

LO.a: Calculate and interpret the sources of return from investing in a fixed-rate bond.

1. Mr. Harris is a buy-and-hold investor who mainly deals in fixed income securities. What will be the *most likely* impact on the returns of his fixed income portfolio, if the market interest rates are lower in future?
 - A. Returns will not change.
 - B. Returns will be higher.
 - C. Returns will be lower.
2. Which of the following is *least likely* to be an assumption for the concept that the yield to maturity at the time of purchase measures the investor's rate of return?
 - A. The investor holds the bond to maturity.
 - B. The investor does not default.
 - C. The investor reinvests the coupon interest payments at varying interest rates.
3. If a bond, bought at a discount, is held to maturity; which of the following is *least likely* to be incorporated for the total return calculation?
 - A. Capital gains earned.
 - B. Coupon payments reinvested.
 - C. Principal repaid.
4. A & B are two identical bonds except for their coupon rates. The bond that will have the lowest interest rate risk *most likely* has the:
 - A. lowest coupon rate.
 - B. highest coupon rate.
 - C. coupon rate significantly different from YTM.
5. An investor purchased 9% annual pay bond with maturity of 3 years and face value of \$1,000 at the current market price of \$1,025.78. The investor plans to hold the bond till maturity. What is the expected annualized holding period return? What is the future value of reinvested coupons?
 - A. 7%, 290.45.
 - B. 8%, 292.18.
 - C. 10%, 291.45.
6. A horizon yield is the internal rate of return between the total return and the:
 - A. purchase price of the bond.
 - B. redemption price of the bond.
 - C. capital gain on the bond.
7. Bond A has a maturity of 8 years. Bond B has a maturity of 4 years. All else equal:
 - A. bond A will have higher reinvestment risk.
 - B. bond B will have higher reinvestment risk.
 - C. both bonds will have the same reinvestment risk.
8. Bond A has a coupon rate of 10%. Bond B has a coupon rate of 5%. All else equal:

- A. bond A will have higher reinvestment risk.
 - B. bond B will have higher reinvestment risk.
 - C. both bonds will have the same reinvestment risk.
9. Holding all other characteristics the same, the bond exposed to the lowest level of reinvestment risk is *most likely* the one selling at:
- A. par.
 - B. premium.
 - C. discount.
10. Analyst 1: If the investment horizon is short, reinvestment risk will dominate the market price risk.
Analyst 2: If the investment horizon is short, market price risk will dominate the reinvestment risk.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Neither of them.
11. Investor A is a long-term bond investor. Investor B is a short-term bond investor. If the market interest rates are lower in future:
- A. investor A will gain the most.
 - B. investor B will gain the most.
 - C. both investors will have similar gains.
12. Miss Williamson is long term investor. She recently purchased a 10-year, 8% annual coupon payment bond and plans to hold it till maturity. What will be the *most likely* impact on the returns of this bond, if the market interest rates are higher in future?
- A. Return will be lower.
 - B. Return will not change.
 - C. Return will be higher.

LO.b: Define, calculate, and interpret Macaulay, modified, and effective durations.

13. A fixed-income security's current price is \$102.50. The manager estimates that the price will rise to \$104.25 if interest rates decrease by 0.50% or fall to \$101.25 if interest rates increase by 0.5%. The security's effective duration is *closest* to:
- A. 2.93%.
 - B. 3.00%.
 - C. 29.3%.
14. A bond with a par value of \$1,000 matures in 12 years with a coupon of 12% paid semiannually; it is priced to yield 13% and has a modified duration of 8.50. If the yield of the bond declines by 0.5%, the approximate percentage price change for the bond is *closest* to:
- A. -4.25%.
 - B. 4.25%.

