TEXAS INSTRUMENTS

BA II PLUS™
Calculator

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1

Overview of Calculator Operations

This chapter contains information on:

- Basic calculator operation
- Clearing and correcting
- Math operations
- Memory
- Last Answer
- Worksheets

Turning the Calculator On and Off

Turning the Calculator On

Press [ON/OFF] to turn the calculator on.

- If you turned the calculator off by pressing [ON/OFF], the calculator returns to operation in the standard-calculator mode. A value of zero is displayed and the values in all of the worksheets are the same as you left them, as are the formats for numbers, angle units, dates, separators, and calculation method.
- If the APD™ feature turned the calculator off, the calculator, including the display and any error condition, returns exactly as you left it.

Turning the Calculator Off

When you press [ON/OFF] to turn the calculator off:

- The displayed value is cleared.
- Any unfinished standard-calculator operation is canceled.
- Any worksheet calculation in progress is canceled.
- Any error condition is cleared.
- The Constant Memory™ feature retains all worksheet values and settings, including the contents of the 10 memories and all format settings.

Automatic Power Down™ (APD™) Feature

To prolong the life of the battery, the Automatic Power Down (APD) feature turns the calculator off automatically if you do not press any key for approximately 10 minutes.

Resetting the Calculator

Resetting the calculator restores all default settings and clears all data. Because you can clear only selected portions of data, you should reserve the reset function for appropriate situations. You might choose to reset when you first purchase the calculator or when you start a new project.

Effects of Resetting

- Clears the display and any unfinished calculation.
- Clears all 10 memories.
- Clears all worksheet data and restores the default settings. (For information on specific worksheets, refer to the specific worksheet chapters.)
- Returns the calculator to the standard-calculator mode.

Alternatives to Resetting

Before resetting the calculator, consider the other methods for clearing described in this chapter. For example, if you need to clear only one worksheet, you can do so without resetting.

Procedure: Resetting the Calculator

If necessary, first press [CE/C] to clear any error condition.

❶ Press [2nd] [Reset].

RST ? and the **ENTER** indicator are displayed.

❷ To reset the calculator, press [ENTER]. **RST** and **0.00** are displayed.

Note: To cancel the reset operation instead, press [2nd] [QUIT]. **0.00** is displayed.

The calculator is in standard-calculator mode.

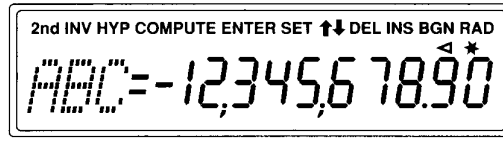
Keys and 2nd Functions

The primary function of each key is printed on the key. For example, press [ON/OFF] to turn the calculator on or off.

Some keys provide a secondary function. which is printed in yellow above the key. When you press [2nd], the character, abbreviation, or word printed above a key becomes active for the next keystroke. For example, press [2nd] [QUIT] to leave a worksheet and return to standard-calculator mode.

The Display

The display shows entries and results with up to 10 digits. The indicators along the top of the display provide information about the status of the calculator and tell you what keys are available at different times.



ABC represents the spaces where the three-letter abbreviations for the variable labels are displayed.

Display Indicators

Indicator	Meaning
2nd	The calculator will access the second function of the next key pressed.
INV	The calculator will access the inverse function of the next key or key sequence pressed.
HYP	The calculator will access the hyperbolic function of the next key or key sequence pressed.
COMPUTE	You can compute a value for the displayed variable by pressing [CPT].
ENTER	You can enter a value for the displayed variable by keying in a value and pressing [ENTER].
SET	The displayed variable is a setting that you can change by pressing [2nd] [SET].
↑ ↓	You can press [↑] to view previous variables in the current worksheet or [↓] to view subsequent variables.
DEL	You can press [2nd] [DEL] to delete a cash flow or a statistical data point.
INS	You can press [2nd] [INS] to insert a cash flow or a statistical data point.
BGN	You have selected beginning-of-period payments for TVM calculations. If the **BGN** indicator is not displayed when you are in the TVM worksheet, end-of-period payments are selected.
RAD	The calculator is in the radian mode. All angle values are displayed and must be entered as radians. If the **RAD** indicator is not displayed, all angle values are displayed and must be entered as degrees.
◁	The displayed value has been entered in a worksheet. After a computation, the ◁ indicators are cleared.
*	The displayed value has been computed in a worksheet. If you make a change to the worksheet that invalidates a previously computed value, the * indicator is removed from that value.
=	The displayed value is "assigned" to the variable represented by the label in the display. If the **=** indicator is **not** displayed, the displayed value is not assigned to the displayed variable.
-	The displayed value is negative.

Setting Calculator Formats

You can set formats for five aspects of the calculator.

Format	Options	Default
Number of decimal places	0 – 9 (floating-decimal format = 9)	**2** places
Angle units	degrees (**DEG**) or radians (**RAD**)	**DEG** (degrees)
Dates	**US** format mm-dd-yyyy or **Eur** (European) format dd-mm-yyyy	**US** format
Number separators	**US** format 1,000.00 or **Eur** (European) format 1.000,00	**US** format
Calculation method	**Chn** (chain) or **AOS™** (Algebraic Operating System) calculations	**Chn** (chain)

The sections that follow give details about each format and instructions for changing the format.

Number of Decimal Places

The calculator internally stores numeric values to an accuracy of 13 digits. You can specify the number of decimal places to be displayed. The default is two decimal places, rounding if necessary.

The decimal format setting affects only the display; it does not round the internal value, except for amortization and depreciation results. To round the internal value, use the round function.

Note: Examples in this guidebook assume a setting of two decimal places. Other settings may show different results.

Procedure: Changing the Number of Decimal Places

1. Press 2nd [Format]. **DEC=** is displayed with the current decimal-place setting.
2. Enter the number of decimal places to be displayed (0 through 9) and press ENTER. To specify a floating-decimal format, enter 9.
3. Choose one of the following to continue:
   - To continue setting formats, press ↓.
   - To return to the standard-calculator mode, press 2nd [QUIT].
   - To access a worksheet, press the appropriate worksheet key or key sequence.

Angle Unit Format

You can enter and display angle values in either degrees or radians. You can specify which method you require.

The default setting for angle units is degrees. There is no display indicator for this setting. However, if you specify radians, the **RAD** indicator is displayed in the upper right-hand corner of the display.

Procedure: Changing the Angle Unit Format

1. If necessary, press 2nd [Format] ↓.

   The most recently selected angle-units format is displayed, either **DEG** or **RAD**.
2. Press 2nd [SET] repeatedly to set either **DEG** or **RAD**.
3. Choose one of the following to continue:
   - To continue setting formats, press ↓ or ↑.
   - To return to the standard-calculator mode, press 2nd [QUIT].
   - To access a worksheet, press the appropriate worksheet key or key sequence.

Date Format

Both the Bond and Date worksheets use dates. You can select either the US or the European display format. The default setting for dates is the US format.

US format (**US**):	Month		Day		Year
	12	**-**	**31**	**-**	**1990**
European format (**EUR**):	Day		Month		Year
	31	**-**	**12**	**-**	**1990**

Procedure: Changing the Date Format

❶ If necessary, press [2nd] [Format] [↓] [↓].

The most recently selected date format is displayed, either **US** or **EUR**.

❷ Press [2nd] [SET] repeatedly to select either **US** or **EUR**.

❸ Choose one of the following to continue:

- To continue setting formats, press [↓] or [↑].
- To return to the standard-calculator mode, press [2nd] [QUIT].
- To access a worksheet, press the appropriate worksheet key or key sequence.

Separator Format

You can select either the US or the European format for the display of separators in numbers. The default setting for separators is the US format.

US and UK format (**US**):	**1,000.00**
European format (**EUR**):	**1.000,00**

Procedure: Changing the Separator Format

❶ If necessary, press [2nd] [Format] [↓] [↓] [↓].

The most recently selected separator format is displayed, either **US** or **EUR**.

❷ Press [2nd] [SET] repeatedly to select either **US** or **EUR**.

❸ Choose one of the following to continue:

- To continue setting formats, press [↓] or [↑].
- To return to the standard-calculator mode, press [2nd] [QUIT].
- To access a worksheet, press the appropriate worksheet key or key sequence.

Calculation Method

You can select either the chain calculation method or the **AOS** (algebraic operating system) calculation method. The default setting for calculation method is chain (**Chn**).

When the calculation method is set to **Chn** (chain), the calculator solves problems in the order that you enter them. This calculation method is used in most financial calculators.

For example, in **Chn** when you enter 3 [+] 2 [×] 4 [=], the answer is 20 (3 + 2 = 5, 5 * 4 = 20).

When the calculation method is set to **AOS** (the algebraic operating system), the calculator solves problems according to the standard rules of algebraic hierarchy. In AOS, multiplication and division operations are completed before addition and subtraction operations.

This calculation method is used in most scientific calculators.

For example, in **AOS** when you enter 3 [+] 2 [×] 4 [=], the answer is 11 (2 × 4 = 8; 3 + 9 = 11). The multiplication operation is completed before the addition operation.

Procedure: Changing the Calculation Method

❶ If necessary, press [2nd] [Format] [↓] [↓] [↓] [↓].

The most recently selected calculation method is displayed, either **Chn** (Chain) or **AOS** (Algebraic Operating System).

❷ Press [2nd] [SET] repeatedly to select either **Chn** or **AOS**.

❸ Choose one of the following to continue:

- To continue setting formats, press [↓] or [↑].
- To return to the standard-calculator mode, press [2nd] [QUIT].
- To access a worksheet, press the appropriate worksheet key or key sequence.

Clearing the Calculator

To clear . . .	Keystrokes
. . . one character at a time from the display (including decimal points).	→
. . . an incorrect entry, an error condition, or an error message from the display.	CE/C
. . . out of a worksheet and return to standard-calculator mode.	2nd [QUIT]
. . . all pending operations in the standard-calculator mode and display zero.	2nd [QUIT]
. . . in a worksheet, a value you have keyed into the display but not yet entered as a variable value. The previous value returns.	CE/C CE/C *
. . . any calculation you have started but have not yet completed.	CE/C CE/C
. . . the TVM worksheet and return the values in the worksheet to a known starting point.	2nd [QUIT] 2nd [CLR TVM]
. . . any worksheet (not TVM) and return the values in the worksheet to a known starting point. Also returns you to the first variable in the worksheet.	2nd [CLR Work]
. . . all 10 memories.	2nd [MEM] 2nd [CLR Work]
. . . one of the 10 memories without affecting the others.	0 STO and the key for the number of the memory (0–9)

* When you are in a worksheet, press CE/C repeatedly to return to standard-calculator mode.

Correcting Entry Errors

If you enter an incorrect number but have not yet pressed an operation key (such as [+] or [x²]), you can correct the number without clearing the calculation.

- Remove the last digit or decimal point from a number you have keyed in by pressing the backspace key [→] and then enter the correct digit.
- Erase the entire number by pressing [CE/C] once, then key in the correct number and continue with your calculation.

Note: Pressing [CE/C] to correct a numeric entry immediately after you have pressed an operation key clears any calculation in progress.

Example: Correcting an Entry Error

Compute 3 × 1234.56, but accidentally enter .86 instead of .56. Use [→] to correct the mistake, and then continue with your calculation.

Procedure	Keystrokes	Display
Clear the calculator.	[2nd] [QUIT]	**0.00**
Begin the expression.	**3** [×]	**3.00**
Enter the second number incorrectly.	**1234.86**	**1,234.86**
Erase the 86.	[→] [→]	**1,234.**
Complete the number correctly.	**56**	**1,234.56**
Compute the result.	[=]	**3,703.68**

Math Operations

When the calculation method is set to chain (**Chn**), mathematical expressions, such as $3 + 2 \times 4$, are evaluated in the order that you enter them. The [=] key completes an operation and displays the result.

Operation	Example	Keystrokes	Display
Addition	$6 + 4$	**6** [+] **4** [=]	**10.00**
Subtraction	$6 - 4$	**6** [−] **4** [=]	**2.00**
Multiplication	6×4	**6** [×] **4** [=]	**24.00**
Division	$6 \div 4$	**6** [÷] **4** [=]	**1.50**
Universal power	$3^{1.25}$	**3** [y^x] **1.25** [=]	**3.95**
Parentheses	$7 \times (3 + 5)$	**7** [×] [(] **3** [+] **5** [)] [=]	**56.00**
Percent	4% of \$453	**453** [×] **4** [%] [=]	**18.12**
Percent ratio	14 is what percent of 25?	**14** [÷] **25** [%] [=]	**56.00**
Percent add-on	\$498 + 7% sales tax	**498** [+] **7** [%] [=]	**34.86** **532.86**
Percent discount	\$69.99 − 10% discount	**69.99** [−] **10** [%] [=]	**7.00** **62.99**
Square	6.3^2	**6.3** [x^2]	**39.69**
Combinations	n = 52, r = 5	**52** [2nd] [nCr] **5** [=]	**2,598,960.00**
Permutations	n = 8, r = 3	**8** [2nd] [nPr] **3** [=]	**336.00**

Math Operations (cont.)

Some operations are performed immediately and do not require that you press [=].

Operation	Example	Keystrokes	Display
Square root	$\sqrt{15.5}$	**15.5** [√x]	**3.94**
Reciprocal	1/3.2	**3.2** [1/x]	**0.31**
Factorial	5!	**5** [2nd] [x!]	**120.00**
Natural logarithm	ln 203.45	**203.45** [LN]	**5.32**
Natural antilogarithm	$e^{.69315}$	**.69315** [2nd] [e^x]	**2.00**
Round	Round 2 ÷ 3 to the set decimal format	**2** [÷] **3** [=] [2nd] [Round]	**0.67**
Random number*	Generate random number	[2nd] [Rand]	**0.86**
	Store "seed" value	[STO] [2nd] [Rand]	**0.86**
Sine**	sin(11.54°)	**11.54** [2nd] [SIN]	**0.20**
Cosine**	cos(120°)	**120** [2nd] [COS]	**−0.50**
Tangent**	tan(76°)	**76** [2nd] [TAN]	**4.01**
Arcsine**	$\sin^{-1}(.2)$	**.2** [INV] [SIN]	**11.54**
Arccosine**	$\cos^{-1}(-.5)$	**.5** [+/−] [INV] [COS]	**120.00**
Arctangent**	$\tan^{-1}(4)$	**4** [INV] [TAN]	**75.96**
Hyperbolic sine	sinh(.5)	**.5** [2nd] [HYP] [SIN]	**0.52**
Hyperbolic cosine	cosh(.5)	**.5** [2nd] [HYP] [COS]	**1.13**
Hyperbolic tangent	tanh(.5)	**.5** [2nd] [HYP] [TAN]	**0.46**
Hyperbolic arcsine	$\sinh^{-1}(5)$	**5** [2nd] [HYP] [INV] [SIN]	**2.31**
Hyperbolic arccosine	$\cosh^{-1}(5)$	**5** [2nd] [HYP] [INV] [COS]	**2.29**
Hyperbolic arctangent	$\tanh^{-1}(.5)$	**.5** [2nd] [HYP] [INV] [TAN]	**0.55**

* The random number generated when you press [2nd] [Rand] may not be the one shown here.

** Angles are interpreted according to the current setting for angle units (degrees or radians). These examples show angles in degrees.

More on Selected Math Operations

Universal Power

[y^x] lets you raise a positive number to any power ($2^{.5}$ or $2^{(1/3)}$, for example). However, you can raise a negative number only to an integer power or the reciprocal of an odd number. In either case, the power can be either positive or negative.

Parentheses

Parentheses let you control the order in which a numeric expression is evaluated. The portion of an expression enclosed in parentheses is evaluated separately. Up to 15 levels of parentheses are available, with up to 8 pending operations.

If an expression would end in a series of closed parentheses you can omit pressing [)]. Press [=] to close all of the parentheses automatically, evaluate the expression, and display the end result. To see intermediate results, press [)] repeatedly.

Factorial

To compute the factorial of a displayed number, press [2nd] [x!]. The number must be a positive integer ≤69.

Random Numbers

To generate a random real number between zero and one ($0<x<1$) from a uniform distribution, press [2nd] [Rand].

To repeat a sequence of random numbers, you must first store a "seed" value in the random number generator. To store a seed value, key in an integer greater than zero and press [STO] [2nd] [Rand]. This lets you recreate experiments by generating the same series of random numbers.

Combinations

[2nd] [nCr] computes the number of combinations of n items taken r at a time.

$$nCr = \frac{n!}{(n-r)! \times r!}$$

Permutations

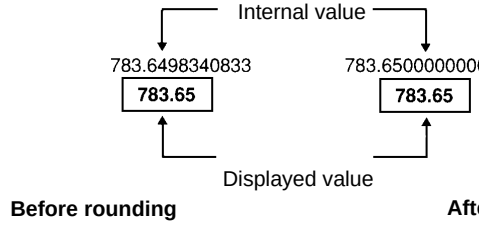
2nd [nPr] computes the number of permutations of n items taken r at a time.

$$nPr = \frac{n!}{(n-r)!}$$

Rounding

The round function is useful when you need to perform a calculation using the displayed form of a number rather than the unrounded value that the calculator stores internally. The decimal format setting does not round the calculator's internally stored value, only the displayed value.

2nd [Round] lets you change the internal value to match its displayed form.



For example, in the Bond worksheet, you might want to round a computed selling price to the nearest penny (two decimal places) before continuing with your calculation.

Scientific Notation

If you compute a value that is larger or smaller than the calculator can display in standard decimal format, the value is displayed in scientific notation. A value in scientific notation is displayed as a base value (sometimes called a mantissa), followed by a blank space, followed by an exponent.

