CHAPTER 4

Smart *Excel* Appendix

Appendix Contents

Use the Smart *Excel* spreadsheets and animated tutorials at the Smart Finance section of http://www.cengage.co.uk/megginson

EXCEL PREREQUISITES

You need to be familiar with the following *Excel* features to use this appendix:

- The use of cell references in a formula
- Relative cell references
- Absolute and mixed cell references

If this is new to you, be sure to complete the ***Excel Prereqs*** tab of the Chapter 4 *Excel* file before proceeding.

BASIC BOND VALUATION IN *EXCEL*

Annual Interest Payments

Open the Chapter 4 Excel file at the Smart Finance Web site.

Problem: Find the value of a €1,000 par value bond with a coupon rate of 9%, interest paid annually, and 10 years to maturity if the current yield to maturity is 8.25%.

To determine a bond’s price you must design a model to forecast the bond’s cash flows and calculate the present value of these cash flows. Remember the components of a basic model: inputs, calculations, and output. The output is the bond’s price. The inputs are the assumptions regarding coupon rate, par value, time to maturity, and current yield to maturity. Use the inputs to calculate the bond’s cash flows and determine the present value of the cash flows.

We will create models to solve the problem, using two different approaches: the present-value function built into *Excel* and the mathematical formula approach.

Recall from the Chapter 3 appendix the four steps in building a basic financial model.

Step 1: Determine the desired output and select an approach to calculate it (mathematical formula or *Excel* function).
Step 2: Set up an area for input assumptions (done for you in this *Excel* file).
Step 3: Build a formula to calculate output by **USING CELL REFERENCES**, not by typing in the actual numbers.
Step 4: Change the input assumptions, as desired, and analyze the effect on output.

Consider the five key variables here:

Present value	You are solving for the present value or bond price.
Future value	the bond's par value of €1,000
Payment	the annual interest payment of 9%
Rate	the current yield to maturity of 8.25%
Number of periods	10 years

Approach 1: Use the present-value function in*Excel*.

Valuing bonds using the present-value function in *Excel* is straightforward. The function has the following format:

=pv(rate,nper,pmt,fv,type)

Type allows for payment at the beginning (if type = 1) or at the end (if type = 0) of the year. If type is omitted, the default is year-end cash flows.

1. On the ***Bond basics*** tab of the Chapter 4 *Excel* file, fill in the input assumptions.
2. Under Calculations, create a formula for the coupon payment by multiplying the par value times the coupon rate.
3. Under Output, use the present-value function to find the bond price.

Solutions are provided in the file. The formula result is –€1,049.76.

The sign is negative because the bond's price represents cash outflow for an investor who buys the bond and receives the interest and principal payments over the next 10 years.

Apply it

Change the input assumptions and analyze the effect.

- *Suppose the yield to maturity is 9.5% instead of 8.25%.*
  As rates rise, bond values fall. At 9.5%, the bond value is €968.61.
- *Suppose the time to maturity is 25 years instead of 10 years (leave YTM at 8.25%).*
  The bond price is €1,078.38.

Approach 2: Use the mathematical formula.

Equation 4.2 in the chapter shows the formula for a bond's price as the present value of the future cash flows from interest payments and par value.

1. On the ***Bond basics*** tab of the Chapter 4 *Excel* file, fill in the input assumptions.

Your input section should look like this:

Inputs

Enter the inputs
Par value €1,000.00
Coupon rate 9%
\# periods 10
Yield to maturity 8.25%

2. Next, begin the calculations section by inserting the years, beginning with Year 0. Simply type in the number; do not type the word, Year.
3. In the Year 1 column, create a formula for the annual coupon interest payment, using cell references. Remember to use absolute cell references, as needed (see the prerequisites tab if you are not familiar with absolute cell references). Copy this formula across for the life of the bond.

   The formula is =par value * coupon rate
   =$C$44*$C$45

4. In the final year, use a cell reference for the par value.
5. Create a formula using cell references to sum the cash flows in Year 1 and copy across for the life of the bond.
6. Create a formula to find the present value of each year's cash flows. Again, use absolute cell references, as needed.

   The formula in Year 1 is =total cash flow / (1 + YTM) ^ Year #
   =D53/(1+$C$47)^D50

   When complete, your calculations section should look like this:

Calculations

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Coupon payment		€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	
Principal payment												€1,000.00
Total cash flow		€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	€90.00	€90.00		€1.090.00

PV of cash flow €83.14 €76.80 €70.95 €65.54 €60.55 €55.93
€51.67 €47.73 €44.10 €493.34

The last row shows the present value of each year's cash flows. The sum of these values is the bond price.

