HEWLETT-PACKARD

Step-by-Step Solutions
For Your HP Calculator

Marketing and Sales

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

HEWLETT
PACKARD

Marketing and Sales

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

HEWLETT PACKARD

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Contents

How To Use This Book

The Marketing and Sales solutions book provides sets of keystrokes and routines to assist you in making marketing, sales, forecasting, and distribution planning decisions. These routines can be used by anyone involved in these areas in any business. This book is designed to show you how your HP business 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.
- How to enter cash flows in a cash-flow list. (This function is not available on the HP-27S.)
- How to enter numbers for statistics.
- How to enter and use equations in the Solver.

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: %CH (found in the %CHG 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 a particular operation. 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 store a Solver equation and its menu:		
SOLVE NEW type equation INPUT CALC	SOLVE type equation CALC	■ SOLVE NEW type equation INPUT CALC
To edit a Solver equation:		
EDIT edit equation INPUT CALC	EDIT edit equation CALC	EDIT edit equation INPUT CALC
To display the cash-flow (CFLO) menu:		
CFLO	CFLO	Not available
To display markup menus:		
■ MAIN BUS	MAIN BUS	Not available
To display the correct 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. The following hints help you with some common questions and 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. When 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.

The equations in this book use variable names that are intended to remind you of what to store. Feel free to change them.

1

Marketing

Planning Advertising Expenditures

The advertising-sales ratio helps marketers and advertisers determine how much money to spend for advertising, based on projected sales. To use the equation below, you need to know the forecasted unit sales, the revenues per unit, and the percent of sales to be spent on advertising.

Although this calculation is simple to do on any calculator, using the Solver makes it easy to try what-if situations to analyze how a change in advertising dollars or revenues will change advertising as a percent of sales.

Entering and Using the AD$ Equation:

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

   AD$=FCST×$REV×AD%÷100
2. Display the AD$ equation menu.
3. Store or calculate the following variables:
   - Advertising cost in AD$.
   - Number of units forecasted to be sold in FCST.
   - Dollars of revenue per unit (price less discount) in $REV.
   - Percent of sales that makes up the advertising budget in AD%.

* To key in $, press WXYZ OTHER MORE $.

Example: Part 1. You expect to sell 78,000 units next month. The unit revenue is $10. The normal advertising budget is 5% of projected sales. How much can you spend on advertising next month?

Display the AD$ equation menu.

Keys:	**Display:**	**Description:**
78000 FCST	FCST=78,000.00	Stores sales forecast.
10 $REV	$REV=10.00	Stores unit revenue.
5 AD%	AD%=5.00	Stores advertising percentage.
AD$	AD$=39,000.00	Calculates advertising dollars for the month.

Part 2. To become a major factor in the marketplace, you feel you should spend $60,000 on advertising next month. What percentage of your revenue must you convince management to spend?

60000 AD$	AD$=60,000.00	Stores advertising dollars.
AD%	AD%=7.69	Calculates advertising as a percent of revenue.

Estimating the Financial Feasibility of New Product Ideas

Note These procedures cannot be done on the HP-27S. For an equation to calculate NPV and IRR% on the HP-27S, refer to "Net Present Value and Internal Rate of Return on the HP-27S" starting on page 98.

One way to analyze a new product idea is to estimate the cost for development, the expected profit, and the life of the product, and then calculate the internal rate of return. Net present value (NPV) and internal rate of return (IRR%) are used to determine whether an investment meets a minimum rate of return and what rate of return can be expected. The built-in CFLO menu makes it easy to calculate these two values.

Use the following steps to calculate NPV or IRR%.

1. In the CFLO menu, enter the cash flows and number of periods into the cash-flow number list.
2. Display the CFLO CALC menu and do either a or b:
   a. To calculate the net present value, enter the periodic interest rate as a percent in I%, then press NPV.
   b. To calculate the internal rate of return, press IRR%.

Example: Part 1. Development costs on a new product are estimated to be $1 million. Unit sales are estimated to be 4,000 units the first year; 5,000 in years two, three, and four; and 3,000 in years five and six. Revenue (price less discount) per unit is $1,000. Your anticipated net profit is 8%. What is the IRR% on the product?

Display the CFLO menu.

Keys:	**Display:**	**Description:**
■ [CLEAR DATA] [YES] [YES] or [GET] [*NEW]	FLOW(0)=?*	Clears current list or gets a new one.
1000000 [+/-] [INPUT]	FLOW(1)=?*	Stores initial cash flow.
4000 [×] 1000 [×] 8 [%] [INPUT] [INPUT]	FLOW(2)=?	Calculates first year profit and stores FLOW(1).
5000 [×] 1000 [×] 8 [%] [INPUT] 3 [INPUT]	FLOW(3)=?	Calculates second year profit and stores FLOW(2).
3000 [×] 1000 [×] 8 [%] [INPUT] 2 [INPUT]	FLOW(4)=?	Calculates third year profit and stores FLOW(3).

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

[EXIT]		
[CALC]		Displays CALC menu.
[IRR%]	IRR%=26.01	Calculates IRR%.

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

Part 2. Your company requires an IRR% of 30%. Calculate the development costs that would meet this goal by finding the difference between the net present value at 30% and the original development costs of $1 million.

Keys:	Display:	Description:
30 [I%]	I%=30.00	Stores required rate of return.
[NPV]	NPV=−80,680.92	Calculates net present value of cash flows discounted at 30%.
[+] 1000000 [=]	919,319.08	Calculates development costs to meet 30% IRR%, assuming no change in profits.

Part 3. Suppose your actual profits are 25% less than forecasted. Calculate the IRR%.

[EXIT]	FLOW(4)=?	
■ [↑] [↓]	FLOW(1)=320,000.00	Moves pointer to FLOW(1).
[RCL] [INPUT] [−] 25 [%] [INPUT] [↓]	FLOW(2)=400,000.00	Reduces FLOW(1) by 25% to 240,000.
[RCL] [INPUT] [−] 25 [%] [INPUT] [↓]	FLOW(3)=240,000.00	Reduces FLOW(2) by 25% to 300,000.
[RCL] [INPUT] [−] 25 [%] [INPUT]		Reduces FLOW(3) by 25% to 180,000.

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

EXIT		
CALC		Displays CALC menu.
IRR%	IRR%=13.88	Calculates IRR% with 25% less profit per year.

Return on Investment

One way of evaluating a new investment is through a simple return on investment (ROI) analysis. Return on investment is the ratio of net profit after taxes to the assets used to make the net profit.

Although this calculation is simple to do on any calculator, using the Solver makes it easy to try what-if situations and to analyze what you can do to meet a minimum return on investment.

Entering and Using the ROI% Equation:

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

   `ROI%=$REV×PROF%÷100÷$INV×100`

2. Display the ROI% equation menu.
   - Store or calculate the following variables:
   - Return on investment as a percent in ROI%.
   - Total revenues in $REV.
   - Net profit as a percent of revenue in PROF%.
   - Capital investment in the project or business in $INV.

Example: Part 1. A new store requires $480,000 in new assets. The anticipated revenues the first year are $1 million. Your net profit goal is 10%. Assuming that goal is met, calculate the return on investment.

Display the ROI% equation menu.

* To key in $, press WXYZ OTHER MORE $.

Keys:	Display:	Description:
1000000 $REV	$REV=1,000,000.00	Stores total anticipated revenues.
10 PROF%	PROF%=10.00	Stores net profit percent.
480000 $INV	$INV=480,000.00	Stores investment.
ROI%	ROI%=20.83	Calculates percent return on investment.

Part 2. The store's sales are actually $750,000 in the first year. Calculate the ROI%.

750000 $REV	$REV=750,000.00	Stores actual revenues.
ROI%	ROI%=15.63	Calculates percent return on investment.

Part 3. At the level of revenues in part 2, what total investment can you make to achieve an ROI of 18%.

18 ROI%	ROI%=18.00	Stores required ROI%.
$INV	$INV=416,666.67	Calculates investment to reach this goal.

Part 4. Suppose you realize a 5% net profit on revenues of $750,000 (you stored this value in part 2). Your investments are $480,000. Calculate the ROI%.

5 PROF%	PROF%=5.00	Stores net profit.
480000 $INV	$INV=480,000.00	Stores investment.
ROI%	ROI%=7.81	Calculates percent return on investment.

Elasticity of Demand

Elasticity of demand is a measure of how sensitive the market demand is for a product relative to price changes in the product. If a small price change results in a large change in demand, the demand is said to be highly elastic. The equation below calculates a relative measure of elasticity. You can project changes in sales given changes in prices, assuming that a price change is the only factor affecting the change in quantity sold.

Entering and Using the ELAST Equation:

1. Enter the ELAST equation into the Solver.

   ```
   ELAST=(LOPQ-HIPQ)÷(LOPQ+HIPQ)÷
   2÷-(LOWP-HIP)×(LOWP+HIP)×2
   ```

2. Display the ELAST equation menu.
3. Store the following variables:
   - Quantity sold at the lower price in LOPQ.
   - Quantity sold at the higher price in HIPQ.
   - Lower price in LOWP.
   - Higher price in HIP.
4. Press ELAST to calculate the elasticity of demand.

Example: Part 1. You lowered the price on your product from $150 to $100. Sales increased from 11,000 units to 15,000 units. Assuming that the price change was the only factor affecting sales, calculate the estimated elasticity of demand.

Display the ELAST equation menu.

Keys:	Display:	Description:
15000 LOPQ	LOPQ=15,000.00	Stores quantity sold at lower price.
11000 HIPQ	HIPQ=11,000.00	Stores quantity sold at higher price.

100 LOWP	LOWP = 100.00	Stores lower price.
150 HIP	HIP = 150.00	Stores higher price.
ELAST	ELAST = −0.77	Calculates elasticity of demand.

Part 2. You have another product, priced at $120. Your are currently selling 18,000 units per month. Your knowledge of your market indicates that the elasticity of demand for this product is the same as for the product in part 1, that is, −0.77. Calculate the quantity you would sell if you dropped the price by $25.

.77 ELAST	ELAST = −0.77 *	Stores elasticity of demand.
18000 HIPQ	HIPQ = 18,000.00	Stores quantity sold at higher price.
120 [−] 25 LOWP	LOWP = 95.00	Stores lower price.
120 HIP	HIP = 120.00	Stores higher price.
LOPQ	LOPQ = 21,540.23 †	Calculates an estimate of the quantity sold at the lower price.