- C. 8.50%.
15. Consider a 7% coupon bond with annual payments and a maturity of 4 years. The face value of the bond is \$1,000 and the current market yield is 6%. The Macaulay duration for this bond is *closest* to:
- A. 3.1563.
 - B. 3.7954.
 - C. 3.6314.
16. Which of the following is *most likely* to be incorrect about investment horizon, Macaulay duration, and interest rate risk?
- A. When the investment horizon is greater than the Macaulay duration of a bond, coupon reinvestment risk dominates the market price risk.
 - B. When the investment horizon is less than the Macaulay duration of a bond, the investor's risk is to lower interest rates.
 - C. When the investment horizon risk is equal to the Macaulay duration of a bond, the coupon reinvestment risk offsets market price risk.
17. Which of the following is *least likely* to be a type of bond duration?
- A. Curve.
 - B. Spot.
 - C. Yield.
18. Given that the Macaulay duration of an 8% annual payment bond with a 7% yield is 6.5, which of the following is *most likely* to be the modified duration?
- A. 6.02.
 - B. 6.07.
 - C. 7.00.
19. Owing to a yield change of 50 bps, the price of the bond increases and decreases to \$102.86 and \$101.31. Given that the current price of the bond is \$102.00, which of the following is *most likely* to be the approximate modified duration?
- A. 1.02.
 - B. 1.52.
 - C. 3.04.
20. Which of the following is *least likely* to be used for the calculation of effective duration?
- A. Change in bond's yield to maturity.
 - B. Change in benchmark yield curve.
 - C. Original price of the bond.
21. An investor wants to see how bond prices move with small changes in yield. The measure he will *most likely* use is:

- A. Macaulay duration.
 - B. modified duration.
 - C. accelerated duration.
22. A bond is purchased at a price above par value. The carrying value of this bond will *most likely* be equivalent to the purchase price:
- A. minus the amortized amount of the premium.
 - B. plus the amortized amount of the premium.
 - C. minus the amortized amount of the discount.
23. A 10 year bond with face value of \$10,000 and 6% annual coupon is currently trading at par. If the yield decreased by 20 basis points the price would increase to \$10,148.61. If the yield increased by 20 basis points the price would decrease to \$9,854.18. What is the approximate modified duration of this bond?
- A. 6.36.
 - B. 7.36.
 - C. 8.36.
24. Analyst 1: Yield duration statistics measure the sensitivity of a bond's full price to the bond's own yield to maturity.
Analyst 2: Curve duration statistics measure the sensitivity of a bond's full price to the benchmark yield curve.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Both.
25. A bond with a Macaulay duration of 10 years, a yield to maturity of 8% and semiannual payments will have a modified duration of:
- A. 8.45 years.
 - B. 9.62 years.
 - C. 10 years.
26. Which of the following statements about duration is incorrect? A bond's:
- A. effective duration is a measure of curve duration.
 - B. modified duration is a measure of yield duration.
 - C. Macaulay duration cannot be larger than its modified duration.
27. Analyst 1: Modified duration is useful and accurate for small changes in yield but it is not useful and accurate for larger changes in yield.
Analyst 2: Modified duration is useful and accurate for large changes in yield but it is not useful and accurate for small changes in yield.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Neither of them.

LO.c: Explain why effective duration is the most appropriate measure of interest rate risk for bonds with embedded options.

28. A measure that is *most* appropriate to price bonds with embedded options is:
- A. modified duration.
 - B. Macaulay duration.
 - C. effective duration.
29. Analyst 1: In general, the modified duration and effective duration of a traditional option-free bond are identical.
Analyst 2: In general, the modified duration and effective duration of a traditional option free bond are not identical.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Neither of them.
30. Which of the following statements is *least accurate*?
- A. Effective duration is the appropriate duration measure for a callable bond.
 - B. The duration of a callable bond is the sensitivity of the bond price to change in the yield-to-worst.
 - C. A callable bond does not have a well-defined internal rate of return, hence modified and Macaulay duration cannot be used.

LO.d: Define key rate duration and describe the key use of key rate durations in measuring the sensitivity of bonds to changes in the shape of the benchmark yield curve.

31. Analyst 1: The interest rate risk is the sensitivity of a bond to parallel shifts of the yield curve. The yield curve risk is a bond's sensitivity to changes in the shape of the yield curve.
Analyst 2: The yield curve risk is the sensitivity of a bond to parallel shifts of the yield curve. The interest rate risk is a bond's sensitivity to changes in the shape of the yield curve.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Neither of them.
32. A bond duration is a measure of the sensitivity of:
- A. a bond's full price excluding accrued interest to a change in interest rate.
 - B. a bond's full price including accrued interest to a change in interest rate.
 - C. a bond's full price to a change in time to maturity.
33. The sensitivity of bond to changes in a single spot rate, holding all other spot rates constant is:
- A. effective duration.
 - B. modified duration.

C. key rate duration.

LO.e: Explain how a bond's maturity, coupon, and yield level affect its interest rate risk.

