISTERS

| | | | |
|-----------------------------|--------------------------|--------------------------|-------------------------|
| R ₀ Initial date | R ₁ Next date | R ₂ \$ amount | R ₃ Interest |
| R ₄ | R ₅ | R ₆ | R ₇ |


- 1) Key in the program.
- 2) Set the Payment switch to END and press **f** **ALL**.
- 3) Key in the date (MM.DDYYYY) of the first transaction; press **ENTER***.
- 4) Key in the annual nominal interest rate as a percent; press **ENTER***.

- 5) Key in the amount of the initial deposit; press **[R/S]**.
- 6) Key in the date of the next transaction; press **[ENTER+]**.
- 7) Key in the amount of the transaction (positive for money deposited, negative for cash withdrawn); press **[R/S]** to determine the amount in the account.
- 8) Repeat steps 6 and 7 for subsequent transactions.
- 9) To see the total interest to date, press **[RCL] 3**.
- 10) For a new case press **[9] [CL P]** and go to step 2.

Example:

Compute the amount remaining in this 5.25% account after the following transactions:

- 1) January 18, 1978 deposit \$125.00
- 2) February 24, 1978 deposit \$60.00
- 3) March 16, 1978 deposit \$70.00
- 4) April 5, 1978 withdraw \$50.00
- 5) June 1, 1978 deposit \$175.00
- 6) July 6, 1978 withdraw \$100

| Keystrokes | Display | |
|---|---------------|---|
| BEGIN  END | | |
| [f] [ALL] | | |
| 1.181978 [ENTER+] | | |
| 5.25 [ENTER+] | | |
| 125 [R/S] | 125.00 | Initial deposit |
| 2.241978 [ENTER+] | | |
| 60 [R/S] | 185.67 | Balance in account February 24, 1978 |
| 3.161978 [ENTER+] | | |
| 70 [R/S] | 256.20 | Balance in account March 16, 1978 |
| 4.051978 [ENTER+] | | |
| 50 [CHS] [R/S] | 206.94 | Balance in account April 5, 1978 |

| | | | |
|--------------|------------------------------------|---------------|------------------------------------|
| 6.011978 | ENTER \blacktriangleright | | |
| 175 | R/S | 383.64 | Balance in account June 1, 1978 |
| 7.061978 | ENTER \blacktriangleright | | |
| 100 | CHS R/S | 285.58 | Balance in account July 6, 1978 |
| RCL 3 | | 5.58 | Total interest |

Compounding Periods Different From Payment Periods

In financial calculations involving a series of payments equally spaced in time with periodic compounding, both periods of time are normally equal and coincident. This assumption is programmed into the HP-37E and HP-38E.

In savings plans however, money may become available for deposit or investment at a frequency different from the compounding frequencies offered. The HP-37E and HP-38E can easily be used in these calculations. However, because of the assumptions mentioned, the compounding period interest rate must be adjusted to correspond to an equivalent rate for the payment period.

These procedures present solutions for future value, payment amount, and number of payments. In addition, it should be noted that only annuity due (payments at the beginning of payment period) calculations are shown since this is most common in savings plan calculations.

















To calculate the equivalent payment period interest rate, information is entered as follows:

- 1) Set the Payment switch to BEGIN and press **CL FIN**.
- 2) Key in the annual interest rate (as a percent); press **ENTER** \blacktriangleright .
- 3) Key in the number of compounding periods per year; press **n** **÷** **i**.
- 4) Key in 100; press **PV** **FV**.
- 5) Key in the number of payments (deposits) per year; press **n** **i** **CL FIN** **i**.

The interest rate which corresponds to the payment period is now in register "i" and you are ready to proceed.


















Example 1: Solving for future value.

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

| Keystrokes | Display | |
|--|-----------------|-----------------------------------|
| BEGIN  END | | |
|  | | |
| 5  | | |
| 365    | | |
| 100   | | |
| 12   | | |
|   | 0.42 | Equivalent periodic interest rate |
| 7  25   | | |
|  | 2,519.61 | Future value |

Example 2: Solving for payment amount.