You cannot directly enter a number in scientific notation, but when the AOS calculation method is selected, you can use the y^x key to enter a number in scientific notation.

For example, for 3×10^3, key in **3** × **10** y^x **3**.

Memory Operations

Your calculator always has 10 memories available.

- The memories can hold any numeric value within the range of the calculator.
- The memories are numbered **M0** through **M9**. This lets you access each memory using a single keystroke.

Clearing Memory

There are two ways to clear memory.

- Storing a zero in an individual memory clears the memory (shown in "Memory Examples" below).
- To clear all of the memories simultaneously, press 2nd [MEM] 2nd [CLR Work] to clear the Memory worksheet.

Storing to Memory

To store a displayed value to a memory (0 through 9), press STO and a digit key 0 through 9.

- Any previous value in that memory is replaced by the new value.
- When you turn the calculator off, the Constant Memory feature retains all stored values.

Recalling from Memory

To recall a number stored in a memory to the display, press RCL and a digit key 0 through 9. The number is displayed, but also remains in memory.

Memory Examples

Function	Keystrokes
Store a zero in memory 4 (clear memory 4).	**0** STO **4**
Store 14.95 in memory 3.	**14.95** STO **3**
Recall a value from memory 7.	RCL **7**

Memory Arithmetic

Memory arithmetic allows you to perform a calculation on a stored value and then store the result with a single operation.

- Memory arithmetic does not change the displayed value, only the value in the affected memory.
- Memory arithmetic does not complete any calculation in progress.

The table below shows the memory arithmetic functions available with the calculator. In each case, the result is stored in the specified memory.

These examples assume that a value is already in the display.

Function	Keystrokes
Add the value in the display to the value in memory 9.	STO + **9**
Subtract the value in the display from the value in memory 3.	STO − **3**
Multiply the value in memory 0 by the value in the display.	STO × **0**
Divide the value in memory 5 by the value in the display.	STO ÷ **5**
Raise the value in memory 4 to the power of the displayed value.	STO y^x **4**

Calculations Using Constants

2nd [K] stores a number and an operation for use in repetitive calculations.

After you store the constant, you can use it in subsequent calculations by entering a new value and pressing =. The constant is cleared when you press any key other than a numeric entry key or =.

Example: Multiply 3, 7, and 45 by 8.

Procedure	Keystrokes	Display
Clear calculator.	2nd [QUIT]	**0.00**
Begin first calculation.	**3**	**3**
Store × 8 in the constant register.	× 2nd [K] **8** =	**24.00**
Compute 7 × 8.	**7** =	**56.00**
Compute 45 × 8.	**45** =	**360.00**

Keystrokes for Constant Calculations

The following table shows how to set the constant for addition, subtraction, multiplication, division, universal power, and percent. The constant value is denoted by ***c***.

Keystrokes	Function
n + 2nd [K] ***c*** =	Adds ***c*** to each subsequent entry.
n − 2nd [K] ***c*** =	Subtracts ***c*** from each subsequent entry.
n × 2nd [K] ***c*** =	Multiplies each subsequent entry by ***c***.
n ÷ 2nd [K] ***c*** =	Divides each subsequent entry by ***c***.
n y^x 2nd [K] ***c*** =	Raises each subsequent entry to the power of ***c***.
n + 2nd [K] ***c*** % =	Adds ***c***% of each subsequent entry to that entry.
n − 2nd [K] ***c*** % =	Subtracts ***c***% of each subsequent entry from that entry.

Repeat constant calculations with ***n*** =.

Last Answer Feature

To display the last answer, press [2nd] [ANS]. If your current equation calls for the last answer repeatedly, you can retrieve the value of **ANS** more than once.

You can use the last answer feature to copy a value:

- From one place to another within the same worksheet.
- From one worksheet to another.
- From a worksheet to the standard-calculator mode.
- From the standard-calculator mode to a worksheet.

ANS is updated when:

- You enter a value by pressing [ENTER].
- You compute a value by pressing [CPT].
- You press [=] to complete a calculation.
- The calculator automatically computes a value.

Example: Last Answer

Procedure	Keystrokes	Display
Clear the calculator.	[2nd] [QUIT]	**0.00**
Enter a calculation and complete it with the equal key.	**3** [+] **1** [=]	**4.00**
Begin a new calculation.	**2** [y^x]	**2.00**
Recall the last answer.	[2nd] [ANS]	**4.00**
Complete the calculation.	[=]	**16.00**

Using Worksheets: Tools for Financial Solutions

What Is a Worksheet?

Each worksheet is designed as a framework for a set of variables. The formulas that define the relationships between the variables, though not visible, are built into each worksheet.

- Each worksheet is designed to solve specific types of problems such as time-value-of money, cash-flow, bond, or depreciation problems.
- You access the Time-Value-of-Money (TVM) worksheet variables with the five TVM keys on the third row of the keyboard (N, I/Y, PV, PMT, FV).
- All other worksheets are prompted. For example, the 2nd [Amort] key sequence lets you access the variables in the prompted worksheet to amortization calculations.
- You select settings for some variables, assign known values to other variables, and compute values for the unknown variables.
- Variable labels are displayed one at a time, along with any value previously assigned to the variable.
- By changing the values of the variables, you can quickly perform "what if" calculations.
- Generally, each worksheet is independent of the others; operations you perform in one worksheet do not affect variables in other worksheets.
- All current worksheet data is retained when you stop using a worksheet, even if you turn off the calculator.

Types of Worksheets

The calculator has two modes.

- In the standard-calculator mode, you can perform standard math operations and compute TVM values (**N**, **I/V**, **PV**, **PMT**, **FV**).
- In the prompted worksheet modes, you are guided through specialized tasks such as amortization calculations and cash-flow analyses.

Worksheet Variables

TVM Variables

You access the five time-value-of-money variables with the five TVM keys on the third row of the keyboard. You can access other parts of the TVM worksheet and other TVM functions by pressing the 2nd key.

[xP/Y]	[P/Y]	[Amort]	[BGN]	[CLR TVM]
[N]	[I/Y]	[PV]	[PMT]	[FV]

You can enter values using the five basic TVM keys at any time, even when you are in another worksheet. However, to compute TVM values or clear the TVM worksheet, you must be in the standard-calculator mode. To return to the standard-calculator mode, press 2nd [QUIT].

Prompted-worksheet Variables

To access the column of variables within a prompted worksheet (or portion of a prompted worksheet), press the appropriate worksheet key or key sequence.

For example, to access the amortization variables **P1**, **P2**, **BAL**, **PRN**, and **INT** (first payment in a range, last payment in a range, remaining balance, principal, and interest), press [2nd] [Amort]. This is the prompted worksheet for amortization calculations.

Press [↓] and [↑] to move to the next or previous variable in a prompted worksheet. Different variable labels and values are displayed. Indicators in the display prompt you to select settings, enter values, or compute results.

To return to standard-calculator mode, press [2nd] [QUIT].

There are five types of worksheet variables:

- Enter-only
- Compute-only
- Automatic-compute
- Enter-or-compute
- Settings

Enter-Only Variables

You cannot compute a value for enter-only variables. Values may be limited to a specified range. An enter-only variable can be:

- Entered directly from the keyboard.
- The result of a math calculation.
- Recalled from memory.
- Obtained from another worksheet using the last answer feature.

When you access an enter-only variable, the variable label and the **ENTER** indicator are displayed. The **ENTER** indicator also reminds you that once you have keyed a value into the display, you must press [ENTER] to assign that value to the variable. An = sign is displayed between the label and the value when the value has been assigned to the variable.

Compute-Only Variables

For compute-only variables, you compute values by displaying the appropriate label and pressing [CPT]; you cannot enter a value for this type of variable.

When you access a compute-only variable, the variable label and the **COMPUTE** indicator are displayed. This indicator reminds you to press [CPT] to compute a value for the displayed variable. An = sign is displayed between the label and the value when the value has been assigned to the variable.

Automatic-Compute Variables

For automatic-compute variables, you do not have to press [CPT]; a value is automatically computed and displayed when you access the variable by pressing [↓] or [↑]. After a value is automatically computed, an = sign is displayed between the label and the value.

Enter-or-Compute Variables in the TVM Worksheet

The five variables in the TVM worksheet (**N**, **I/Y**, **PV**, **PMT**, and **FV**) are enter-or-compute variables. It is not necessary to be in the standard-calculator mode when you enter values for these variables. However, you must be in the standard-calculator mode to compute values for these variables.

- To enter a TVM value, key a value into the display and press the appropriate variable key.
- To compute a TVM value, press [CPT] and the appropriate variable key.

Enter-or-Compute Variables in Prompted Worksheets

Some prompted worksheets contain variables that you can either enter or compute. When you access an enter-or-compute variable, the variable label is displayed along with both the **ENTER** and **COMPUTE** indicators.

- The **ENTER** indicator reminds you that if you key in a value for the variable, you must press [ENTER] to assign the value to the variable.
- The **COMPUTE** indicator reminds you that if you want to compute a value for the variable, you must press [CPT].

After you press [ENTER] or [CPT], an = sign is displayed between the label and the value.

Selecting Worksheet Settings

Most prompted worksheets have variables with two or more options (settings). When you access a setting, the variable label and the **SET** indicator are displayed. The label that is displayed indicates the current setting.

Press [2nd] [SET] repeatedly to cycle through the options to the one you want.

Indicators

When you enter a value for a variable, the calculator displays ◃. When you compute a value for a variable, the calculator displays ∗. If you make a change to a worksheet that invalidates previously entered or computed values, the ◃ and ∗ indicators are removed.

Clearing Worksheets and Setting Defaults

Label	2nd [Reset] ENTER *	2nd [CLR TVM]	2nd [P/Y] 2nd [CLR Work]	2nd [BGN] 2nd [CLR Work]	2nd [Amort] 2nd [CLR Work]
N	0	0			
I/Y	0	0			
PV	0	0			
PMT	0	0			
FV	0	0			
P/Y	12		12		
C/Y	12		12		
END / BGN	**END**			**END**	
P1	1				1
P2	1				1
BAL	0				0
PRN	0				0
INT	0				0

Note: 2nd [Reset] ENTER also sets the calculator formats (2 decimal places, DEG, US dates, US number separators, CHN calculations).

2

Time-Value-of-Money and Amortization Worksheets

The Time-Value-of-Money and Amortization worksheets are useful in applications where the cash flows are equal, evenly spaced, and either all inflows or all outflows. They help you solve problems involving annuities, loans, mortgages, leases, and savings. You can also generate an amortization schedule.

Press [↓] and [↑] to move through each set of variables.

[xP/Y]	[P/Y]	[Amort]	[BGN]	[CLR TVM]
[N]	[I/Y]	[PV]	[PMT]	[FV]

TVM and Amortization Worksheet Labels

Keys	Label	Meaning	Type of Variable
[N]	**N**	Number of periods	Enter/compute
[I/Y]	**I/Y**	Interest rate per year	Enter/compute
[PV]	**PV**	Present value	Enter/compute
[PMT]	**PMT**	Payment	Enter/compute
[FV]	**FV**	Future value	Enter/compute
[2nd] [P/Y]	**P/Y**	Number of payments per year	Enter-only
[↓]	**C/Y**	Number of compounding periods per year	Enter-only
[2nd] [BGN]	**END**	End-of-period payments	Setting
[2nd] [SET]	**BGN**	Beginning-of-period payments	Setting
[2nd] [Amort]	**P1**	Starting payment	Enter-only
[↓]	**P2**	Ending payment	Enter-only
[↓]	**BAL**	Balance	Auto-compute
[↓]	**PRN**	Principal paid	Auto-compute
[↓]	**INT**	Interest paid	Auto-compute

Notes about the TVM and Amortization Worksheets

- [2nd] [Reset] [ENTER] sets **N=0**, **I/Y=0**, **PV=0**, **PMT=0**, **FV=0**; **P/Y=12**, **C/Y=12**; **END** (not **BGN**); **P1=1**, **P2=1**; **BAL=0**, **PRN=0**, **INT=0**.
- [2nd] [CLR TVM] sets **N**, **I/Y**, **PV**, **PMT**, and **FV** to zero; does not affect **P/Y**, **C/Y**, or the **BGN/END** setting.
- [2nd] [P/Y] [2nd] [CLR Work] sets **P/Y=12** and **C/Y=12**.
- [2nd] [BGN] [2nd] [CLR Work] sets **END** (not **BGN**).
- [2nd] [Amort] [2nd] [CLR Work] sets **P1=1**, **P2=1**, **BAL=0**, **PRN=0**, and **INT=0**.
- When solving a problem using only four of the five TVM variables, make sure the unused variable is zero.

Notes about TVM and Amortization Worksheets (cont.)

- Enter values for **PV**, **PMT**, and **FV** as negative if they are outflows (cash paid out) or as positive if they are inflows (cash received). To enter a negative value, press [+/−] after entering the number.
- Enter **I/Y** as the nominal interest rate. The TVM worksheet automatically converts **I/Y** to a "per period" rate based on the values for **P/Y** and **C/Y**.
- When you enter a value for **P/Y**, the same value is automatically entered for **C/Y**. (You can change **C/Y**.)
- The **END**/**BGN** setting lets you specify whether the transaction is an ordinary annuity or an annuity due.
  - In ordinary annuities, the payments occur at the end of each payment period. Most loans are in this category. For ordinary annuities, select **END**.
  - In annuities due, payments occur at the beginning of each payment period. Most leases are in this category. For annuities due, select **BGN**.
- Pressing [CPT] when **P1** or **P2** is displayed updates **P1** and **P2** to represent the next range of payments.
- A computed value for **BAL** after a specified number of payments may be slightly different than a computed value for **FV** after the same number of payments.
  - When solving for **BAL**, **PRN**, and **INT**, the calculator uses the **PMT** value rounded to the number of decimal places specified by the decimal format.
  - When solving for **FV**, the calculator uses the unrounded value for **PMT**.

Entering, Recalling, and Computing TVM Values

You enter a TVM value by keying in a value and pressing the appropriate TVM key ([N], [I/Y], [PV], [PMT], or [FV]). The value is stored in the TVM variable (**N**, **I/Y**, **PV**, **PMT**, or **FV**).

You recall a TVM value to the display by pressing [RCL] and the TVM key.

When you enter or recall a value for any of the five TVM variables (**N**, **I/Y**, **PV**, **PMT**, or **FV**), you can be in either standard calculator mode or a worksheet mode. The display responds differently according to the mode you are in.

- In standard calculator mode (accessed by pressing [2nd] [QUIT]), the variable label, the = sign, and the value you entered or recalled are displayed.
- In worksheet mode, only the value you entered or recalled is displayed. Any label previously in the display remains.

To compute a TVM value, press [CPT] and the appropriate TVM key. When you compute a TVM value, you must be in standard calculator mode. Press [2nd] [QUIT] to return to standard calculator mode.

Entering a Value for N Using [xP/Y]

You can use [2nd] [xP/Y] to enter a value for **N**. Pressing [2nd] [xP/Y] automatically multiplies a displayed number by the value stored in the **P/Y** variable (number of payments per year).

By entering the number of years (for example, 30) and pressing [2nd] [xP/Y], you can compute the number of payments required to pay off an annuity. Press [N] to enter that value as the number of payments in a TVM calculation.

Compound Interest

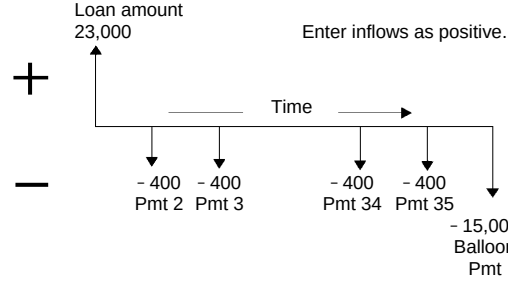
Many lending institutions add the interest you earn to the principal. The interest you earn from the previous compounding period becomes part of the principal for the next compounding period. Compound interest enables you to earn a greater amount of interest on your initial investment.

In order to earn compound interest, the interest must remain with the principal. For example, if you invest $100 at an annual interest rate of 10% compounded annually, you earn $10 interest after one year. At the end of the second year, the interest is calculated on $110 ($100 principal plus $10 accumulated interest), so you earn $11 in the second year. As additional interest accumulates, your interest earnings increase each year.

Time-Line Diagrams

A time-line diagram can help you visualize cash flows by showing the amounts paid or received (cash outflows or cash inflows) at various points in time.

- Cash flows received are shown with arrows pointing up, as with the loan amount at the left.
- Cash flows invested have arrows pointing down, as with the 35 regular payments and the balloon payment at the right.



Entering Inflows and Outflows

The calculator follows the established convention of treating inflows of cash (cash received) as positive and outflows of cash (cash paid out) as negative.

- You must enter inflows as positive values and outflows as negative values.
- The calculator displays computed inflows as positive values and computed outflows as negative values.

Procedure: Using the TVM Worksheet

The worksheet stores the values and settings you enter until you clear the worksheet or change the values or settings. Therefore, you may not need to do all the steps in the procedure every time you work a TVM problem.

❶ Press [2nd] [Reset] [ENTER] to reset all variables to their defaults (**N=0**, **I/Y=0**, **PV=0**, **PMT=0**, **FV=0**; **P/Y=12**, **C/Y=12**; **END**; **P1=1**, **P2=1**; **BAL=0**, **PRN=0**, **INT=0**).

❷ If **P/Y** (payments per year) should not be 12, press [2nd] [P/Y], key in the number of payments per year, and press [ENTER].

❸ Press [↓]. **C/Y=** (compounding periods per year) and its current value are displayed. When you enter a value for **P/Y**, the same value is automatically entered for **C/Y**. If the compounding periods per year is different than the payments per year, key in the value and press [ENTER].

