

Hewlett-Packard 10BII Tutorial










This tutorial has been developed to be used in conjunction with Brigham and Houston's *Fundamentals of Financial Management 11th edition* and *Fundamentals of Financial Management: Concise Edition*. In particular, the tutorial was developed in conjunction with Chapter 2: The Time Value of Money and Chapter 8: Risk and Return. Today, most financial analysis is performed with computer spreadsheet programs, but most educational institutions are constrained to using financial calculators. While the tools may be different, the underlying financial principles remain the same.

To begin, look at the face of the calculator. Every key (except two, the gold shift key and the purple shift key) on the 10BII has at least two functions, and some have three functions. Each key's primary function is noted in white on the key itself, while a secondary function may be noted in gold on the bottom half of the key or in purple above the key. To use the primary function in white on the key, simply press the key. To access the gold function at the bottom of each key, first press the key with the solid gold face, which we will call the "gold shift" key, and then press the desired function key. Likewise, to access the purple function above some of the keys, first press the key with the solid purple face, which we will call the "purple shift" key, and then press the desired function key. (Note that the gold and purple shift keys are located on the left side of the calculator keyboard.)


BASIC CALCULATOR FUNCTIONS



First, it is important to review how some elementary calculator functions are performed using the HP10BII. This calculator performs all the basic arithmetic functions, such as addition, multiplication and exponents. The numeric keypad and command keys operate just like any other calculator.

The GOLD and PURPLE shift keys

The two shift keys allow the user to access specific functions the calculator can perform. Also, note that pressing the gold shift key  places a little "SHIFT" symbol in the lower left corner of the LCD display. Press the gold shift key again and the symbol goes away. Likewise, pressing the purple shift key places a "STATS" symbol in the lower left area of the display. The  key is a toggle key that switches back and forth between the "regular" and the "gold" functions. Likewise, the purple shift key  is a toggle between "regular" and "STATS" functions. The  and  keys can be likened to typewriter shift keys. After you press , look only at the gold writing, and after you press , look only at the purple writing. In this tutorial, whenever you see the or   label on the next key corresponds to the gold or purple label corresponding to the key, not the primary label on the key itself.



Turning the calculator ON and OFF

To turn on the calculator, press .

Note that the ON key is on the lower left corner of the keyboard—the face of the key has a white "ON," while the word "OFF" appears at the bottom of the key in gold. To turn the calculator off, press  , the keystrokes to turn the calculator off are (1) press the gold shift key, and (2) then press the "ON" key. Thus, by pressing the gold shift key first, we are activating the gold function below the "ON" key, which is the "OFF" function.





To conserve the battery, the calculator turns itself off about 10 minutes after your last keystroke. Note, too, that the calculator has a continuous memory, so turning it off does not affect any data stored in the calculator.

Clearing the Calculator

To clear the calculator's memory, press  .




Clearing the calculator is very important, since unwanted data in memory can result in improper calculations, and hence wrong answers. Users should get into the habit of automatically clearing memory before starting a new 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 three different levels of clearing data:

-  clears numbers on the display one at a time.
-  clears the entire display, but not the memory.
-   clears all memory and the display.



Changing the decimal display

Depending on the calculations being performed, you may want no decimal places, two decimal places, 4 decimal places, etc. Luckily, the HP10BII allows for the number of decimals shown to be quickly and easily changed. To demonstrate, enter the value 5555.5555.



If your display is currently set for two decimal places, you will notice that the value is truncated to 5555.56. To change the number of decimal places from 2 places to 4 places, press   . The value 5,555.5555 is displayed in its entirety.

To change back from 4 decimal places to 2, press   . Now, the value 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.




If periods and commas are reversed, press   (any European countries use a period-comma convention that is the opposite of ours. In other words, the number 5,555.56 would be written as 5.555,56 in some countries.)




Operating pending and screen brightness

When performing a function, you will notice that “PEND” will often appear in the display. This simply means that an operation is pending, or awaiting the next step. For example,   . The calculator is waiting for the denominator, so “PEND” appears in the display.