34. A zero coupon bond with a time to maturity of 5 years has an YTM of 8%. Its Macaulay duration is:
- A. 5 years.
 - B. 8 years.
 - C. cannot be determined.
35. As interest rates go up, the future value of reinvested coupon payments:
- A. decreases.
 - B. increases.
 - C. remains unchanged.
36. Which of the following is *most likely* to reduce a duration measure? Assume that a premium bond is being considered.
- A. Lower coupon rate.
 - B. Lower yield to maturity.
 - C. Shorter time to maturity.
37. For a single coupon bond with constant yield as time passes during the coupon period,:
- A. Macaulay duration rises steadily until a coupon payment results in a downwards jump.
 - B. Macaulay duration declines steadily until a coupon payment results in an upwards jump.
 - C. Macaulay duration is a flat line.
38. The plot of Macaulay duration against time of a perpetual bond:
- A. is upward sloping.
 - B. is downward sloping.
 - C. is flat.
39. Bond A has a coupon rate of 8%. Bond B has a coupon rate of 5%. All else equal:
- A. bond A will have the higher Macaulay duration.
 - B. bond B will have the higher Macaulay duration.
 - C. both bonds will have the same Macaulay duration.
40. Bond A has a yield to maturity of 5%. Bond B has a yield to maturity of 7%. All else equal:
- A. bond A will have the higher Macaulay duration.
 - B. bond B will have the higher Macaulay duration.
 - C. both bonds will have the same Macaulay duration.
41. Analyst 1: Time-to-maturity and Macaulay duration are usually positively related.
Analyst 2: Time-to-maturity and Macaulay duration are usually negatively related.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.

C. Neither of them.

LO.f: Calculate the duration of a portfolio and explain the limitations of portfolio duration.

42. Which of the following is *not* a limitation of weighted average duration as a measure of portfolio interest rate risk? Duration:
- A. changes over time.
 - B. is just an approximation.
 - C. assumes a non-parallel shift in the yield curve.

43. A portfolio manager holds the following three bonds, which are option free and have the indicated durations.

Bond	Par Value Owned	Market Value Owned	Duration
1	₹ 4,000,000	₹ 6,000,000	3
2	₹ 3,000,000	₹ 2,000,000	5
3	₹ 2,000,000	₹ 4,000,000	7

The portfolio's duration is *closest* to:

- A. 3.5.
 - B. 4.6.
 - C. 6.5.
44. An investor has three bonds in his portfolio. Bond A has a market value of \$250,000 and duration of 9. Bond B has market value of \$190,000 and duration of 10. Bond C has market value of \$300,500 and duration of 7. The portfolio duration for this investor is *closest* to:
- A. 8.445.
 - B. 7.445.
 - C. 9.445.
45. Which of the following is *not* a way to calculate the duration of a bond portfolio?
- A. Weighted average of the time to receipt of the aggregate cash flows.
 - B. Weighted average of the time to maturity of the individual bonds.
 - C. Weighted average of the durations of the individual bonds.
46. Analyst 1: The 'weighted average of the durations of individual bonds' method to calculate portfolio duration is simple to use and quite accurate when the yield curve is flat.
Analyst 2: The main limitation of the 'weighted average of the durations of individual bonds' method to calculate portfolio duration is that it assumes a parallel shift in the yield curve.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Both.

47. The following table provides information about a portfolio of three bonds:

Bond	Par Value	Price	Maturity	Duration
A	PKR 320 million	PKR 105	15	10

B	PKR 160 million	PKR 103	12	8
C	PKR 180 million	PKR 98	10	7

Based on this information, the duration of the portfolio is *closest* to:

- A. 9.69.
- B. 8.73.
- C. 12.97.

48. Which of the following is *not* a limitation of the 'weighted average of the time to receipt of aggregate cash flow' approach to calculate portfolio duration?

- A. This method cannot be used for bonds with embedded options.
- B. The change in cash flow yield is not necessarily the same as the change in the yields to maturity on the individual bonds.
- C. Interest rate risk is usually expressed as a change in the cash flow yield.

LO.g: Calculate and interpret the money duration of a bond and price value of a basis point (PVBP).

49. The price value of a basis point is an estimate of a change in the full price of the bond given a:

- A. 1 bp change in the coupon rate.
- B. 1 bp change in the price of the bond.
- C. 1 bp change in the yield to maturity.

50. A bond has a coupon of 7%, market value of \$3.5 million, maturity of 8 years, modified duration of 6.3, and a full price of \$103.25, per \$100 of face value. The money duration of the bond is *closest* to:

- A. \$650.47.
- B. \$50.4.
- C. \$722.75.