❹ If you want beginning-of-period payments (**END** is the default setting), press [2nd] [BGN] [2nd] [SET].

If beginning-of-period payments are selected, the **BGN** indicator is displayed; no indicator is displayed for end-of-period payments.

❺ Press [2nd] [QUIT] to return to standard calculator mode.

❻ Enter values for the four known variables. Key in each value and press the appropriate key ([N], [I/Y], [PV], [PMT], or [FV]). The value of the unknown variable is 0.

❼ Press [CPT] and the key for the unknown variable to compute its value.

Procedure: Generating an Amortization Schedule

The worksheet for amortization calculations uses the values you entered and computed in the TVM worksheet to compute amortization data. The procedures on these pages give you two ways to generate an amortization schedule.

❶ Press [2nd] [Reset] [ENTER] to reset all variables to their defaults (**N=0**, **I/Y=0**, **PV=0**, **PMT=0**, **FV=0**; **P/Y=12**, **C/Y=12**; **END**; **P1=1**, **P2=1**; **BAL=0**, **PRN=0**, **INT=0**).

❷ Press [2nd] [Amort].

P1= and its current value are displayed.

❸ Specify the range of payments.

- To enter a value for **P1** (the first payment in the range), key in a value and press [ENTER].
- To enter a value for **P2** (the last payment in the range), press [↓], enter a value, and press [ENTER].

❹ Press [↓] repeatedly to display the automatically computed values:

- **BAL** — the remaining balance after payment **P2**
- **PRN** — the principal
- **INT** — the interest paid over the specified range

❺ Press [2nd] [Amort] or, if **INT** is displayed, press [↓] to display **P1** again.

❻ Repeat steps 2 and 3 for each range of payments to generate an amortization schedule.

Procedure: Automatically Generating a Schedule

After you enter the initial values for **P1** and **P2**, as described above, you can automatically compute an amortization schedule.

❶ Press [2nd] [Amort] or, if **INT** is displayed, press [↓] to display **P1=** and its current value.

❷ Press [CPT]. This automatically updates both **P1** and **P2** to represent the next range of payments.

The calculator computes the next range of payments using the same number of periods as in the previous range of payments. For example, if the previous range was 1 through 12 (12 payments), pressing [CPT] updates the range to 13 through 24 (12 payments).

❸ Press [↓] to display **P2**.

- If you pressed [CPT] when **P1** was displayed, a new value for **P2** is automatically displayed. (You can still enter a new value for **P2**, if necessary.)
- If you did not press [CPT] when **P1** was displayed, you can press [CPT] when **P2** is displayed to enter values for both **P1** and **P2** for the next range of payments.

❹ Press [↓] as needed to display the automatically computed values for **BAL**, **PRN**, and **INT** for the next range of payments.

❺ Repeat steps 1 through 4 until the schedule is complete.

Example: Interest Rate

You have a 30-year mortgage for $75,000 and make payments each month of $576.69. What is the interest rate of your mortgage?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Enter number of payments using payment multiplier.	30 2nd [xP/Y] N	N=	360.00◁
Enter loan amount.	75000 PV	PV=	75,000.00◁
Enter payment amount.	576.69 +/– PMT	PMT=	-576.69◁
Compute interest rate.	CPT I/Y	I/Y=	8.50*

The interest rate is 8.5% per year.

Basic Loan Calculations—Payments

Example: Monthly Payment

You are considering a 30-year mortgage at 8.5% for $75,000.

How much would the monthly payment be?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**360.00**◃
Enter interest rate.	**8.5** I/Y	**I/Y=**	**8.50**◃
Enter loan amount.	**75000** PV	**PV=**	**75,000.00**◃
Compute payment.	CPT PMT	**PMT=**	**-576.69**∗

The monthly payment would be $576.69.

Example: Quarterly Payment

(continued from previous example)

Your mortgage company also offers an option for a quarterly mortgage with quarterly compounding.

How much would your quarterly payment be? (You do not need to enter the loan amount or the interest rate. The compounding periods is automatically reset to equal the payments periods.)

Procedure	Keystrokes		Display
Set payments per year to 4.	2nd [P/Y] **4** ENTER	**P/Y=**	**4.00**◃
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**120.00**◃
Compute payment.	CPT PMT	**PMT=**	**-1,732.71**∗

The quarterly payment would be $1,732.71.

Future Value of Savings

Example: Future Value of Savings

You have opened a savings account with $5,000. The bank pays 5%, compounded at the end of each year. What is the future value of the account after 20 years?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments.	**20** N	**N=**	**20.00**◁
Enter interest rate.	**5** I/Y	**I/Y=**	**5.00**◁
Enter beginning balance.	**5000** +/– PV	**PV=**	**-5,000.00**◁
Compute future value.	CPT FV	**FV=**	**13,266.49**∗

The future value is $13,266.49.

Present Value of Savings

Example: Future Value of Savings

You are opening a savings account that you want to be worth $10,000 in 20 years. The bank pays 5%, compounded at the end of each year. How much do you need to deposit now?

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments.	**20** N	**N=**	**20.00**◁
Enter interest rate.	**5** I/Y	**I/Y=**	**5.00**◁
Enter final balance.	**10000** FV	**FV=**	**10,000.00**◁
Compute future value.	CPT PV	**PV=**	**-3,768.89**∗

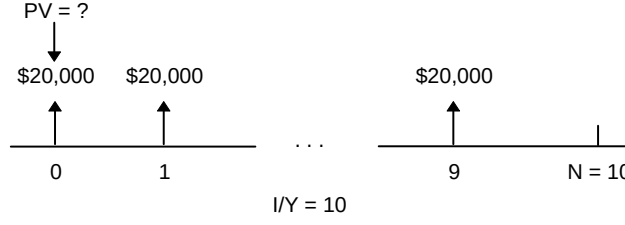
The present value is $3,768.89. This is the amount you need to deposit.

Example: Present Value of Cost Savings

The Furros Company purchased a machine that provides annual savings of $20,000 per year for the next 10 years. Using an annual discount rate of 10%, compute the present value of the savings using an ordinary annuity and an annuity due.

- For a present value ordinary annuity:

- For a present value annuity due for a leasing agreement:



Example: Present Value of Cost Savings (cont.)

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments.	**10** N	**N=**	**10.00**◁
Enter interest rate per payment period.	**10** I/Y	**I/Y=**	**10.00**◁
Enter payment.	**20000** +/– PMT	**PMT=**	**-20,000.00**◁
Compute PV for an ordinary annuity.	CPT PV	**PV=**	**122,891.34**✻
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	**BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Compute PV for annuity due.	CPT PV	**PV=**	**135,180.48**✻

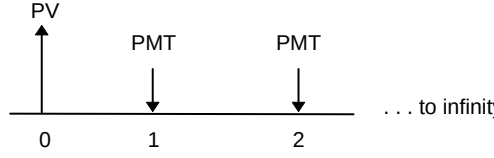
The present value is $122,891.34 with an ordinary annuity and $135,180.48 with an annuity due.

Perpetual Annuities

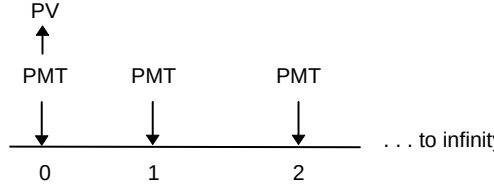
A perpetual annuity consists of equal payments that continue indefinitely. An example of a perpetual annuity is a preferred stock that yields a constant dollar dividend.

These time-line diagrams represent a perpetual annuity as an ordinary annuity and as an annuity due.

- For a perpetual ordinary annuity:



- For a perpetual annuity due:



Because the term $(1 + I/Y / 100)^{-N}$ in the present value annuity equations approaches zero as N becomes larger, you can use the following equations to solve for the present value of a perpetual annuity.

- For a perpetual ordinary annuity:

$$PV = \frac{PMT}{(I/Y / 100)}$$

- For a perpetual annuity due:

$$PV = PMT + \frac{PMT}{(I/Y / 100)}$$

Example: Present Value of Perpetual Annuities

The Land of OZ has issued perpetual bonds for replacing bricks in their highway system. The bonds pay $110 per $1000 bond. You plan to purchase the bonds if you can earn 15% annually. What price should you pay for the bonds?

Procedure	Keystrokes	Display
Clear.	2nd [QUIT] CE/C CE/C	**0.00**
Calculate PV for a perpetual ordinary annuity.	**110** ÷ **15** % =	**733.33**
Calculate PV for a perpetual annuity due.	+ **110** =	**843.33**

You should pay $733.33 for a perpetual ordinary annuity and $843.33 for a perpetual annuity due.

Variable Cash Flows

In annuities, all payments are equal. In variable cash flows, however, the payments are unequal. You can solve for the present value of variable cash flows by treating the cash flows as a series of compound interest payments.

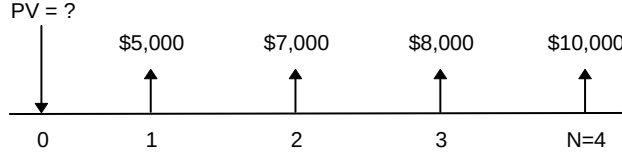
The present value of variable cash flows is the value of cash flows occurring at the end of each payment period discounted back to the beginning of the first cash flow period (time zero).

Example: Present Value of Annual Savings

The ABC Company is purchasing a machine that will save the following end-of-year amounts.

Year	1	2	3	4
Amount	$5000	$7000	$8000	$10000

Assuming a discount rate of 10%, does the present value of the cash flows exceed the original cost of $23,000?



Example: Present Value of Annual Savings

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Set payments per year to 1.	2nd [P/Y] 1 ENTER	P/Y=	1.00◁
Return to calculator mode.	2nd [QUIT]		0.00
Enter interest rate per cash flow period.	10 I/Y	I/Y=	10.00◁
Enter 1st cash flow.	5000 +/– FV	FV=	-5,000.00◁
Enter period number of 1st cash flow.	1 N	N=	1.00◁
Compute present value of 1st cash flow.	CPT PV	PV=	4,545.45*
Store in **M1**.	STO 1		
Enter 2nd cash flow.	7000 +/– FV	FV=	-7,000.00◁
Enter period number.	2 N	N=	2.00◁
Compute present value of 2nd cash flow.	CPT PV	PV=	5,785.12*
Sum to memory.	STO + 1		
Enter 3rd cash flow.	8000 +/– FV	FV=	-8,000.00◁
Enter period number.	3 N	N=	3.00◁
Compute present value of 3rd cash flow.	CPT PV	PV=	6,010.52*
Sum to memory.	STO + 1		
Enter 4th cash flow.	10000 +/– FV	FV=	-10,000.00◁
Enter period number.	4 N	N=	4.00◁
Compute present value of 4th cash flow.	CPT PV	PV=	6,830.13*
Sum to memory.	STO + 1		
Recall total present value.	RCL 1		23,171.23
Subtract original cost.	– 23000 =		171.23

The present value of the cash flows is $23,171.23, which exceeds the machine's cost by $171.23. This is a profitable investment for the company.

Lease-or-Buy Decision

Your business is considering getting a new computer server. If you lease, you would pay $36,000 per year for five years at the first of each year. You could buy it for $125,000. The server is expected to save the company $46,000 per year. It will have no resale value at the end of the five years. The company can borrow at 15% annual interest. You require a 20% annual return on projects and investments of this kind. Ignoring tax effects, should you acquire it, and if so, should you lease or purchase it?

Example: Present Value of Cost Savings

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of periods.	**5** N	**N=**	**5.00**◁
Enter required annual return rate.	**20** I/Y	**I/Y=**	**20.00**◁
Enter annual savings.	**46000** +/– PMT	**PMT=**	**-46,000.00**◁
Compute present value of savings.	CPT PV	**PV=**	**137,568.16**✻

The present value of the annual savings exceeds the purchase price (i.e., the investment will exceed your annual required return rate). Acquiring the server is a good financial move. Should you lease or buy it?

Example: Present Value of Lease Payments

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set payments per year to 1.	2nd [P/Y] **1** ENTER	**P/Y=**	**1.00**◁
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	**BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of periods.	**5** N	**N=**	**5.00**◁
Enter periodic interest rate at which your firm can borrow.	**15** I/Y	**I/Y=**	**15.00**◁
Enter annual lease payment.	**36000** +/– PMT	**PMT=**	**-36,000.00**◁
Compute present value of lease payments.	CPT PV	**PV=**	**138,779.22***

The present value of the lease payments is greater than the purchase price of $125,000, so it would be best to buy the server outright.

Present Value of Lease with Residual Value

The Peach Bright Company wants to purchase a machine that it is currently leasing from your company. You offer to sell it for the present value of the lease discounted at an annual interest rate of 22% compounded monthly. The machine has a residual value of $6500, and 46 monthly payments of $1200 remain on the lease. If the payments are due at the beginning of each month, how much should you charge for the machine?

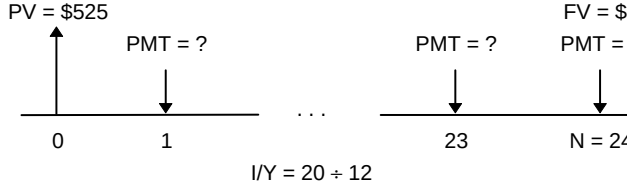
The total value of the machine is the present value of the residual value plus the present value of the lease payments.

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Set payments per year to 1.	2nd [P/Y] 1 ENTER	P/Y=	1.00◁
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	BGN	
Return to calculator mode.	2nd [QUIT]		0.00
Enter number of payments.	46 N	N=	46.00◁
Calculate and enter periodic interest rate.	22 ÷ 12 = I/Y	I/Y=	1.83◁
Enter residual value of asset.	6500 +/– FV	FV=	-6,500.00◁
Compute present value of residual.	CPT PV	PV=	2,818.22*
Enter amount of lease payment.	1200 +/– PMT	PMT=	-1,200.00◁
Compute present value of lease payments.	CPT PV	PV=	40,573.18*

Peach Bright should pay your company $40,573.18 for the machine.

Monthly Payments

You are planning to purchase a new small desk and chair set that is sale priced at $525. You can finance your purchase at 20% APR, compounded monthly, for two years. How much is the monthly payment?



Example: Monthly Payments

Procedure	Keystrokes		Display
Set all variables to defaults.	[2nd] [Reset] [ENTER]	**RST**	**0.00**
Enter number of payments using payment multiplier.	**2** [2nd] [xP/Y] [N]	**N=**	**24.00**◃
Enter interest rate.	**20** [I/Y]	**I/Y=**	**20.00**◃
Enter loan amount.	**525** [+/–] [PV]	**PV=**	**-525.00**◃
Compute payment.	[CPT] [PMT]	**PMT=**	**26.72***

Your monthly payment is $26.72.

Yield to Maturity on Bond Purchased on Interest Date

A 9% $1,000 semiannual commercial bond has 13 remaining coupon payments. You can purchase the bond for $852.50 (ignoring commissions). At this price, what is your yield to maturity and the annual effective rate?

Example: Yield to Maturity

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Set payments per year to 2.	2nd [P/Y] 2 ENTER	P/Y=	2.00◁
Return to calculator mode.	2nd [QUIT]		0.00
Enter number of remaining coupon payments.	13 N	N=	13.00◁
Enter bond price.	852.5 +/– PV	PV=	-852.50◁
Calculate the coupon payment.	9 % ÷ 2 × 1000 = PMT	PMT=	45.00◁
Enter bond redemption value.	1000 FV	FV=	1,000.00◁
Compute annual yield.	CPT I/Y	I/Y=	12.37*
Store in memory.	STO 1		

Example: Effective Annual Interest

(continued from previous example)

Use the Interest Conversion worksheet (Chapter 7) to calculate the effective annual interest rate.

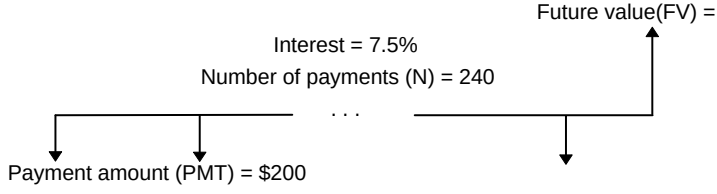
Procedure	Keystrokes		Display
Select and clear Interest Conversion worksheet.	2nd [I Conv] 2nd [CLR Work]	NOM=	0.00
Recall rate from memory.	RCL 1 ENTER	NOM=	12.37◁
Enter compounding periods.	↓ ↓ 2 ENTER	C/Y=	2.00◁
Compute annual effective rate.	↑ CPT	EFF=	12.75*

The annual yield to maturity is 12.37% with semiannual compounding. The equivalent annual effective rate is 12.75%.

Saving for the Future by Making Monthly Deposits

Accounts with payments made at the beginning of the period are referred to as "annuity due" accounts. Interest on annuity due accounts starts accumulating earlier and produces slightly higher yields.

An individual has decided to invest $200 at the beginning of each month in a retirement plan. What will the account balance be at the end of 20 years if the fund earns an annual interest of 7.5 % compounded monthly, assuming beginning-of-period payments?



Example: Regular Deposits (Annuity Due)

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	**BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments using payment multiplier.	**20** 2nd [xP/Y] N	**N=**	**240.00**◃
Enter interest rate.	**7.5** I/Y	**I/Y=**	**7.50**◃
Enter amount of payment.	**200** +/– PMT	**PMT=**	**-200.00**◃
Compute future value.	CPT FV	**FV=**	**111,438.31**∗

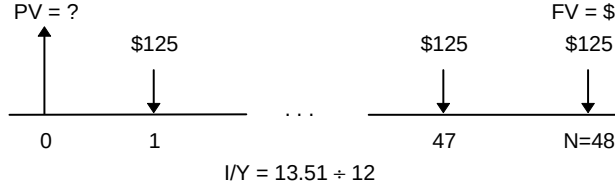
Depositing $200 at the beginning of each month for 20 years results in a future amount of $111,438.31.

