

4.11: Problems

? Problem 4.11.1

Find the price for a 7.5% coupon bond under the following conditions.

- a. 30 years to maturity, required return is 9%
- b. 30 years to maturity, required return is 7.5%
- c. 30 years to maturity, required return is 6%
- d. 10 years to maturity, required return is 9%
- e. 10 years to maturity, required return is 7.5%
- f. 10 years to maturity, required return is 6%
- g. 2 years to maturity, required return is 9%
- h. 2 years to maturity, required return is 7.5%
- i. 2 years to maturity, required return is 6%

Answer

Part 1a

Step 1: 60 N
Step 2: 9 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV⇒ \$845.21

Part 1b

Step 1: 60 N
Step 2: 7.5 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV⇒ \$1,000.00

Part 1c

Step 1: 60 N
Step 2: 6 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV⇒ \$1,207.57

Part 1d

Step 1: 20 N
Step 2: 9 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV⇒ \$902.44

Part 1e

Step 1: 20 N
Step 2: 7.5 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV⇒ \$1,000.00

Part 1f

Step 1: 20 N
Step 2: 6 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV \Rightarrow \$1,111.58

Part 1g

Step 1: 4 N
Step 2: 9 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV \Rightarrow \$973.09

Part 1h

Step 1: 4 N
Step 2: 7.5 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV \Rightarrow \$1,000.00

Part 1i

Step 1: 4 N
Step 2: 6 I/Y
Step 3: 1000 FV
Step 4: 37.50 PMT
Step 5: PV \Rightarrow \$1,027.88

? Problem 4.11.2

The current price of a 4.25% coupon bond with 10 years to maturity is \$918.23, what is the YTM?

Answer

Step 1: 20 N
Step 2: -918.23 PV
Step 3: 1000 FV
Step 4: 21.25 PMT
Step 5: I/Y \Rightarrow 5.31%

? Problem 4.11.3

The current price of a 9.75% coupon bond with 20 years to maturity is \$1318, what is the YTM? If the bond contains a call provision that allows the company to call the bond for \$1050 7-years from now, what is the YTC? Based on the available information, is this bond likely to be called?

Answer

Yield to Maturity

Step 1: 40 N
Step 2: -1318 PV
Step 3: 1000 FV

Step 4: 48.75 PMT
Step 5: I/Y \Rightarrow 6.81%

Yield to Call

Step 1: 14 N
Step 2: -1318 PV
Step 3: 1050 FV
Step 4: 48.75 PMT
Step 5: I/Y \Rightarrow 4.93%

Since the YTC is less than the YTM, this bond is likely to be called based on information available today. Note that the interest rate environment may change before the call date arrives in 7 years which may cause the YTC and YTM to change. Therefore, we are not saying the bond WILL be called, only that it is LIKELY to be called. An investor should buy this bond only if he or she is happy with the 4.89% rate of return that would be earned if the bond was called in 7 years.

? Problem 4.11.4

Find the price of a 20-year zero coupon bond if the required return on such a bond was 12%? What if the required return was 10%

Answer

NOTE – Even though zero coupons don't pay a semi-annual coupon payment (they actually pay no coupon payment) we are using the semi-annual convention – 2 P/Y – to keep consistent with regular coupon bond valuation.

Price with a 12% required return

Step 1: 40 N
Step 2: 12 I/Y
Step 3: 1000 FV
Step 4: 0 PMT
Step 5: PV \Rightarrow \$97.22

Price with a 10% required return

Step 1: 40 N
Step 2: 10 I/Y
Step 3: 1000 FV
Step 4: 0 PMT
Step 5: PV \Rightarrow \$142.05

? Problem 4.11.5

Ten years ago you purchased a 30-year 9% coupon bond. At that time, the market rate of interest was 6.5%. Today, you sell the bond (the current market rate of interest is 10.5%).

- How much did you pay for the bond when you purchased it 10 years ago?
- How much can you sell the bond for today?
- What rate of return did you earn on your investment over the 10-year period that you held the bond?

Answer

Part 5a

It is important to recognize that the value of the bond is the present value of remaining cash flows. At the time of purchase, the bond had 30 years until maturity and this is when we purchased it. This means the value at the time it was purchased should be based on the 30 years until maturity (60 semi-annual periods).

Step 1: 60 N
Step 2: 6.5 I/Y
Step 3: 1000 FV
Step 4: 45 PMT
Step 5: PV \Rightarrow \$1,328.17

Part 5b

Since you purchased the bond 10 years ago when it had 30 years to maturity, there are now 20 years (40 semi-annual periods) remaining until maturity.

Step 1: 40 N
Step 2: 10.5 I/Y
Step 3: 1000 FV
Step 4: 45 PMT
Step 5: PV \Rightarrow \$875.59

Part 5c

Now, it is no longer a bond pricing problem, but a time value of money problem. You paid \$1328.17 ten years (20 periods) ago, you received \$45 twice per year in coupon payments, and today you sold the bond for \$875.59 \Rightarrow Solve for your return.

Step 1: 20 N
Step 2: -1328.17 PV
Step 3: 875.59 FV
Step 4: 45 PMT
Step 5: I/Y \Rightarrow 3.97%

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