Enter  and  to get 0.67.

Press    see 0.6667.

Press    shift back to 2 decimal places.

Lastly, to control the brightness of the LCD display, hold down , depending upon whether you want more or less brightness, press either  or .




INTRODUCTION TO USING FINANCIAL FUNCTIONS




The clearest advantage this calculator has over standard scientific calculators is the preprogrammed financial functions stored into this calculator. Many of the functions described can be solved an alternate way using some mathematical manipulation and a normal calculator, but if we understand the principles underlying the functions, the financial calculator saves us a lot of time.



Periods per Year (P/YR) Setting

One important setting that can cause problems is the periods per year setting. The HP10BII comes out-of-the-box set at 12 payments per year. This means that it assumes that annuity payment streams occur every month. So, if you told the calculator there

were 8 periods of payments, it would assume that there were 8 monthly payments being made. However, if you intended to suggest 8 annual payments were being made, you will get incorrect answers when you solve.

To check the current payment per year setting, press  then press and hold down . The  sets the setting for periods per year. As mentioned, the calculator comes pre-set at 12 periods per year, and assumes calculations occur on a monthly basis. However, the majority finance textbook problems leave the calculator at 1 P/YR.

To change to one payment per year, press   

Now the calculator is set to assume 1 P/YR. To confirm this setting, press and hold  . Unless specifically needed for a problem, we generally leave the calculator setting at 1 P/YR. Even if a problem calls for monthly payments, we can get around it by changing the number of periods and interest rate (to be explained later).

TIME VALUE OF MONEY (TVM)

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



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

Lump Sum PV and FVs

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.

Example 1: Calculating the FV of a lump sum

What is the FV of \$100 after 3 years if the interest rate is 5 percent?

First, clear by pressing **G** **CLEAR ALL**

Next, enter the following data:

3 **N**
5 **I/YR**
100 **PV**
0 **PMT**

To calculate the FV, simply press **FV** and the FV is shown to be -\$115.76.

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 as positive. When entering values for PV, PMT, and FV, some logic needs to be used to determine which values should be positive and which should be negative. Try to think of the “direction” of the cash flow. If money is placed in an account and subsequent contributions, or payments, or made each year with the goal of eventually withdrawing the money in the future, then the PV and PMT could be positive (going into the account) and the FV could be negative (being taken out of the account).

Example 2: Calculating the PV of a lump sum

What is the PV of \$115.76 due in 3 years, if the interest rate is 5 percent? Clear first and then enter the following data.

3 **N**
5 **I/YR**
0 **PMT**
115.76 **FV**

Pressing **PV** reveals that \$100 will grow to \$115.76 in 3 years at a 5 percent rate. Notice, that this operation is just the mirror opposite of the FV example. In other words, if the number of periods and interest rate are the same, the FV of \$100 is \$115.76 and the PV of \$115.76 is \$100.

Calculating N and I/YR

A reoccurring theme throughout this tutorial will be how the interest rate, number of periods, present value, periodic payment, and future value are all intimately tied to one another. This was demonstrated in the previous example where we saw that PV and FV calculations are really the same thing, and they just require you to stand on different sides of the mirror. We can drive this point home further by constructing TVM examples, where the interest rate and number of periods are calculated.

Example 3: Calculating I/YR

Assume an investment security can be purchased today for \$100. It will return \$150 after 10 years. The bond pays no interest during its life. What rate of return would you earn if you bought the bond?




10	N	
100	+ / -	PV
0	PMT	
150	FV	

Press the **I/YR** key and the calculator determines the appropriate rate of return, or interest rate, to be 4.14 percent.

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






Example 4: Overriding a value to calculate a new I/YR


Suppose you learn that the bond will actually cost \$95. What rate of return will you earn?

If you have all the original data stored in your calculator, you can override the price of \$100 by entering 95   and then pressing  get 4.67 percent. If you pay less for the bond, you earn more for it, and vice versa. The important thing to note is that you can do “what if” analyses with the calculator.