For 8 years you wish to make weekly deposits in a savings account paying 5.5% compounded quarterly. What amount must you deposit each week to accumulate \$6000?

| Keystrokes | Display | |
|--|---------------|-----------------------------------|
| BEGIN  END | | |
|  | | |
| 5.5  | | |
| 4    | | |
| 100   | | |
| 52   | | |
|   | 0.11 | Equivalent periodic interest rate |
| 8  52   | | |
| 6000   | -11.49 | Periodic payment |

Example 3: Solving for number of payment periods.




You can make weekly deposits of \$10 into an account paying 5.25% compounded daily (365-day basis). How long will it take you to accumulate \$1000?



Keystrokes**Display**

BEGIN  END



5.25 

365   

100  

52  

0.10

Equivalent periodic
interest rate

10   1000 



95.22

Weeks

52 

1.83

Years

Leasing

Advance Payments

Situations may exist where payments are made in advance (leasing is a good example). Sometimes these agreements call for extra payments to be made when the transaction is closed, before the payments would normally be due.

This first procedure finds the periodic payment amount necessary to achieve a desired yield when a number of payments are made in advance. And, given the periodic payment, the second procedure calculates the periodic yield.

To calculate the payment, information is entered as follows:

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the total number of payments in the lease and press **ENTER**.
- 3) Key in the total number of payments made in advance and press **STO** 0 **-** **n**.
- 4) Key in or calculate the periodic interest rate as a percent and press **i**.
- 5) Key in 1; press **CHS** **PMT** **PV** **RCL** 0 **+**.
- 6) Key in the initial loan amount and press **x_{xy}** **-** to obtain the periodic payment to be received by the lessor.

Example 1:

Equipment worth \$750 is leased for 12 months. The equipment is assumed to have no salvage value at the end of the lease. The lessee has agreed to make 3 payments at the time of closing. What monthly payment is necessary to yield the lessor 10% annually?

Keystrokes

Display

BEGIN  END

CL FIN

12 ENTER*

3 STO 0 - n

10 12÷ 1 CHS PMT

PV RCL 0 +

750 x2y ÷

64.45

Monthly payment to be received

For repeated leases of this type use the following HP-38E program:

| KEY ENTRY | DISPLAY | KEY ENTRY | DISPLAY |
|--------------|-----------|-----------|-------------|
| g P/R g CL P | 00- | CHS | 10- 32 |
| f FIN | 01- 24 32 | PMT | 11- 14 |
| STO 1 | 02- 21 1 | PV | 12- 13 |
| g R+ | 03- 25 33 | RCL 0 | 13- 22 0 |
| i | 04- 12 | + | 14- 51 |
| g R+ | 05- 25 33 | RCL 1 | 15- 22 1 |
| STO 0 | 06- 21 0 | x2y | 16- 33 |
| - | 07- 41 | ÷ | 17- 71 |
| n | 08- 11 | g GTO 00 | 18- 25 7 00 |
| 1 | 09- 1 | | |

REGISTERS

| | | | |
|------------------|-------------------|----------------|----------------|
| R ₀ A | R ₁ PV | R ₂ | R ₃ |
| R ₄ | R ₅ | R ₆ | R ₇ |

- 1) Key in the program.
- 2) Set the Payment switch to END.
- 3) Key in the total number of payments in the lease; press ENTER*.
- 4) Key in the total number of payments made in advance; press ENTER*.

- 5) Key in the periodic interest rate as a percent; press **ENTER+**.
- 6) Key in the initial loan amount and press **R/S** to obtain the periodic payment to be received by the lessor.
- 7) For a new case, return to step 3.

Keystrokes**Display**BEGIN  END12 **ENTER+**3 **ENTER+**10 **ENTER+** 12 **÷**750 **R/S****64.45**

Monthly payment to be received

Example 2:

In the previous example, what monthly payment is necessary to yield the lessor 10% annually if one payment is due at the time of closing?