* If you do not store −.77 in ELAST, but use the value calculated in part 1, the quantity sold at the new price will be 21,536.35. This is because the ELAST value calculated in part 1 is not exactly −.77, but a rounded value. Press ■ [SHOW] to see all significant digits.

† The solver searches for an iterative solution and displays intermediate estimates.

Total Market Size Potential

Total market size potential is the total sales (in dollars or units) available to all firms selling a given product for a specified time. To estimate the total market potential, you need to estimate the number of buyers of the product, the quantity each buyer will purchase, and the average price of the product.

Entering and Using the SIZE Equation:

1. Enter the size equation into the Solver.*

   `SIZE=#BUY×QTY×PRICE`

2. Display the SIZE equation menu.
3. Store the following variables:
   - Estimated total number of buyers in #BUY.
   - Quantity each buyer will purchase in QTY.
   - Average retail price of the product in PRICE.
4. Press SIZE to calculate the total market size potential.

Example: Part 1. Market research shows that the estimated number of buyers for your product is 3 million people this year, and that each buyer will purchase 1.3 units. The average price for the product is $95. What is the total market potential?

Display the SIZE equation menu.

Keys:	Display:	Description:
3000000 #BUY	#BUY=3,000,000.00	Stores estimated number of buyers.

* To key in #, press WXYZ OTHER #.

1.3 QTY	QTY=1.30	Stores number each buyer will purchase.
95 PRICE	PRICE=95.00	Stores average price of product.
SIZE	SIZE=370,500,000.00	Calculates total market size in dollars.
STO 0		Stores market size for later use.

Part 2. Your goal for the year is a 15% dollar share of this market. What must your yearly sales be before discount to meet this goal?

× 15 % =	55,575,000.00	Calculates dollar share to meet this goal.

Part 3. Realistically, your firm can achieve sales of only $40 million for the year. What share will you realize?

HP-17B and HP-19B Steps:

■ MAIN		Displays MAIN menu.
BUS %TOTL		Displays %TOTL menu.
RCL 0 TOTAL	TOTAL= 370,500,000.00	Stores total market size.
40000000 PART	PART=40,000,000.00	Stores maximum sales.
%T	%TOTAL=10.80	Calculates dollar market share your firm can achieve.

HP-27S Steps:

40000000 $\boxed{\div}$ $\boxed{\text{RCL}}$ 0 $\boxed{\times}$ 100 $\boxed{=}$	10.80	Calculates dollar market share your firm can achieve.

Source: Philip Kotler, MarketingManagement:analysis, planning, and control (Fifth Edition). Englewood Cliffs, N.J.: Prentice-Hall, 1984.

Simple Payback Period

The simple payback period method determines the length of time (in years) required for a business to recover its entire investment in a capital expenditure. Capital expenditures are purchases of assets, such as machinery or equipment, that have service periods of one year or more.

The shorter the payback period, the better – the sooner the investment is recovered, the sooner funds can be used for another project. For a capital expenditure to be considered profitable, its service period must exceed the length of the payback period.

Entering and Using the PBK Equation:

1. Enter the PBK equation into the Solver.

   `PBK=INV÷FLOW`

2. Display the PBK equation menu.
3. Store or calculate the following variables:
   - Length of time in years required to recover investment in PBK.
   - Investment in capital expenditure in INV.
   - Annual cash inflow for the life of the purchase in FLOW.

Example: Part 1. You are considering a new machine costing $100,000. The annual cash inflow for the service period of the machine is $15,000. What is the payback period?

Display the PBK equation menu.

Keys:	**Display:**	**Description:**
100000 INV	INV=100,000.00	Stores investment.
15000 FLOW	FLOW=15,000.00	Stores yearly inflow.
PBK	PBK=6.67	Calculates payback period in years.

Part 2. Your company desires a payback period of five years. What must the investment be to meet this goal?

5 PBK	PBK=5.00	Stores required payback period.
INV	INV=75,000.00	Calculates investment.

Using NPV and IRR To Make Investment Decisions

Note These procedures cannot be done 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 98.

Net present value (NPV) and internal rate of return (IRR%) are used to determine if an investment is acceptable. The built-in CFLO menu makes it easy to calculate these two values.

The method below helps the decision-making process when choosing between two mutually exclusive options – such as deciding between two pieces of equipment. This method looks at the period-by-period difference between the two investments, then uses these differences as cash flows. The investment becomes the difference between option A and option B. If the net present value is positive at the desired rate of return, then the more expensive option is the better one; otherwise, the less expensive option is better.

When the differences result in a conventional series of cash flows (one sign change), you can also look at the IRR% to determine which is the better investment. (Refer to your owner's manual for the definition of "conventional series of cash flows.") If the IRR% is higher than your required percent, the investment in the more expensive machine is a good investment.

If the differences are not a conventional series of cash flows (multiple sign changes), you can still use NPV to analyze the investment.

Use the following steps to calculate NPV and IRR%:

1. Calculate the difference between the cash flows for the two options for each period (net cash flows). You may find it helpful to make a table of the cash flows like the one in the example below.
2. In the CFLO menu, enter the net cash flows and number of periods into the cash-flow number list.
3. Display the CFLO CALC menu and do either a or b:
   a. To calculate the net present value, enter the periodic interest rate as a percent in I%, then press NPV.
   b. To calculate the internal rate of return, press IRR%.

Example. You want to choose between two equipment options. The table below summarizes the initial flows, the cash flows over the five-year service periods of the machines, and the difference between the two options (net cash flows).

	A	B	A-B
Initial investment	$-35,000	$-25,000	$-10,000
Cost in year 1	-200	-1,300	1,100
Cost in year 2	-200	-1,400	1,200
Cost in year 3	-200	-2,500	2,300
Cost in year 4	-800	-2,500	1,700
Cost in year 5	15,000	7,000	8,000

Calculate the NPV and IRR% to determine the machine to purchase. (Note that A – B is a conventional series of cash flows.) The required rate of return is 10%.

Display the CFLO menu.

Keys:	Display:	Description:
■ [CLEAR DATA] YES	FLOW(0)=? *	Clears current list or gets a new one.
or GET *NEW		
10000 [+/-] [INPUT]	FLOW(1)=? †	Stores initial cash flow.
1100 [INPUT] [INPUT]	FLOW(2)=?	Stores FLOW(1).
1200 [INPUT] [INPUT]	FLOW(3)=?	Stores FLOW(2).
2300 [INPUT] [INPUT]	FLOW(4)=?	Stores FLOW(3).
1700 [INPUT] [INPUT]	FLOW(5)=?	Stores FLOW(4).
8000 [INPUT]	#TIMES(5)=1	Stores FLOW(5).

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

[EXIT]		
CALC		Displays CALC menu.
10 I%	I%=10.00	Stores required return on investment.
NPV	NPV= -151.75	Calculates NPV.
IRR%	IRR%=9.56	Calculates IRR%.

Option B is the better choice because the NPV is negative. The IRR% calculation tells you the same thing – that because IRR% is less than the required 10%, option B is the better choice.

* On the HP-19B this prompt is INIT=.

† On the HP-19B this prompt is FLOW(1)=.

Pricing To Maximize Profit

Selecting a price point for a new product is an art as much as it is a science. Several factors that influence a price point include competitive product prices, the value customers place on your product, your firm's marketing strategy and objectives, and, of course, product costs. A quantitative method that is used in pricing analysis is pricing to maximize profit. The steps below describe one method of performing such an analysis, using the SUM* menu to calculate a demand equation, then using the PROF equation below to find the price at which profit is maximized.

1. Enter the PROF equation into the Solver.

   ```
   PROF=PRICE×(B+M×PRICE)-FIXC-
   (VARC×(B+M×PRICE))
   ```

2. Develop a forecast of sales demand over a range of prices.
3. In the SUM* menu, enter the data for the price points and the forecasted sales demand.
4. Calculate the curve fit that yields the best correlation coefficient for your data–that is, the one that has an absolute value closest to one.
5. Calculate the values for B and M using the SUM menu.
6. Display the PROF equation menu.
7. Store the following variables:
   - Value of B calculated in the SUM menu in B.
   - Value of M calculated in the SUM menu in M.
8. Store or calculate the following variables:
   - Profit in PROF.
   - Price per unit in PRICE.
   - Fixed costs in FIXC.
   - Variable costs in VARC.

* On the HP-27S, press ■ [STAT] to use the STAT menu.

Example: Part 1. To calculate the demand relationship, you estimate the following prices and demands. You are determining demand based on price, so price is the x- (independent) variable and demand is the y- (dependent) variable.

Price per unit	Demand
$100	7,000
$200	5,000
$300	3,000
$400	1,000

Use the SUM* menu to find the best fitting curve for the data (correlation coefficient closest to ±1) by calculating the correlation coefficient for each of the four models. Return to the model with the best correlation coefficient to calculate B and M.

The HP-17B and HP-27S keystrokes for statistics are different than those for the HP-19B. Two sets of steps follow. The first is for the HP-17B and HP-27S, and the second, beginning on page 33, is for the HP-19B.

HP-17B and HP-27S Steps:

On the HP-17B, display the SUM menu. On the HP-27S, display the STAT menu.

Keys:	Display:	Description:
■ [CLEAR DATA] [YES] or [GET] [*NEW]	ITEM(1)=?	Clears current list or gets a new one.
100 [INPUT]		Enters the prices.
200 [INPUT]		
300 [INPUT]		
400 [INPUT]	TOTAL=1,000.00	

* On the HP-27S, press ■ [STAT] to use the STAT menu.

Keys:	Display:	Description:
EXIT		
NAME PRICE INPUT		Names the list.
GET *NEW	ITEM(1)=?	Displays a new list.
7000 INPUT 5000 INPUT 3000 INPUT 1000 INPUT	TOTAL=16,000.00	Enters sales demand estimates.
EXIT		
NAME DMAN INPUT		Names the list.
CALC MORE FRCST	SELECT X VARIABLE	
PRICE	SELECT Y VARIABLE	Selects *PRICE* as x-variable.
DMAN	LINEAR *	Selects *DMAN* as y-variable.
CORR	CORR= −1.00	Calculates linear correlation coefficient.
MORE MODL LOG	LOGARITHMIC	Selects logarithmic model.
CORR	CORR= −0.98	Calculates logarithmic correlation coefficient.
MORE MODL EXP	EXPONENTIAL	Selects exponential model.

* If your calculator displays something else, press MORE MODL LIN to change the model.