51. The following table shows details for a bond.

Par	PVFlat	PVFull	ModDur	EffDur
\$100	\$101	\$104	7.44	7.39

Which of the following is *most likely* to be the approximate money duration (MoneyDur) of the bond?

- A. 751.
- B. 769.
- C. 774.

52. The money duration of a bond is \$200,000. If the yield increases by 20 basis points, the change in price of the bond will be *closest* to:

- A. -\$40,000.
- B. -\$400.
- C. -\$4,000.

53. A bond with exactly six years remaining until maturity offers a 2% coupon rate with annual coupons. The bond, with a yield to maturity of 4% is priced at \$89.5157 per 100 of par value. The estimated price value of a basis point for the bond is *closest* to:
- A. 0.142.
 - B. 0.086.
 - C. 0.049.

LO.h: Calculate and interpret approximate convexity and distinguish between approximate and effective convexity.

54. If we ignore convexity and estimate bond prices considering duration only, we will get an estimated value:
- A. higher than actual prices.
 - B. lower than actual prices.
 - C. equal to actual prices.
55. A bond is currently trading for £104.50 per £100 of par value. If the bond's yield to maturity falls by 50 bps, the bond's full price is expected to rise to £106.50. If the bond's yield to maturity rises by 50 bps, the bond's full price is expected to fall to £103.25. The bond's approximate convexity is *closest* to:
- A. 2.87.
 - B. 28.70.
 - C. 287.08.
56. A bond is trading at 134.6722. If the bond's YTM falls by 20 basis points the bond's full price is expected to rise to 137.5888. If the bond's YTM rises by 20 basis points the bond's full price is expected to fall to 131.8439. The approximate convexity of the bond is *closest* to:
- A. 69.05.
 - B. 163.92.
 - C. 187.58.
57. Owing to a yield change of 50 bps, the price of the bond increases and decreases to \$102.86 and \$101.31. Given that the current price of the bond is \$102.00, which of the following is *most likely* to be the approximate convexity?
- A. 61.
 - B. 67.
 - C. 72.
58. Which of the following factors is considered an additional factor that effects the convexity but not the duration of a bond?
- A. Coupon rate volatility.
 - B. Dispersion of cash flows.
 - C. Time to maturity.
59. Which of the following bonds is *least likely* to have negative convexity?

- A. All bonds with embedded options.
 - B. Only callable bonds.
 - C. Only puttable bonds.
60. An analyst wants to find convexity of bonds with call and put options. The *most* appropriate measure to use for this purpose is:
- A. modified convexity.
 - B. Macaulay convexity.
 - C. effective convexity.
61. Analyst 1: The first order effect on a bond's percentage price change given a change in yield-to-maturity can be best described as convexity.
Analyst 2: The second order effect on a bond's percentage price change given a change in yield-to-maturity can be best described as duration.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Neither of them.

LO.i: Estimate the percentage price change of a bond for a specified change in yield, given the bond's approximate duration and convexity.

62. The duration and convexity of an option-free bond priced at \$95.50 are 7.50 and 98, respectively. If yields increase by 150 bps, the percentage change of the price is *closest* to:
- A. -9.04%.
 - B. -10.14%.
 - C. -12.75%.
63. A bond has an annual modified duration of 6.12 and annual convexity of 88.910. If the bond's yield to maturity increase by 50 basis points, the expected percentage price change is *closest* to:
- A. -3.06%.
 - B. -2.94%.
 - C. -2.78%.
64. If the annual modified duration is 6.883 and annual convexity is 56.290, which of the following is *most likely* to be the expected percentage price change if the bond's yield to maturity is expected to increase by 50 basis points?
- A. - 3.44%
 - B. - 3.37%
 - C. - 1.07%
65. A bond has an annual modified duration of 6.12 and annual convexity of 88.910. If the bond's yield to maturity decreases by 20 basis points, the expected percentage price change is *closest* to:
- A. 1.22%.

- B. 1.78%.
- C. 1.24%.

66. A bond is currently trading at 1030. The coupon rate is 7% and the YTM is 6%. The duration of bond is 7.59 and the convexity of the bond is 55.63. The percentage change in price of bond considering 20 basis points increase in YTM is *closest* to:
- A. -1.5069 %.
 - B. 2.50669 %.
 - C. -1.2563 %.
67. Analyst 1: Convexity improves the estimate of change in price of bonds with negative convexity. However, it has little value for bonds with positive convexity.
Analyst 2: Convexity improves the estimate of a change in price of bonds with positive convexity. However it has little value for bonds with negative convexity.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Neither of them.