Example 5: Calculating N

Suppose you are investing \$100 today at a rate of 6 percent. At some point in the future, you need to have \$175. At the current rate of return, how long will the investment take to provide the required return?

6		
100		
0		
175		

Press the  key and the calculator determines the number of years it will take to get the required \$175, which is 9.6 years.

Recalling information

Now, press **G** **OFF**, turn off the calculator. Next, turn on the calculator **ON** the display shows 0.00. Is the memory erased? Not completely. What was on the screen may be gone, but the data that had been entered can be recalled by pressing the following keys: **RCL** **I/YR** the interest rate will be recalled, and $I/YR = 6$. Any of the TVM inputs can be recalled. The other memory registers also retain information unless you press **G** **CLEAR ALL**.

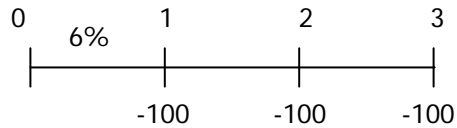
Annuities

An annuity is a security in which equal, periodic payments are made. If the periodic payments are made at the end of periods, the security is called an ordinary annuity, or deferred annuity. If the periodic payments are made at the beginning of periods, the security is called an annuity due. This is the first time we shall introduce entering payments into our time value of money calculations.

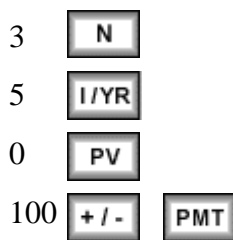
Fundamentally, calculations involving annuities are no different than those involving lump sums. Again, we are entering input data and solving for a missing value. Since ordinary annuities are far more prevalent, we focus on these securities and then show how annuities due require only a minor amount of tinkering to solve. To do so, we must introduce the BEGIN and END settings on the calculator. The default setting is END, which assumes that any payments entered occur at the end of each period. Meanwhile, BEGIN mode assumes that all payments occur at the beginning of each period. For example, a \$100 payment, two-year ordinary annuity has one payment in a year and another payment the next year, while a \$100 payment, two-year annuity due has a payment today and another in one year. However, for both annuities, the PV refers to the value today, while the FV refers to the value at the end of the second year.

Example 6: FV of an ordinary annuity

What is the FV of an ordinary annuity of \$100 paid each year for 3 years, if the interest rate equals 5 percent?



Here, N, I/YR, and PMT are given, while PV is set to zero, and we are solving for the FV:

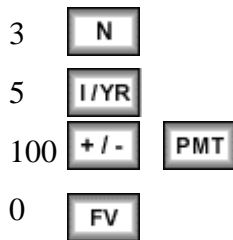


Now, press the **FV** key, and a FV of \$315.25 is displayed.

Example 7: PV of an ordinary annuity

What is the PV of the same annuity?

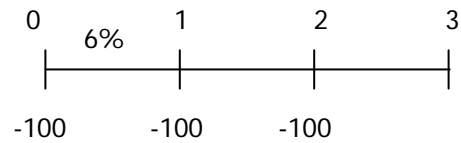
Leave data in calculator, but enter 0 as the FV to override the existing future value, or enter the following:



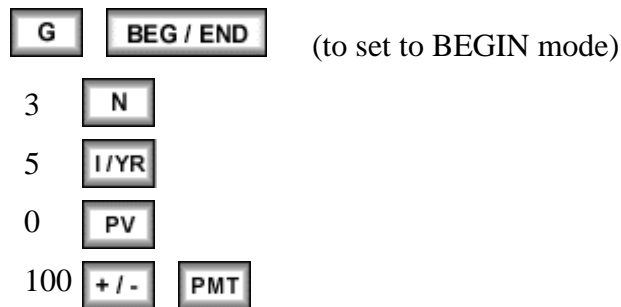
Then, press **PV**, and you get a PV of \$272.32.