CORR	CORR = −0.96	Calculates exponential correlation coefficient.
MORE MODL PWR	POWER	Selects power model.
CORR	CORR = −0.90	Calculates power series correlation coefficient.

The linear correlation coefficient is closest to ±1, so that is the best curve fit. Calculate and store M and B using the linear model.

MORE MODL LIN	LINEAR	Selects linear model.
M	M = −20.00	Determines price elasticity.
STO 0		Stores price elasticity.
B	B = 9,000.00	Calculates the y-intercept.
STO 1		Stores y-intercept.

HP-19B Steps:
Display the SUM menu.

Keys:	**Display:**	**Description:**
■ CLEAR DATA YES YES *or* GET *NEW	ITEM(1) =	Clears current list or gets a new one.
100 INPUT 200 INPUT 300 INPUT 400 INPUT	TOTAL = 1,000.00	Enters the prices.

NAME PRICE INPUT		Names the list.
GET *NEW	ITEM(1)=?	Displays a new list.
7000 INPUT 5000 INPUT 3000 INPUT 1000 INPUT	TOTAL=16,000.00	Enters sales demand estimates.
NAME DMAN INPUT		Names the list.
CALC MORE FRCST	SELECT X VARIABLE	
PRICE	SELECT A MODEL	Selects *PRICE* as x-variable.
LIN	LINEAR	Selects linear model.
CORR	CORR=−1.00	Calculates linear correlation coefficient.
EXIT LOG	SELECT A MODEL LOGARITHMIC	Selects logarithmic model.
CORR	CORR=−0.98	Calculates logarithmic correlation coefficient.
EXIT EXP	SELECT A MODEL EXPONENTIAL	Selects exponential model.
CORR	CORR=−0.96	Calculates exponential correlation coefficient.
EXIT PWR	SELECT A MODEL POWER	Selects power model.
CORR	CORR=−0.90	Calculates power series correlation coefficient.

The linear correlation coefficient is closest to ±1, so that is the best curve fit. Calculate and store *M* and *B* using the linear model.

[EXIT] LIN	SELECT A MODEL LINEAR	Selects linear model.
M	M = −20.00	Determines price elasticity.
[STO] 0		Stores price elasticity.
B	B = 9,000.00	Calculates the y-intercept.
[STO] 1		Stores y-intercept.

Part 2. You know that your fixed costs are $15,000, and your variable costs are $80. Calculate your profit at prices of $260, $265, and $270.

Display the PROF equation menu.

[RCL] 1 B	B = 9,000.00	Stores value for *B*.
[RCL] 0 M	M = −20.00	Stores value for *M*.
15000 FIXC	FIXC = 15,000.00	Stores fixed costs.
80 VARC	VARC = 80.00	Stores variable costs.
260 PRICE	PRICE = 260.00	Stores price.
PROF	PROF = 669,000.00	Calculates profit.
265 PRICE	PRICE = 265.00	Stores price.
PROF	PROF = 669,500.00	Calculates profit.
270 PRICE	PRICE = 270.00	Stores price.
PROF	PROF = 669,000.00	Calculates profit.

Profit is the highest at $265. To pinpoint the exact price for the best profit, try $264 and $266.

264 PRICE	PRICE=264.00	Stores price.
PROF	PROF=669,480.00	Calculates profit.
266 PRICE	PRICE=266.00	Stores price.
PROF	PROF=669,480.00	Calculates profit.

Your profit is maximized at a price of $265 (because at higher and lower prices, your profit is less than $669,500).

2

Sales

Markup Calculations

Note To do these calculations on the HP-27S, first enter the equations into the Solver as described on page 41. The equations are built into the HP- 17B and HP-19B.

Markup calculations are used by retailers and wholesalers to determine the selling price of an item. The HP-17B and HP-19B have a built-in menu for calculating markup as a percent of cost and markup as a percent of price.

1. From the BUS menu, press MU%C to display the MU%C (markup on cost) menu, or press MU%P to display the MU%P (markup on price) menu.
2. Store each of the values you know by keying in the number and pressing the appropriate menu key.
3. Press the menu key for the value you want to calculate.

Example 1: Calculate Selling Price and Markup as a Percent of Cost. Part 1. An item costs $160. The reseller's required markup as a percent of selling price is 20%. What is the selling price?

Display the MU%P menu.*

Keys:	Display:	Description:
160 COST	COST=160.00	Stores cost.

* On the HP-27S, you must use the equation on page 41.

20 M%P	MARKUP%P=20.00	Stores markup as a percent of price.
PRICE	PRICE=200.00	Calculates selling price.

Part 2. What is the markup as a percent of the cost?

EXIT MU%C *		Displays MU%C menu.
M%C	MARKUP%C=25.00	Calculates markup as a percent of cost.

Example 2: Calculate Cost and Markup as a Percent of Price.
Part 1. An item sells for $21. The markup as a percent of cost is 50%. What is its cost?

Display the MU%C menu.

Keys:	**Display:**	**Description:**
21 PRICE	PRICE=21.00	Stores selling price.
50 M%C	MARKUP%C=50.00	Stores markup as a percent of cost.
COST	COST=14.00	Calculates cost.

Part 2. What is the markup expressed as a percent of price?

EXIT MU%P †		Displays MU%P menu.
M%P	MARKUP%P=33.33	Calculates markup as a percent of price.

* On the HP-27S, press ↑ or ↓ to go to the MU%C equation, then press CALC.

† On the HP-27S, press ↑ or ↓ to go to the MU%P equation, then press CALC.

Example 3: Calculate Cost and Markup on Cost. Part 1. An item sells for $38, with a markup on price of 30%. What is the markup on cost?

Display the MU%P menu.

Keys:	Display:	Description:
38 PRICE	PRICE=38.00	Stores selling price.
30 M%P	MARKUP%P=30.00	Stores markup on price.
COST	COST=26.60	Calculates cost.
EXIT MU%C *		Displays MU%C menu.
M%C	MARKUP%C=42.86	Calculates markup on cost.

Part 2. If the markup on cost is raised to 50%, what is the new selling price?

50 M%C	MARKUP%C=50.00	Stores new markup on cost.
PRICE	PRICE=39.90	Calculates new selling price.

* On the HP-27S, press ↑ or ↓ to go to the MU%C equation, then press CALC.

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 M%P or M%C 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 :.

Setting a Sales Price

One method of setting a unit sales price is to determine the unit cost of production, then multiply by the desired rate of return. For this method to be accurate, you must identify all costs associated with the product.

Entering and Using the PRICE Equation:

1. Enter the PRICE equation into the Solver.*

   `PRICE=COST÷#U×(1+%RTN÷100)`

2. Display the PRICE equation menu.
3. Store or calculate the following variables:
4. Price per unit in PRICE.
5. Total costs in COST.
6. Number of units produced in #U.
7. Desired percent rate of return in %RTN.

Example: Part 1. To produce 100,000 units, your cost is $1 million. You want a 20% rate of return. What price should you charge?

Display the PRICE equation menu.

Keys:	Display:	Description:
1000000 COST	COST=1,000,000.00	Stores total production costs.
100000 #U	#U=100,000.00	Stores number of units.
20 %RTN	%RTN=20.00	Stores rate of return.
PRICE	PRICE=12.00	Calculates price.

* To key in #, press WXYZ OTHER #.

Part 2. You know that on this particular product, you can charge only $11.50. At that price, what is your rate of return?

11.5 PRICE	PRICE=11.50	Stores price.
%RTN	%RTN=15.00	Calculates percent rate of return.

A variation of the equation on page 42 uses operating costs, the number of units produced, and the cost per unit to calculate a price.

Entering and Using the PR2 Equation:

1. Enter the PR2 equation into the Solver.*

   PR2=(OPCOST÷#U+UCOST)×(1+%RTN÷100)

2. Display the PR2 equation menu.
3. Store or calculate the following variables:
   - Price per unit in PR2.
   - Total costs in OPCOS.
   - Number of units produced in #U.
   - Cost per unit in UCOST.
   - Desired percent rate of return in %RTN.

Example: Part 1. Your operating costs are $20,000.00. You want a 10% rate of return. Your sales forecast is 2,000 units, and each unit costs $13.50. Calculate the price to charge.

Display the PR2 equation menu.

---

* To key in #, press WXYZ OTHER #.

Keys:	**Display:**	**Description:**
20000 OPCOS	OPCOST = 20,000.00	Stores total operating costs.
2000 #U	#U = 2,000.00	Stores number of units.
13.5 UCOST	UCOST = 13.50	Stores cost per unit.
10 %RTN	%RTN = 10.00	Stores rate of return.
PR2	PR2 = 25.85	Calculates price.

Part 2. On this particular product, you can charge only $22.50. At that price, what is your rate of return?

22.5 PR2	PR2 = 22.50	Stores price.
%RTN	%RTN = −4.26	Calculates percent rate of return.

Since the rate of return is negative, you must either charge more than the going rate or reduce your costs.

Part 3. At a zero rate of return (the break-even point), and the price in part 2, what would your operating costs have to be?

0 %RTN	%RTN = 0.00	Stores zero percent return.
OPCOS	OPCOST = 18,000.00	Calculates operating cost to break even.

Break-Even Analysis

Break-even analysis is a technique for analyzing the relationships among fixed costs, variable costs, and income. Until the break-even point is reached (total costs equal total income), the producer operates at a loss. After the break-even point, each unit produced and sold makes a profit.

Entering and Using the PROFIT Equation:

1. Enter the PROFIT equation into the Solver.*

PROFIT=#SLD×(PRICE-VARC)-FIXC

2. Display the PROFIT equation menu.

3. Store or calculate the following variables:

- Gross profits in PROFI.
- Number of units sold in #SLD.
- Price per unit in PRICE.
- Variable costs per unit in VARC.
- Fixed costs in FIXC.

Example: Part 1. Your product sells for $13. The fixed costs are $12,000. Variable costs are $6.75 per unit. Calculate the number of units that must be sold to break even (profit equals zero).

Display the PROFIT equation menu.

Keys:	Display:	Description:
0 PROFI	PROFIT=0.00	Stores break-even profit of zero.

* To key in #, press WXYZ OTHER #.

Keys:	Display:	Description:
13 PRICE	PRICE=13.00	Stores price per unit.
6.75 VARC	VARC=6.75	Stores variable costs per unit.
12000 FIXC	FIXC=12,000.00	Stores fixed costs.
#SLD	#SLD=1,920.00	Calculates number that must be sold to break even.