Amount to Borrow and Down Payment

You want to buy a car that sells for $5,100. The finance company charges 13.51% APR, compounded monthly, on a 48-month loan. If you can afford a monthly payment of $125, how much can you borrow? How much do you need for the down payment?

Example: Loan Amount and Down Payment

Calculate the loan amount. Then subtract it from the cost of the car to find the down payment.



Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**4** 2nd [xP/Y] N	**N=**	**48.00**◁
Enter monthly interest rate.	**13.51** I/Y	**I/Y=**	**13.51**◁
Enter payment.	**125** +/– PMT	**PMT=**	**-125.00**◁
Compute loan amount.	CPT PV	**PV=**	**4,615.73**∗
Calculate down payment.	+ **5100** +/– =		**-484.27**

To buy the car, you can borrow $4,615.73 and make a down payment of $484.27.

Regular Deposits for a Specified Future Amount

You plan to open a savings account and deposit the same amount of money at the beginning of each month. In 10 years, you want to have $25,000 in the account. How much should you deposit if the annual interest rate is 7% with quarterly compounding?

C/Y (compounding periods per year) is automatically set to equal **P/Y** (payments per year), so you need to set **C/Y**.

Example: Monthly Deposits Compounded Quarterly

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Set compounding periods to 4.	2nd [P/Y] ↓ **4** ENTER	**P/Y=** **C/Y=**	**12.00** **4.00**◁
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	 **BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of deposits using payment multiplier.	**10** 2nd [xP/Y] N	**N=**	**120.00**◁
Enter interest rate.	**7** I/Y	**I/Y=**	**7.00**◁
Enter future value.	**25000** FV	**FV=**	**25,000.00**◁
Compute deposit amount.	CPT PMT	**PMT=**	**-143.92***

You need to make monthly deposits of $143.92.

Time Value of Money/Amortization Schedule

This two-part example shows you how to use the TVM and Amortization worksheets to compute the monthly payment on a 30-year loan and then generate an amortization schedule for the first three years of the loan.

Example: Mortgage Payment

Using the TVM worksheet, determine the monthly payment on a 30-year mortgage with a loan amount of $120,000 and an annual percentage rate of 9.125%.

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**360.00**◁
Enter interest rate.	**9.125** I/Y	**I/Y=**	**9.13**◁
Enter loan amount.	**120000** PV	**PV=**	**120,000.00**◁
Compute payment.	CPT PMT	**PMT=**	**-976.36**∗

Notice that the interest rate displays as 9.13, even though you entered 9.125. The calculator uses 9.125 for **I/Y** to make the calculation. To see the stored value of **I/Y** displayed with three digits, press 2nd [Format] **3** ENTER 2nd [QUIT] RCL **I/Y**.

The computed monthly payment is $976.36. Because **PMT** is money paid out, it is displayed as a negative number.

Example: Loan Amortization

(continued from previous example)

Use the Amortization worksheet to generate an amortization schedule for the first three years of the loan. Assume that the first payment is in April; therefore, the first year has 9 payment periods. There are 12 payment periods per year thereafter.

Procedure	Keystrokes		Display
Select the Amortization worksheet.	2nd [Amort]	**P1=**	**1.00**
Set ending period to 9.	↓ **9** ENTER	**P2=**	**9.00**◁
Display first year amortization data.	↓ ↓ ↓	**BAL=** **PRN=** **INT=**	**119,407.46*** **-592.54*** **-8,194.70***
Change beginning period to 10.	↓ **10** ENTER	**P1=**	**10.00**◁
Change ending period to 21.	↓ **21** ENTER	**P2=**	**21.00**◁
Display second year amortization data.	↓ ↓ ↓	**BAL=** **PRN=** **INT=**	**118,551.85*** **-855.61*** **-10,860.71***
Move to **P1** and press CPT to enter next range of payments.	↓ CPT	**P1=**	**22.00**◁
Display **P2**.	↓	**P2=**	**33.00**◁
Display third year amortization data.	↓ ↓ ↓	**BAL=** **PRN=** **INT=**	**117,614.86*** **-936.99*** **-10,779.33***

Note that the principal and interest are displayed as negative because they are outflows.

Interest and Loan Balance after Specified Payment

To evaluate the financial advisability of financing all or some of the sale price of a property, a seller must know the amount of interest that will be received and the remaining balance at the end of the term (balloon payment).

A seller is asked to finance $82,000 at 10% annual interest, amortized over a 30-year term but with a balloon payment due after five years.

The seller wants to know:
- The amount of the monthly payment.
- The amount of interest he will receive.
- The amount of the balloon payment.

Example: Compute Monthly Payment

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Enter number of payments using payment multiplier.	**30** 2nd [xP/Y] N	**N=**	**360.00**◃
Enter interest rate.	**10** I/Y	**I/Y=**	**10.00**◃
Enter loan amount.	**82000** PV	**PV=**	**82,000.00**◃
Compute payment.	CPT PMT	**PMT=**	**-719.61***

Example: Compute Amortization Schedule

(continued from previous example)

Procedure	Keystrokes		Display
Select Amortization worksheet.	2nd [Amort]	**P1=**	**1.00**
Enter end period after five years.	↓ **5** 2nd [xP/Y] ENTER	**P2=**	**60.00**◃
View computed balance due after five years.	↓	**BAL=**	**79,190.83***
View computed interest paid after five years.	↓ ↓	**INT=**	**-40,367.43***

If the seller financed the sale, he would receive:
- $719.61 each month for five years.
- $40,367.43 in interest over the five-year term.
- $79,190.83 as the balloon payment.

Canadian Mortgages

Canadian mortgages typically require the borrower to make monthly payments, although interest is compounded semiannually. Additionally, mortgages are usually refinanced at the end of a fixed period of time, such as five years.

A home buyer borrows $60,000 for 20 years at an annual interest rate of 13 % compounded semiannually. How much are the monthly payments and the amount necessary to pay off the mortgage after five years?

Example: Payment

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Leave payments per year at 12.	2nd [P/Y]	**P/Y=**	**12.00**◃
Set compounding periods per year to 2.	↓ **2** ENTER	**C/Y=**	**2.00**◃
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter number of payments using payment multiplier.	**20** 2nd [xP/Y] N	**N=**	**240.00**◃
Enter interest rate per year.	**13** I/Y	**I/Y=**	**13.00**◃
Enter present value.	**60000** PV	**PV=**	**60,000.00**◃
Compute payment.	CPT PMT	**PMT=**	**-688.52**∗

Example: Amortization Schedule

(continued from previous example)

Procedure	Keystrokes		Display
Select Amortization worksheet.	2nd [Amort]	**P1=**	**1.00**
Enter number of payments as **P2** using payment multiplier.	↓ **5** 2nd [xP/Y] ENTER	**P2=**	**60.00**◃
View balance after five years.	↓	**BAL=**	**55,389.85**∗

The monthly payment is $688.52, and $55,389.85 is required to pay off the mortgage after five years.

3

Cash Flow Worksheet

Three keys are used for performing cash-flow calculations.

[CF] lets you enter cash flow data.

[NPV] lets you compute net present value.

[IRR] lets you compute internal rate of return.

Press [↓] and [↑] to move through each set of variables.

Cash Flow Worksheet Labels

Key	Label	Meaning	Variable Type
CF	**CFo**	Initial cash flow	Enter-only
↓	**C*nn*** *	Amount of n^{th} cash flow	Enter-only
↓	**F*nn*** *	Frequency of n^{th} cash flow	Enter-only
NPV	I	Discount rate	Enter-only
↓	**NPV**	Net present value	Compute-only
IRR	**IRR**	Internal rate of return	Compute-only

* ***nn*** represents the number of the cash flow (**C01**–**C24**) or the number of the corresponding frequency (**F01**–**F24**).

Notes about the Cash Flow Worksheet

- CF 2nd [CLR Work] sets all variable values to zero.
- 2nd [Reset] ENTER sets all variable values to zero.
- To enter cash-flow values and frequencies, press CF. You can enter the initial cash flow (**CFo**) plus up to 24 cash flows, each of which can be a unique value. Enter inflows (cash received) as positive and outflows (cash paid out) as negative. Use +/– to enter a negative value.
- The **INS** and **DEL** indicators in the display let you know that you can use 2nd [INS] and 2nd [DEL] to insert or delete cash flows.

Interpreting the Results of IRR Calculations

When you compute a value for **IRR** (internal rate of return), the calculator displays either a solution or an error message.

When a solution is displayed, there are two possibilities.

- The displayed solution is the only solution.
- There may be additional solutions. This occurs when there are two or more sign changes in the cash flow sequence.

When an error message is displayed, there are two possibilities.

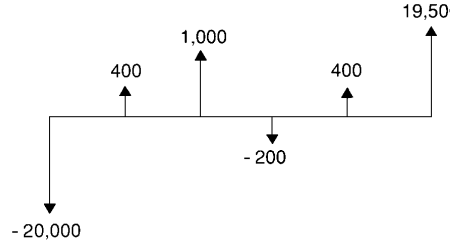
- No solution for **IRR** exists (**Error 5**). This occurs when there are no sign changes in the cash flow sequence.
- The calculator is unable to determine a value for **IRR** within a maximum number of iterations (**Error 7**).

For a detailed description of sign changes as they relate to **IRR**, refer to "IRR Calculations" in the Appendix.

Uneven and Grouped Cash Flows

Uneven Cash Flows

The Cash Flow worksheet lets you analyze the value of money over equal time periods. It allows you to enter uneven values, each of which can be either an inflow (cash received) or an outflow (cash paid out).



Similar to an annuity's present value (**PV**) in the TVM worksheet, a typical cash-flow problem usually has an initial cash flow (labeled **CFo**). This is always a known, entered value.

Grouped Cash Flows

In some cash-flow problems, every cash flow may be a unique value. In other cash-flow problems, there may be consecutive cash flows of equal value.

You must enter unequal cash flows separately, but you can save time and space by using the **F*nn*** variable to enter groups of consecutive cash flows of equal value.

Entering Cash Flows

You can enter the initial cash flow and up to 24 additional cash flows, each of which can be a unique value. Enter inflows as positive and outflows as negative. If you have consecutive cash flows of equal value, you can enter the cash-flow value and then a frequency of up to 9,999 for the number of times the value occurs.

Procedure: Entering Cash Flows

1. Press [CF] to select the cash flow entry portion of the Cash Flow worksheet.

   CFo= and its current value are displayed.

2. If necessary, press [2nd] [CLR Work] to clear the worksheet.

3. Key in a value for **CFo** (initial cash flow) and press [ENTER].

4. Press [↓] to display **C01**.

   Key in a value for the first cash flow or group of cash flows and press [ENTER]. Enter an inflow (cash received) as a positive number; enter an outflow (cash paid out) as a negative number.

5. Press [↓] to display **F01**.

   If there are multiple, consecutive, equal occurrences of the cash flow you entered, key in the number of occurrences (frequency) and press [ENTER]. The default value is **1**.

6. Press [↓] to display the next available cash flow.

   Key in the value of the cash flow(s) and press [ENTER].

7. Press [↓].

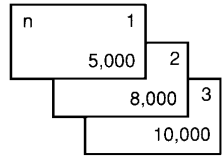
   If there are multiple, consecutive, equal occurrences of the cash flow you entered, key in a value for the frequency and press [ENTER].

8. Repeat steps 6 and 7 until all cash flows and frequencies are entered.

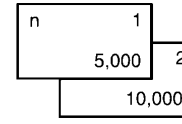
   When you have entered all the cash-flow data, you can press [↓] or [↑] to review the entries.

Deleting Cash Flows

When you delete a cash flow, the calculator decreases the numbers of subsequent cash flows .



Before deleting
8,000 cash flow



After deleting
8,000 cash flow

Procedure: Deleting a Cash Flow

The **DEL** indicator lets you know when you can delete a cash flow.

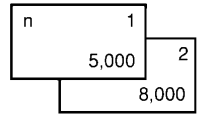
❶ Press ↓ or ↑ until the cash flow you want to delete is displayed.

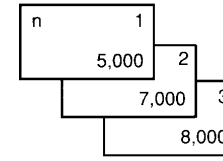
❷ Press 2nd [DEL].

The cash flow you specified (and its frequency) is deleted. The calculator decreases the numbers of subsequent cash flows so that there is no gap.

Inserting Cash Flows

When you insert a cash flow, the calculator increases the numbers of the current and subsequent cash flows.





When inserting cash flows, remember that the most cash flows you can enter is 24.

Procedure: Inserting a Cash Flow

The **INS** indicator lets you know when you can insert a cash flow.

1. Press ↓ or ↑ until the display shows the current cash flow where you want to insert the new cash flow.

   For example, if you want to insert a new second cash flow, display **C02**.

2. Press 2nd [INS].

3. Key in the value of the new cash flow and press ENTER.

   The new cash flow is entered "before" the current cash flow. The calculator increases the numbers of the current and subsequent cash flows. For example, **C02** becomes **C03**.

4. If necessary, press ↓, enter a value for the frequency, and press ENTER.

Computing NPV and IRR

IRR (internal rate of return) is the interest rate at which the net present value of the cash flows is equal to zero. **NPV** (net present value) is the sum of the present values for the cash inflows (cash received) and outflows (cash paid out).

A positive value for **NPV** indicates a profitable investment.

Procedure: Computing Net Present Value

❶ Press [NPV].

I= and its current value are displayed.

❷ Key in a value for I (discount rate) and press [ENTER].

❸ Press [↓] to display the **NPV** variable label.

❹ Press [CPT] to compute the net present value of the series of cash flows.

The calculator computes and displays the value.

Procedure: Computing Internal Rate of Return

❶ Press [IRR].

IRR= and its current value are displayed.

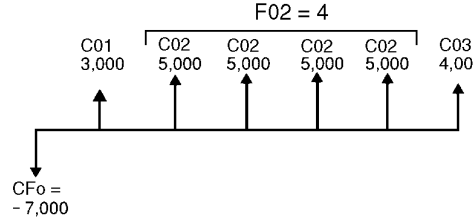
❷ Press [CPT] to compute the internal rate of return. The calculator computes and displays the value.

Uneven Cash Flows

A company plans to pay $7,000 for a new machine. The company would like a 20% annual return on its investment. Over the next six years, the company expects to receive the annual cash flows shown below.

Year	Cash Flow Number	Cash Flow Estimate
1	1	3,000
2–5	2	5,000 each year
6	3	4,000

The following time line shows that these cash flows are a combination of equal and unequal values. Because the initial cash flow (**CFo**) is an outflow, it is a negative value.



On the next few pages, you will enter cash flow data, edit the data when a change is necessary, and compute the net present value and internal rate of return.

Example: Entering Cash Flow Data

Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Select Cash Flow worksheet.	CF	**CFo=**	**0.00**
Enter initial cash flow.	**7000** +/– ENTER	**CFo=**	**–7,000.00**◃
Enter cash flow for first year.	↓ **3000** ENTER	**C01=**	**3,000.00**◃
	↓	**F01=**	**1.00**◃
Enter cash flows for years two through five.	↓ **5000** ENTER	**C02=**	**5,000.00**◃
	↓ **4** ENTER	**F02=**	**4.00**◃
Enter cash flow for sixth year.	↓ **4000** ENTER	**C03=**	**4,000.00**◃
	↓	**F03=**	**1.00**◃

Example: Editing Cash Flow Data

(continued from previous example)

After entering the data, you learn that the cash flow projections you were given were incorrect. The $4,000 cash-flow value should occur in the second year instead of the sixth. Otherwise, the entries are correct.

Year	Incorrect Cash Flow	Correct Cash Flow
1	3,000	3,000
2	5,000	4,000
3	5,000	5,000
4	5,000	5,000
5	5,000	5,000
6	4,000	5,000

Edit the existing data in the Cash Flow worksheet by deleting the $4,000 value for year 6 and inserting it for year 2.

Procedure	Keystrokes	Display	
Move to third cash flow.	↑	**C03=**	**4,000.00**
Delete third cash flow.	2nd [DEL]	**C03=**	**0.00**
Move to second cash flow.	↑ ↑	**C02=**	**5,000.00**
Insert new second cash flow.	2nd [INS] **4000** ENTER ↓	**C02=** **F02=**	**4,000.00** **1.00**
Move to next cash flow to verify data.	↓ ↓	**C03=** **F03=**	**5,000.00** **4.00**

Example: Computing Net Present Value

(continued from previous example)

Compute the net present value (**NPV**) using an interest rate per period (**I**) of 20%.

Procedure	Keystrokes	Display	
Access **NPV**.	NPV	**I=**	**0.00**
Enter interest rate per period.	**20** ENTER	**I=**	**20.00**◁
Compute net present value.	↓ CPT	**NPV=**	**7,266.44**∗

Example: Computing Internal Rate of Return

(continued from previous example)

Compute the internal rate of return (**IRR**).

Procedure	Keystrokes	Display	
Access **IRR**.	IRR	**IRR=**	**0.00**
Compute internal rate of return.	CPT	**IRR=**	**52.71**∗

The internal rate of return is 52.71%.

Value of a Lease with Uneven Payments

A lease with an uneven payment schedule usually accommodates seasonal or other anticipated fluctuations in the lessee's cash position.

Suppose a 36-month lease has the following payment schedule, with beginning-of-period payments.

