Section 6 Examples

1. An insurance company is making annual payments under the settlement provisions of a personal injury lawsuit. A payment of 24,000 has just been made and ten more payments are due. Future payments are indexed to the Consumer Price Index which is assumed to increase at 5% per year. Find the present value of the remaining obligation if the rate of interest assumed is 8%.

a. 202,325 b. 204,725 c. 206,225 d. 210,875 e. 212,125

2. Consider a yield curve defined by the following equation:

$i_k = 0.09 + 0.002k - 0.001k^2$ where i_k is the annual effective rate of return for zero coupon bonds with maturity of k years.

Let j be the one-year effective rate during year 5 that is implied by this yield curve.

Calculate j.

a. 4.7% b. 5.8% c. 6.6% d. 7.5% e. 8.2%

3. A bond will pay a coupon of 100 at the end of each of the next three years and will pay the face value of 1000 at the end of the three-year period. The bond's duration (Macaulay Duration) when valued using an annual effective interest rate of 20% is X.

Calculate X.

a. 2.61 b. 2.70 c. 2.77 d. 2.89 e. 3.00

4. John purchased three bonds to form a portfolio as follows:

Bond A has semiannual coupons at 4%, a duration of 21.46 years, and was purchased for 980.

Bond B is a 15 year bond with a duration of 12.35 years and was purchased for 1015.

Bond C has a duration of 16.67 years and was purchased for 1000.

Calculate the duration (in years) of the portfolio at the time of purchase

a. 16.62 b. 16.67 c. 16.72 d. 16.77 e. 16.82

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5. The current price of an annual coupon bond is 100. The derivative of the price of the bond with respect to the yield to maturity is –700. The yield to maturity is an annual effective rate of 8%.

Calculate the duration of the bond.

a. 7.00 b. 7.49 c. 7.56 d. 7.69 e. 8.00

6. An insurance company accepts an obligation to pay 10,000 at the end of each year for 2 years. The insurance company purchases a combination of the following two bonds at a total cost of X in order to exactly match its obligation:

(i) 1-year 4% annual coupon bond with a yield rate of 5%
(ii) 2-year 6% annual coupon bond with a yield rate of 5%

Calculate X.

a. 18,564 b. 18,574 c. 18,584 d. 18,594 e. 18,604

7. Liability payments of $2,000 and $1000 are due at the end of years 2 and 4, respectively. Assets that pay $X in 1 year and $Y in 3 years have the same present value and Macaulay duration as the liabilities. Interest is at an annual effective rate of 10%.
Find X.

a. 533 b. 678 c. 823 d. 968 e. 1113

8. A single liability payment of 6000 due in 3 years is to be fully immunized at an annual effective interest rate of 6% using asset payments of X at the end of 1 year and Y at the end of 4 years. Let E denote the excess at the time the liability is due if the interest rate is changed to 4% annual effective and let F denote the excess at the time the liability is due if the interest rate is changed to 8% annual effective. Determine the sum $E + F$.

a. 4.3 b. 7.1 c. 12.8 d. 17.2 e. 25.3

Section 6 Key

1. C
2. A
3. B
4. D
5. C
6. D
7. A
8. A