Part 2. Calculate the gross profit if 2,500 units are sold.

2500 #SLD	#SLD=2,500.00	Stores number sold.
PROFI	PROFIT=3,625.00	Calculates gross profit.

Part 3. You want a gross profit of $4,500 at the sales volume in part 2 (2,500 units). What should the sales price be?

4500 PROFI	PROFIT=4,500.00	Stores required gross profit.
PRICE	PRICE=13.35	Calculates required sales price.

Sales Analysis

Sales analysis compares actual sales to sales goals. The equations below use forecast sales, forecast price, actual sales, and actual price to calculate sales variance, variance due to a price change, and variance due to volume change.

Entering and Using the Equations:

1. Enter the volume variance (*V VAR*) equation into the Solver.*

   `V VAR=FCSTP×(FCST#-ACT#)`

2. Enter the price variance (*PVAR*) equation into the Solver.

   `PVAR=(FCSTP-ACTP)×ACT#`

3. Enter the sales variance (*SVAR*) equation into the Solver.

   `SVAR=FCST#×FCSTP-ACT#×ACTP`

4. Display the SVAR equation menu.
5. Store the following variables:
   - Number of units forecast in FCST.
   - Forecast price per unit in FCSTP.
   - Number of units actually sold in ACT#.
   - Actual selling price in ACTP.
6. Press SVAR to calculate the sales variance.
7. Display the PVAR equation menu.
8. Press PVAR to calculate the variance due to price.
9. Display the V VAR equation menu.
10. Press VVAR to calculate the variance due to volume.

* To key in #, press WXYZ OTHER #.

Example: Part 1. In your marketing plan, you forecast monthly sales to be 1,000 units, at $425. Actual sales were 730 units, at $410. What is the sales variance?

Display the SVAR equation menu.

Keys:	Display:	Description:
1000 FCST	FCST# = 1,000.00	Stores forecast sales.
425 FCSTP	FCSTP = 425.00	Stores forecast price.
730 ACT#	ACT# = 730.00	Stores actual sales.
410 ACTP	ACTP = 410.00	Stores actual price.
SVAR STO 0	SVAR = 125,700.00	Calculates sales variance; stores it for use in part 4.

Part 2. Calculate the portion due to price change using the PVAR equation.

EXIT		Displays SOLVE menu.
↑ or ↓	PVAR = (FCSTP − ACTP)×ACT#	Selects PVAR equation.
CALC		Displays PVAR menu.
PVAR	PVAR = 10,950.00	Calculates portion due to price change.

Part 3. Calculate the portion due to volume change using the VVAR equation.

EXIT		Displays SOLVE menu.
↑ or ↓	VVAR = FCSTP× (FCST# − ACT#)	Selects VVAR equation.
CALC		Displays VVAR menu.

VVAR	VVAR=114,750.00	Calculates portion due to volume change.

Part 4. Calculate the percentage of total sales variance that is due to a change in volume.

HP-17B or HP-19B Steps:

■ MAIN		Displays MAIN menu.
BUS %TOTL		Displays %TOTL menu.
STO PART	PART=114,750.00	Stores volume variance.
RCL 0 TOTAL	TOTAL=125,700.00	Stores total variance.
%T	%TOTAL=91.29	Volume change is 91% of variance in sales.

HP-27S Steps:

÷ RCL 0 × 100 =	91.29	Volume change is 91% of variance in sales.

The majority (91.29%) of the sales variance is due to the shortfall in volume. The next step would be to analyze what caused sales to fall short of the goal.

Source: Philip Kotler, *Marketing Management: analysis, planning, and control* (Fifth Edition). Englewood Cliffs, N.J.: Prentice-Hall, 1984.

Calculating Commissions

This section helps you create an equation to calculate commissions. The table below shows some common elements in determining the amount of commissions. Following the table are sample equations and examples. Using these three, and your company's commission schedule, you can write your own equation.

Equation Elements

Element	How It's Calculated	Equation
Basic commission.	\$sales × commission% ÷ 100	\$SLS×COM%÷100
\$ premium for selling certain products.	#special units sold × \$premium per unit	+#UNITS×\$PREM
Additional commission for exceeding quota.	Sales greater than break point × additional commission%	+IF(\$SLS>BKPT:\$SLS−BKPT:0)×AD%÷100

Sample Equations

Next are some sample equations for calculating commissions:

- Two commission rates for two products:*

$$\$COM=\underbrace{\$SL1\times CO\%1\div 100}_{\text{basic commission}}+\underbrace{\$SL2\times CO\%2\div 100}_{\text{basic commission}}$$

where: *$COM* = dollars of commission paid.
$SL1 = dollars sold of product one.
CO%1 = commission percent paid on product one.
$SL2 = dollars sold of product two.
CO%2 = commission percent paid on product two.

- Multiple commission rates, depending on dollar sales volume:

$$\$COM=\underbrace{\$SLS\times COM\%\div 100}_{\text{basic commission}}+$$
$$\underbrace{IF(\$SLS>BKPT:\$SLS-BKPT:0)\times AD\%\div 100}_{\text{additional commission for exceeding quota}}$$

where: *$COM* = dollars of commission paid.
$SLS = dollar volume sold.
COM% = commission percent paid on all sales.
BKPT = dollar break point where commission increases.
AD% = additional commission for sales above break point.

- Premium for selling certain products:

$$\$COM=\underbrace{\$SLS\times COM\%\div 100}_{\text{basic commission}}+\underbrace{\#UNITS\times \$PREM}_{\text{premium for certain products}}$$

where: *$COM* = dollars of commission paid.
$SLS = dollar volume sold.
COM% = commission percent paid on all sales.
#UNITS = number of units sold on which premium is paid.
$PREM = premium paid on each unit.

* This equation can be expanded by adding the appropriate equation element for each product. For example, for four products, you would add + $SL3 × CO%3 ÷ 100 + $SL4 × CO%4 ÷ 100 to the end of the equation.

Entering and Using Your Equation:

1. Enter your equation into the Solver.
2. Display the equation menu.
3. Store the variables you know.
4. Press the menu key to calculate the unknown variable.

Example 1: Multiple Commission Rates Depending on the Product. Suppose you sell products for three companies. All pay 15% commission on major equipment. One pays 10% on accessories and supplies. Another pays 20% on their parts.

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

   ```
   $COM=$EQ×.15+$ACC×.1+$PTS×.2
   ```

2. Display the $COM equation menu.
3. Store or calculate the following variables:
   - Commission paid in $COM.
   - Dollars of equipment sold in $EQ.
   - Dollars of accessories sold in $ACC.
   - Dollars of parts sold in $PTS.

You sold a $10,000 piece of equipment, $350 of accessories and supplies, and $400 in parts. What is your commission on the sale?

Display the $COM equation menu.

Keys:	**Display:**	**Description:**
10000 $EQ	$EQ=10,000.00	Stores equipment sold.
350 $ACC	$ACC=350.00	Stores accessories sold.

* To key in $, press WXYZ OTHER MORE $.

400 $PTS	$PTS=400.00	Stores parts sold.
$COM	$COM=1,615.00	Calculates commission on the sale.

Example 2: Multiple Commission Rates Depending on Dollar Sales Volume. Your company pays one commission rate up to a dollar break point, and then an additional rate above this point. The break point and commission percentages change from time to time, so you write your equation so you can store these values each time you use the equation. The equation below is the same as a sample equation on page 51.

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

   ```
   $COM=$SLD×COM%÷100+IF($SLD>BKPT:$SLD-
   BKPT:0)×AD%÷100
   ```

2. Display the $COM equation menu.
3. Store or calculate the following variables:
   - Commission paid in $COM.
   - Dollars sold in $SLD.
   - Commission percent on all sales in COM%.
   - Dollars of sales at break point in BKPT.
   - Additional commission percent above break point in AD%.

Part 1. This quarter your company is paying 1.5% commission on sales plus 1% on all sales over $200,000. You use the SUM menu to keep a running list of all sales. Each time you have a sale, you enter the item into the list. The total from this list is $252,400. Calculate the commission paid for the period.

Display the $COM equation menu.

---

* To key in $, press WXYZ OTHER MORE $.
To key in >, press WXYZ OTHER >.
To key in :, press WXYZ OTHER :.

Keys:	**Display:**	**Description:**
252400 $SLD	$SLD=252,400.00	Stores dollar amount of sales.
1.5 COM%	COM%=1.50	Stores commission percentage.
200000 BKPT	BKPT=200,000.00	Stores break point.
1 AD$	AD%=1.00	Stores additional commission percent.
$COM	$COM=4,310.00	Calculates commission paid this period.

Part 2. Your commission check was $3,970. Calculate the dollar amount of sales on which your check was calculated.

3970 $COM	$COM=3,970.00	Stores amount of commission check.
$SLD	$SLD=238,800.00 *	Calculates dollar sales to generate commission check.

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

Calculating Quotes

In many sales situations, you have some leeway in what you charge the customer. You can negotiate the price by changing the discount rate, offering a special rate for quantity purchase, and so on. Your HP calculator makes it easy to give your customer price quotes on the spot, and to change those quotes quickly based on input from the customer. If the price is too high, for example, the customer can select lower-cost products, or he can increase his quantity to get a discount. You can store the new product cost or discount rate and quote the new price.

An example of some elements that may go into your equation are in the following list. To develop your own equation, list all the elements that you use to make a quote and how each relates to the other elements. (Do you add or subtract it? multiply or divide?.) Then use the table of elements and the examples to help you turn your elements into an equation to key into your HP calculator.

Equation Elements

Element	How It's Calculated	Equation
Price of goods sold.	#units × price per unit	#UNITS×PRICE
Total cost of goods sold.	+ cost	+COST
Service agreement.	Service unit × price per unit	+SRVUNIT×SRVPR
Service as a flat rate.	+ service	+SERV
Freight costs, based on rate per mile.	Miles × rate per mile	+MILES×R/MI
Freight as a flat rate.	+ freight	+FRT
Trade-in allowance.	− trade in	−TRADE
Profit or overhead.	1 + profit% ÷ 100	×(1+PROF%÷100)
Quantity sales discount.	1 − discount% ÷ 100	×(1−DISC%÷100)
Credit terms.	If bill is paid within a certain time (D days), subtract discount rate	×(1−IF(#DAYS<D:1:0)×DISC%÷100)

Entering and Using Your Equation:

1. Enter your equation into the Solver.
2. Display the equation menu.
3. Store the variables you know.
4. Press the menu key to calculate the unknown variable.