Number of Months	Payment Amount
4	$0
8	$5000
3	$0
9	$6000
2	$0
10	$7000

If the required earnings rate is 10% annually with monthly compounding:

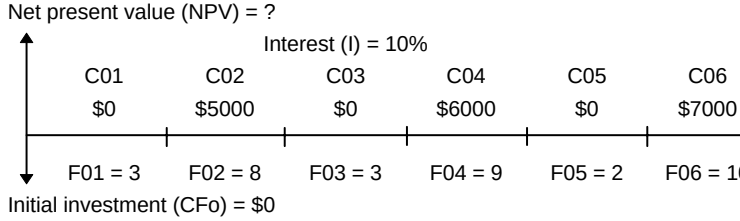
- What is the present value of these lease payments?
- What even payment amount at the beginning of each month would result in the same present value?

Because the cash flows are uneven, use the Cash Flow worksheet to determine the net present value (**NPV**) of the lease.

Example: Compute Net Present Value of Cash Flows

The cash flows for the first four months are stated as a group of four $0 cash flows. Because the lease specifies beginning-of-period payments, you must treat the first cash flow in this group as the initial investment (**CFo**) and enter the remaining three cash flows on the cash flow screens (**C01** and **F01**).

Note: The BGN/END setting in the TVM worksheet does not affect the Cash Flow worksheet.

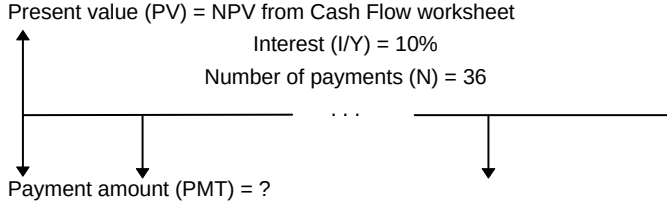


Procedure	Keystrokes		Display
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Select Cash Flow worksheet.	CF	**CFo=**	**0.00**
Enter first group of cash flows.	↓ ↓ **3** ENTER	**C01=** **F01=**	**0.00**◂ **3.00**◂
Enter second group of cash flows.	↓ **5000** +/– ENTER ↓ **8** ENTER	**C02=** **F02=**	**–5000.00**◂ **8.00**◂
Enter third group of cash flows.	↓ ↓ **3** ENTER	**C03=** **F03=**	**0.00**◂ **3.00**◂
Enter fourth group of cash flows.	↓ **6000** +/– ENTER ↓ **9** ENTER	**C04=** **F04=**	**–6000.00**◂ **9.00**◂
Enter fifth group of cash flows.	↓ ↓ **2** ENTER	**C05=** **F05=**	**0.00**◂ **2.00**◂
Enter sixth group of cash flows.	↓ **7000** +/– ENTER ↓ **10** ENTER	**C06=** **F06=**	**–7000.00**◂ **10.00**◂
Select NPV.	NPV	**I=**	**0.00**
Enter monthly earnings rate.	**10** ÷ **12** ENTER	**I=**	**0.83**◂
Compute NPV.	↓ CPT	**NPV=**	**-138,088.44***
Store in memory 0.	STO **0**	**NPV**	**-138,088.44**

Example: Compute Equivalent Monthly Payments

(continued from previous example)

Use the net present value (**NPV**) from the Cash Flow worksheet as the present value (**PV**) in the TVM worksheet to compute the equivalent even monthly payment that is equivalent to the uneven cash flows.



Procedure	Keystrokes		Display
Set beginning-of-period payments.	2nd [BGN] 2nd [SET]	**BGN**	
Return to calculator mode.	2nd [QUIT]		**0.00**
Enter **NPV** as **PV** and make it positive.	RCL **0** +/– PV	**PV=**	**138,088.44**◁
Enter interest per year.	**10** I/Y	**I/Y=**	**10.00**◁
Enter number of payments.	**36** N	**N=**	**36.00**◁
Compute payment.	CPT PMT	**PMT=**	**-4,418.90***

At the required earnings rate of 10%, the present value of the lease payments is $138,088.44. An even monthly payment of $4,418.90 would result in the same present value.

4

Bond Worksheet

To access the Bond worksheet, press [2nd] [Bond].

Press [↓] and [↑] to move through each set of variables.

Bond Worksheet Labels

Label	Meaning	Variable Type
SDT	Settlement date	Enter-only
CPN	Annual coupon rate in percent	Enter-only
RDT	Redemption date	Enter-only
RV	Redemption value (percentage of par value)	Enter-only
ACT*	Actual/actual day-count method	Setting
360*	30/360 day-count method	Setting
2/Y*	Two coupons per year	Setting
1/Y*	One coupon per year	Setting
YLD	Yield to redemption	Enter/compute
PRI	Dollar price	Enter/compute
AI	Accrued interest	Auto-compute

* Press [2nd] [SET] repeatedly to view the options for day-count method or coupons per year.

Notes about the Bond Worksheet

- [2nd] [Bond] [2nd] [CLR Work] sets **RV=100**, **CPN=0**, **YLD=0**, and **PRI=0**. (**SDT**, **RDT**, day-count method, and coupon frequency are not affected.)
- [2nd] [Reset] [ENTER] sets **RV=100**, **CPN=0**, **YLD=0**, and **PRI=0**; **SDT** and **RDT** to 12-31-1990; day-count method to **ACT**; coupon frequency to **2/Y**.
- If you have not entered the necessary values, an error occurs when you press [↓] or [↑] to move through the worksheet.
- You can enter dates in US format (MM.DDYY) or European format (DD.MMYY). Dates are displayed with hyphens, either MM-DD-YYYY (US format) or DD-MM-YYYY (European format).
- You can enter dates from January 1, 1950, through December 31, 2049.
- When you enter a value for **CPN**, remember that it is the annual coupon rate as a percent—not the dollar amount of the coupon payment.

Notes about the Bond Worksheet (cont.)

- Enter a date for **RDT** (redemption date) in the date format you selected (U.S. or European). The calculator assumes that the redemption date (**RDT**) coincides with a coupon date.
  - For "to maturity" calculations, enter the maturity date for **RDT**.
  - For "to call" calculations, enter the call date for **RDT**.
- Redemption value (**RV**) is a percentage of the bond's par value.
  - For "to maturity" analysis, enter 100 for **RV**.
  - For "to call" analysis, enter the call price for **RV**.
- When either **ACT** or **360** is displayed, you can set the day-count method by pressing [2nd] [SET] repeatedly to select either **ACT** (actual/actual) or **360** (30/360).
- When either **1/Y** or **2/Y** is displayed, you can press [2nd] [SET] repeatedly to set coupon frequency as **2/Y** (two coupon payments per year) or **1/Y** (one coupon payment per year).
- To compute a value for **YLD**, enter a value for **PRI**.
- To compute a value for **PRI**, enter a value for **YLD**.
- A value for **AI** is computed automatically in terms of dollars per $100 of par value.

Terminology

The following terminology applies to the Bond worksheet.

Call Date — A bond that can be retired by the issuing agency before the bond's maturity date is a callable bond. The call date for such a bond is printed in the bond contract.

Coupon Payment — The periodic payment made to the owner of the bond as interest.

Coupon Rate — The annual interest rate printed on the bond.

Dollar Price — Price of the security expressed in terms of dollars per $100 of par value.

Par Value (or face value) — The value printed on the bond.

Premium Bond — A bond that sells for an amount greater than the par value sells at a premium.

Discount Bond — A bond selling for less than the par value sells at a discount.

Redemption Date — The date on which the issuing agency retires the bond. This date may be the date of maturity or, for a callable bond, a call date.

Redemption Value — The amount paid to the owner of the bond when it is retired. If the bond is redeemed at the maturity date, the redemption value is the par value printed on the bond. If the bond is redeemed at a call date, the redemption value is the bond's par value plus any call premium. The calculator treats the redemption value in terms of dollars per $100 of par value.

Settlement Date — The date on which a bond is exchanged for funds.

Yield to Maturity — The rate of return to the investor earned from payments of principal and interest, with interest compounded semiannually at the stated yield rate. The yield to maturity takes into account the amount of premium or discount, if any, and the time value of the investment.

Entering Bond Data and Computing Results

Before computing values for price or yield and accrued interest, enter the four known values (settlement date, coupon rate, redemption date, and redemption value). If necessary, change the day-count method and coupon frequency settings. The worksheet stores values and settings until you clear the worksheet or change the values and settings.

Procedure: Entering Bond Data

First enter the known values:

1. Press [2nd] [Bond].

   SDT is displayed, along with the previous date.

2. Press [2nd] [CLR Work] to clear the worksheet.

3. Key in a value for **SDT** (settlement date) and press [ENTER].

4. Press [↓] repeatedly and enter values for **CPN** (coupon rate), **RDT** (redemption date), and **RV** (redemption value) just as you did for **SDT**.

Procedure: Selecting Bond Settings

After entering the known values, select the settings:

1. Press [↓] until **ACT** or **360** is displayed to select the day-count method.

   - To select the actual/actual day-count method, press [2nd] [SET] repeatedly until **ACT** is displayed.
   - To select the 30/360 day-count method, press [2nd] [SET] repeatedly until **360** is displayed.

2. Press [↓] until **2/Y** or **1/Y** is displayed to select coupon frequency.

   - To select two coupons per year, press [2nd] [SET] repeatedly until **2/Y** is displayed.
   - To select one coupon per year, press [2nd] [SET] repeatedly until **1/Y** is displayed.

Procedure: Computing Bond Price (PRI)

❶ Press ↓ until **YLD** is displayed.

❷ Key in a value for **YLD** and press ENTER.

❸ Press ↓ to display **PRI**, and then press CPT.

A value for **PRI** is computed and displayed.

Procedure: Computing Bond Yield (YLD)

❶ Press ↓ until **PRI** is displayed.

❷ Key in a value for **PRI** and press ENTER.

❸ Press ↓ to display **YLD**, and then press CPT.

A value for **YLD** is computed and displayed.

Computing Accrued Interest (AI)

A value for **AI** (accrued interest) is computed and displayed automatically when you access the variable. **AI** is computed in terms of dollars per $100 of par value.

Press ↓ repeatedly until **AI** and its value are displayed.

Bond Price and Accrued Interest Example

You want to purchase a semiannual corporate bond that matures on 12/31/97 to settle on 6/12/96. The bond is based on the 30/360 day-count method with a coupon rate of 7%. It will be redeemed at 100% of its par value. For an 8% yield to maturity, compute the bond's price and the accrued interest.

Example: Entering Bond Data

Procedure	Keystrokes	Display	
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Select Bond worksheet.	2nd [Bond]	**SDT =**	**12-31-1990**◁
Enter settlement date.	**6.1296** ENTER	**SDT =**	**6-12-1996**◁
Enter coupon rate.	↓ **7** ENTER	**CPN =**	**7.00**◁
Enter redemption date.	↓ **12.3197** ENTER	**RDT =**	**12-31-1997**◁
Leave redemption value as is.	↓	**RV =**	**100.00**

Example: Computing Bond Price and Accrued Interest

(continued from previous example)

Select 30/360 day-count method.	↓ 2nd [SET]	**360**	
Leave two coupon payments per year.	↓ 2nd [SET]	**2/Y**	
Enter yield.	↓ **8** ENTER	**YLD =**	**8.00**◁
Compute price	↓ CPT	**PRI =**	**98.56**∗
View accrued interest.	↓	**AI =**	**3.15**∗

For an 8% yield to maturity, the price of the bond is $98.56 per 100 and the accrued interest is $3.15 per 100.

5

Depreciation Worksheet

To access the Depreciation worksheet, press [2nd] [Depr]. Then choose a depreciation method, enter the known values, and compute the unknown values.

To choose a depreciation method, press [2nd] [SET] repeatedly until the desired method is displayed.

Press [↓] and [↑] to move through each set of variables.

Depreciation Worksheet Labels

Label	Meaning	Variable Type
SL*	Straight line method	Setting
SYD*	Sum-of-the-years'-digits method	Setting
DB*	Declining-balance method	Setting/Enter
DBX*	**DB** method with crossover to **SL**	Setting/Enter
SLF*	French straight-line method	Setting/Enter
DBF*	French declining balance method	Setting/Enter
LIF	Life of the asset in years	Enter-only
M01	Starting month	Enter-only
DT1	Starting date (**SLF**)	Enter-only
CST	Cost of the asset	Enter-only
SAL	Salvage value of the asset	Enter-only
YR	Year to compute	Enter-only
DEP	Depreciation for the year	Auto-compute
RBV	Remaining book value at the end of the year	Auto-compute
RDV	Remaining depreciable value	Auto-compute

* Press [2nd] [SET] repeatedly to view all of the options for depreciation method.

Notes about the Depreciation Worksheet

- [2nd] [Depr] [2nd] [CLR Work] sets **LIF=1**, **M01=1**, **YR=1**; **CST=0**, **SAL=0**. The depreciation method is not affected.
- [2nd] [Reset] [ENTER] sets the depreciation method to **SL**; declining-balance percent (for **DB** and **DBX** only) to **200**; **LIF=1**, **M01=1**, **YR=1**; **CST=0**, **SAL=0**.
- **SLF** (straight-line, French method) and **DBF** (declining-balance, French method) are European depreciation methods. They are only available if you have selected the European format for entering dates or entering separators in numbers. **DT1** (initial date) is available only for **SLF**.
- **DEP**, **RBV**, and **RDV** are computed a year at a time. Results are rounded to the number of decimal places specified by the display format.

Notes about the Depreciation Worksheet (cont.)

- Values for **DEP**, **RBV**, and **RDV** are computed and displayed automatically when you press [↓] to display each variable.
- If you choose **DB** or **DBX** as the depreciation method, enter a value for declining-balance percent when you display the **DB** or **DBX** label. The value you enter must be a positive number. (The default value is 200.)
- The value you enter for **LIF** must be:
  - If **SL** or **SLF** is selected, a positive real number.
  - If **SYD**, **DB**, **DBX**, or **DBF** is selected, a positive integer.
- The value you enter for **M01** has two parts. The integer portion represents the month that the asset is placed into service. The decimal portion represents the fraction of the initial month in which the asset begins to depreciate. For example, entering 1.5 specifies that the asset begins to depreciate in the middle of the first month. Entering 4.25 specifies that the asset begins to depreciate a quarter of the way through the fourth month.
- When computing depreciation, the value you enter for **YR** must be a positive integer.
- From **RDV**, you can press [↓] to return to **YR**. To represent the next depreciation year, press [CPT] to increment the value for **YR** by one.
- Repeatedly returning to **YR**, pressing [CPT] to increment the value for **YR**, and computing values for **DEP**, **RBV**, and **RDV** computes a depreciation schedule. The schedule is complete when **RDV** equals zero.

Entering Data and Computing Results

Because the worksheet stores previous values and settings until you change them or clear the worksheet, you may not need to do all the steps every time you work a depreciation problem.

Procedure: Selecting a Depreciation Method

1. Press [2nd] [Depr] to select the Depreciation worksheet.

   The label for the current depreciation method is displayed.

2. Press [2nd] [CLR Work] to clear the worksheet.

3. Press [2nd] [SET] repeatedly until the depreciation method you want is displayed (**SL**, **SLF**, **SYD**, **DB**, **DBX**, or **DBF**).

4. If you select **DB** or **DBX**, key in a value for the declining-balance percent. The default value is 200.

Procedure: Entering Depreciation Data

1. Press [↓] to display **LIF**.

2. Key in a value for **LIF** and press [ENTER].

3. Repeat for **M01**, **DT1** (if **SLF**), **CST**, **SAL**, and **YR**.

To use **SLF** or **DBF**, do not forget to set either the European date format or the European format for separators ([2nd] [Format]).

Computing Results

After entering the data, press [↓] repeatedly to automatically compute and display values for **DEP**, **RBV**, and **RDV**.

The * symbol in the display lets you know that each value has been computed.

Procedure: Generating a Depreciation Schedule

To generate a depreciation schedule and compute values for other years:

1. Press [↓] to display the **YR** variable, and then press [CPT] to increment the value by one.

2. Press [↓] repeatedly to automatically compute and display new values for **DEP**, **RBV**, and **RDV**.

Declining Balance with Straight-Line Crossover Example

In mid-May, a company begins to depreciate a machine with a seven-year life and no salvage value. The machine cost is $100,000. Use the declining-balance with straight-line crossover method to compute the depreciation expense, remaining book value, and remaining depreciable value for the first two years. The declining-balance percent is 200.

Example: Declining-Balance Data

Procedure	Keystrokes	Display	
Set all variables to defaults.	2nd [Reset] ENTER	RST	0.00
Select Depreciation worksheet.	2nd [Depr]	SL	
Select declining-balance crossover method.	2nd [SET] 2nd [SET] 2nd [SET]	DBX =	200.00◂
Enter life in years.	↓ 7 ENTER	LIF =	7.00◂
Enter starting month.	↓ 5.5 ENTER	M01 =	5.50◂
Enter cost.	↓ 100000 ENTER	CST =	100,000.00◂
Leave salvage value at 0.	↓	SAL =	0.00
Leave year at 1.	↓	YR =	1.00
Display depreciation amount, remaining book value, and remaining depreciable value.	↓ ↓ ↓	DEP = RBV = RDV =	17,857.14* 82,142.86* 82,142.86*
View second year.	↓ CPT	YR = YR =	1.00 2.00◂
Display second year depreciation data.	↓ ↓ ↓	DEP = RBV = RDV =	23,469.39* 58,673.47* 58,673.47*

For the first year, the depreciation amount is $17,857.14, the remaining book value is $82,142.86, and the remaining depreciable value is $82,142.86.

For the second year, the depreciation amount is $23,469.39, the remaining book value is $58,673.47, and the remaining depreciable value is $58,673.47.

Straight-Line Depreciation Example

In mid-March, a company begins depreciation of a commercial building with a 31½ year life and no salvage value. The building cost $1,000,000. Use the straight-line depreciation method to compute the depreciation expense, remaining book value, and remaining depreciable value for the first two years.

