Hewlett-Packard 12C Tutorial

To begin, look at the face of the calculator. Every key (except the arithmetic function keys in the far right column and the five keys on the bottom left row) has two or three functions: each key's primary function is noted in white on the key itself, while each key's secondary function is noted in gold above the key or in blue on the lower face of the key. To use the function on the key, simply press the key. To access the gold function above each key, first press the gold $\boxed{f}$ key, which we will call the "gold shift" key, and then press the desired function key. (Note that the gold shift key is near the lower left corner of the calculator keyboard.) To access the blue function on the bottom of each key, first press the blue $\boxed{g}$ key, which we will call the "blue shift" key, and then press the desired function. (The blue shift key is located just to the right of the gold shift key.)

Turning the Calculator On and Off

To turn on the calculator, press $\boxed{ON}$.

Note that the ON key is on the lower left corner of the keyboard—the face of the key has a white "ON". Also, we will designate keys throughout this tutorial by the use of small boxes, as above. To conserve the battery, the calculator turns itself off about 10 minutes after your last keystroke.

To turn the calculator off, press $\boxed{ON}$ again.

Also, note that pressing the gold shift key places a little "f" in the lower left corner of the display. Pressing the blue shift key places a little "g" at the bottom of the display. Press the $\boxed{CLX}$ key and the symbol goes away. The shift keys are toggle keys that switch back and forth between the "regular" and the "gold" or "blue" functions. They are like the typewriter shift key. After you press the "gold" (or "blue") key, look only at gold (or blue) writing.

Note that the calculator has a continuous memory, so turning it off does not affect any data stored in the calculator.

Clearing the Calculator

Clearing the calculator is very important, since unwanted data in memory can result in improper calculations, and hence wrong answers. It is best to get into the habit of automatically clearing memory before starting a calculation. Occasionally, you may purposely want to save data, but, in general, you will be entering all new data, so starting with a clear memory is the safest approach.

There are four different levels of clearing data:

| f | REG | clears all memory and the display.

| CLX | clears the entire display, but not the memory.

| f | FIN | clears the financial register but not the display.

| f | E | clears the statistics register and the display.

Note that the keys above are designated as CLEAR keys on the face of the calculator.

Changing the Display

Enter 5555.5555.

To change decimals from 2 to 4, press | f | 4 |. 5,555.5555 is displayed.

To change from 4 places to 2, press | f | 2 |. 5,555.56 is displayed. (Rounding is automatic.)

We usually set the display to 2 places, which is especially convenient when working with dollars and percentages. However, we often use 4 places when dealing with interest rates and rates of return that are entered as decimals.

Time Value of Money (TVM)

The TVM keys are located on the top row of the keyboard.

| n | i | PV | PMT | FV |

In general, TVM problems involve four variables—three are known and the fourth is unknown.

Lump Sums

To begin, we consider TVM calculations with single (lump) sums. In this situation, we do not use the PMT key, so be sure to either clear all, which sets the payment (PMT) equal to 0, or enter 0 as the PMT when entering the input data. If you know any three variables, you can find the value of the fourth.

Example 1:

What is the FV of $100 after 3 years if the interest rate is 26 percent? First, clear with [f] [FIN].

Next, enter the data.

    3   [n]

  26   [i]

100   [PV]

    0   [PMT]   (Optional if registers are cleared.)

To determine the FV simply press [FV] and the FV of -$200.04 is displayed.

The HP is programmed so that if the PV is + then the FV is displayed as - and vice versa, because the HP assumes that one is an inflow and the other is an outflow. When entering both PV and FV, one must be entered as negative and the other positive.

Example 2:

What is the PV of $500 due in 5 years if the interest rate is 10 percent? Clear first and then enter the following data:

    5   [n]

  10   [i]

    0   [PMT]   (Optional if registers are cleared.)

500   [FV]

Pressing the [PV] key reveals that $310.46 will grow to $500 in 5 years at a 10 percent rate.

Example 3:

Assume a bond can be purchased today for $200. It will return $1,000 after 14 years. The bond pays no interest during its life. What rate of return would you earn if you bought the bond?

14 | n |

200 | CHS | | PV | (The | CHS | key changes the sign.)

0 | PMT |

1000 | FV |

Simply press the | i | key and the HP calculates the rate of return to be 12.18 percent.

Remember that the HP is programmed so that if the PV is + then the FV is displayed as - and vice versa, because the HP assumes that one value is an inflow and other is an outflow. Also note that the negative sign is placed on the 200 PV entry by pressing the key marked "CHS" for change sign.

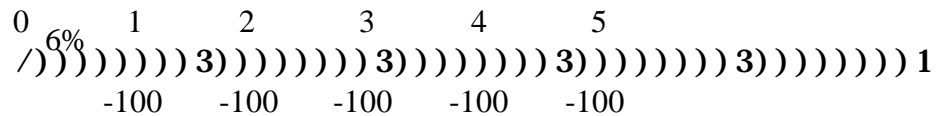Now suppose you learn that the bond will actually cost $300. What rate of return will you earn?