Example 1. You sell paper goods. You calculate your quotes as follows:

Price of the order − discount rate if order is over $200 + freight

1. Enter the QTE equation into the Solver.*

```
QTE=PRICE×(1-
IF(PRICE>200:1:0)×DISC%÷100)+FRT
```

2. Display the QTE equation menu.
3. Store or calculate the following variables:
   - Quote in QTE.
   - Total price of the goods in PRICE.
   - Discount rate as a percent in DISC%.
   - Freight in FRT.

Your customer places an order worth $300. The standard discount rate is 2%. The freight is $35. Calculate the quote for the order.

Display the QTE equation menu.

Keys:	**Display:**	**Description:**
300 PRICE	PRICE=300.00	Stores price of goods sold.
2 DISC%	DISC%=2.00	Stores discount percent.
35 FRT	FRT=35.00	Stores freight cost.
QTE	QTE=329.00	Calculates quote.

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

Example 2. You sell two major products along with the supplies and service to go with them. You calculate your quotes as follows:

Quantity of product 1 × price of product 1
\+ Quantity of product 2 × price of product 2
\+ Supplies + Number of years of service agreement × price per year

1. Enter the QTE equation into the Solver.*

   QTE=QUA1×PR1+QUA2×PR2+$SUP+YRSRV×PRSRV

2. Display the QTE equation menu.
3. Store or calculate the following variables:
   - Quote in QTE.
   - Quantity sold of product 1 in QUA1.
   - Price of product 1 in PR1.
   - Quantity sold of product 2 in QUA2.
   - Price of product 2 in PR2.
   - Dollar value of supplies in $SUP.
   - Number of years of service in YRSRV.
   - Price per year of service in PRSRV.

Your customer wants to order three of product 1 at $1,000 each, and he wants two of product 2 at $4,500 each. The order includes $150 in supplies and a three-year service agreement at $500 per year. Calculate the quote.

Display the QTE equation menu.

Keys:	Display:	Description:
3 QUA1	QUA1 =3.00	Stores quantity of product 1.

* To key in $, press WXYZ OTHER MORE $.

1000 PR1	PR1 = 1,000.00	Stores price of product 1.
2 QUA2	QUA2 = 2.00	Stores quantity of product 2.
4500 PR2	PR2 = 4,500.00	Stores price of product 2.
MORE		
150 $SUP	$SUP = 150.00	Stores dollar value of supplies.
3 YRSRV	YRSRV = 3.00	Stores years of service.
500 PRSRV	PRSRV = 500.00	Stores price of service for one year.
MORE		
QTE	QTE = 13,650.00	Calculates quote.

Example 3. You always tell your customers about your cash discount – that is, if they pay within 10 days, you give a discount. When giving quotes, you want your customers to see how this can help their businesses. You base your quotes on:

Price of goods sold – discount rate if paid within 10 days + freight

1. Enter the QTE equation into the Solver.*

```
QTE=PRICE×(1-
IF(#DAY<11:1:0)×DISC%÷100)+FRT
```

2. Display the QTE equation menu.

3. Store or calculate the following variables:

- Quote in QTE.
- Total price of the goods in PRICE.
- Number of days until bill is paid in #DAY.

---

* To key in #, press WXYZ OTHER #.
To key in <, press WXYZ OTHER <.
To key in :, press WXYZ OTHER :.

- Discount rate as a percent in DISC%.
- Freight in FRT.

Part 1. The price of the goods sold is $2,575. The freight is $55. Calculate the quote if the bill will be paid in 30 days. The discount rate is 2%.

Display the QTE equation menu.

Keys:	**Display:**	**Description:**
2575 PRICE	PRICE=2,575.00	Stores price of goods sold.
30 #DAY	#DAY=30.00	Stores number of days until bill is paid.
2 DISC%	DISC%=2.00	Stores discount percent.
55 FRT	FRT=55.00	Stores freight.
QTE	QTE=2,630.00	Calculates quote.

Part 2. Calculate the quote if the bill is paid in nine days.

9 #DAY	#DAY=9.00	Stores number of days until bill is paid.
QTE	QTE=2,578.50	Calculates quote.

Sales Force Requirements

The equation in this section helps you determine the size of your sales force based on the number of territories, the number of calls to be made on a customer, and the average number of calls to be made by a sales person. The accuracy of your result depends on your ability to estimate call frequencies for different size accounts.

Entering and Using the #SFC Equation:

1. Enter the #SFC equation into the Solver.*

   ```
   #SFC=Σ(I:1:SIZES(#CST):1:ITEM(#CST:I)×
   ITEM(#CALL:I))÷C/YR
   ```

2. Enter the number of customers in each territory in a SUM† list, and name the list #CST.
3. Enter the call frequency in each territory in a SUM list, and name the list #CALL.
4. Display the #SFC equation menu.
   - Store the average number of calls made each year by a sales person in C/YR.
   - Press #SFC to calculate the sales force size.

* To key in #, press WXYZ OTHER #.
To key in Σ, press WXYZ OTHER MORE Σ.
To key in :, press WXYZ OTHER :.
To key in /, press WXYZ OTHER MORE /.

† On the HP-27S, press ■ STAT to display the STAT menu.

Example. The table below describes your sales situation:

Territory	Number of Customers (#CST)	Number of Calls (#CALL)
1	3	1000
2	7	2500
3	10	3000

Each salesperson averages 2,000 calls per year. Calculate the size of your sales force.

Display the SUM menu.*

Keys:	Display:	Description:
■ [CLEAR DATA] [YES] *or* [GET] [*NEW]	ITEM(1)=?	Clears current list or gets a new one.
3 [INPUT] 7 [INPUT] 10 [INPUT]	TOTAL=20.00	Enters number of customers in each territory.

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

[EXIT]		
[NAME] #CST [INPUT]		Names the list.
[GET] [*NEW]	ITEM(1)=?	Displays a new list.
1000 [INPUT] 2500 [INPUT] 3000 [INPUT]	TOTAL=6,500.00	Enters number of calls.

* On the HP-27S, press ■ [STAT] to display the STAT menu.

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

EXIT	
NAME #CALL INPUT	Names the list.

Display the #SFC equation menu.

2000 C/YR	C/YR=2,000.00	Stores calls per sales person per year.
#SFC	#SFC=25.25	Calculates sales force size.

Source: S.E. Heymann, "Determining the Optimum Size of the Sales Force," in *Marketing Research in Action*. New York: The Conference Board Report, Studies in Business Policy, No. 84, 1957, pp 82-84.

Performance Measurements

Note To do the percent of total calculations on the HP-27S, first enter the %TOTL equation into the Solver as described on page 67. The %CHG equation is built into the HP-27S, and both equations are built into the HP-17B and HP-19B.

This section uses percentages to analyze sales performance. Percentages can be used to compare:

- Individual sales or expenses to average sales or expenses.
- Individual sales and expenses to total sales and expenses.
- Current sales and expenses to past sales and expenses.
- Calls made to actual sales.
- Individual percentages of total sales to percentages of total expenses.

The built-in %CHG and %TOTL* menus makes it easy to calculate these percentages.

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

* On the HP-27S, you must use the Solver equation on page 67.

Example 1: Calculate Percent Change in Sales Over Time. Sales this period were $36,450; sales last period were $33,220. Calculate the percent change in sales.

Display the %CHG menu.

Keys:	Display:	Description:
33220 OLD	OLD=33,220.00	Stores old sales.
36450 NEW	NEW=36,450.00	Stores new sales.
%CH	%CH=9.72	Calculates percent change in sales from last period to this period.

Example 2: Compare Individual Sales and Expenses to Total Sales and Expenses. Total sales for the period were $134,000. Expenses for the period were $12,250. The sales force records for the period are as follows:

Sales Person	$Sales	$Expenses
#1	35,000	3,500
#2	33,750	2,750
#3	39,500	4,000
#4	25,750	2,000

Part 1. Calculate the percentage of individual sales to total sales for each sales person.

Display the %TOTL menu.*

* On the HP-27S, you must use the Solver equation on page 67.

Keys:	Display:	Description:
134000 TOTAL	TOTAL=134,000.00	Stores total sales.
35000 PART	PART=35,000.00	Stores sales for #1.
%T	%TOTAL=26.12	Calculates percent of total sales for #1.
33750 PART	PART=33,750.00	Stores sales for #2.
%T	%TOTAL=25.19	Calculates percent of total sales for #2.
39500 PART	PART=39,500.00	Stores sales for #3.
%T	%TOTAL=29.48	Calculates percent of total sales for #3.
25750 PART	PART=25,750.00	Stores sales for #4.
%T	%TOTAL=19.22	Calculates percent of total sales for #4.

In order of sales performance, sales person #3 was best, followed by #1, #2, and #4.

Part 2. Calculate the percentage of individual expenses to total expenses for each sales person. The total expenses for the sales force is $12,250.

12250 TOTAL	TOTAL=12,250.00	Stores total expenses.
3500 PART	PART=3,500.00	Stores expenses for #1.
%T	%TOTAL=28.57	Calculates percent of total expenses for #1.
2750 PART	PART=2,750.00	Stores expenses for #2.
%T	%TOTAL=22.45	Calculates percent of total expenses for #2.
4000 PART	PART=4,000.00	Stores expenses for #3.
%T	%TOTAL=32.65	Calculates percent of total expenses for #3.

2000 PART	PART=2,000.00	Stores expenses for #4.
%T	%TOTAL=16.33	Calculates percent of total expenses for #4.

In order of expense performance, sales person #4 had the lowest expenses, followed by #2, #1, and #3.

Looking at the percentages, however, sales person #4 achieved 19.2% of the sales, while spending only 16.3% of the expenses. Sales person #3, on the other hand, achieved 29.5% of the sales, but spent 32.7% of the expenses. In this period, sales person #4 was more efficient than #3.

%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 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 :, press WXYZ OTHER :.

3

Forecasting

Forecasting Based on History

One method of forecasting is to look at historical trends. Once you have historical data, the data are fit to a curve with time on the x-axis and the quantity you are forecasting on the y-axis. Linear curve fit is appropriate if you have a fairly constant growth rate; exponential curve fit is appropriate with compound growth, such as sales for a new product. Use the following steps to forecast based on history:

1. In the SUM* menu, enter the time data (x-data). Press [INPUT] after each item.
2. Name your list.
3. Get a new list and enter the historical data (y-data).
4. Name your list.
5. In the FRCST menu, select the time list as your x-variable and the historical data list as your y-variable.†
6. If necessary, select the forecast model.
7. Key in the known value and press the menu key for that variable.
8. Press the menu key for the variable you want to forecast.