LO.j: Describe how the term structure of yield volatility affects the interest rate risk of a bond.

68. Analyst 1: Volatility of a bond's price depends on the volatility of bond's yield and the volatility of the currency rates.
Analyst 2: Volatility of bond's price depends on the sensitivity of the bond's price to a given change in yield and the volatility of the bond's yield.
Which analyst's statement is *most likely* correct?
- A. Analyst 1.
 - B. Analyst 2.
 - C. Neither of them.
69. If the term structure of yield volatility is upward sloping then:
- A. long term rates are higher than short-term rates.
 - B. short-term yields are more stable than long-term yields.
 - C. long term bonds will always experience greater price fluctuation than short term bonds.

LO.k: Describe the relationships among a bond's holding period return, its duration, and the investment horizon.

70. When an investor's horizon is equal to Macaulay duration of the bond he owns:
- A. the investor is hedged against interest rate risk.
 - B. reinvestment risk dominates, and the investor is at risk of lower rates.
 - C. market price risk dominates and the investor is at risk of higher rates.

71. An investor purchases an annual coupon bond with a 5% coupon rate and 10 years remaining until maturity. The investor's investment horizon is three years. The Macaulay duration of the bond is 7.52 years. The duration gap at the time of purchase is *closest* to:
- A. -4.52 years.
 - B. 4.52 years.
 - C. 0 years.
72. Which of the following statements is *most accurate*?
- A. A positive duration gap results in exposure to market price risk. The investor risk is to higher interest rates.
 - B. A positive duration gap results in exposure to reinvestment risk. The investor risk is to lower interest rates.
 - C. A positive duration gap results in exposure to market price risk. The investor risk is to lower interest rates.
- LO.I: Explain how changes in credit spread and liquidity affect yield-to-maturity of a bond and how duration and convexity can be used to estimate the price effect of the changes.**
73. What are the two major components of a bond's spread over the benchmark curve?
- A. Premium for credit risk and premium for market price risk.
 - B. Premium for market price risk and premium for reinvestment risk.
 - C. Premium for credit risk and premium for liquidity risk.
74. Due to downgrading of ratings, a fixed rate corporate bond's flat price decreases from 93.75 to 92.85 per 100 of par value. Assuming that the annual modified duration of this bond is 6.45, and that benchmark yields are unchanged, the *closest* estimated change in credit spread on the corporate bond is:
- A. 15 bps.
 - B. 55 bps.
 - C. 96 bps.
75. A pharmaceutical company receives a rating downgrade and the price of its fixed-rate bond decreases. The price decrease was *most likely* caused by a(n):
- A. decrease in the bond's liquidity spread.
 - B. decrease in the bond's underlying benchmark rate.
 - C. increase in the bond's credit spread.

Solutions

1. C is correct. In a buy-and-hold strategy if the market interest rates are lower in the future, the returns will decrease because the reinvestment income will decrease.
2. C is correct. The investor reinvests the coupon interest payments at the same interest rate.
3. A is correct. When a bond is held to maturity, there is no capital gain or loss because the carrying value of the bond at maturity is the same as the redemption amount.
4. B is correct. A higher coupon rate means that more of the bond's value comes from coupon and less from the market interest rate.
5. B is correct. Annualized holding period return is the IRR of the investment:
 $N = 3$, $PV = -1,025.78$, $PMT = 90$, $FV = \$1,000$, $CPT I/Y$. $I/Y = 8\%$.
 The total portion of coupon payments and reinvestment return
 $90(1.08)^2 + 90(1.08)^1 + 90 = \292.18 .
6. A is correct. A horizon yield is the internal rate of return between the total return (i.e. the sum of reinvested coupon payments and sale price) and the purchase price of the bond.
7. A is correct. The longer the maturity, the higher the reinvestment risk.
8. A is correct. The higher the coupon rate, the higher the reinvestment risk.
9. C is correct. A bond selling at a discount has a lower coupon rate. All else being equal, bonds with lower coupon rates have lower reinvestment risk. The reason is that the lower the coupon rate, the less dependent the bond's total dollar return will be on the reinvestment of the coupon payments in order to produce the yield to maturity at the time of purchase.
10. B is correct. If the investment horizon is short, market price risk will dominate the reinvestment risk.
11. B is correct. A decrease in market interest rates, benefits short term investors more than the long term investors. This is because in the short term, market price risk dominates the reinvestment risk.
12. C is correct. In a buy-and-hold strategy if the market interest rates are higher in the future, the returns will increase because the reinvestment income will increase.
13. A is correct.
$$\text{Effective Duration} = \frac{[(PV-) - (PV+)]}{[2 (\Delta \text{Yield}) * PV_0]}$$

$$\text{Effective Duration} = \frac{[104.25 - 101.25]}{[2 (0.005) * 102.50]} = 2.93\%$$