Override the -200 by entering 300 | CHS | | PV |, then press | i | to get 8.98 percent. If you pay more for the bond, you earn less on it. The important thing, though, is that you can do "what if" analyses with the calculator.

Now press | ON | to turn off the calculator. Then turn on the calculator | ON |. The display still shows 8.98. The memory is not erased. What was on the screen when you turned the calculator off returns when you turn it back on. Now press | CLX |. What was on the screen is gone, but press | RCL | | n | to get N = 14. The other memory registers also retain information unless you press | f | | FIN |.

Ordinary Annuities

Example 1:

What is the FV of an annuity of $100 paid at the end of each year for 5 years if the interest rate equals 6 percent?

```
 0       1       2       3       4       5
  6%
/))))))))3))))))))3))))))))3))))))))3))))))))1
      -100    -100    -100    -100    -100
```

5 | n |

6 | i |

0 | PV |

100 | CHS | | PMT |

Now press the | FV | key, and an FV of $563.71 is displayed.

Example 2:

What is the PV of the same annuity?

Leave data in calculator, but enter 0 as the FV to override, then press | PV | to get $421.24.

Annuities Due

Each payment of an annuity due occurs at the beginning of the period instead of at the end as with a regular annuity. In essence, each payment is shifted back one period. To analyze annuities due press | g | | BEG |. The word "BEGIN" appears on the screen. Now the HP analyzes the cash flows based on beginning of period payments. Change back to end mode by pressing | g | | END |.

Interest Conversion

The following equation is used to convert a nominal rate to an effective rate.

$$\text{EAR} = \left[1 + \frac{k_{Nom}}{m} \right]^{m} - 1.$$

Given: $k_{Nom} = 10\%$ and m = 12 payments/year,

$$EAR = \left[1 + \frac{0.10}{12}\right]^m - 1 = (1.0083)^{12} - 1 = 1.1047 - 1 = 0.1047 = 10.47\%.$$

However, it's much easier to convert the nominal rate using the calculator:

First, clear the financial register, [f] [FIN].

10   [ENTER]

12   [n] [÷] [i]

[CHS] [PMT] [FV]   10.47% shows on the screen.

Cash Flow Operations

We can also find the PV, FV, and IRR (rate of return) of a series of unequal cash flows.

Example 1: Uneven Cash Flows

Assume the following cash flows:

```
        0   10%   1       2       3       4
        /))))))))) 3))))))) 3))))))) 3))))))) 1
        0        50     100     150     200
```

What is the PV of these CFs?

First clear the HP's financial register, [f] [FIN].

0   [g] [CF$_0$]   Sets CF$_0$ equal to 0.

50   [g] [CF$_j$]   Sets CF$_1$ equal to 50.

100   [g] [CF$_j$]

150   [g] [CF$_j$]

200   [g] [CF$_j$]

The CFs from the time line are entered. Now enter the interest rate:

10 $\boxed{\text{i}}$

At this point the HP knows the cash flows, the number of periods, and the interest rate. To find the PV, press $\boxed{\text{f}}$ $\boxed{\text{NPV}}$ to get PV = NPV = \$377.40.

Example 2: Embedded Annuities

We have these cash flows, which contain embedded annuities:

0   10%   1   2   3   4   5   6   7   8   9

/)))))))3))))))3))))))3))))))3))))))3))))))3))))))3))))))3)))))) 1

0   100   100   100   200   200   300   300   300   300

What's the PV?

Clear the HP, $\boxed{\text{f}}$ $\boxed{\text{FIN}}$.

0    $\boxed{\text{g}}$ $\boxed{\text{CF}_0}$

100    $\boxed{\text{g}}$ $\boxed{\text{CF}_j}$

3    $\boxed{\text{g}}$ $\boxed{\text{N}_j}$

200    $\boxed{\text{g}}$ $\boxed{\text{CF}_j}$

2    $\boxed{\text{g}}$ $\boxed{\text{N}_j}$

300    $\boxed{\text{g}}$ $\boxed{\text{CF}_j}$

4    $\boxed{\text{g}}$ $\boxed{\text{N}_j}$

Now the HP knows the cash flows. Thus, enter the interest rate:

10 $\boxed{\text{i}}$

Now press $\boxed{\text{f}}$ $\boxed{\text{NPV}}$ to get PV = NPV = \$1,099.94.

To check your entries:

	RCL	0		to see CF_0.

RCL 1   to see first CF entry, 100.00 in this example.

1   n   RCL   g N_j to see how many times CF_1 is repeated. The display shows that the first CF occurs three consecutive times.