Example 8: FV of an annuity due

What is the FV of an annuity due with \$100 payments each period for 3 years, if the interest rate equals 5 percent?



Recall that annuity due makes payments at the beginning of each period, therefore the calculator needs to be set to BEGIN mode. Here, N, I/YR, and PMT are given, while PV is set to zero, and we are solving for the FV:

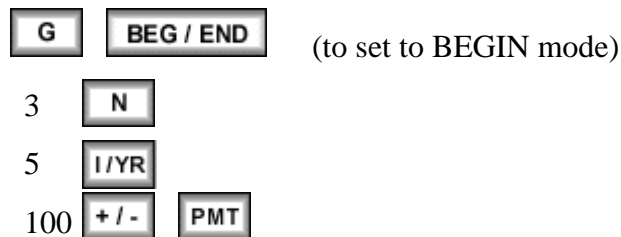


Now, press the **FV** key, and a FV of \$331.01 is displayed. Nearly all calculations will probably be done in END mode, hence it is a good habit to always revert back to END mode after solving a problem.

Example 9: PV of an annuity due

What is the PV of the same annuity due?

Leave data in calculator, but enter 0 as the FV to override the existing future value, or enter the following:



0 **FV**

Then, press **PV**, and you get a PV of \$285.94. Again, reverting back to END mode after finishing the problem is a good practice.

Perpetuities

A perpetuity is just an annuity that makes periodic payments forever. Several national governments have issued perpetuities. Since the value of an asset is the present value of all cash flows the asset pays in the future, the value of a perpetuity should be a sum of an infinite series of cash flows. However, this would be very tiring to actually perform. Luckily, the value of a perpetuity breaks down into simply:

$$V_p = \text{PMT}/r$$

As you can see, a financial calculator isn't necessarily needed to find the value of a perpetuity, a standard calculator would suffice.

Example 10: Value of a perpetuity

What is the PV a perpetuity that pays \$6 every year, if the interest rate is 5%?

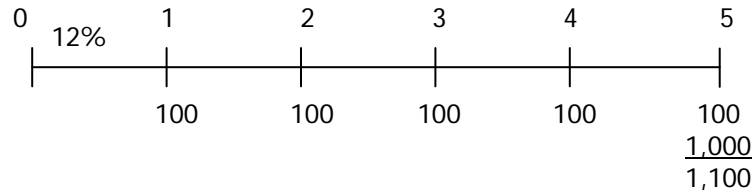
Divide the perpetuity payment by the interest rate to get: $V_p = \$6/.05 = \120 .

Working with Uneven Cash Flow Streams

The basic TVM operations work easily when we have constant periodic payments each period and are solving for a simple PV or FV. However, now we introduce the idea of nonconstant periodic cash flows. Uneven cash flows can take on several different forms, which we will outline here.

Example 11: Annuity plus a lump sum

Assume a security pays the following cash flows:



What is the PV of this security, if the interest rate is 12 percent?

At first, this looks like an ordinary annuity (which we have already learned to find the PV). However, this security has an additional cash flow at the end of its life. Therefore, we need to enter both a PMT of \$100 and a FV of \$1000. There are five equal \$100 payments, so you must enter:

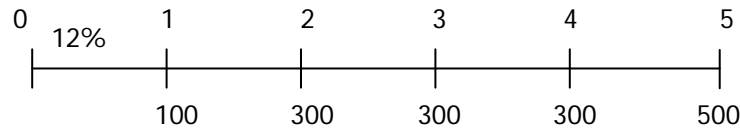
5	<input type="text" value="N"/>
12	<input type="text" value="I/YR"/>
100	<input type="text" value="PMT"/>
1000	<input type="text" value="FV"/>

Then, press , and you get a PV of \$927.90. Notice, both the PMT and FV are entered with the same sign (as positive), because they both represent cash flows received by the investor. A common error in this type of problem is that students will enter that there is a FV of \$1,100 and four payments of \$100 (hence, $N = 4$ and $PMT = 100$). However, this is clearly incorrect as there are five periods to the problem and five payments rendered. The remaining cash flow in year five is the future value that is inputted. Besides, entering $N = 4$ would have suggested that the future value is sitting in year four, which is also wrong.