14. B is correct. Approximate percentage price change = $\% \Delta PV^{\text{Full}} \approx -\text{AnnModDur} \times \Delta \text{Yield} = -8.50 (-0.005) = 4.25\%$
15. C is correct. Macaulay duration is the weighted average sum of the present values of the bond discounted at the YTM.
The present values of the cash flows are:
 $70/(1.06) = 66.038$; $70/(1.06)^2 = 62.29$; $70/(1.06)^3 = 58.77$; $1070/(1.06)^4 = 847.54$
The weights are:
 $= 66.038/1034.64 = 0.0638(1) = 0.0638$
 $= 62.29/1034.64 = 0.06020(2) = 0.1204$
 $= 58.77/1034.64 = 0.0568(3) = 0.1704$
 $= 847.54/1034.64 = 0.8192(4) = 3.2768$
Macaulay duration = $0.0638 + 0.1204 + 0.1704 + 3.2768 = 3.6314$
16. B is correct. When the investment horizon is less than the Macaulay duration of a bond, the investor's risk is to higher interest rates.
17. B is correct. There is no bond duration known as spot duration.
18. B is correct.
$$\text{ModDur} = \frac{\text{MacDur}}{1+r} = \frac{6.5}{1.07} = 6.07.$$
19. B is correct.
$$\text{Approx ModDur} = \frac{(PV_- - PV_+)}{2 * \Delta \text{Yield} * PV_0} = \frac{102.86 - 101.31}{2 * 0.005 * 102} \approx 1.52$$
20. A is correct. Unlike the modified duration, effective duration is a curve duration statistic that measures interest rate risk in terms of a change in the benchmark yield curve. Thus, the change in the bond's own yield to maturity is not used for calculation.
21. B is correct. Modified duration states the change in price of a bond as a result of change in yield for specific basis points/percentage. Macaulay duration states the weighted average time period until each payment due on a bond is expected to be paid off. Accelerated duration is an incorrect term.
22. A is correct. The carrying value of a bond purchased at a price above the par is the purchase price minus the amortized amount of the premium.
23. B is correct.
$$\text{Approximate modified duration} = \frac{V_- - V_+}{2 * V_0 * \Delta \text{YTM}}$$

$$= \frac{10148.61 - 9854.18}{2 * 10000 * 0.0020}$$

= 7.36.

The bond price is expected to change by 7.36% when the yield changes by 0.2%.

24. C is correct. Yield duration statistics measure the sensitivity of a bond's full price to the bond's own yield to maturity. Curve duration statistics measure the sensitivity of a bond's full price to the benchmark yield curve
25. B is correct. Modified duration = $\frac{\text{Macaulay Duration}}{1 + r}$
 $= \frac{10}{1 + \frac{0.08}{2}} = 9.62$ years
26. C is incorrect. Modified duration = $\frac{\text{Macaulay Duration}}{1 + r}$. Therefore a bonds Macaulay duration is typically more than its modified duration.
27. A is correct. Modified duration is useful and accurate for small changes in yield but it is not useful and accurate for larger changes in yield.
28. C is correct. Effective duration is used to value bonds with embedded options. This duration considers changes in a benchmark yield curve and not the bond's current YTM.
29. B is correct. The modified duration and effective duration of an option free bond are identical only in the rare circumstance of an absolutely flat yield curve.
30. B is correct. The yield to worst is the lowest of the yield to maturity, yield to first call, yield to second call and so forth. The duration of a callable bond is *not* the sensitivity of the bond price to change in the yield-to-worst.
31. A is correct. The interest rate risk is the sensitivity of a bond to parallel shifts of the yield curve. The yield curve risk is a bond's sensitivity to changes in the shape of the yield curve.
32. B is correct. A bond's duration is a measure of the sensitivity of a bond's full price including accrued interest to a change in interest rate.
33. C is correct. The key rate duration is the sensitivity of bond to changes in a single spot rate, holding all other spot rates constant.
34. A is correct. The Macaulay duration of a zero-coupon bond is its time to maturity.
35. B is correct. As interest rates go up, the future value of reinvested coupon payments increases.
36. C is correct. The duration measure reduces due to higher coupon rate, higher yield to maturity, and shorter time to maturity.