Keystrokes**Display**BEGIN  END**CL FIN**12 **ENTER+**1 **STO** 0 **-** **n**10 **12÷** 1 **CHS** **PMT****PV** **RCL** 0 **+**750 **x_zy** **÷****65.39**

Monthly payment to be received

Since this is an annuity due situation (one payment at the beginning of the period) the calculation could also be done as follows:

Keystrokes**Display**BEGIN  END**CL FIN**12 **n** 10 **12÷**750 **CHS** **PV** **PMT****65.39**

Monthly payment to be received


To calculate the periodic yield, information is entered as follows:

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the total number of payments in the lease and press **ENTER***.
- 3) Key in the total number of payments made in advance and press **STO 0 - n**.
- 4) Key in the periodic payment to be received and press **PMT**.
- 5) Key in the total amount of the loan and press **CHS RCL 0 RCL PMT x + PV**.
- 6) Press **i** to obtain the periodic yield.

Example 1:

A lease has been written to run for 60 months. The leased equipment has a value of \$25,000 with a \$600 monthly payment. The lessee has agreed to make 3 payments at the time of closing (\$1800). What is the annual yield to the lessor?

Keystrokes

BEGIN  END
CL FIN
 60 **ENTER***
 3 **STO 0 - n**
 600 **PMT**
 25000 **CHS RCL 0**
RCL PMT x + PV
i
 12 **x**

Display

1.44 Monthly yield
17.33 Annual yield as a %

Advance Payments With Residual

Situations may arise where a transaction has advance payments and a residual value (salvage value) at the end of the normal term.

To calculate the payment amount, information is entered as follows:

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the total number of payments and press **n**.
- 3) Key in or calculate the periodic interest rate and press **i**.

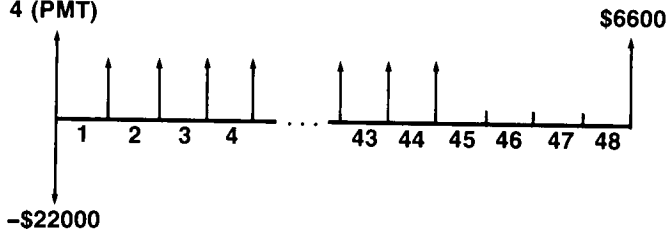
34 Leasing

- 4) Key in the residual value and press $\boxed{\text{FV}} \boxed{\text{PV}}$.
- 5) Key in the loan amount and press $\boxed{+} \boxed{\text{STO}} \boxed{0}$.
- 6) Press $0 \boxed{\text{FV}} \boxed{\text{RCL}} \boxed{n}$.
- 7) Key in the total number of payments made in advance and press $\boxed{\text{STO}} \boxed{1} \boxed{-} \boxed{n} \boxed{1} \boxed{\text{CHS}} \boxed{\text{PMT}} \boxed{\text{PV}} \boxed{\text{RCL}} \boxed{1} \boxed{+} \boxed{\text{RCL}} \boxed{0} \boxed{\text{x}\div\text{y}} \boxed{\div}$ to obtain the payment amount received by the lessor.

Example 1:

A copier worth \$22,000 is to be leased for 48 months. The lessee has agreed to make 4 payments in advance, with a purchase option at the end of 48 months enabling him to buy the copier for 30% of the purchase price. What monthly payment is necessary to yield the lessor 12% annually?

4 (PMT)



