Question guide

- Questions 7.1 – 7.11 test material from Sections 7.1 – 7.4
- Questions 7.12 – 7.18 test material from Sections 7.5 – 7.8
- Questions 7.19 – 7.20 are from the SOA Course 6 exam

Question 7.1

A 4-year bond pays annual coupons of 8%. The annual effective yield on the bond is 5%. Calculate the modified duration of the bond.

Question 7.2

The current price of a bond is \$114.72 and the current yield is 6.00%. The modified duration of the bond is 7.02. Use the modified duration to estimate the price of the bond if the yield increases to 6.10%.

Question 7.3

A zero-coupon bond matures in 20 years for \$1,500. The bond's yield is 4% compounded semiannually. Calculate the modified duration of the bond.

Question 7.4

A two-year bond has 8% annual coupons payable semiannually. The bond's yield is 10% compounded semiannually. Calculate the modified duration of the bond.

Question 7.5

A zero-coupon bond matures in 15 years for \$2,000. The bond's yield is 7% compounded monthly. Calculate the Macaulay duration of the bond.

Question 7.6

Determine the modified duration of the zero-coupon bond in the preceding question.

Question 7.7

A 22-year bond pays 7% annual coupons and has a current price of \$81.12. The annual effective yield on the bond is 9%. The Macaulay duration of the bond is 10.774. Estimate the new price if the yield falls to 8.95%.

Question 7.8

A 30-year bond pays 6% annual coupons payable semiannually. The bond's yield is 6% compounded semiannually. Calculate the modified duration of the bond.

Question 7.9

A 15-year mortgage is repaid with level monthly payments. The yield is 12% compounded monthly. Calculate the Macaulay duration of the mortgage.

Question 7.14

A perpetuity pays \$1 at the end of each year. The annual effective yield is 5%. Calculate the price, modified duration, and convexity of the perpetuity.

Question 7.17

An insurance company has committed to making a payment of \$100,000 in 10 years. In order to fund this liability, the company has invested \$27,919.74 in a 5-year zero-coupon bond and \$27,919.74 in a 15-year zero-coupon bond. The annual effective yield on all assets and liabilities is 6%. Determine whether the company's position is immunized.

Question 7.18

An insurance company has committed to making a payment of \$100,000 in 5 years. The insurance company can fund this liability only through the purchase of 4-year zero-coupon bonds and 10-year zero-coupon bonds. The annual effective yield for all assets and liabilities is 12%. Determine how much the bank should invest in each bond in order to immunize its position.

Chapter 7: Duration, convexity and immunization

Q7.1: 3.428

Q7.2: \$113.915

Q7.3: 19.608

Q7.4: 1.7955

Q7.5: 15

Q7.6: 14.913

Q7.7: \$81.52

Q7.8: 13.8378

Q7.9: 5.414

Q7.14: The price is \$20.0, the modified duration is 20.0, and the convexity is 800.0.

Q7.17: The company's position is immunized.

Q7.18: The company invests \$47,285.58 in the 4-year bond and \$9,457.12 in the 10-year bond.