Similarly, if we are interested in solving for the FV of this uneven cash flow stream, we just have to enter a value of zero for the PV and solve for $FV = \$1,635.28$.

Example 12: Irregular series of uneven cash flows

Assume a security pays the following irregular stream of cash flows:



What is the PV of this security, if the interest rate is 12 percent?

This problem requires us to use something called the cash flow register. The calculator has a feature that allows us to enter a series of input data and perform calculations based upon these data. First, be sure to clear out the calculator's memory. Then enter the following:

0

100

300

300

300

500

These keystrokes tell the calculator to store a cash flow stream (shown above) into its memory. Notice that after each time you enter a cash flow and press the button, a number flashes on the screen that indicates how many values have been entered. For instance, after the first entry, "1.00" flashes on the screen (the number of decimals will depend upon the decimal setting you have given the calculator). After the second entry,

“2.00” will flash onscreen. Once the CFs from the time line are entered, input the interest rate.

10

At this point the HP knows the cash flows, the number of periods, and the interest rate. To find the PV of the cash flows, the NPV function is used by pressing , to get $PV = NPV = \$1016.35$.

The problem could have been solved an alternative method. Since the \$300 cash flow occurs multiple times, we could have used our register to solve for the PV by entering:

0
100
300
3 (tells the calculator that the \$300 cash flow occurs 3 times)
500

10

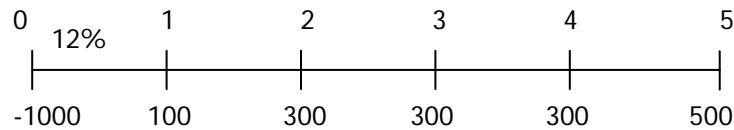
The button allows us to streamline the process of entering cash flows into the cash flow register. It doesn't seem like a big deal here because the problem only lasts for five years, but imagine a security that lasts for thirty years and has reoccurring cash flows that occur 8 or 9 times in a row. Then, this procedure would be very valuable.

Solving for I/YR for an uneven cash flow stream

In the simple TVM set up, solving for the interest rate was easy. We just entered all the input data and solved for I/YR.

Example 13: The Internal Rate of Return of an Investment (IRR)

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



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

	G	CLEAR ALL
1000	+ / -	CF _j
100	CF _j	
300	CF _j	
3	N _j	
500	CF _j	

Press **G** **IRR** to solve for the interest rate of 12.55%

SPECIAL TIME VALUE OF MONEY TOPICS

Thus far, we have assumed that each period in a problem represents a year, and that interest is only calculated once a year. However, these can be dangerous assumptions to make and as the financial language gets more tenuous, the rate of error becomes far greater.

Multiple interest compounding

Often, interest may be compounded on an account more than once a year, and it is then said to have multiple compounding. If compounding occurs twice a year, it is called

semiannual compounding. Four compoundings in a year is called quarterly compounding. We assume that if multiple compoundings occur, the compounding periods are equal. In other words, if there are 12 compoundings, we are assuming an equal amount of time during the year between compoundings, or monthly compounding.

In situations such as these, we may be told that the interest rate on an account is 7 percent, but if we don't know how many times interest is compounded, we don't know much at all. For instance, if the interest is compounded twice a year on a principal of \$100, the actual interest payments would be $\$100 \times (0.035) = \3.50 , and $\$103.50 \times (0.035) = \3.6225 . Therefore, there is a total of $\$7.1225$ in interest paid, which suggests the actual interest earned was $\$7.1225/\$100 = 7.1225$ percent, rather than 7 percent. Therefore, even though the interest rate is stated to be 7 percent (nominal rate), it acts like 7.1225 percent (effective rate), because of the compounding. The following equation is used to convert a nominal rate to an effective rate:

$$EAR = \left(1 + \frac{i_{\text{NOM}}}{m}\right)^m - 1, \text{ } i_{\text{NOM}} \text{ is the stated rate, and } m \text{ is the \# of compoundings}$$

Example 14: Multiple compounding

Given: $i_{\text{NOM}} = 7\%$ and $m = 2$ payments / year, we can solve for the annual effective rate using this formula. However, this formula is programmed into your calculator and it is much easier to convert to the effective rate using the calculator:

7
 2
 = 7.1225% is displayed on the screen.