Keystrokes

BEGIN $\boxed{\text{END}}$ END

$\boxed{\text{CL FIN}}$

48 \boxed{n} 12 $\boxed{12\div}$

22000 $\boxed{\text{STO}} \boxed{2}$

30 $\boxed{\%}$ $\boxed{\text{FV}} \boxed{\text{PV}}$

$\boxed{\text{RCL}} \boxed{2} \boxed{+} \boxed{\text{STO}} \boxed{0}$

0 $\boxed{\text{FV}}$

$\boxed{\text{RCL}} \boxed{n} \boxed{4} \boxed{\text{STO}} \boxed{1} \boxed{-}$

$\boxed{n} \boxed{1} \boxed{\text{CHS}} \boxed{\text{PMT}} \boxed{\text{PV}}$

$\boxed{\text{RCL}} \boxed{1} \boxed{+}$

$\boxed{\text{RCL}} \boxed{0} \boxed{\text{x}\div\text{y}} \boxed{\div}$

Display

453.84

Monthly payment received
by lessor

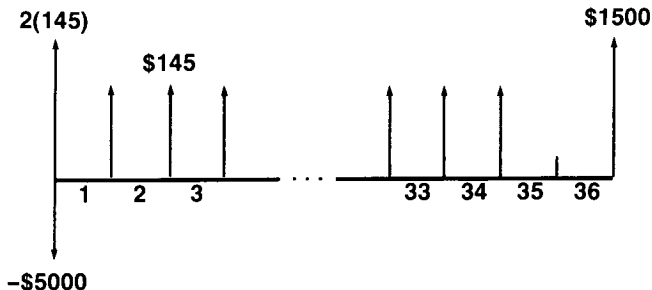
To calculate the periodic yield on the HP-37E, an iteration (trial and error) procedure must be used. Information is entered as follows:

- 1) Set the Payment switch to END and press $\boxed{\text{CL FIN}}$.

- 2) Key in the total number of payments made in advance and press **[STO] 0**.
- 3) Key in the total number of payments and press **[STO] 1**.
- 4) Key in the periodic payment amount and press **[STO] 2**.
- 5) Key in the loan amount and press **[CHS] [STO] 3**.
- 6) Key in the residual value and press **[STO] 4**.
- 7) Choose a best-guess periodic interest rate and press **[i] [RCL] 1 [n] [RCL] 4 [FV] [PV] [STO] 5** to obtain the present value of the residual value at the chosen interest rate.
- 8) Press **0 [FV] [RCL] [n] [RCL] 0 [-] [n] [RCL] 2 [PMT] [PV] [STO] [+]** 5 to obtain the present value of the periodic cash flows at the chosen interest rate.
- 9) Press **[RCL] 3 [RCL] 0 [RCL] 2 [x] [+]** **[RCL] 5 [-]** to obtain the net present value (NPV) of all the cash flows at the chosen interest rate.
- 10) If the NPV is negative, the yield is lower than the value chosen in step 7. If the NPV is positive, the yield is higher than the value chosen in step 7.
- 11) Repeat steps 7-10 until the net present value is sufficiently close to zero.

Example 1:

Equipment worth \$5000 is leased for 36 months, at \$145 per month. The lessee has agreed to pay the first and last month's payments in advance. At the end of the lease, the equipment may be purchased for \$1500. What is the annual yield to the lessor?



Keystrokes

BEGIN  END

CL FIN

2 STO 0

36 STO 1

145 STO 2

5000 CHS STO 3

1500 STO 4

Display

2.00

36.00

145.00

-5,000.00

1,500.00

Number of advance
payments
Total number of payments
Monthly payment
Amount given by lessor
Residual value

Choose 20% as the first guess of the annual yield.

20 $\frac{12}{\div}$ RCL 1 n

RCL 4 FV PV

STO 5

0 FV RCL n

RCL 0 - n

RCL 2 PMT PV

STO + 5

-827.30

-3,740.39

Present value of residual

Present value of periodic
payments

RCL 3 RCL 0

RCL 2 x +

RCL 5 -

-142.31

Net present value

Since the NPV is negative, the yield is less than 20%; choose 18% as next guess.

CL FIN

18 $\frac{12}{\div}$ RCL 1 n

RCL 4 FV PV

STO 5

0 FV RCL n

RCL 0 - n

RCL 2 PMT PV

STO + 5

-877.63

-3,839.85

Present value of residual

Present value of periodic
payments

RCL 3 RCL 0

RCL 2 x +


RCL 5 -

7.49

Net present value

The yield to the lessor is slightly higher than 18%. (It is actually 18.0978%.)