Example: Entering Straight-Line Depreciation Data

Procedure	Keystrokes	Display	
Set all variables to defaults.	2nd [Reset] ENTER	**RST**	**0.00**
Select Depreciation worksheet.	2nd [Depr]	**SL**	
Enter life in years.	↓ **31.5** ENTER	**LIF =**	**31.50**◁
Enter starting month.	↓ **3.5** ENTER	**M01 =**	**3.50**◁
Enter cost.	↓ **1000000** ENTER	**CST =**	**1,000,000.00**◁
Leave salvage value as is.	↓	**SAL =**	**0.00**
Leave year as is.	↓	**YR =**	**1.00**
Display depreciation amount, remaining book value, and remaining depreciable value.	↓ ↓ ↓	**DEP =** **RBV =** **RDV =**	**25,132.28*** **974,867.72*** **974,867.72***
View second year.	↓ CPT	**YR =** **YR =**	**1.00** **2.00**◁
Display second year depreciation data.	↓ ↓ ↓	**DEP =** **RBV =** **RDV =**	**31,746.03*** **943,121.69*** **943,121.69***

For the first year, the depreciation amount is $25,132.28, the remaining book value is $974,867.72, and the remaining depreciable value is $974,867.72.

For the second year, the depreciation amount is $31,746.03, the remaining book value is $943,121.69, and the remaining depreciable value is $943,121.69.

6

Statistics Worksheet

Two keys are used for performing statistics calculations.

2nd [Data] lets you enter statistical data.

2nd [Stat] lets you choose a statistics calculation method and compute results.

Press ↓ and ↑ to move through each set of variables.

Statistics Worksheet Labels

Keys	Label	Meaning	Variable Type
2nd [Data]	**X*nn*** *	Current X value	Enter-only
↓	**Y*nn*** *	Current Y value	Enter-only
2nd [Stat]	**LIN**	Standard linear regression	Setting
2nd [SET]	**Ln**	Logarithmic regression	Setting
	EXP	Exponential regression	Setting
	PWR	Power regression	Setting
	1-V	One-variable statistics	Setting
↓	**n**	Number of observations	Auto-compute
(as needed)	$\bar{x}$	Mean (average) of X values	Auto-compute
	Sx	Sample standard deviation of X	Auto-compute
	σ**x**	Population standard deviation of X	Auto-compute
	$\bar{y}$**	Mean (average) of Y values	Auto-compute
	Sy**	Sample standard deviation of Y	Auto-compute
	σ**y****	Population standard deviation of Y	Auto-compute
	a**	Linear regression y-intercept	Auto-compute
	b**	Linear regression slope	Auto-compute
	r**	Correlation coefficient	Auto-compute
	X'**	Predicted X value	Enter/compute
	Y'**	Predicted Y value	Enter/compute
	Σ**X**	Sum of X values	Auto-compute
	Σ**X**^{2}	Sum of X squared values	Auto-compute
	Σ**Y****	Sum of Y values	Auto-compute
	Σ**Y**^{2}**	Sum of Y squared values	Auto-compute
	Σ**XY****	Sum of XY products	Auto-compute

* ***nn*** indicates the number of the current **X** or **Y** value.

** Not displayed for one-variable statistics.

Notes about the Statistics Worksheet

2nd [Data] 2nd [CLR Work] sets all **X** and **Y** values and all values in the Stat portion of the worksheet to zero, but does not affect the statistics calculation method.

2nd [Stat] 2nd [CLR Work] sets the statistics calculation method to **LIN** and all values to zero.

2nd [Reset] ENTER sets the statistics calculation method to **LIN** and **X**, **Y**, and all other values to zero.

You can enter up to 50 (x,y) data points.

If you have not entered any data points, an error will occur when you press ↓ or ↑ to move through the portion of the worksheet that displays results.

When you are entering data for one-variable statistics, ***Xnn*** represents the value and ***Ynn*** specifies the number of occurrences (frequency). When you enter a value for ***Xnn***, the value for ***Ynn*** defaults to 1.

To analyze one-variable statistics, select **1-V**. Only values for **n**, $\bar{x}$, **Sx**, σ**X**, Σ**X**, and Σ**X²** are computed and displayed for one-variable statistics.

When analyzing two-variable statistics, you have four regression methods to choose from:

- **LIN** — Standard linear regression analysis
- **Ln** — Logarithmic regression analysis
- **EXP** — Exponential regression analysis
- **PWR** — Power regression analysis

Except for **X'** and **Y'**, the values for the statistics variables are automatically computed and displayed when you access them.

You can use the **X'** and **Y'** variables for regression predictions. You can enter a value for **X'** to compute **Y'**, or enter a value for **Y'** to compute **X'**.

Regression Models

For two-variable data, the Statistics worksheet has four regression models for curve fitting and forecasting.

The **X** value is interpreted as the independent variable and the **Y** value as the dependent variable.

Model	Formula	Restrictions
Linear (**LIN**)	$Y = a + b\ X$	
Logarithmic (**Ln**)	$Y = a + b\ \ln(X)$	All X values > zero
Exponential (**EXP**)	$Y = a\ b^x$	All Y values > zero
Power (**PWR**)	$Y = a\ X^b$	All X and Y values > zero

The statistical results are computed using transformed values:

- The linear model uses X and Y.
- The logarithmic model uses ln(X) and Y.
- The exponential model uses X and ln(Y).
- The power model uses ln(X) and ln(Y).

The calculator determines the values for **a** and **b** that create the line or curve that best fits the data.

Correlation Coefficient

The calculator also determines **r** (the correlation coefficient) which measures the goodness of fit of the equation with the data.

In general, the closer **r** is to 1 or –1, the better the fit; the closer **r** is to zero, the worse the fit.

Entering Statistical Data

2nd [Data] lets you enter and display up to 50 data points. The Statistics worksheet stores the values you enter until you clear the worksheet or change the values. Therefore, you may not need to do all the steps each time you perform a Statistics calculation.

Procedure: Entering Data Points

1. Press 2nd [Data] to select the data-entry portion of the Statistics worksheet.

   X01 is displayed, along with any previous value.

2. Press 2nd [CLR Work] to clear the worksheet.

3. Key in a value for **X01** and press ENTER.

   - If you are entering one-variable data, **X01** is the first data point.
   - If you are entering two-variable data, **X01** is the first **X** value.

4. Press ↓ to display the **Y01** variable. Key in a value for **Y01** and press ENTER.

   - If you are entering one-variable data, you can enter the number of times the **X** value occurs (frequency). The default value is 1.
   - If you are entering two-variable data, enter the first **Y** value.

5. Press ↓ to display the next **X** variable.

6. Repeat steps 3 through 5 until all of the data points are entered.

Displaying Data Points

As with other worksheets, you can move up and down through the data-entry portion of the Statistics worksheet by pressing ↓ or ↑.

Editing Statistical Data

Pressing [2nd] [Data] also lets you insert or delete data points. You may not need to do all the steps each time you perform a Statistics calculation.

Procedure: Deleting a Data Point

When the **DEL** indicator is displayed, you can delete a data point.

1. Press [↓] or [↑] until the data point you want to delete is displayed.
2. Press [2nd] [DEL].

The data point you specified (both **X** and **Y**) is deleted. The calculator decreases the numbers of subsequent data points so that there is no gap.

Procedure: Inserting a Data Point

When the **INS** indicator is displayed, you can insert a data point.

1. Press [↓] or [↑] until the display shows the current **X** variable of the data point where you want to insert the new data.

   For example, if you want to insert a new second data point, display **X02**.
2. Press [2nd] [INS].
3. Key in the new **X** value and press [ENTER].

   The new **X** value is entered "above" the current data point. The calculator increases the numbers of the current and subsequent data points. For example, **X02** becomes **X03**.
4. If necessary, press [↓], and then key in a value for the **Y** variable and press [ENTER].

Computing Statistical Results

Procedure: Selecting a Statistics Calculation Method

❶ Press 2nd [Stat] to select the statistical calculation portion of the Statistics worksheet.

The most recently selected statistics calculation method is displayed (**LIN**, **Ln**, **EXP**, **PWR**, or **1-V**).

❷ Press 2nd [SET] repeatedly until the statistics calculation method you want is displayed.

If you are analyzing one-variable data, select **1-V**.

❸ Press ↓ to begin computing results.

Computing Results

To compute results based on the current data set, press ↓ repeatedly after you have selected the statistics calculation method.

The results of the statistical calculations (except for **X'** and **Y'**) are computed and displayed automatically when you access them.

For one-variable statistics, only values for **n**, $\bar{x}$, **Sx**, σ**x**, Σ**X**, and Σ**X**^{2} are computed and displayed.

Procedure: Computing Y'

❶ If necessary, press 2nd [Stat].

❷ Press ↑ or ↓ until **X'** is displayed.

❸ Key in a value for **X'** and press ENTER.

❹ Press ↓ to display the **Y'** variable.

❺ Press CPT to compute a predicted **Y'** value.

Procedure: Computing X'

1. If necessary, press [2nd] [Stat].
2. Press [↑] or [↓] until **Y'** is displayed.
3. Key in a value for **Y'** and press [ENTER].
4. Press [↑] to display the **X'** variable.
5. Press [CPT] to compute an **X'** value.

One-Variable Statistics Example

You randomly select a sample of 10 stores to see how much they charge for a particular item. You find the following prices:

$63, $69, $71, $69, $74, $74, $72, $66, $74, $76

Note that $69 occurs twice and $74 occurs three times. You can save time entering by using the frequency factor (**Y*nn***) for them.

Find the mean and the sample standard deviation.

Example: Entering One-Variable Statistical Data

Procedure	Keystrokes	Display	
Select and clear data-entry portion of Statistics worksheet.	2nd [Data] 2nd [CLR Work]	**X01**	**0.00**
Enter data set.	**63** ENTER	**X01=**	**63.00**
	↓	**Y01=**	**1.00**
	↓ **69** ENTER	**X02=**	**69.00**
	↓ **2** ENTER	**Y02=**	**2.00**
	↓ **71** ENTER	**X03=**	**71.00**
	↓	**Y03=**	**1.00**
	↓ **74** ENTER	**X04=**	**74.00**
	↓ **3** ENTER	**Y04=**	**3.00**
	↓ **72** ENTER	**X05=**	**72.00**
	↓	**Y05=**	**1.00**
	↓ **66** ENTER	**X06=**	**66.00**
	↓	**Y06=**	**1.00**
	↓ **76** ENTER	**X07=**	**76.00**
	↓	**Y07=**	**1.00**

Example: Computing One-Variable Statistical Results

Procedure	Keystrokes	Display	
Select and clear statistical calculation portion of Statistics worksheet.	2nd [Stat] 2nd [CLR Work]	**LIN**	
Select one-variable calculation method.	2nd [SET] 2nd [SET] 2nd [SET] 2nd [SET]	**1-V**	
Display sample size.	↓	**n=**	**10.00***
Display mean.	↓	**$\bar{x}$=**	**70.80***
Display sample standard deviation.	↓	**Sx=**	**4.08***

Two-Variable Statistics Example

A life insurance company wants to explore the relationship between the number of salespeople in an office and the volume of sales. Offices in various cities have the following number of salespeople and resulting total sales.

Number of salespeople	Sales $ per month
7	99,000
12	152,000
4	81,000
5	98,000
11	145,000
9	112,000

Treating the number of salespeople as the **X** variable and the sales per month as the **Y** variable, use the linear regression model to perform the following analysis.

- Determine the Y-intercept, slope, and correlation coefficient of the data.
- Predict the amount of sales (**Y'**) if the company establishes a new office with 10 salespeople.
- Determine the number of salespeople needed (**X'**) to produce $115,000 in monthly sales.

Example: Entering Two-Variable Statistical Data

Procedure	Keystrokes	Display	
Select and clear data-entry portion of Statistics worksheet.	2nd [Data] 2nd [CLR Work]	X01	0.00
Enter data set.	7 ENTER	X01=	7.00◁
	↓ 99000 ENTER	Y01=	99,000.00◁
	↓ 12 ENTER	X02=	12.00◁
	↓ 152000 ENTER	Y02=	152,000.00◁
	↓ 4 ENTER	X03=	4.00◁
	↓ 81000 ENTER	Y03=	81,000.00◁
	↓ 5 ENTER	X04=	5.00◁
	↓ 98000 ENTER	Y04=	98,000.00◁
	↓ 11 ENTER	X05=	11.00◁
	↓ 145000 ENTER	Y05=	145,000.00◁
	↓ 9 ENTER	X06=	9.00◁
	↓ 112000 ENTER	Y06=	112,000.00◁

Example: Computing Two-Variable Statistical Results

(continued from previous example)

Procedure	Keystrokes	Display	
Select and clear statistical calculation portion of Statistics worksheet.	2nd [Stat] 2nd [CLR Work]	**LIN**	
Display intercept.	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓	**a=**	**47,115.38***
Display slope.	↓	**b=**	**8,423.08***
Display correlation.	↓	**r=**	**0.96***
Enter X' (people).	↓ **10** ENTER	**X'=**	**10.00◁**
Compute Y' (sales).	↓ CPT	**Y'=**	**131,346.15***
Enter Y' (sales).	**115000** ENTER	**Y'=**	**115,000.00◁**
Compute new X' (people).	↑ CPT	**X'=**	**8.06***

Because the correlation coefficient (**r**) of .96 is close to 1, the following equation is a good approximation of the data.

$Y = 47{,}115.38 + 8{,}423.08 \times X$

The analysis indicates that 10 salespeople would produce approximately $131,346.15 in sales per month. To produce $115,000 in sales per month, you would need approximately eight salespeople.

7

Other Worksheets

This chapter contains information about six worksheets:

- Percent Change/Compound Interest Worksheet
- Interest Conversion Worksheet
- Date Worksheet
- Profit Margin Worksheet
- Breakeven Worksheet
- Memory Worksheet

Percent Change/Compound Interest Worksheet

To access the Percent Change/Compound Interest worksheet, press [2nd] [Δ%]. You can also compute compound interest or perform cost-sell-markup calculations.

Percent Change/Compound Interest Worksheet Labels

Label	Meaning	Variable Type
OLD	Old value	Enter/compute
NEW	New value	Enter/compute
%CH	Percent change	Enter/compute
#PD	Number of periods	Enter/compute

Notes about the Percent Change/Compound Interest Worksheet

- [2nd] [Δ%] [2nd] [CLR Work] sets **OLD=0**, **NEW=0**, **%CH=0**, and **#PD=1**.
- [2nd] [Reset] [ENTER] sets **OLD=0**, **NEW=0**, **%CH=0**, and **#PD=1**.
- For percent-change calculations, enter values for any two of the three variables (**OLD**, **NEW**, and **%CH**) and compute a value for the unknown variable. (Leave **#PD=1**.) A positive percent change represents a percentage increase, and a negative percent change represents a percentage decrease.
- For compound-interest calculations, enter values for three of the four variables and compute a value for the unknown.
  - **OLD** = present value
  - **NEW** = future value
  - **%CH** = interest rate per period
  - **#PD** = number of periods
- For cost-sell-markup calculations, enter values for two of the three variables (**OLD**, **NEW**, and **%CH**) and compute a value for the unknown.
  - **OLD** = cost
  - **NEW** = selling price
  - **%CH** = percent markup
  - **#PD** = **1**

Procedure: Computing Percent Change, Compound Interest, or Cost-Sell-Markup

❶ Press [2nd] [Δ%] to select the worksheet.

OLD is displayed, along with the previous value.

❷ Press [2nd] [CLR Work] to clear the worksheet.

❸ Enter the known values. Do not enter a value for the variable you wish to solve for.

- **Percent Change** — Enter values for two of the three variables: **OLD**, **NEW**, and **%CH**. Leave **#PD** set to 1.
- **Compound Interest** — Enter values for three of the four variables: **OLD**, **NEW**, **%CH**, and **#PD**.
- **Cost-Sell-Markup** — Enter values for two of the three variables: **OLD**, **NEW**, and **%CH**. Leave **#PD** set to 1.

To enter values for the known variables, press [↓] or [↑] until the variable label you want is displayed, and then key in a value and press [ENTER].

❹ Compute a value for the unknown variable.

Press [↓] or [↑] until the variable label you want is displayed, and then press [CPT].

The calculator computes and displays the value.

Example: Percent Change

First, determine the percentage change from a forecast amount of $658 to an actual amount of $700, and then determine what the new amount would be if it were 7% below the original forecast.

Procedure	Keystrokes	Display	
Select and clear Percent Change/Compound Interest worksheet.	2nd [Δ%] 2nd [CLR Work]	OLD=	0.00
Enter original forecast amount.	658 ENTER	OLD=	658.00◁
Enter actual amount.	↓ 700 ENTER	NEW=	700.00◁
Compute percent change.	↓ CPT	%CH=	6.38*
Enter –7 as percent change.	7 +/– ENTER	%CH=	–7.00◁
Compute new actual amount.	↑ CPT	NEW=	611.94*

$700 represents a 6.38% increase over the original forecast of $658.

A decrease of 7% would result in a new actual amount of $611.94.

Example: Compound Interest

You purchased some stock for $500 in 1995. Five years later, you sell the stock for $750. What was the annual growth rate?

Procedure	Keystrokes	Display	
Select and clear Percent Change/Compound Interest worksheet.	2nd [Δ%] 2nd [CLR Work]	OLD=	0.00
Enter stock purchase price.	500 ENTER	OLD=	500.00◁
Enter stock selling price.	↓ 750 ENTER	NEW=	750.00◁
Enter number of years.	↓ ↓ 5 ENTER	#PD=	5.00◁
Compute annual growth rate.	↑ CPT	%CH=	8.45*

The annual growth rate is 8.45%.