Example 1: Forecasting Using Linear Curve Fit. You want to determine the sales forecast for the next two years using a linear curve fit. The following data represents your sales for the past five years.

Year (x)	Sales (y)
1	130,600
2	160,750
3	205,900
4	210,000
5	240,650

* On the HP-27S, press ■ [STAT] to display the STAT menu.

† On the HP-19B, you don't select the y-variable. The current list is used.

The keystrokes for statistics on the HP-17B and HP-27S are slightly different than on the HP-19B. Two sets of steps follow. The first set is for the HP-17B and HP-27S. The second set, beginning on page 71, is for the HP-19B.

HP-17B and HP-27S Steps:
On the HP-17B, display the SUM menu. On the HP-27S, display the STAT menu.

Keys:	Display:	Description:
■ [CLEAR DATA] YES YES *or* GET *NEW	ITEM(1)=?	Clears current list or gets a new one.
1 [INPUT] 2 [INPUT] 3 [INPUT] 4 [INPUT] 5 [INPUT]	TOTAL=15.00	Enters time values.
[EXIT]		
NAME YEAR [INPUT]		Names the list.
GET *NEW	ITEM(1)=?	Displays a new list.
130600 [INPUT] 160750 [INPUT] 205900 [INPUT] 210000 [INPUT] 240650 [INPUT]	TOTAL=947,900.00	Enters sales data.
[EXIT]		
NAME SALES [INPUT]		Names the list.
CALC MORE FRCST	SELECT X VARIABLE	Displays the FRCST menu.

YEAR	SELECT Y VARIABLE	Selects YEAR as x-variable.
SALES	LINEAR *	Selects SALES as y-variable.
6 YEAR	YEAR = 6.00	Stores year 6 as the x-value.
SALES	SALES = 270,385.00	Calculates sales forecast for year 6.
7 YEAR	YEAR = 7.00	Stores year 7 as the x-value.
SALES	SALES = 297,320.00	Calculates sales forecast for year 7.

HP-19B Steps:
Display the SUM menu.

Keys:	Display:	Description:
■ CLEAR DATA YES *or* GET *NEW	ITEM(1) =	Clears current list or gets a new one.
1 INPUT 2 INPUT 3 INPUT 4 INPUT 5 INPUT	TOTAL = 15.00	Enters time values.
NAME YEAR INPUT		Names the list.

* If your display doesn't say LINEAR, press MORE MODL LIN to change the model.

GET *NEW	ITEM(1)=	Displays a new list.
130600 [INPUT] 160750 [INPUT] 205900 [INPUT] 210000 [INPUT] 240650 [INPUT]	TOTAL=947,900.00	Enters sales data.
NAME SALES [INPUT]		Names the list.
CALC MORE FRCST	SELECT X VARIABLE	Displays the FRCST menu.
YEAR	SELECT A MODEL	Selects YEAR as x-variable.
LIN	LINEAR	Selects linear model.
6 XLIST	XLIST=6.00	Stores year 6 as the x-value.
YLIST	YLIST=270,385.00	Calculates sales forecast for year 6.
7 XLIST	XLIST=7.00	Stores year 7 as the x-value.
YLIST	YLIST=297,320.00	Calculates sales forecast for year 7.

Example 2: Forecasting Using Exponential Curve Fit. The sales history for your new product is shown below for the first six months after introduction.

Month (x)	Sales ($K) ($y$)
June	31.7
July	52.5
August	48.3
September	56.6
October	72.7
November	90.9

Part 1. Using the exponential model, estimate the sales for December.

The keystrokes for statistics on the HP-17B and HP-27S are slightly different than on the HP-19B. Two sets of steps follow. The first set is for the HP-17B and HP-27S. The second set, beginning on page 74, is for the HP-19B.

HP-17B and HP-27S Steps:

On the HP-17B, display the SUM menu. On the HP-27S, display the STAT menu.

Keys:	**Display:**	**Description:**
■ [CLEAR DATA] [YES] [YES] *or* [GET] [*NEW]	ITEM(1)=?	Clears current list or gets a new one.
1 [INPUT] 2 [INPUT] 3 [INPUT] 4 [INPUT] 5 [INPUT] 6 [INPUT]	TOTAL=21.00	Enters month numbers.
[EXIT]		
[NAME] MONTH [INPUT]		Names the list.
[GET] [*NEW]	ITEM(1)=?	Displays a new list.
31.7 [INPUT] 52.5 [INPUT] 48.3 [INPUT] 56.6 [INPUT] 72.7 [INPUT] 90.9 [INPUT]	TOTAL=352.70	Enters sales data.
[EXIT]		
[NAME] MSLS [INPUT]		Names the list.

CALC MORE FRCST	SELECT X VARIABLE	Displays the FRCST menu.
MONT	SELECT Y VARIABLE	Selects MONTH as x-variable.
MSLS		Selects MSLS as y-variable.
MORE MODL EXP	EXPONENTIAL	Selects exponential model.
7 MONT	MONTH=7.00	Stores month 7 as the x-value.
MSLS	MSLS=105.78	Calculates projected sales for December, month 7.

Part 2. Calculate the estimate of the monthly compound growth rate as a percent.

M [×] 100 [=]	18.29	Calculates estimate of monthly compound growth rate.

HP-19B Steps:
Display the SUM menu.

Keys:	Display:	Description:
■[CLEAR DATA] YES *or* GET *NEW	ITEM(1)=	Clears current list or gets a new one.
1 [INPUT]		Enters month numbers.
2 [INPUT]		
3 [INPUT]		
4 [INPUT]		
5 [INPUT]		
6 [INPUT]	TOTAL=21.00	

NAME MONTH INPUT		Names the list.
GET *NEW	ITEM(1)=	Displays a new list.
31.7 INPUT 52.5 INPUT 48.3 INPUT 56.6 INPUT 72.7 INPUT 90.9 INPUT	TOTAL=352.70	Enters sales data.
NAME MSLS INPUT		Names the list.
CALC MORE FRCST	SELECT X VARIABLE	Displays the FRCST menu.
MONT	SELECT A MODEL	Selects MONTH as x-variable.
EXP	EXPONENTIAL	Selects exponential model.
7 XLIST	XLIST=7.00	Stores month 7 as the x-value.
YLIST	YLIST=105.78	Calculates projected sales for December, month 7.

Part 2. Calculate the estimate of the monthly compound growth rate as a percent.

M × 100 =	18.29	Calculates estimate of monthly compound growth rate.

Forecasting Sales of Accessories

Many products have optional accessories or peripheral products. For example, cars have lots of extras, and computers have software and optional equipment.

The sales forecasts of these optional items are often based on a percentage of the sales of the main product. The following equation helps determine sales of these optional products.

Although this calculation is simple to do on any calculator, using the Solver means you don't have to reenter values to calculate the forecast of many optional products for one main product, or to try what-if situations.

Entering and Using the FCST Equation:

1. Enter the FCST equation into the Solver. *

   `FCST=#MAIN×(%MAIN÷100)`

2. Display the FCST equation menu.
3. Store or calculate the following variables:
   - Forecast for the optional product in FCST.
   - Units of the main product in #MAI.
   - Percent of main product in %MAI.

Example: Part 1. Seventy-five percent of your customers are expected to order a particular software product to use with your computer. The computer is forecast to sell 1,100 units per month. What should your sales forecast be for the software product?

Display the FCST equation menu.

* To key in #, press WXYZ OTHER #.

Keys:	**Display:**	**Description:**
1100 #MAI	#MAIN = 1,100.00	Stores computer forecast.
75 %MAI	%MAIN = 75.00	Stores percent expected to buy the software.
FCST	FCST = 825.00	Calculates software sales forecast.

Part 2. Last month, computer sales were 900 and software orders were 750. What should the software sales forecast be to reflect last month's actual sales rate? The computer is forecast to sell 1,100 units this month.

750 FCST	FCST = 750.00	Stores number of software products sold last month.
900 #MAI	#MAIN = 900.00	Stores number of computers sold last month.
%MAI	%MAIN = 83.33	Calculates percent of computer sales.
1100 #MAI	#MAIN = 1,100.00	Stores computer forecast.
FCST	FCST = 916.67	Calculates new software forecast.

Forecasting Using Centered Moving Average

Seasonal variation factors are a useful concept in many types of forecasting. One method of developing seasonal moving averages is to calculate the ratio of the periodic value to a centered moving average for the same period.

For example, to determine the sales for the third quarter of next year, you calculate the centered moving average for the third quarter using the sales figures from the first, second, third, and fourth quarters of the year plus the first quarter of the next year. The seasonal variation factor for the third quarter is the ratio of the actual sales in the third quarter to the centered moving average for that quarter. This factor can be used to make forecasts for the third quarter of future years.

The equation below can be used for quarters or months. You specify the periods per year in #PER.

Entering and Using the CMA Equation:

1. Enter the CMA equation into the Solver.*

```
CMA:IF(S(CMA):(ITEM(SLS:P#-#PER÷2)÷2+
Σ(I:P#-#PER÷2+1:P#+#PER÷2-1:
1:ITEM(SLS:I))+ITEM(SLS:(P#+#PER÷2))÷2)÷
#PER-CMA:FACT-ITEM(SLS:P#)÷CMA×100)
```

2. Enter the periodic sales in a SUM† list, and name the list SLS.
3. Display the CMA equation menu.
4. Store the following variables:
   - Period number of interest in P#.
   - Number of periods per year in #PER. (For example, enter 4 for quarterly data, 12 for monthly data.)

---

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

† On the HP-27S, press ■ STAT to use the STAT menu.

5. Press CMA to calculate the centered moving average for the period of interest.
6. Press FACT to calculate the seasonal variation factor for the period.

Example 1. Your sales for the last 15 periods were as follows:

Period	Sales (SLS)	Period	Sales (SLS)
1	397	9	513
2	376	10	434
3	460	11	562
4	501	12	593
5	455	13	579
6	390	14	601
7	530	15	598
8	560		

Calculate the centered 12-month moving average and seasonal variation factor for months 7 through 9.

Display the SUM menu. (On the HP-27S, press ■ STAT to display the STAT menu.)