Similarly, if there are 12 compoundings per year, the effective rate is:

7 **G** **NOM %**
12 **G** **P/YR**
G **EFF %** = 7.2290% is displayed on the screen.

Recall, that the majority of calculator operations require 1 payment per year, so after solving for effective rates and changing the payments per year, it is important to switch back to 1 payment per year: **1** **G** **P/YR**

You will notice that the more often compounding occurs, the higher the effective rate grows. Does the effective rate grow forever, as long as the number of compoundings increases? The answer is no. As the number of compoundings per period approaches infinity (implying continuous compounding), the effective rate and future value calculations converge and the FV of an investment growing at i percent for n years is:

$$FV = PV(e^{i \times n})$$

Loan Amortization

An important application of compound interest involves loans that are paid off in installments over time. Automobile loans, home mortgage loans, student loans, and many business loans are examples of this. If a loan is to be repaid in equal periodic amounts (monthly, quarterly, or annually), it is said to be an amortized loan.

The HP10BII can also be used to calculate amortization schedules. An amortization schedule determines, for each time period, the payments being made, how much pays down the principal, and how much services the interest on the loan.

Example 15: Loan amortization

To illustrate amortization, let's consider a \$100,000 loan that will be paid back with three equal loan payments at the end of the next three years. First, we must solve for the corresponding loan payment.

First, check payments/year and be sure it is set to 1. Now perform the following steps:

	G	CLEAR ALL
3	N	
6	I/YR	
100000	PV	
0	FV	
	PMT	A payment of -\$37,410.98 is displayed.

There are three annual payments of \$37,410.98, both of which cover the interest due and reduce the outstanding loan amount. Although the payments are equal, they pay different amounts of interest and principal. Think about the first payment, the principal outstanding is \$100,000 and the interest rate is 3 percent, so the interest due is $\$100,000 \times 0.06 = \$10,000$. The remaining portion of the payment pays down the principal. Therefore, after the second year, the outstanding principal is less than \$100,000 and hence less than \$10,000 is due in interest. This can be seen in the following table.

<u>Period</u>	<u>Beg. Bal.</u>	<u>Payment</u>	<u>Interest</u>	<u>Princ. Pmt.</u>	<u>Ending Bal.</u>
1	100000.00	37410.98	6000.00	31410.98	68589.02
2	68589.02	37410.98	4115.34	33295.64	35293.38
3	35293.38	37410.98	2117.60	35293.38	0.00

The financial calculator performs all these calculations and creates this table and holds it in its memory. If we want to look at a range of payments, we enter how many payments we want to look at (starting from the first):

1 **INPUT** **G** **AMORT**

“PER 1-1” is displayed.

= Press to see “PRIN”, which is the amount paid towards principal over the first year. Write it into a table as -31410.98.

= Press to see “INT” = -6000.00. This is the amount paid towards interest over the first year. Write it into the table.

= Press to see “BAL” = 68589.02, the balance at the end of the first year.

G **AMORT**

“PER 2-2” is displayed.

= -33295.64 is the principal paid in Year 2.

= -4115.34 is the interest paid in Year 2.

= 35293.38 is the ending balance at end of Year 2.

G **AMORT**

“PER 3-3” is displayed.

= -35293.38 is the principal repayment in Year 3.

= -2117.60 is the interest paid in Year 3.

= 0.00 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:

1 **INPUT** **3** **G** **AMORT**

“PER 1-3” is displayed.