Example: Cost-Sell-Markup

The original cost of an item is $100; the selling price is $125. Find the markup.

Procedure	Keystrokes	Display	
Select and clear Percent Change/Compound Interest worksheet.	2nd [Δ%] 2nd [CLR Work]	OLD=	0.00
Enter original cost.	100 ENTER	OLD=	100.00◁
Enter selling price.	↓ 125 ENTER	NEW=	125.00◁
Compute percent markup.	↓ CPT	%CH=	25.00*

The markup is 25%.

Interest Conversion Worksheet

Interest Conversion Worksheet Labels

Press [2nd] [I Conv] to access the Interest Conversion worksheet.

Label	Meaning	Variable Type
NOM	Nominal rate	Enter/compute
EFF	Annual effective rate	Enter/compute
C/Y	Compounding periods per year	Enter-only

Notes about the Interest Conversion Worksheet

- You may need to compare interest rates on investments that have the same nominal interest rate (annual percentage rate) but a different number of compounding periods per year. In these situations, simply comparing the nominal rates is misleading. Before you can make a valid comparison, you should convert the nominal interest rate (**NOM**) to the annual effective interest rate (**EFF**) for each investment.
- The nominal interest rate (**NOM**) is the interest rate per compounding period multiplied by the number of compounding periods per year.
- The annual effective interest rate (**EFF**) is the compound annual interest rate that you actually earn for the period of time stated.
- [2nd] [CLR Work] sets **NOM** and **EFF** to zero, but does not affect **C/Y**.
- [2nd] [Reset] [ENTER] sets **NOM** and **EFF** to zero, and **C/Y** to 12.
- You can convert a nominal rate to an annual effective rate, or vice versa.
- Enter a value for **NOM** or **EFF** as an annual rate.

Procedure: Converting Interest

❶ Press 2nd [I Conv] to select the worksheet.

NOM is displayed, along with the previous value.

❷ Press 2nd [CLR Work] to clear the worksheet.

❸ Enter a value for the known interest rate, either **NOM** or **EFF**.

To enter a value for a known variable, press ↓ or ↑ until the variable label you want (**NOM** or **EFF**) is displayed, and then key in a value and press ENTER.

❹ Press ↓ until **C/Y** is displayed. If necessary, key in a value for number of compounding periods per year and press ENTER.

❺ Compute a value for the unknown interest rate.

To compute a value for the unknown variable, press ↓ or ↑ until the variable label you want (**NOM** or **EFF**) is displayed, and then press CPT.

The calculator computes and displays the value.

Example: Interest Conversion

A bank is offering a certificate that pays a nominal interest rate of 15% with quarterly compounding. What is the annual effective interest rate?

Procedure	Keystrokes	Display	
Select and clear Interest Conversion worksheet.	2nd [I Conv] 2nd [CLR Work]	**NOM=**	**0.00**
Enter nominal interest rate.	**15** ENTER	**NOM=**	**15.00**◃
Enter number of compounding periods per year.	↓ ↓ **4** ENTER	**C/Y=**	**4.00**◃
Compute annual effective interest rate.	↑ CPT	**EFF=**	**15.87**∗

A nominal interest rate of 15% compounded quarterly is equivalent to an annual effective interest rate of 15.87%.

Date Worksheet

Press [2nd] [Date] to access the Date worksheet. This worksheet can help you find the number of days between two dates. You can also compute a date and day of the week based on a starting date and a specified number of days.

Date Worksheet Labels

Label	Meaning	Variable Type
DT1	Date 1	Enter/compute
DT2	Date 2	Enter/compute
DBD	Days between dates	Enter/compute
ACT*	Actual/actual day-count method	Setting
360*	30/360 day-count method	Setting

* Press [2nd] [SET] repeatedly to view the options for day-count method.

Notes about the Date Worksheet

- [2nd] [CLR Work] sets **DT1** and **DT2** to 12-31-1990 (if date format is U.S.), and **DBD** to zero. The day-count method is not affected.
- [2nd] [Reset] [ENTER] sets **DT1** and **DT2** to 12-31-1990 (if date format is U.S.), **DBD** to zero, and the day-count method to **ACT**.
- **DT1** is assumed to be the earlier date and **DT2** the later date.
  - Enter dates for **DT1** and **DT2** in the currently selected date format (U.S. or European).
  - When you compute a date for **DT1** or **DT2**, a three-letter abbreviation for the day of the week (for example, **WED**) is also displayed. The day-count method you select affects your calculations.
  - If you select **ACT** as the day-count method, the calculator uses the actual number of days in each month and each year, including adjustments for leap years.
  - If you select **360** as the day-count method, the calculator assumes 30 days per month (360 days per year). You can compute **DBD** using this day-count method, but not **DT1** or **DT2**.

Procedure: Computing Dates

❶ Press [2nd] [Date] to select the worksheet.

DT1 is displayed, along with the previous date.

❷ Press [2nd] [CLR Work] to clear the worksheet.

❸ Enter values for two of the three variables: **DT1**, **DT2**, and **DBD**. Do not enter a value for the variable you wish to solve for.

Press [↓] or [↑] until the variable label you want is displayed, and then key in a value and press [ENTER].

❹ If necessary, change the day-count method setting.

Press [↓] until **ACT** or **360** is displayed, and then press [2nd] [SET] repeatedly until the day-count method you want (**ACT** or **360**) is displayed.

❺ Compute a value for the unknown variable.

Press [↓] or [↑] until the variable label you want is displayed, and then press [CPT].

The calculator computes and displays the value.

Example: Computing Days between Dates

A loan is made on January 4, 1996, but the first payment is deferred until March 1, 1996. How many days does the loan accrue interest before the first payment?

Procedure	Keystrokes	Display	
Select and clear date worksheet.	[2nd] [Date] [2nd] [CLR Work]	**DT1=**	**12-31-1990**
Enter first date.	**1.0496** [ENTER]	**DT1=**	**1-04-1996**◁
Enter second date.	[↓] **3.0196** [ENTER]	**DT2=**	**3-01-1996**◁
If necessary, select actual/ actual day-count method.	[↓] [↓] [2nd] [SET]	**ACT**	
Compute days between dates.	[↑] [CPT]	**DBD=**	**57.00**∗

Because there are 57 days between the two dates, the loan accrues interest for 57 days before the first payment.

Profit Margin Worksheet

To access the Profit Margin worksheet, press [2nd] [Profit]. This worksheet lets you solve for cost, selling price, or profit margin.

Profit Margin Worksheet Labels

Label	Meaning	Variable Type
CST	Cost	Enter/compute
SEL	Selling price	Enter/compute
MAR	Profit margin	Enter/compute

Notes about the Profit Margin Worksheet

- Gross profit margin is a term commonly used in business. Sometimes the terms margin and markup are used interchangeably, but each has a distinct meaning.
  - Gross profit margin is the difference between selling price and cost, expressed as a percentage of the selling price.
  - Markup is the difference between selling price and cost, expressed as a percentage of the cost.
- This worksheet deals only with gross profit margin. You can perform markup calculations using the Percent Change/ Compound Interest worksheet.
- [2nd] [CLR Work] sets **CST**, **SEL**, and **MAR** to zero.
- [2nd] [Reset] [ENTER] sets **CST**, **SEL**, and **MAR** to zero.
- Enter values for two of the variables, and then compute a value for the third variable.

Procedure: Profit Margin Calculations

❶ Press [2nd] [Profit] to select the worksheet.

CST is displayed, along with the previous value.

❷ If necessary, press [2nd] [CLR Work] to clear the worksheet.

❸ Enter values for two of the three variables; for example, enter values for **SEL** and **MAR**.

Press [↓] or [↑] until the variable label you want is displayed, and then key in a value and press [ENTER].

❹ Compute a value for the unknown variable; for example, compute a value for **CST**.

Press [↓] or [↑] until the variable label you want is displayed, and then press [CPT].

The calculator computes and displays the value.

Example: Profit Margin Calculations

The selling price of an item is $125. The gross profit margin is 20%. Find the original cost.

Procedure	Keystrokes	Display	
Select and clear Profit Margin worksheet.	[2nd] [Profit] [2nd] [CLR Work]	**CST=**	**0.00**
Enter selling price.	[↓] **125** [ENTER]	**SEL=**	**125.00**◁
Enter profit margin.	[↓] **20** [ENTER]	**MAR=**	**20.00**◁
Compute cost.	[↑] [↑] [CPT]	**CST=**	**100.00**∗

The original cost is $100.

Breakeven Worksheet

Press [2nd] [Brkevn] to access the Breakeven worksheet. This worksheet allows you to determine the breakeven point and sales level necessary to earn a given level of profit.

Breakeven Worksheet Labels

Label	Meaning	Variable Type
FC	Fixed cost	Enter/compute
VC	Variable cost per unit	Enter/compute
P	Unit price	Enter/compute
PFT	Profit	Enter/compute
Q	Quantity	Enter/compute

Notes about the Breakeven Worksheet

- The Breakeven worksheet is a tool for analyzing the relationships between fixed costs, variable costs per unit, quantity, price, and profit. Until the breakeven quantity is reached (total costs = total revenues), you operate at a loss.
- [2nd] [CLR Work] sets **FC=0**, **VC=0**, **P=0**, **PFT=0**, and **Q=0**.
- [2nd] [Reset] [ENTER] sets **FC=0**, **VC=0**, **P=0**, **PFT=0**, and **Q=0**.
- Enter values for any four of the five variables, and then compute a value for the fifth variable.
- To solve for **Q** (the breakeven quantity), enter a value of zero for **PFT** (profit).

Procedure: Computing Breakeven

❶ Press [2nd] [Brkevn] to select the worksheet.

FC is displayed, along with the previous value.

❷ If necessary, press [2nd] [CLR Work] to clear the worksheet.

❸ Enter values for four of the five variables; for example, enter values for **FC**, **VC**, **P**, and **PFT**.

Press [↓] or [↑] until the variable label you want is displayed, and then key in a value and press [ENTER].

❹ Compute a value for the unknown variable; for example, compute a value for **Q**.

Press [↓] or [↑] until the variable label you want is displayed, and then press [CPT].

The calculator computes and displays the value.

Example: Computing Breakeven Quantity

A canoe company sells paddles for $20 each. The unit variable cost is $15, and the fixed costs are $3,000. How many paddles must be sold to break even?

Procedure	Keystrokes	Display	
Select and clear Breakeven worksheet.	[2nd] [Brkevn] [2nd] [CLR Work]	**FC=**	**0.00**
Enter fixed costs.	**3000** [ENTER]	**FC=**	**3,000.00**◃
Enter variable cost per unit.	[↓] **15** [ENTER]	**VC=**	**15.00**◃
Enter price.	[↓] **20** [ENTER]	**P=**	**20.00**◃
Leave profit as is.	[↓]	**PFT=**	**0.00**
Compute quantity.	[↓] [CPT]	**Q=**	**600.00**∗

600 paddles must be sold to break even.

Memory Worksheet

To access the Memory worksheet, press [2nd] [MEM]. This worksheet lets you display the calculator's 10 memories. The Memory worksheet makes it easy to compare stored values and reduces the chance of recalling the wrong value.

Memory Worksheet Labels

Label	Meaning	Variable Type
M0	Memory 0	Enter-only
M1	Memory 1	Enter-only
M2	Memory 2	Enter-only
M3	Memory 3	Enter-only
M4	Memory 4	Enter-only
M5	Memory 5	Enter-only
M6	Memory 6	Enter-only
M7	Memory 7	Enter-only
M8	Memory 8	Enter-only
M9	Memory 9	Enter-only

Notes about the Memory Worksheet

- The Memory worksheet has no built-in formulas, no settings to select, and no values to compute. All variables are enter-only variables.
- You can access the 10 memories individually by using [STO], [RCL], and the digit keys as described in Chapter 1. However, by selecting the Memory worksheet, you can easily review the 10 memories by pressing [↓] and [↑].
- To clear all of the memories at once, press [2nd] [MEM] [2nd] [CLR Work].

Procedure: Using the Memory Worksheet

❶ Press [2nd] [MEM] to select the worksheet.

M0 is displayed, along with any value you may have stored in this memory.

❷ Perform any of the following operations.

- To clear all 10 memories at once, press [2nd] [CLR Work].
- To view the contents of the memories, press [↓] or [↑].
- To store a value in a memory, key in the value when the memory you want is displayed (**M0** through **M9**) , and then press [ENTER].
- To perform memory arithmetic without being in the Memory worksheet, refer to "Memory Operations" in Chapter 1.

Procedure: Clearing a Memory

To store a zero in memory 4 (in effect, clearing the memory):

❶ Press [↓] or [↑] until **M4** is displayed.

❷ Press **0** [ENTER].

Procedure: Storing a Value to a Memory

To store 95 in memory 3:

❶ Press [↓] or [↑] until **M3** is displayed.

❷ Press **95** [ENTER].

Procedure: Adding a Value to a Memory

To add 95 to the value in memory 9:

❶ Press [↓] or [↑] until **M9** is displayed.

❷ Press [+] **95** [ENTER].

Procedure: Subtracting a Value from a Memory

To subtract 95 from the value in memory 5:

❶ Press [↓] or [↑] until **M5** is displayed.

❷ Press [−] **95** [ENTER].

Procedure: Multiplying a Value in a Memory

To multiply the value in memory 0 by 95.

❶ Press [↓] or [↑] until **M0** is displayed.

❷ Press [×] **95** [ENTER].

Procedure: Dividing a Value in a Memory

To divide the value in memory 6 by 95.

❶ Press [↓] or [↑] until **M6** is displayed.

❷ Press [÷] **95** [ENTER].

Procedure: Raising a Value in Memory to a Power

To raise the value in memory 7 to the 66th power.

❶ Press [↓] or [↑] until **M7** is displayed.

❷ Press [y^x] **66** [ENTER].

APPENDIX
Reference Information

This appendix provides supplemental information on formulas, error conditions, and accuracy that may be helpful as you use your calculator.

- Formulas
- Error Conditions
- Accuracy Information
- IRR (Internal-Rate-of-Return) Calculations
- Algebraic Operating System (AOS™)
- Battery Information
- In Case of Difficulty
- TI Product Service and Warranty Information

Formulas

Formulas used internally by your calculator are included here for your information.

Time Value of Money

$$i = \left[e^{(y \times ln(x+1))}\right] - 1$$

where: $PMT \neq 0$

y = C/Y ÷ P/Y

x = (.01 × I/Y) ÷ C/Y

C/Y = compounding periods per year

P/Y = payment periods per year

I/Y = interest rate per year

$$i = (^{-}FV \div PV)^{(1 \div N)} - 1$$

where: $PMT = 0$

The iteration used to compute i:

$$0 = PV + PMT \times G_i\left[\frac{1-(1+i)^{-N}}{i}\right] + FV \times (1+i)^{-N}$$

$$I/Y = 100 \times C/Y \times \left[e^{(y \times ln(x+1))} - 1\right]$$

where: $x = i$

$y = P/Y \div C/Y$

$$G_i = 1 + i \times k$$

where: $k = 0$ for end-of-period payments

$k = 1$ for beginning-of-period payments

$$N = \frac{ln\left(\frac{PMT \times G_i - FV \times i}{PMT \times G_i + PV \times i}\right)}{ln(1+i)}$$

where: $i \neq 0$

$$N = {}^{-}(PV + FV) \div PMT$$

where: $i = 0$

$$PMT = \frac{-i}{G_i} \times \left[PV + \frac{PV + FV}{(1+i)^N - 1} \right]$$

where: $i \neq 0$

$PMT = -(PV + FV) \div N$

where: $i = 0$

$$PV = \left[\frac{PMT \times G_i}{i} - FV \right] \times \frac{1}{(1+i)^N} - \frac{PMT \times G_i}{i}$$

where: $i \neq 0$

$PV = -(FV + PMT \times N)$

where: $i = 0$

$$FV = \frac{PMT \times G_i}{i} - (1+i)^N \times \left(PV + \frac{PMT \times G_i}{i} \right)$$

where: $i \neq 0$

$FV = -(PV + PMT \times N)$

where: $i = 0$

Amortization

If computing $bal(\,)$, $pmt2 = npmt$

Let $bal(0) = RND(PV)$

Iterate from $m = 1$ to $pmt2$

$$\begin{cases} I_m = RND\left[RND12\left(-i \times bal(m-1) \right) \right] \\ bal(m) = bal(m-1) - I_m + RND(PMT) \end{cases}$$

then: $bal(\,) = bal(pmt2)$

$\Sigma Prn(\,) = bal(pmt2) - bal(pmt1)$

$\Sigma Int(\,) = (pmt2 - pmt1 + 1) \times RND(PMT) - \Sigma Prn(\,)$

where: RND = round the display to the number of decimal places selected

$RND12$ = round to 12 decimal places

Balance, principal, and interest are dependent on the values of **PMT**, **PV**, **I/Y**, and $pmt1$ and $pmt2$.

Cash Flow

$$NPV = CF_0 + \sum_{j=1}^{N} CF_j (1+i)^{-S_{j-1}} \frac{(1-(1+i)^{-n_j})}{i}$$

where: $S_j = \begin{cases} \sum_{i=1}^{j} n_i & j \geq 1 \\ 0 & j = 0 \end{cases}$

Net present value is dependent on the values of the initial cash flow (CF_0), subsequent cash flows (CF_j), frequency of each cash flow (n_j), and the specified interest rate (i).

$IRR = 100 \times i$, where i satisfies $npv() = 0$

Internal rate of return is dependent on the values of the initial cash flow (CF_0) and subsequent cash flows (CF_j).