Example 3: The Rate of Return Offered by an Investment (IRR)[1]

Assume that we invest \$1,000 now (t = 0) and then expect to receive an uneven set of cash flows. Here is the CF time line:

```
        0      1      2      3      4
       /)))))))))3)))))))))3)))))))))3))))))))1
     -1000    300    400    200    600
```

What rate of return will we earn? Enter the following:

	f	FIN		
1000	CHS	g	CF_0	
300	g	CF_j		
400	g	CF_j		
200	g	CF_j		
600	g	CF_j		
	f	IRR	= 16.71%	

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[1] If a negative CF occurs at the end of a project's life, then the HP may give an error message, indicating that there are two IRRs. Enter data, then enter 10 ENTER and then RCL g R/S to get the first IRR. Then enter a large percentage, such as 100 ENTER and then RCL g R/S to find the other IRR. You might have to experiment with "guesses" to locate the two IRRs.

You can also determine the NPV of the investment. Leave data entered and then enter the opportunity cost interest rate, say 8 percent. To find NPV press:

8 | i | | f | | NPV |

The NPV of $220.50 is displayed. Thus, the PV of the cash inflows exceeds the cost of the investment by $220.50.

Statistical Calculations

The HP can also be used for several types of statistical calculations.

Mean and Standard Deviation (F)

Year	Sales
1994	$150
1995	95
1996	260

What's the mean (average) and standard deviation (F) of sales over the 3 years?

Use the E+ key to enter data:

	f		E		Clears the statistical register.
150	E+		A number 1 is displayed.
95	E+		A number 2 is displayed.
260	E+		A number 3 is displayed.

Determine the mean and standard deviation by simply pressing

| g | | X̄ | The mean equals $168.33.

| g | | S | The standard deviation is $84.01. S is the sample standard deviation.

Linear Regression

Beta coefficients can be calculated by using the HP's linear regression capabilities. The X (independent variable) and Y (dependent variable) values must be entered in the proper sequence, where X data is on the horizontal axis (**market**) and Y data is on the vertical axis (**stock**).

Year	Market (k_M)	Stock (k_j)
1	23.8%	38.6%
2	-7.2	-24.7
3	6.6	12.3
4	20.5	8.2
5	30.6	40.1

Enter the data as follows:

| f | E |

Note: The order in which the data is entered is very important. The Y value (k_j) must be entered before the X value (k_M).

38.6	ENTER		23.8	E+
24.7	CHS	ENTER	7.2	CHS	E+
12.3	ENTER		6.6	E+
8.2	ENTER		20.5	E+
40.1	ENTER		30.6	E+

0 | g | ŷ, r | The value -8.92 is y when x = 0, or k_j when $k_M = 0$, which is the *vertical axis intercept*.

| STO | 0 | Stores the value of the Y intercept for use in calculating the slope (beta).

0 | g | x̂, r | 5.57 is the value of x when y = 0.

| RCL | 0 | CHS | X ⋛Y | ÷ | The value displayed, 1.60, is the slope coefficient, or the *beta coefficient*.

Amortization

The HP can also be used to calculate amortization schedules.

Example:

Determine the interest and principal paid each year and the balance at the end of each year on a three-year $1,000 amortizing loan which carries an interest rate of 10 percent. The payments are due annually.

Perform the following steps:

	f FIN	Clears the financial register.
3	n	
10	i	
1000	PV	
	PMT	A payment of -402.11 is displayed.

This is the amortization schedule corresponding to the loan.

	Beg. Bal.	Payment	Interest	Princ. Repmt.	Ending Bal.
1	1,000.00	402.11	100.00	302.11	697.89
2	697.89	402.11	69.79	332.32	365.57
3	365.57	402.11	36.56	365.55	.02

With the data still entered in the TVM menu, do the following:

1	f AMORT	Tells the calculator that you want to amortize the first payment only. The display shows -100.000, which is the interest payment during the first year. Write it into a table as 100.00.
	X ⩾ Y	The display shows -302.11. This is the repayment of principal in the first year. Write it in the table.
	RCL PV	The display shows 697.89. This is the remaining principal balance at the end of the first year. Write it down.
1	f AMORT	This tells the calculator that you want to amortize the next payment only. The number of payments keyed in just before f AMORT is taken to be the payments following any that have been already amortized. Thus, keying in 1 at this step moved you into the second payment period.

-69.79 is the interest paid in Year 2.

X ≷ Y	-332.32 is the principal paid in Year 2.
RCL PV	365.57 is the ending balance at end of Year 2.
1 f AMORT	-35.56 is the interest paid in Year 3.
X ≷ Y	-365.55 is the principal repayment in Year 3.
RCL PV	0.02 is the balance at end of Year 3.

See the manual for an explanation of how to do monthly amortization.

Next, with the data still in the calculator, do the following:

1000 PV	This returns the calculator to the original principal balance of $1,000.
3 f AMORT	Tells the calculator that you want to amortize the first three payments together. In this example there are only 3 payments, but that is not always the case. The display shows -206.35. This is the total interest paid over Years 1 to 3.
X ≷ Y	-999.98 is the total repayment of principal over Years 1 to 3.
RCL PV	0.02 is the remaining balance.