Keys:	Display:	Description:
■ CLEAR DATA YES YES *or* GET *NEW	ITEM(1)=?	Clears current list or gets a new one.
397 INPUT 376 INPUT 460 INPUT 501 INPUT 455 INPUT 390 INPUT 530 INPUT 560 INPUT 513 INPUT 434 INPUT 562 INPUT 593 INPUT 579 INPUT 601 INPUT		Enters monthly sales.
598 INPUT	TOTAL=7,549.00	

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

EXIT		
NAME SLS INPUT		Names the list.

Display the CMA equation menu.

7 P#	P# = 7.00	Stores month of interest.
12 #PER	#PER = 12.00	Stores number of periods per year.
CMA	CMA = 488.50	Calculates centered moving average for month 7.
FACT	FACT = 108.50	Calculates seasonal variation factor for month 7.
8 P#	P# = 8.00	Stores month of interest.
CMA	CMA = 505.46	Calculates centered moving average for month 8.
FACT	FACT = 110.79	Calculates seasonal variation factor for month 8.
9 P#	P# = 9.00	Stores month of interest.
CMA	CMA = 520.58	Calculates centered moving average for month 9.
FACT	FACT = 98.54	Calculates seasonal variation factor for month 9.

Example 2. Suppose the data listed on page 79 is for quarters. Find the centered moving average and seasonal variation factor for quarter three.

If the SLS list is still in your calculator, you don't have to enter the data again.

Display the CMA equation menu.

Keys:	**Display:**	**Description:**
3 P#	P# = 3.00	Stores quarter of interest.
4 #PER	#PER = 4.00	Stores number of periods per year.
CMA	CMA = 440.75	Calculates centered moving average for quarter 3.
FACT	FACT = 104.37	Calculates seasonal variation factor for quarter 3.

Revising a Forecast To Reflect Current Market Conditions

Most sales forecasts are based on certain assumptions about, and incomplete knowledge of, the market and competition. After the forecasts are made, internal and external changes make the original assumptions and the forecasts incomplete. Examples of these changes in the market that were not reflected in the original forecast are a price drop (yours or your competitors), advertising or promotional campaign, rebate offer, introduction of a new product by a competitor, or a change in distribution of your product. The equation below helps you revise your forecast, based on the perceived impact of the market changes.

Entering and Using the FCST Equation:

1. Enter the FCST equation into the Solver.

   `FCST=BASE×(1+(A%+B%+C%)÷100)`

2. Display the FCST equation menu.
3. Store or calculate the following variables:
   - New forecast in FCST.
   - Original forecast in BASE.
   - Expected change in sales caused by each change in the market in A%, B%, and C%.*

Example. The forecast for your product for next month is 2,000 units. Three market changes have occurred that are not reflected in your current forecast. The price on the product has dropped (causing an expected 20% increase in sales), a major sales force training program started (causing an expected 5% increase in sales), and you've learned that a competitor is introducing a new product (creating an expected 15% cut into your sales). Calculate the new forecast for next month.

---

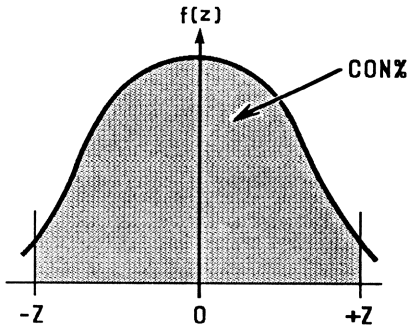
* This formula can be modified to fit the number of changes for your current market conditions. For example, if you have two factors, omit +C%; if you have five factors, change the part in parentheses to (A%+B%+C%+D%+E%).

Display the FCST equation menu.

Keys:	**Display:**	**Description:**
2000 BASE	BASE=2,000.00	Stores original forecast.
20 A%	A%=20.00	Stores sales increase expected due to price drop.
5 B%	B%=5.00	Stores sales increase expected due to sales force training.
15 +/- C%	C%= −15.00	Stores sales decrease due to new product introduction by a competitor.
FCST	FCST=2,200.00	Calculates new forecast for the month.

Estimating the Standard Normal Variate (Z) and the Sample Size

Your calculator can be used to calculate the normal variate (*Z*). The *Z* value calculated is the same value you would find in a statistical table that gives *Z* for a two-tailed region, as shown below:



The CONFIDENCE equation is used to calculate the *Z* value for a specified confidence level. There are always two possible solutions for *Z*, only one of which is positive. The useful range for *Z* is a positive number between 0 and 4. Therefore, the guesses you enter to estimate *Z* should be between 0 and 4.

Entering and Using the CONFIDENCE Equation:

1. Enter the CONFIDENCE equation into the Solver.*

```
CONFIDENCE:1÷(1-CON%÷100)=
(1+.049867347×Z+.0211410061×Z^2
+.0032776263×Z^3+3.80036E-5×Z^4+
4.88906E-5×Z^5+5.383E-6×Z^6)^16
```

2. Display the CONFIDENCE equation menu.
3. Store or calculate the following variables:
   - Confidence level estimate as a percentage in CON%.
   - Standard normal variate in Z.

Example. Calculate Z for a confidence interval of 99%. The solution for Z involves an iterative search. A solution can be reached more quickly by entering initial guesses before solving for Z. Use 3 and 4 as the initial guesses.

Display the CONFIDENCE equation menu.

Keys:	Display:	Description:
99 CON%	CON%=99.00	Stores confidence interval.
3 Z	Z=3.00	Stores first estimate of *Z*.
4 Z	Z=4.00	Stores second estimate of *Z*.
Z	Z=2.58†	Calculates *Z*.

* Source: Abramowitz and Stegun, *Handbook of Mathematical Functions.* National Bureau of Standards, 1972, pp 932.

To key in ^ on the HP-17B and HP-27S, press ■ [y^x].

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

Sample Size for Estimating Population Mean

When performing market research, you typically can't talk to all of your potential market about their needs and opinions. Instead, a sample is selected. The equation below helps you determine how large a simple random sample should be to represent the population to the accuracy you desire.

Entering and Using the SSIZE Equation:

1. Enter the SSIZE equation into the Solver.*

   `SSIZE=(Z×SDEV÷ERROR)^2`

2. Display the SSIZE equation menu.
3. Store or calculate the following variables:
   - Sample size in SSIZE.
   - Standard normal variate (Z) in Z. (Note that for 95% confidence, $Z=1.96$; for 99% confidence, $Z=2.58$. You can calculate this value using the Confidence equation or use a table in a statistics book. Refer to a statistics book for more information about Z.)
   - Population standard deviation in SDEV.
   - Maximum acceptable difference between the sample mean and the population mean in ERROR.

Example: Part 1. You are investigating radio advertising in your city. Prior research indicated that the standard deviation for the number of hours per week that adults listen to the radio is 2.3 hours. If you wish to estimate the average number of hours that adults listen to the radio by taking a simple random sample, how many adults must you sample to be 95% confident that your estimate is within .5 hour of the true average number of hours?

---

* To key in ^ on the HP-17B and HP-27S, press ■ y^x.

Display the SSIZE equation menu.

Keys:	Display:	Description:
1.96 Z	Z=1.96	Stores normal distribution for 95% confidence.
2.3 SDEV	SDEV=2.30	Stores standard deviation.
ERROR	ERROR=0.50	Stores error.
SSIZE	SSIZE=81.29	Calculates size of the sample needed.

Part 2. Suppose you want your error to be only .25 hour. Calculate the sample size.

ERROR	ERROR=0.25	Stores the error.
SSIZE	SSIZE=325.15	Calculates sample size.

4

Distribution Planning

Stockturn or Inventory Turnover Rate

The stockturn or inventory turnover rate is a measure of the number of times the average inventory is sold in a year. The stockturn rate is important because it shows how rapidly the firm's inventory is moving. The data needed to compute the stockturn rate are beginning and ending inventory in cost dollars and the cost of the goods sold, or the beginning and ending inventory in retail dollars and the retail dollars sold.

Entering and Using the TURN Equation:

1. Enter the TURN equation into the Solver.*

   TURN=$SLD÷((BEG+END)÷2)
2. Display the TURN equation menu.
3. Store or calculate the following variables:
   - Stockturn rate in TURN.
   - Inventory sold in $SLD.
   - Beginning inventory in dollars in BEG.
   - Ending inventory in dollars in END.

* To key in $, press WXYZ OTHER MORE $.

Example: Part 1. Last year, the cost of the goods that were sold was $30,000, beginning inventory was $8,000, and ending inventory was $7,000. Calculate the stockturn rate.

Display the TURN equation menu.

Keys:	**Display:**	**Description:**
30000 $SLD	$SLD=30,000.00	Stores inventory sold.
8000 BEG	BEG=8,000.00	Stores beginning inventory.
7000 END	END=7,000.00	Stores ending inventory.
TURN	TURN=4.00	Calculates stockturn rate for the year.

Part 2. Suppose the company prefers that inventory with a limited shelf life turn over every two months (six times a year). How would this change your ending inventory?

6 TURN	TURN=6.00	Stores desired stockturn rate.
END	END=2,000.00	Calculates ending inventory.

Economic Ordering Quantity

The economic ordering quantity (*EOQ*) is the optimum quantity to order each time an order is placed. It is based on the cost of placing and receiving an order, annual sales, holding cost (including warehousing costs, interest on funds tied up in inventory, insurance, and obsolescence), and the purchase price of the goods.

The equation assumes that usage is at a constant rate and that delivery lead times are constant.

Entering and Using the EOQ Equation:

1. Enter the EOQ equation into the Solver.*

   `EOQ=SQRT(2×CPO×SLS÷(HOLD%÷100×CPU))`

2. Display the EOQ equation menu.
3. Store or calculate the following variables:
   - Economic ordering quantity in EOQ.
   - Cost of placing an order in CPO.
   - Annual unit sales in SLS.
   - Holding costs as a percent of inventory value in HOLD%.
   - Cost per unit in CPU.

Example 1. Your annual sales are 10,000 units. Cost per unit is $4.73. Holding cost is 20% of inventory value, and the cost of placing and receiving an order is $35. What is the economic ordering quantity?

Display the EOQ equation menu.

* To key in the square-root function (SQRT), press ■ √x.

Keys:	Display:	Description:
35 CPO	CPO=35.00	Stores cost of placing order.
10000 SLS	SLS=10,000.00	Stores annual sales in units.
20 HOLD%	HOLD%=20.00	Stores holding cost.
4.73 CPU	CPU=4.73	Stores cost per unit.
EOQ	EOQ=860.21	Calculates economic ordering quantity.