Hold down to see Int, then release and -12232.94 displayed. This is the total interest paid over Years 1 to 3.

Hold down to see Prin, then release and -100,000.00 is displayed. This is the total repayment of principal over Years 1 to 3.

Hold down to see Bal, then release and 0.00 is displayed. This is the remaining balance.

Amortization data can be constructed for any time range. Suppose in a 100-payment loan, we want to analyze the last half of the payments, we would enter 51 , and then enter ate the amortization table.

Partial amortization

In the preceding section we discussed fully amortized loans. However, many loans are set up on a *partial amortization basis*, with a “*balloon payment*” coming due at some date before the loan has been fully amortized. A regular, full amortization schedule would be calculated, but then the balance outstanding at the “balloon date” would be due on that date, when the loan would be said to mature. For example, homebuyers sometimes do not have enough cash to make the required down payment, and the seller agrees to take a note rather than cash to enable the potential buyer to make the purchase.

Example 16: Partial amortization

To illustrate, suppose a house is on the market for \$200,000, and a bank agrees to lend the potential homebuyer \$175,000 secured by a mortgage on the house. Thus, the buyer must come up with \$25,000 to complete the transaction. Now suppose the buyer has only \$5,000, and the seller, who is anxious to sell the house, agrees to take a note with the following terms: a face value of \$20,000, at an 8% interest rate, and with yearly payments

based on a 20-year amortization schedule, *but with the loan maturing at the end of the 10th year*. What value are the annual payments and balloon payment?

The annual payments would be calculated as:

20 **G** **CLEAR ALL**
8 **N**
20000 **I/YR**
0 **PV**
 FV
 PMT A payment of -\$2037.04 is displayed.

Next, with the data still in the calculator, do the following to construct an amortization schedule for the first ten years:

1 **INPUT** 10 **G** **AMORT**

“PER 1-10” is displayed.

Press **=** three times to see the remaining balance of \$13,668.73.

Therefore, the parties have agreed that \$2,037.04 payments will be made every year for ten years, and then the remaining \$13,668.73 will be paid in a balloon payment.

STATISTICAL CALCULATIONS

The HP10BII is also equipped with the ability to perform a number of statistical functions. In this tutorial, we will focus on the statistical functions relating to means, standard deviations, and regression analysis.

Mean and Standard Deviation

<u>Year</u>	<u>Sales</u>
1999	\$150
2000	95
2001	260

What is the mean (average) and standard deviation (σ) of sales over the 3 years?

Use the $\Sigma+$ key to enter data:

	G	CLEAR ALL
150	$\Sigma+$	
95	$\Sigma+$	
260	$\Sigma+$	

Determine the mean and standard deviation by simply pressing

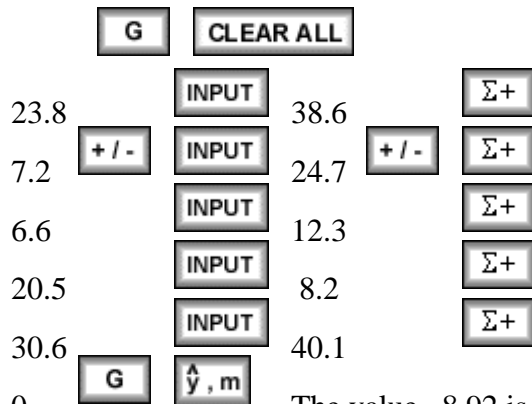
G	\bar{x}, \bar{y}	The mean equals \$168.33
G	S_x, S_y	The standard deviation is \$84.01. S_x and S_y are sample standard deviations. σ_x and σ_y refer to population statistics.

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 the X data is on the horizontal axis (**market**) and Y data is on the vertical axis (**stock**).

<u>Year</u>	<u>Market (k_M)</u>	<u>Stock (k_j)</u>
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:



The value -8.92 is y when $x = 0$, or k_j when $k_M = 0$, which is the vertical axis intercept of the regression line.



The value displayed, 1.60, is the *beta* coefficient.