

**Exercise Set 7**

1. My pension plan will pay me $20,500 once a year for a 10-year period. The first payment will come in exactly 5 years. The pension fund wants to immunize its position:
   1. What is the duration of its obligation to me? The current interest rate is 10% per year.
   2. If the plan uses 5-year and 20-year zero-coupon bonds to construct the immunized position, how much money ought to be placed in each bond? What will be the face value of the holdings in each zero?
2. A bond with 7 years maturity and modified duration of 3.5 is currently trading at 120. What is the expected bond price if interest rates increase 0.5%? Ignore convexity effects.
3. Consider a 10-year zero coupon bond with a yield of 12%. If the market yield increases by 50 basis points, what will be the actual percentage change in the bond’s price? Present both a first and second order approximation of the change in price and compare them to the actual change in the price.
4. Find the duration of a 8% coupon bond making annual coupon payments if it has 3 years until maturity and has a yield to maturity of 8%. What is the duration if the yield to maturity is 12%? Explain the differences in duration you find.
5. Which of the following is not true?
   1. Ceteris paribus, the duration of a bond increases with time to maturity.
   2. Given time to maturity, the duration of a zero-coupon decreases with yield to maturity.
   3. Given time to maturity and yield to maturity, the duration of a bond is higher when the coupon rate is lower.
   4. Duration is a better measure of price sensitivity to interest rate changes than is time to maturity.
   5. All of the options.
6. The basic purpose of immunization is to:
   1. eliminate default risk.
   2. produce a zero net-interest-rate risk by offsetting price and default risk between assets and liabilities.
   3. offset price and liquidity risk.
   4. eliminate default risk and produce a zero net-interest-rate risk.
   5. produce a zero net-interest-rate risk by offsetting price and reinvestment risk between assets and liabilities.
7. An insurance company must make payments to a customer of 10 million in 1 year and 6 million in 5 years. The yield curve is flat at 8%.
   1. If the company wants to fully fund and immunize its obligation to this customer with a single issue of a zero-coupon bond, what maturity must it purchase?
   2. What must be the face value and market value of that zero-coupon bond?
8. My pension plan will pay me €12,000 once a year for a 10-year period. The first payment will come in exactly 5 years. The pension fund wants to immunize its position
   1. What is the duration of the pension fund’s obligation to me? The current interest rate is 12% per year.
   2. If the plan uses 5-year and 20-year zero-coupon bonds to construct the immunized position, how much money ought to be placed in each bond?
   3. What will be the face value of the holdings in each zero?
9. If interest rates change by 50bp what would be the new approximate price of a par value bond with a coupon rate of 8% paid annually and a remaining time to maturity of 5 years? Estimate the new price using both a first order and a second order approximation. Compare the obtained results.