The following HP-38E routine could be used to give a direct solution to the previous example:

| Keystrokes (HP-38E) | Display | |
|---|------------------|-----------------------------|
| BEGIN  END | | |
| f ALL | | |
| 5000 CHS ENTER * | | |
| 145 ENTER * 2 x + | | |
| g CF₀ | -4,710.00 | Net amount of cash advanced |
| 145 g CF₁ 34 g N₁ | 34.00 | 34 cash flows of \$145.00 |
| 0 g CF₁ | 0.00 | 35 th cash flow |
| 1500 g CF₁ | 1,500.00 | 36 th cash flow |
| f IRR 12 x | 18.10 | Annual yield to lessor |

Skipped Payments

Sometimes a loan (or lease) may be negotiated in which a specific set of monthly payments are going to be skipped each year. Seasonality is usually the reason for such an agreement. For example, because of heavy rainfall, a bulldozer cannot be operated in Oregon during December, January, and February, and the lessee wishes to make payments only when his machinery is being used. He will make nine payments per year, but the interest will continue to accumulate over the months in which a payment is not made.

To find the monthly payment amount necessary to amortize the loan in the specified amount of time, information is entered as follows:

- 1) Set the Payment switch to END and press **CL FIN**.
- 2) Key in the number of the last payment period before payments close the first time; press **n**.
- 3) Key in the annual interest rate as a percent; press **12 ÷** | **PMT** **FV**.
- 4) Press **CHS** **PV** 12 **RCL** **n** **-** **n** 0 **PMT** **FV** **STO** 0 **RCL** **n**.
- 5) Key in the number of payments which are skipped; press **-** **n** | **PMT** 0 **PV** **FV** **STO** **+** 0.

- 6) Press 0 $\boxed{\text{PMT}}$ 12 $\boxed{\text{n}}$ 100 $\boxed{\text{PV}}$ $\boxed{\text{FV}}$ $\boxed{\text{RCL}}$ $\boxed{\text{PV}}$ $\boxed{+}$ $\boxed{\text{CHS}}$ $\boxed{\text{CL FIN}}$ $\boxed{\text{i}}$.
- 7) Key in the total number of years in the loan; press $\boxed{\text{n}}$.
- 8) Key in the loan amount; press $\boxed{\text{PV}}$ $\boxed{\text{PMT}}$ $\boxed{\text{RCL}}$ 0 $\boxed{\div}$ to obtain the monthly payment amount when the payment is made at the end of the month.
- 9) Press $\boxed{\text{CHS}}$ $\boxed{\text{FV}}$ 0 $\boxed{\text{PMT}}$ 1 $\boxed{\text{n}}$.
- 10) Key in the annual interest rate as a percent; press $\boxed{12\div}$ $\boxed{\text{PV}}$ to find the monthly payment amount when the payment is made at the beginning of the month.

Example 1:

A bulldozer worth \$100,000 is being purchased in September. The first payment is due one month later, and payments will continue over a period of 5 years. Due to the weather, the machinery will not be used during the winter months, and the purchaser does not wish to make payments during January, February, and March (months 4 thru 6). If the current interest rate is $8\frac{3}{4}\%$, what is the monthly payment necessary to amortize the loan?