37. B is correct. As time passes during the coupon period, the Macaulay duration declines smoothly and then jumps upward after the coupon is paid.
38. C is correct. The Macaulay duration of a perpetual bond is a flat straight line. The value is $\frac{1+r}{r}$.
39. B is correct. Coupon rate is inversely related to Macaulay duration.
40. A is correct. YTM is inversely related to Macaulay duration. The lower the yield-to-maturity, the higher its Macaulay duration.
41. A is correct. Time-to-maturity and Macaulay duration are usually positively related. The exception is long-term, low coupon bonds, on which it is possible to have a lower duration than on an otherwise comparable short term bond.
42. C is correct. Both A & B are limitations of duration. Duration changes over time and it is just an approximation. Option C is not a limitation of the duration. It does not assume a non-parallel shift.
43. B is correct. The portfolio's duration is a weighted average of the durations of the individual holdings, computed as:
- $$D = \left(\frac{6}{12}\right) * (3) + \left(\frac{2}{12}\right) * (5) + \left(\frac{4}{12}\right) * (7) = 4.667$$
44. A is correct.
- Total market value of bonds = 250,000 + 190,000 + 300,500 = 740,500.
- The respective weights of the bonds are:
- $$\frac{250,000}{740,500} = 0.3376$$
- $$\frac{190,000}{740,500} = 0.2566$$
- $$\frac{300,500}{740,500} = 0.4058$$
- Portfolio duration = 0.3376*9 + 0.2566*10 + 0.4058*7 = 8.445
45. B is correct. The two ways to calculate the duration of a bond portfolio are: weighted average of the time to receipt of the aggregate cash flows and weighted average of the durations of the individual bonds.
46. C is correct. The 'weighted average of the durations of individual bonds' method is simple to use and quite accurate when the yield curve is flat. However, its main limitation is that it assumes a parallel shift in the yield curve.
47. B is correct.
- First, calculate the market value of each bond.

$$\text{Market value of the bond} = \frac{\text{Price} * (\text{Par Value})}{100}$$

Market value of the bond A = $\text{PKR } 320 * \frac{105}{100} = \text{PKR } 336$ million

Market value of the bond B = $\text{PKR } 160 * \frac{103}{100} = \text{PKR } 164.8$ million

Market value of the bond C = $\text{PKR } 180 * \frac{98}{100} = \text{PKR } 176.4$ million

Total value of the portfolio = $\text{PKR } 677.2$ million.

Duration of the portfolio = $\left(\frac{336}{677.2}\right) * 10 + \left(\frac{164.8}{677.2}\right) * 8 + \left(\frac{176.4}{677.2}\right) * 7 = 8.73$

48. C is correct. Interest rate risk is not usually expressed as a change in the cash flow yield.

49. C is correct. The price value of a basis point is an estimate of a change in the full price of the bond given a 1 bp change in the yield to maturity.

50. A is correct.

Money duration = Annual modified duration * Full price = $6.3 * 103.25 = \$650.47$

51. C is correct.

MoneyDur = ModDur * $PV^{\text{Full}} = 7.44 * 104 \approx 774$

52. B is correct. Change in price of bond = $\$200,000 * 0.0020 = \400

The increase of 20 basis points in yield will result in decrease in bond price by \$400.

53. C is correct.

Price value of a basis point is calculated as $PVBP = \frac{PV_- - PV_+}{2}$

where PV_- = Full price calculated by lowering the yield-to-maturity by one basis point.

$N = 6$, $I/Y = 3.99$, $PMT = 2$, $FV = 100$. CPT $PV = \$89.5647$

PV_+ = Full price calculated by raising the yield to maturity by one basis point

$N = 6$, $I/Y = 4.01$, $PMT = 2$, $FV = 100$. CPT $PV = \$89.4667$

$PVBP = \frac{\$89.5647 - \$89.4667}{2} = 0.049$.

54. B is correct. If we ignore convexity then duration alone always gives an estimated value lower than actual prices.

55. C is correct. $\text{ApproxCon} = \frac{[(PV_-) + (PV_+) - 2PV_0]}{[(\Delta\text{Yield})^2 * PV_0]}$

$\text{ApproxCon} = \frac{[106.50 + 103.25 - 2(104.50)]}{[(.0050)^2 * 104.50]}$

$\text{ApproxCon} = 287.08$.

