EXPLORATIONS

CHAPTER 14

When using the TI-83 Plus or TI-84 Plus calculators you access ***Finance*** by pressing the APPS key.

Bonds and Bond Yield to Maturity

A **bond** is a long-term promissory note issued by a corporation. The associated contract, called the bond indenture, specifies that the creditor will receive regular interest payments for the term of the agreement and then receive the **face amount** of the bond. The **coupon rate** is the interest rate.

Example 1:
*A ten-year $1,000 bond promises 6% per year with annual payments of $60 per year (.06 * $1,000) for 10 years. On the maturity date, the lender will be paid the maturity value of $1,000. The total amount that the lender receives is the original $1,000 plus $600 (10 payments of $60 each). Find the market value of the bond.*

The **market value** of a bond is the **present value** (discounted value) of the expected payments (interest and principle).

$$PV = \frac{60}{1.06} + \frac{60}{(1.06)^2} + \ldots \frac{60}{(1.06)^{10}} + \frac{1000}{(1.06)^{10}} = 441.61 + 558.39 = 1000$$

In the above expression, the first ten terms represent the present value of the interest payments. The last term is the discounted value of the $1,000 lump sum payment. The **TVM Solver** will be used twice to compute the market value of the bond.

1. On the calculator, press [2nd] [FINANCE] *(5A)*†, and choose **1:TVM Solver** from the CALC menu. (Figure 1)
2. Because compounding occurs once a year, enter 10 for the number of periods, 6% for the interest rate, 0 for PMT, and -1,000 for FV.
3. Calculate the present value by placing the cursor on PV and pressing [ALPHA] [SOLVE] *(10E)*. (Figure 2)

(Figure 1)

(Figure 2)

The present value of the $1,000 lump sum payment is $558.39.

4. For the present value of the 10 payments of $60 each year, use the **TVM Solver** and input 0 for the FV, and -60 for the PMT per year.
5. Calculate the PV by placing the cursor on PV and press [ALPHA] [SOLVE] *(10E)*. (Figure 3)

(Figure 3)

Notice the sum of $441.61 and $558.39 equals the market value of the $1,000 bond.

† **Refer to the section on Key Arrangement in Chapter 1 for an explanation of the key locator codes used in this manual.**

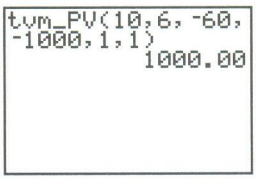
This calculation could have been done in one step with the **TVM Solver**.

6. Set PMT=-60 and FV=-1000. The other values are the same as in the problem above.
7. Place the cursor on PV and press [ALPHA] [SOLVE] *(10E)*. (Figure 4)

(Figure 4)

Another method for calculating the present value is to use the **tvm_PV** command. The syntax for this function is **tvm_PV**(N,I%,PMT,FV,P/Y,C/Y).

(Figure 5)



8. Press [2nd] [QUIT] *(2B)* to return to the Home Screen.
9. Press [2nd] [FINANCE] *(5A)* and choose **4:tvm_PV** from the CALC menu.
10. Enter **tvm_PV(10,6,-60,-1000,1,1)** and press [ENTER]. (Figure 5)

Exploration of Bond Value Versus Current Market Interest Rates

If the current market interest rate is the same as the coupon rate on bonds of similar quality, then the market value of the bond equals the face amount of the bond. If current market interest rates are higher, the market value of the bond is lower and the bond is selling at a discount. If current market interest rates are lower, the market value of the bond is higher and the bond is selling at a premium.

Example 2:
Find the present value of a $1,000 bond paying 8%.

Use the **TVM Solver**.

1. Press [2nd] [FINANCE] *(5A)* and choose **1:TVM Solver**.
2. Enter N=10, I%=8, PMT=-60, FV=-1000, P/Y=1 and C/Y=1.
3. Move the cursor to PV and press [ALPHA] [SOLVE] *(10E)*.

The present value of the bond is $865.80. (Figure 6)

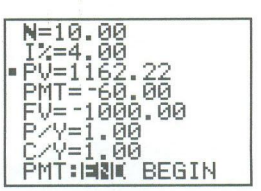
(Figure 6)

Example 3:
If the current market rate for similar bonds is 4%, what should an investor expect to pay for a $1,000, 6% 10-year bond?