Keystrokes

BEGIN  END

$\boxed{\text{CL FIN}}$

3 $\boxed{\text{n}}$

Display

3.00

Number of payments made before a group of payments is skipped

8.75 $\boxed{12\div}$ $\boxed{\text{PMT}}$ $\boxed{\text{FV}}$

$\boxed{\text{CHS}}$ $\boxed{\text{PV}}$

12 $\boxed{\text{RCL}}$ $\boxed{\text{n}}$ $\boxed{-}$ $\boxed{\text{n}}$

0 $\boxed{\text{PMT}}$ $\boxed{\text{FV}}$ $\boxed{\text{STO}}$ 0

$\boxed{\text{RCL}}$ $\boxed{\text{n}}$ 3 $\boxed{-}$ $\boxed{\text{n}}$

1 $\boxed{\text{PMT}}$ 0 $\boxed{\text{PV}}$ $\boxed{\text{FV}}$

$\boxed{\text{STO}}$ $\boxed{+}$ 0

0 $\boxed{\text{PMT}}$ 12 $\boxed{\text{n}}$

100 $\boxed{\text{PV}}$ $\boxed{\text{FV}}$

$\boxed{\text{RCL}}$ $\boxed{\text{PV}}$ $\boxed{+}$ $\boxed{\text{CHS}}$

$\boxed{\text{CL FIN}}$ $\boxed{\text{i}}$

5 $\boxed{\text{n}}$ 100000 $\boxed{\text{PV}}$

$\boxed{\text{PMT}}$ $\boxed{\text{RCL}}$ 0 $\boxed{\div}$

2,761.44

Monthly payment in arrears

Financial Formulas

Compound Interest

n = number of compounding periods

i = periodic interest rate, expressed as %

PV = present value

FV = future value or balance

PMT = periodic payment

S = BEGIN/END switch position factor (0 or 1) indicating treatment of PMT; 0 corresponds to END, 1 to BEGIN.

r = $i/100$, periodic interest rate expressed as decimal

$$0 = PV + (1 + rS) \text{PMT} \left[\frac{1 - (1 + r)^{-n}}{r} \right] + FV (1 + r)^{-n}$$

Loans With a Constant Amount Paid Towards Principal

BAL_K = remaining balance after time period K

CPMT = constant payment to principal

$BAL_K = PV - (K \cdot \text{CPMT})$

K^{th} payment to interest = $i(BAL_K) = (\text{PMT}_i)_K$

K^{th} total payment = $\text{CPMT} + (\text{PMT}_i)_K$

Add-On Interest Rate to APR

r = add-on rate as a decimal

n = number of monthly payments

APR = $1200i$, where i is the solution in the following equation:

$$\frac{n}{1 + \frac{n}{12} r} = \frac{1 - (1 + i)^{-n}}{i}$$

Add-On to APR With Credit Life

CL = credit life as decimal

AMT = loan amount

FC = finance charge

$$\left[\frac{1 + \left(\frac{n}{12}\right) r}{1 - \left(\frac{n}{12}\right) CL - \left(\frac{n}{12}\right)^2 CL \cdot r} \right] AMT = G$$

$$\frac{G}{n} = PMT$$

$$\frac{G \cdot CL \cdot n}{12} = \text{amount of credit life}$$

$$FC = (G - AMT - CL)$$

Rule of 78's Rebate

PV = finance charge

 I_k = interest charged at month k

n = number of months in loan

$$I_k = \frac{2(n - k + 1)}{n(n + 1)} PV$$

$$\text{Rebate} = \frac{(n - k) I_k}{2}$$

$$BAL_k = (n - k) \cdot PMT - \text{Rebate}_k$$

Interest Rate Conversions

Finite compounding

$$EFF = \left(1 + \frac{NOM}{C}\right)^C - 1$$

where C = number of compounding periods per year

Continuous compounding

$$EFF = (e^{NOM} - 1)$$

Compounding Periods Different From Payment Periods

$$i_{PMT} = \left((1 + r/c)^{C/P} - 1\right) 100$$

where C = number of compounding periods per year

P = number of payment periods per year

Advance Payments

$$PMT = \frac{PV - FV(1 + r)^{-n}}{\left[\frac{1 - (1 + r)^{-(n-A)}}{r} + A\right]}$$

where:

A = number of payments made in advance

Skip Payments

A = number of payment periods per year

B = number of years

C = annual percentage rate (as decimal)

D = periodic payment amount

E = loan amount

K = number of last payment before payments close the first time

L = number of skipped payments

$$D_{\text{END}} = \frac{E}{\left[1 - \left(1 + \frac{C}{A}\right)^{-AB}\right]}$$

$$\times \frac{\left[\left(1 + \frac{C}{A}\right)^A - 1\right] \frac{C}{A}}{\left[\left(1 + \frac{C}{A}\right)^A - \left(1 + \frac{C}{A}\right)^{A-K} + \left(1 + \frac{C}{A}\right)^{A-L-K} - 1\right]}$$

$$D_{\text{BEGIN}} = \frac{D_{\text{END}}}{1 + \frac{C}{A}}$$

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