EOQ Using Discount and Tax Rates

The economic ordering quantity equation in this section includes the variables in the first equation, plus variables for the total tax rate and discount rate on the cost of capital.

Entering and Using the EOQ2 Equation:

1. Enter the EOQ2 equation into the Solver.*

   EOQ2=SQRT((2×(1-TAX%÷100)×CPO×#USE)÷((1-TAX%÷100)×HOLD%÷100×CPU+DISC%÷100×CPU))

2. Display the EOQ2 equation menu.
3. Store or calculate the following variables:
   - Economic ordering quantity in EOQ2.
   - Tax rate as a percent in TAX%.
   - Cost of placing an order in CPO.
   - Annual unit use in #USE.
   - Holding costs as a percent of inventory value in HOLD%.

---

* To key in the square-root function (SQRT), press ■ √x.
To key in #, press WXYZ OTHER #.

- Cost per unit in CPU.
- Discount rate as a percent in DISC%.

Example 2. A manufacturing company uses 1,500 units per year of a special part and estimates that it costs $30 to place an order. The inventory manager estimates holding costs to be 4% per year. The finance department uses an 8% discount rate and a 40% tax rate. These units cost $21 per unit for all order quantities. What is the economic ordering quantity?

Display the EOQ2 equation menu.

Keys:	**Display:**	**Description:**
40 TAX%	TAX% = 40.00	Stores tax rate.
30 CPO	CPO = 30.00	Stores cost of placing order.
1500 #USE	#USE = 1,500.00	Stores annual use in units.
4 HOLD%	HOLD% = 4.00	Stores holding cost.
MORE		
21 CPU	CPU = 21.00	Stores cost per unit.
8 DISC%	DISC% = 8.00	Stores discount rate.
MORE		
EOQ2	EOQ2 = 157.24	Calculates economic ordering quantity.

Evaluation of Costs Associated With Seasonal or Perishable Inventory

Excess inventory of seasonal or fad products may have a salvage value below cost. You may even have to pay to dispose of excess inventory of perishable goods, which results in a negative salvage value. However, if insufficient inventory is available, costs in the form of lost sales, good will, and customer loyalty are incurred. The equation below helps evaluate the relationship among these costs.

Entering and Using the SCOST Equation:

1. Enter the SCOST equation into the Solver.

   SCOST=(COST-SALV)÷PROB%×100-PRICE+SALV

2. Display the SCOST equation menu.
3. Store or calculate the following variables:
   - Shortage cost per unit in SCOST.
   - Unit cost of the product in COST.
   - Unit salvage value (negative, if you must pay to dispose of the product) in SALV.
   - Probability of stockout in PROB%.
   - Unit price of the product in PRICE.

Example: Part 1. A store is considering the sale of poinsettias at Christmas. Each poinsettia costs \$6 and the selling price is \$11. You estimate that at an inventory of 1,000, the probability of excess inventory is 15%. The salvage value is \$4. Calculate the shortage cost per unit.

Display the SCOST equation menu.

Keys:	Display:	Description:
6 COST	COST=6.00	Stores unit cost of the product.
11 PRICE	PRICE=11.00	Stores unit price of the product.
15 PROB%	PROB%=15.00	Stores probability of stockout.
4 SALV	SALV=4.00	Stores unit salvage value.
SCOST	SCOST=6.33	Calculates cost of stockout shortage.

Part 2. What is the optimal probability of stockout if the cost of stockout shortage is the gross profit ($11 minus $6) plus $10 per unit for lost goodwill, customer loyalty, and future sales to the customer who comes in expecting to participate in your seasonal special?

11 [-] 6 [+] 10 SCOST	SCOST=15.00	Stores cost of stockout shortage.
PROB%	PROB%=9.09	Calculates probability of stockout.

This value indicates that you should order enough stock so that you have a 9% or less chance of running out during the seasonal selling season.

Source: McClain and Thomas, *Operations Management, Production of Goods and Services*. Prentice-Hall, 1980, pp 290-292.

Estimating Inventory Availability

Availability estimates tell you approximately how long your inventory will last, based on forecasted or use rates. The equation below can be applied to finished goods or production parts.

This equation calculates availability in weeks, based on inventory on hand and use per month. The equation assumes 4.33 weeks per month. You can alter the equation to fit other situations. For example, if you omit ×4.33, the equation calculates availability in months.

Entering and Using the AVAIL Equation:

1. Enter the AVAIL equation into the Solver.

   AVAIL=INV÷USE×4.33

2. Display the AVAIL equation menu.
3. Store or calculate the following variables:
   - Availability in weeks in AVAIL.
   - Inventory on hand in INV.
   - Forecasted or use per month in USE.

Example: Part 1. You have 800 units available at the end of the month. The forecast for the next month is 1,200 units. How long will your supply last?

Display the AVAIL equation menu.

Keys:	Display:	Description:
800 INV	INV=800.00	Stores current inventory.
1200 USE	USE=1,200.00	Stores forecast.
AVAIL	AVAIL=2.89	Calculates weeks of availability.

Part 2. You like to keep 7 weeks of supply on hand. What should your inventory be?

7 AVAIL	AVAIL=7.00	Stores weeks of availability.
INV	INV=1,939.95	Calculates inventory needs.

5

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

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 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.

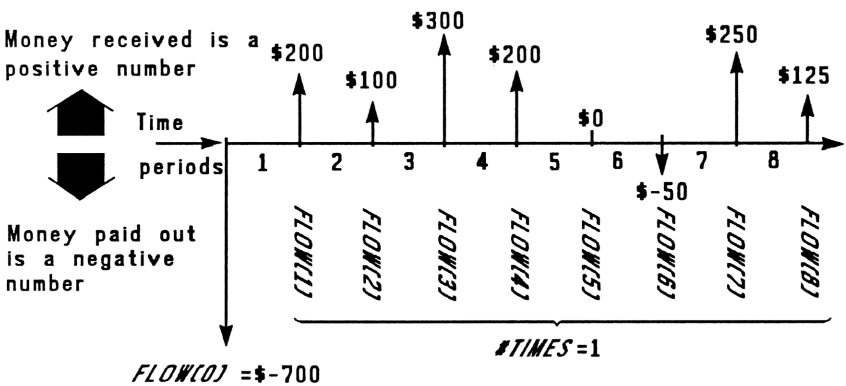
* If the cash flows occur at the beginning of each period, then combine the first flow with the initial flow (which can increase or decrease the flow), and move each cash flow up one period. Remember, a payment made at the beginning of period 2 is equivalent to the same payment made at the end of period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

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 first 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.

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 this case, the investor has invested $700. 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 five, and that the investor pays a small amount in period six.

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.
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 (IRR%):
   - 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.

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

The table below 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 ≡ *or* ≡ GET ≡ ≡ *NEW ≡	ITEM(1)=?	Clears current list or gets a new one.
80000 [+/-] [INPUT]	ITEM(2)=?	Stores the 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)=?	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.

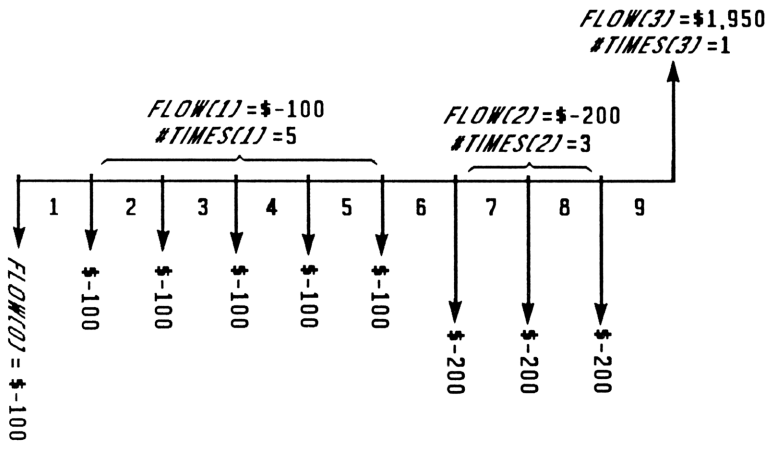
* The Solver searches for an iterative solution and displays intermediate estimates.

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 below is grouped into two sets of consecutive, equal cash flows:



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.

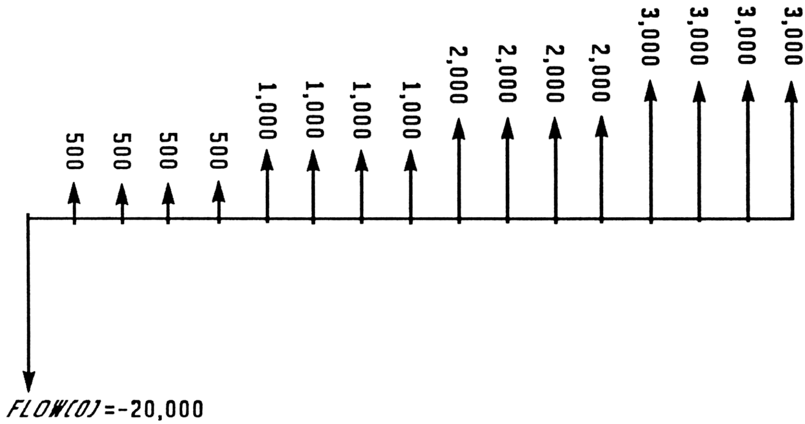
```
GROUPED:Σ(J:2:SIZES(FLOWS):2:
ITEM(FLOWS:J-1)×USPV(I%:ITEM
(FLOWS:J))×SPPV(I%:Σ(L:2:J-2:2:
ITEM(FLOWS:L))-1))=NPV
```

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 (IRR%):
   - Store zero in NPV.
   - Press I% to calculate the internal rate of return.

Example 2. You have the following investment opportunity. The cash flows occur quarterly.

Your initial investment:	\$20,000
Quarterly payments you receive:	4 at \$500
	4 at \$1,000
	4 at \$2,000
	4 at \$3,000

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



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%*×4).

Display the STAT menu.

Keys:	**Display:**	**Description:**
■ [MODES] FIX 2 [INPUT]		Sets display to two places.
■ [CLEAR DATA] YES YES *or* GET *NEW	ITEM(1)=?	Clears current list or gets a new one.
20000 [+/−] [INPUT]	ITEM(2)=?	Stores the 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) = ?	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.

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

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 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 changes sign only once, and the sum of the cash flows is positive.

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.

For more information, refer to an HP-17B or HP-19B owner's manual.

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

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