1. Press [2nd] [FINANCE] *(5A)* and choose **1:TVM Solver** from the CALC menu.
2. Enter N=10, I%=4, PMT=-60, FV=-1000, P/Y=1 and C/Y=1.
3. Move the cursor to PV and press [ALPHA] [SOLVE] *(10E)*.

The investor should expect to pay $1,162.22. (Figure 7)

(Figure 7)



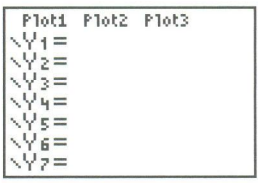
To visualize the impact of interest rate on bond values, explore the graph of the present value of the bond as a function of interest rate.

Let Y_1 be the sum of the present value of the interest payments and the present value of the $1,000 repayment of principle.

Y_1 = **tvm_PV**(10,X,-60,-1000,1,1) where X is the interest rate.

1. To enter the function press the [Y=] key *(1A)*. Use the [CLEAR] key *(4E)* to erase the function in Y_1. (Figure 8)

(Figure 8)

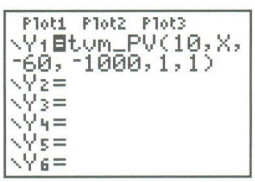


2. Press [2nd] [FINANCE] *(5A)* and choose **4:tvm_PV** from the CALC menu. (Figure 9)

(Figure 9)

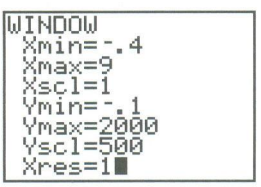
3. Enter the values for the interest payment: **(10,X,-60,-1000,1,1)**. (Figure 10)

(Figure 10)



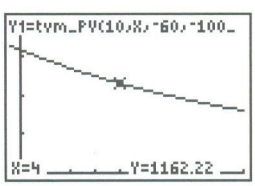
4. Now that the function is entered, press the [WINDOW] key *(1B)*, and enter the values shown. (Figure 11)

(Figure 11)

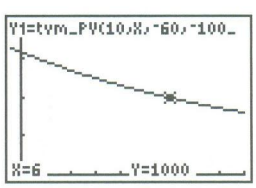


5. Press the [GRAPH] key *(1E)*. Use the [TRACE] key *(1D)* and the arrow keys to explore values. Note both the X and Y values appear on the screen. Again X is the interest rate, and Y is the present value of the bond. (Figures 12 through 14)

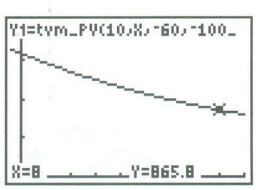
(Figure 12)



(Figure 13)

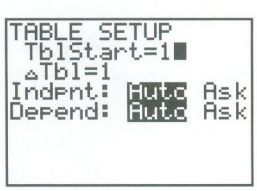


(Figure 14)



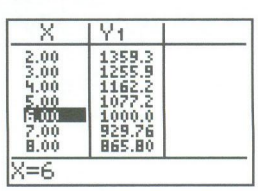
6. To see a table of interest rates and present values, press [2nd] [TBLSET] *(1B)* and set TblStart to 1 and ΔTbl to 1. (Figure 15)

(Figure 15)



7. Press [2nd] [TABLE] *(1E)* to display a table of the present value of the bond at various interest rates. (Figure 16)

(Figure 16)



Example 4:
XYZ Corporation issued a 30-year $1,000 bond in 1985 with a coupon rate of 6.875%. What was it worth in 1993 if the current interest rate for similar investments in 1993 was 8.5%?

1. Press [2nd] [QUIT] *(2B)* to return to the Home Screen.
2. Press [2nd] [FINANCE] *(5A)* and choose **7:npv(** from the CALC menu.

The syntax for this command is **npv**(interest rate, initial cash flow, cash flow list, frequency of cash flow entries). In this example, the cash flow list is $68.75 per year; the last cash flow is principal and interest, or, $1,068.75. The frequency list is {21,1} because $68.75 is used 21 times and $1,068.75 is used once.

3. Enter **npv(8.5, 0, {68.75, 1068.75}, {21,1})**.
4. Press [ENTER].

The net present value in 1993 was $840.59. (Figure 17)

(Figure 17)