7. In the output section, create a formula to find the bond's price by summing the present values.

All solutions are provided in the* Excel *file so you can check your result against the solution. The bond's price is €1,049.76.

You should get the same result as in the first approach.

Now try changing the input assumptions as you did with Approach 1.

Data Tables and Graphs

In the Chapter 3 appendix, we illustrate how to create data tables and graphs. Applications to bond valuation are provided in the Chapter 4 file on the Data table and Graph tabs.

BOND VALUATION WITH SEMIANNUAL INTEREST PAYMENTS

Now consider a bond that pays interest semiannually. Again, solve the following problem using the two different approaches: the present-value function built into *Excel* and the mathematical formula.

Problem: Find the value of a €1,000 par value bond with an annual coupon rate of 7% and four years to maturity if the current yield to maturity is 7.75%. What if interest is paid semiannually instead of annually?

Approach 1: Use the present-value function in*Excel*.

Again, use the present-value function but adapt it to handle semiannual payments.

=pv(rate,nper,pmt,fv,type)

To use the present-value function with semiannual interest payments, adjust the rate, the number of periods, and the payment to semiannual numbers. We do this in the calculation section.

For bonds paying interest semiannually:

Rate: The six-month rate is one half of the YTM.
Nper: The number of six-month periods is two times the number of years.
Pmt: The semiannual interest payment is one half the annual interest payment.
FV: Par value is not affected.

This problem is set up on the ***Semibond*** tab of the Chapter 4 *Excel* file.

Formula result: €974.62

Approach 2: Use the mathematical formula.

1. On the ***Semibond*** tab of the Chapter 4 *Excel* file, fill in the input assumptions.

2. Next, insert the number of periods rather than years under calculations, beginning with Period 0. There will be eight periods on a 4-year bond with semiannual interest.
3. In the Year 1 column, create a formula for the semiannual coupon interest payment, using cell references. Remember to use absolute cell references, as needed (see the prerequisites tab if you are not familiar with absolute cell references). Copy this formula across for the life of the bond.
4. In the final period, use a cell reference for the par value.
5. Create a single formula to sum the cash flows in each period and copy across for the life of the bond.
6. Create a formula to find the present value of each period's cash flows. Again, use absolute cell references, as needed. The key difference here is to use the yield to maturity divided by 2 to discount.

The formula to find present value in Year 1 in cell D55 is

=total cash flow / (1 + YTM) ^ Year #
=D54/(1+$C$48/2)^D51

When complete, your calculations section should look like this:

Calculations

6-month period	0	1	2	3	4	5	6	7	8
Coupon payment		€35.00	€35.00	€35.00	€35.00	€35.00	€35.00	€35.00	€35.00
Principal payment									€1,000.00
Total cash flow		€35.00	€35.00	€35.00	€35.00	€35.00	€35.00	€35.00	€1,035.00
PV of cash flow		€36.69	€32.44	€31.23	€30.06	€28.94	€27.86	€26.82	€763.58

7. In the output section, create a formula to find the bond's price by summing the present values.

   Again, you should find that the bond's price is €974.62.

YIELD TO MATURITY

It is simple to find yield to maturity on a bond, using *Excel*'s rate function.

Problem: Find the yield to maturity of a 5-year €1,000 par value bond with a coupon rate of 9.5% and a current price of €1,145. Solve for both annual and semi-annual payments of interest. Does the yield differ with the timing of interest payments?

Approach 3: Use the rate function in *Excel*.

The rate function can be used to solve for the yield to maturity on a bond. The format of the function is

```
=rate(nper,pmt,pv,fv)
```

For the bond paying interest annually, the solution is straightforward. Remember, the present value must be entered as a negative number.

The yield to maturity is 6.05%.

For the bond paying interest semiannually, you must adapt to handle semiannual payments and periods. Again use the rate function, but nper is the number of six-month periods, and pmt is the semiannual interest payment.

The resulting yield to maturity will be a six-month rate, so it MUST BE DOUBLED to find the actual yield to maturity.

In the model, we handle this by using the following equation:

```
=rate(nper,pmt,pv,fv)*2
```

This problem is set up on the **YTM** of the Chapter 4 *Excel* file. **The formula result is 6.09%.**

Apply it

Why is the semiannual YTM higher than the annual YTM?
Intuitively, if two bonds have the same discount rate and pay the same cash flow, but one bond pays sooner than the other, then the bond paying sooner should have a higher price. But in this example, we created the problem with the assumption that both bonds had the same price—€1,145. The two bonds have the same cash flow, but because the semiannual bond pays sooner, it has a higher resulting yield.