56. B is correct.

Approximate convexity = $\frac{PV_- + PV_+ - 2 * PV_0}{(\Delta\text{Yield})^2 * PV_0} = \frac{131.8439 + 137.5888 - 2 * 134.6722}{0.002^2 * 134.6722} = 163.92$

57. B is correct.

$$\text{Approx Convexity} = \frac{(PV_- + PV_+) - (2 * PV_0)}{(\Delta \text{Yield})^2 * PV_0} = \frac{(102.86 + 101.31) - (2 * 102)}{0.005^2 * 102} = 67$$

58. B is correct. A factor that effects convexity but is not considered for duration is the dispersion of cash flows.
59. C is correct. Putable bonds always have positive convexity.
60. C is correct. In case of bonds with embedded options the effective convexity is the most appropriate measure.
61. C is correct. The first order effect on a bond's percentage price change given a change in yield-to-maturity can be best described as duration. The second order effect can be best described as convexity.
62. B is correct.
 Total percentage change in the price is the sum of duration effect and convexity effect.
 $\% \text{ change in price} = [-\text{AnnModDur} * \Delta \text{Yield}] + [0.5 * \text{AnnConvexity} * (\Delta \text{Yield})^2]$
 Duration effect = $-7.50(.015) = -0.1125$
 Convexity effect = $0.5 * 98(.015)^2 = 0.011025$
 Total percentage change in the price = $-0.1125 + 0.011025 = -0.1014 = -10.14\%$.
63. B is correct.
 $\% \text{ change in price} = [-\text{AnnModDur} * \Delta \text{Yield}] + [0.5 * \text{AnnConvexity} * (\Delta \text{Yield})^2]$
 $= [-6.12 * (0.0050)] + [0.5 * 88.910 * (0.0050)^2]$
 $= -0.0294 \text{ or } -2.94\%$
64. B is correct.
 $\% \Delta PV^{\text{Full}} = [-\text{AnnModDur} * \Delta \text{Yield}] + [0.5 * \text{AnnConvexity} * (\Delta \text{Yield})^2]$
 $\% \Delta PV^{\text{Full}} = [-6.883 * 0.005] + [0.5 * 56.290 * (0.005)^2] = -0.034415 + 0.0007036$
 $= -0.0337$
65. C is correct.
 $\% \text{ change in price} = [-\text{AnnModDur} * \Delta \text{Yield}] + [0.5 * \text{AnnConvexity} * (\Delta \text{Yield})^2]$
 $= [-6.12 * (-0.0020)] + [0.5 * 88.910 * (-0.0020)^2]$
 $= 0.01241 \text{ or } 1.24\%$
66. A is correct. Duration effect = $-7.59 * 0.002 = -0.01518$
 Convexity effect = $0.5 * 55.63 * (0.002)^2 = 0.00011$
 $\% \text{ change in price} = [-\text{AnnModDur} * \Delta \text{Yield}] + [0.5 * \text{AnnConvexity} * (\Delta \text{Yield})^2]$
 $= (-0.01518 + 0.00011)$
 $= -1.5069\%$

67. C is correct. Convexity improves the estimate of change in price of bonds with both positive as well as negative convexity.
68. B is correct. Volatility of bond's price depends on the sensitivity of the bond's price to a given change in yield and the volatility of the bond's yield.
69. B is correct. If the term structure of yield volatility is upward sloping, then long term yields have more volatility than short term yields. Therefore short-term yields will be more stable. The other two statements are not necessarily true.
70. A is correct. When the investment horizon is equal to the Macaulay duration of the bond, coupon reinvestment risk offsets price risk. The investor is hedged against interest rate risk.
71. B is correct. Duration gap = Macaulay duration – Investment horizon
 $= 7.52 - 3 = 4.52$ years.
72. A is correct. When the investment horizon is less than the Macaulay duration of the bond, the duration gap is positive and the price risk dominates coupon reinvestment risk. The investor's risk is to higher interest rates.
73. C is correct. A bond's spread over the benchmark curve is made up of two major components: premium for credit risk and premium for liquidity risk.
74. A is correct.
- $$\text{Percentage price change} = \frac{93.75 - 92.85}{93.75} = 0.0096 \text{ or } 0.96\%$$
- $$\text{Change in Yield} = \frac{-0.0096}{-6.45} = 0.00148$$
75. C is correct. The change was most likely caused by an increase in the bond's credit spread. The increase in credit risk results in a larger credit spread.