---

i = **I/Y** ÷ 100

Bonds

Price (given yield) with one coupon period or less to redemption:

$$PRI = \left[\frac{RV + \frac{100 \times R}{M}}{1 + \left(\frac{DSR}{E} \times \frac{Y}{M} \right)} \right] - \left[\frac{A}{E} \times \frac{100 \times R}{M} \right]$$

where:
- PRI = dollar price per $100 par value
- RV = redemption value of the security per $100 par value ($RV$ = 100 except in those cases where call or put features must be considered)
- R = annual interest rate (as a decimal; CPN _ 100)
- M = number of coupon periods per year standard for the particular security involved (set to 1 or 2 in Bond worksheet)
- DSR = number of days from settlement date to redemption date (maturity date, call date, put date, etc.)

E = number of days in coupon period in which the settlement date falls

Y = annual yield (as a decimal) on investment with security held to redemption (YLD ÷ 100)

A = number of days from beginning of coupon period to settlement date (accrued days)

Note: The first term computes present value of the redemption amount, including interest, based on the yield for the invested period. The second term computes the accrued interest agreed to be paid to the seller.

Yield (given price) with one coupon period or less to redemption:

$$Y = \left[\frac{\left(\frac{RV}{100} + \frac{R}{M}\right) - \left(\frac{PRI}{100} + \left(\frac{A}{E} \times \frac{R}{M}\right)\right)}{\frac{PRI}{100} + \left(\frac{A}{E} \times \frac{R}{M}\right)} \right] \times \left[\frac{M \times E}{DSR} \right]$$

Price (given yield) with more than one coupon period to redemption:

$$PRI = \left[\frac{RV}{\left(1 + \frac{Y}{M}\right)^{N - 1 + \frac{DSC}{E}}} \right] + \left[\sum_{K=1}^{N} \frac{100 \times \frac{R}{M}}{\left(1 + \frac{Y}{M}\right)^{K - 1 + \frac{DSC}{E}}} \right] - \left[100 \times \frac{R}{M} \times \frac{A}{E} \right]$$

where:

N = number of coupons payable between settlement date and redemption date (maturity date, call date, put date, etc.). (If this number contains a fraction, raise it to the next whole number; for example, 2.4 = 3)

DSC = number of days from settlement date to next coupon date

K = summation counter

Note: The first term computes present value of the redemption amount, not including interest. The second term computes the present values for all future coupon payments. The third term computes the accrued interest agreed to be paid to the seller.

Yield (given price) with more than one coupon period to redemption:

Yield is found through an iterative search process using the "Price with more than one coupon period to redemption" formula.

Accrued interest for securities with standard coupons or interest at maturity:

$$AI = PAR \times \frac{R}{M} \times \frac{A}{E}$$

where: AI = accrued interest
PAR = par value (principal amount to be paid at maturity)

Source for bond formulas: Lynch, John J., Jr., and Jan H. Mayle. *Standard Securities Calculation Methods*. New York: Securities Industry Association, 1986.

Depreciation

$RDV = CST - SAL -$ accumulated depreciation

Values for *DEP*, *RDV*, *CST*, and *SAL* are rounded to the number of decimals you choose to be displayed.

In the following formulas, $FSTYR = (13 - MO1) \div 12$.

Straight-line depreciation

$$\frac{CST - SAL}{LIF}$$

First year: $\frac{CST - SAL}{LIF} \times FSTYR$

Last year or more: $DEP = RDV$

Sum-of-the-years'-digits depreciation

$$\frac{(LIF + 2 - YR - FSTYR) \times (CST - SAL)}{((LIF \times (LIF + 1)) \div 2)}$$

First year: $\frac{LIF \times (CST - SAL)}{((LIF \times (LIF + 1)) \div 2)} \times FSTYR$

Last year or more: $DEP = RDV$

Declining-balance depreciation

$$\frac{RBV \times DB\%}{LIF \times 100}$$

where: *RBV* is for YR – 1

First year: $\frac{CST \times DB\%}{LIF \times 100} \times FSTYR$

Unless $\frac{CST \times DB\%}{LIF \times 100} > RDV$; then use $RDV \times FSTYR$

If $DEP > RDV$, use $DEP = RDV$

If computing last year, $DEP = RDV$

Statistics

(Formulas apply to both x and y.)

Standard deviation with n weighting (σ_x):

$$\left[\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n}\right]^{1/2}$$

Standard deviation with n–1 weighting (s_x):

$$\left[\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}\right]^{1/2}$$

Mean: $\bar{x} = \frac{(\sum x)}{n}$

Regressions

Formulas apply to all regression models using transformed data.

$$b = \frac{n(\Sigma xy) - (\Sigma y)(\Sigma x)}{n(\Sigma x^2) - (\Sigma x)^2}$$

$$a = \frac{(\Sigma y - b\Sigma x)}{n}$$

$$r = \frac{b\sigma_x}{\sigma_y}$$

Interest Rate Conversions

$$EFF = 100 \times (e^{C/Y \times ln(x+1)} - 1)$$

where: $x = .01 \times NOM \div C/Y$

$$NOM = 100 \times C/Y \times (e^{1 \div C/Y \times ln(x+1)} - 1)$$

where: $x = .01 \times EFF$

Percent Change

$$NEW = OLD\left(1 + \frac{\%CH}{100}\right)^{\#PD}$$

where: OLD = old value
NEW = new value
$\%CH$ = percent change
$\#PD$ = number of periods

Profit Margin

$$\text{Gross Profit Margin} = \frac{\text{Selling Price} - \text{Cost}}{\text{Selling Price}} \times 100$$

Breakeven

$PFT = P\,Q - (FC + VC\,Q)$

where: PFT = profit
P = price
FC = fixed cost
VC = variable cost
Q = quantity

Days between Dates

With the Date worksheet, you can enter or compute a date within the range January 1, 1950, through December 31, 2049.

Actual/actual day-count method

(assumes actual number of days per month and actual number of days per year):

DBD (days between dates)

$$= \textit{number of days II} - \textit{number of days I}$$

$$\textit{Number of Days I} = (Y1 - YB) \times 365 + (\textit{number of days MB to M1}) + DT1 + \frac{(Y1 - YB)}{4}$$

$$\textit{Number of Days II} = (Y2 - YB) \times 365 + (\textit{number of days MB to M2}) + DT2 + \frac{(Y2 - YB)}{4}$$

where: $M1$ = month of first date
$DT1$ = day of first date
$Y1$ = year of first date
$M2$ = month of second date
$DT2$ = day of second date
$Y2$ = year of second date
MB = base month (January)
DB = base day (1)
YB = base year (first year after leap year)

30/360 day-count method

(assumes 30 days per month and 360 days per year):

$$DBD = (Y2 - Y1) \times 360 + (M2 - M1) \times 30 + (DT2 - DT1)$$

where:
- $M1$ = month of first date
- $DT1$ = day of first date
- $Y1$ = year of first date
- $M2$ = month of second date
- $DT2$ = day of second date
- $Y2$ = year of second date

Note: If DT1 is 31, change DT1 to 30. If DT2 is 31 and DT1 is 30 or 31, change DT2 to 30; otherwise, leave it at 31.

Source for 30/360 day-count method formula: Lynch, John J., Jr., and Jan H. Mayle. *Standard Securities Calculation Methods*. New York: Securities Industry Association, 1986.

Error Conditions

The calculator reports error conditions by displaying the message **Error *n***, where ***n*** is the number of the error. Error messages are listed in numerical order on the next few pages. Use this table to determine the cause of the error.

You cannot make any keyboard entries until you clear an error condition by pressing CE/C.

Error	Possible Causes
Error 1 Overflow	Attempted a calculation whose result is outside the range of the calculator (± 9.9999999999999E99).
	Attempted to divide by zero. (May occur in an internal calculation by the calculator.)
	Attempted to compute 1/x when x is zero.
	In Statistics worksheet, attempted a calculation when all X values or all Y values are the same.
Error 2 Invalid argument	Attempted to compute x! when x is not an integer from zero through 69.
	Attempted to compute LN of x when x is not > 0.
	Attempted to compute y^x when y < 0 and x is not an integer or the inverse of an integer.
	Attempted to compute $\sqrt{x}$ when x < 0.
	In Amortization worksheet, attempted to compute **BAL**, **PRN**, and **INT** when **P2** < **P1**.
	In Depreciation worksheet, attempted a calculation when **SAL** > **CST**.
Error 3 Too many pending operations	Attempted to use more than 15 active levels of parentheses.
	Attempted to use more than 8 pending operations.

Error	Possible Causes
Error 4 Out of range	In Amortization worksheet, attempted to enter a value for **P1** or **P2** that is outside the range 1-9,999.
	In TVM worksheet, attempted to enter a value for **P/Y** or **C/Y** that is ≤ 0.
	In Cash Flow worksheet, attempted to enter a value for **F*nn*** (frequency) that is outside the range 11-9,999.
	In Bond worksheet, attempted to enter a value for **RV** or **CPN** that is less than zero.
	In Bond worksheet, attempted to enter a value for **PRI** ≤ 0.
	In Date worksheet, attempted to compute a date that is outside the range January 1, 1950, through December 31, 2049.
	In Depreciation worksheet, attempted to enter a value for declining balance percent ≤ 0, for **LIF** ≤ 0, for **YR** ≤ 0, for **CST** < 0, for **SAL** < 0, or for **M01** 1 ≤ **M01** ≤ 13.
	In Interest Conversion worksheet, attempted to enter a value for **C/Y** ≤ 0.
	After pressing [2nd] [Format], attempted to enter a value for **DEC** that is outside the range 0-9.
Error 5 No solution exists	In TVM worksheet, attempted to compute **I/Y** when **FV**, (**N** × **PMT**), and **PV** all have the same sign. Make sure that cash inflows are positive and cash outflows are negative.
	In TVM, Cash Flow, and Bond worksheets, input to **LN** (logarithm) is not > 0 during worksheet calculations.
	In Cash Flow worksheet, attempted to compute **IRR** without at least one sign change in the cash-flow list.
Error 6 Invalid date	In Bond or Date worksheets, attempted to enter an invalid date; for example, January 32nd.
	In Bond or Date worksheets, attempted to enter a date in MM.DDYYYY (U.S.) or DD.MMYYYY (European) format. Dates must be entered in MM.DDYY or DD.MMYY format.
	In Bond worksheet, attempted a calculation when the redemption date is earlier than or the same as the settlement date.
Error 7 Iteration limit exceeded	In TVM worksheet, attempted to compute **I/Y** for a very complex problem involving many iterations.
	In Cash Flow worksheet, attempted to compute **IRR** for a complex problem with multiple sign changes.
	In Bond worksheet, attempted to compute **YLD** for a very complex problem.

Error	Possible Causes
Error 8 Canceled iterative calculation	In TVM worksheet, pressed [ON/OFF] to stop the evaluation of **I/Y**.
	In Amortization worksheet, pressed [ON/OFF] to stop the evaluation of **BAL** or **INT**.
	In Cash Flow worksheet, pressed [ON/OFF] to stop the evaluation of **IRR**.
	In Bond worksheet, pressed [ON/OFF] to stop the evaluation of **YLD**.
	In Depreciation worksheet, pressed [ON/OFF] to stop the evaluation of **DEP** or **RDV**.

Accuracy Information

Internally, the calculator stores results as 13-digit numbers. In the display, however, results are rounded to 10 digits or fewer, depending on the decimal format. The internal digits, called "guard" digits, increase the calculator's accuracy. Any later calculations are performed using the internal value, not on the value in the display.

Rounding

If a calculation produces an 11-digit (or greater) result, the calculator uses the internal guard digits to determine how to display the result.

If the eleventh digit of the result is 5 or greater, the calculator automatically rounds the result to the next larger value for display.

For example, consider this problem.

$$1 \div 3 \times 3 = ?$$

Internally, the calculator solves the problem in two steps, as shown below.

1. $1 \div 3 = 0.3333333333333$
2. $0.3333333333333 \times 3 = 0.9999999999999$

The calculator rounds the result and displays it as 1. This rounding enables the calculator to display the most accurate result.

Most calculations are accurate to within ±1 in the last displayed digit. However, higher-order mathematical functions use iterative calculations, and inaccuracies can accumulate in the guard digits. In most cases, the cumulative error from these calculations is maintained beyond the 10-digit display so that no inaccuracy is shown.

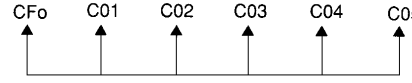
IRR Calculations

When you solve for **IRR**, the calculator performs a series of complex, iterative calculations. An **IRR** problem may have one solution, multiple solutions, or no solution. The number of possible solutions depends on the number of sign changes in your cash-flow sequence.

When There Are No Sign Changes

When a sequence of cash flows has no sign changes, there is no solution for **IRR**. The calculator displays **Error 5** (no solution exists).

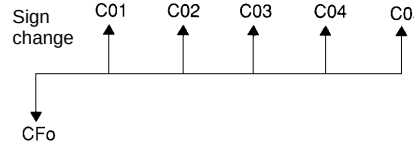
The following time line shows a sequence of cash flows with no sign changes.



When There Is Only One Sign Change

When a sequence of cash flows has only one sign change, there is only one solution for **IRR**. The calculator displays that solution.

The following time line shows a sequence of cash flows with only one sign change.



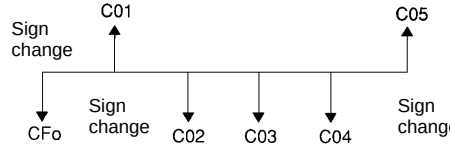
When There Are Two or More Sign Changes

When a sequence of cash flows has two or more sign changes, there may be multiple solutions for **IRR**.

- There is at least one solution.
- There may be as many solutions as there are sign changes.

If there are multiple solutions, the calculator displays the one closest to zero. However, the displayed solution has no financial meaning. Thus, you should use caution in making investment decisions based on an **IRR** computed for a cash-flow stream with more than one sign change.

The following time line shows a sequence of cash flows with three sign changes. There may be one, two, or three solutions for **IRR**.



When Solving a Complex Problem

When you are solving very complex cash-flow problems, the calculator may not be able to find **IRR** even if a solution exists. When this is the case, the calculator displays **Error 7** (iteration limit exceeded).

AOS™ (Algebraic Operating System) Calculations

If you select **AOS** (rather than **Chn**) as the calculation method, the calculator uses the standard rules of algebraic hierarchy to determine the order in which operations are performed.

Algebraic Hierarchy

The table below shows the order in which operations are performed when **AOS** is selected as the calculation method.

Priority	Operations
1 (highest)	**x^2**, **x!**, **1/x**, **%**, **$\sqrt{x}$**, **LN**, **e^2**, **HYP**, **SIN**, **COS**, **TAN**
2	**nCr**, **nPr**
3	**yx**
4	×, ÷
5	**+**, **-**
6	**)**
7 (lowest)	**=**

Battery Information

Replacing the Battery

If it becomes necessary to replace the battery, you must use an Eveready E-2032, Duracell DL2032, or the equivalent.

The calculator cannot retain data when the battery is removed or becomes discharged. Replacing the battery has the same effect as resetting the calculator.

1. Turn off the calculator and place it face down.
2. Using a small Phillips screwdriver, remove the screws from the back case and put them in a safe place.
3. Carefully pry apart the back case and the front case. Be careful not to damage any internal parts.
4. Remove the screws from the metal battery cover and lift it off the battery.
5. Tip the calculator slightly to remove the battery.

   Caution: Avoid contact with other calculator components while changing the battery.
6. Install the new battery with the + down.
7. Replace the battery cover and the screws that hold it in place.
8. Snap the back case onto the front case. Replace the screws.

Take these precautions when replacing batteries.

- Do not leave batteries within the reach of children.
- Do not mix new and used batteries. Do not mix brands (or types within brands) of batteries.
- Do not mix rechargeable and nonrechargeable batteries.
- Install batteries according to polarity (+ and –) diagrams.
- Do not place nonrechargeable batteries in a battery recharger.
- Properly dispose of used batteries immediately.
- Do not incinerate or dismantle batteries.

In Case of Difficulty

If you have difficulty operating the calculator, you may be able to correct the problem without returning the calculator for service. This table lists several problems and possible solutions.

Difficulty	Solution
The calculator computes wrong answers.	Check the settings of the current worksheet to make sure they are right for the problem you are working; for example, check **END** and **BGN** in the TVM worksheet. In the TVM worksheet, also check to make sure that the unused variable is set to zero.
The display is blank; digits do not appear.	Select the worksheet again. Be sure the battery is properly installed; replace the battery if necessary.
The calculator does not display the worksheet variables that you expect.	Be sure the calculator is in the correct worksheet.
The calculator does not display the number of decimal places that you expect.	Press 2nd [Format] to check or adjust the setting for number of decimal places to be displayed.
The calculator does not display the date format that you want.	Press 2nd [Format] ↓ ↓ to check or adjust the setting for date format.
The calculator does not display the separator format that you want.	Press 2nd [Format] ↓ ↓ ↓ to check or adjust the setting for separator format.
The calculator does not display the expected result in a math calculation.	Press 2nd [Format] ↓ ↓ ↓ ↓ to check or adjust the setting for calculation method.
An error occurs.	Check the errors listed in “Error Conditions.”

If you experience difficulties other than those listed above, press 2nd [Reset] ENTER to clear the calculator, and then repeat your calculations.

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Phone: **1-972-917-8324**

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Warranty Performance. During the above one (1) year warranty period, your defective product will be either repaired or replaced with a new or reconditioned model of an equivalent quality (at TI's option) when the product is returned to the original point of purchase. The repaired or replacement unit will continue for the warranty of the original unit or six (6) months, whichever is longer. Other than your cost to return the product, no charge will be made for such repair and/or replacement. TI strongly recommends that you insure the product for value if you mail it.

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