Reading 61

# CURVE-BASED & EMPIRICAL FIXED-INCOME RISK MEASURES

**1. (B) $50.**

**Explanation**

Effective duration should be used for callable bonds as it takes into account the impact the embedded option has on the bond's cash flows.

Approximate percentage price change of a bond = (–)(effective duration)(ΔYTM)

(–5)(1%) = –5%

The change in price is therefore $1,000 × –5% = –$50

**(Module 61.1, LOS 61.b)**

**2. (B) change in yield at a single maturity.**

**Explanation**

Key rate duration is the price sensitivity of a bond or portfolio to a change in the interest rate at one specific maturity on the yield curve.

**(Module 61.1, LOS 61.c)**

**3. (B) 0.58%.**

**Explanation**

The convexity effect, or the percentage price change due to convexity, formula is:

(½)convexity × $(\Delta YTM)^2$. The percentage price change due to convexity is then: $(½)(51.44)(0.015)^2 = 0.0058$.

**(Module 61.1, LOS 61.b)**

**4. (C) 2.05%.**

**Explanation**

The total percentage price change estimate is computed as follows:

Total estimated price change = $-1.89 \times (-0.01) \times 100 + (½)(32) \times (-0.01)^2 \times 100$ =2.05%

**(Module 61.1, LOS 61.b)**

**5. (C) 5.7% decrease.**

**Explanation**

$\Delta P/P = -D\Delta i$

$\Delta P/P = -7.6(+0.0075) = -0.057$, or −5.7%.

**(Module 61.1, LOS 61.b)**

**6. (C) £120.95.**

**Explanation**

Return impact ≈ −(Duration × ΔYield) + (1/2) × (Convexity × (ΔYield))$^2$

≈ −(9.5 × −0.0125) + (1/2) × (107.2) × (−0.0125)$^2$

≈ 0.1188 + 0.0084

≈ 0.1272 or 12.72%

Estimated price of bond = (1 + 0.1272) × 107.30

= 120.95

**(Module 61.1, LOS 61.b)**

**7. (A) +12.675%.**

**Explanation**

Approximate percentage price change of a bond = (-)(modified duration)(ΔYTM) = (-16.9) (-0.75%) = +12.675%

**(Module 61.1, LOS 61.b)**

**8. (A) -12.2%.**

**Explanation**

Recall that the percentage change in prices = Duration effect + Convexity effect = [-duration × (change in yields)] + [(½)convexity × (change in yields)$^2$] = [(-7)(0.02) + (½)(90)(0.02)$^2$] = -0.12 = -12.2%. Remember that you must use the decimal representation of thechange in interest rates when computing the duration and convexity adjustments.

**(Module 61.1, LOS 61.b)**

**9. (A) -11.72%.**

**Explanation**

The estimated percentage price change = the duration effect plus the convexity effect. The formula is: [–duration × (ΔYTM)] +½[convexity × (ΔYTM)$^2$ ]. Therefore, the estimated percentage price change is: [–(10.27)(0.0125)] + [(½)(143) (0.0125) $^2$ ] = –0.128375 + 0.011172 = –0.117203 = –11.72%.

**(Module 61.1, LOS 61.b)**

**10. (A) decrease by less than 5.3%.**

**Explanation**

The positive convexity effect will mean yields will drop by less than 5.3% (the effect of duration alone).

Price change = (–5.3 × 0.01) + (0.5 × 110 × 0.01$^2$)= -0.0475 = –4.75%.

**(Module 61.1, LOS 61.b)**

**11. (A) -4.06%.**

**Explanation**

Recall that the percentage change in prices = Duration effect + Convexity effect = [- duration × (change in yields)] + [(½)convexity × (change in yields) $^2$] = (-.5)(0.01) + (½)(87.2)(0.01)$^2$ = -4.06%. Remember that you must use the decimal representation of the change in interest rates when computing the duration and convexity adjustments.

**(Module 61.1, LOS 61.b)**

**12. (B) +11.0%.**

**Explanation**

You can answer this question without calculations. A decrease in interest rates must cause the price to increase. Because duration alone will underestimate a price increase, the price must increase by more than 10%

percentage change in price

$$= [-\text{duration} \times \Delta\text{YTM}] + \frac{1}{2}\left[\text{convexity} \times (\Delta\text{YTM})^2\right] \times 100$$

$$= [(-10)(-0.01)] + \frac{1}{2}[(200)(-0.01)^2] = 0.11 = 11\%$$

**(Module 61.1, LOS 61.b)**

**13. (A) effective duration.**

**Explanation**

Effective duration is used to measure the sensitivity of a bond price to a parallel shift in the yield curve. Key rate duration, also known as partial duration, is used to measure the sensitivity of a bond price to a change in yield at a specific maturity.

**(Module 61.1, LOS 61.c)**

**14. (C) 4.98%.**

**Explanation**

The estimated price change is -(duration)(ΔYTM) + (½)(convexity) × (ΔYTM)$^2$ = -8 × (-0.006) +(½)(100) × (-0.006$^2$) = +0.0498 or 4.98%.

**(Module 61.1, LOS 61.b)**

**15. (B) –7.45%.**

**Explanation**

Return impact ≈ −(Duration × ΔYield) + (1/2) × (Convexity × (ΔYield)$^2$)
≈ −(7.8 × 0.0100) + (1/2) × (69.8) × (0.0100)$^2$
≈ −0.0780 + 0.0035
≈ −0.0745 or −7.45%

**(Module 61.1, LOS 61.b)**

**16. (A) empirical duration.**

**Explanation**

Empirical duration is estimated by using historical data between benchmark yield changes and bond price changes. Analytical duration approaches based on mathematical analysis include Macaulay, modified, and effective durations.

**(Module 61.1, LOS 61.d)**

**17. (B) 1.74%.**

**Explanation**

The effective duration is computed as follows:

$$\text{Effective duration} = \frac{105.56 - 98.46}{2 \text{x} 101.76 \text{x} 0.01} = 3.49$$

Using the effective duration, the approximate percentage price change of the bond is computed as follows:

Percent price change = -3.49 × (-0.005) × 100 = 1.74%

**(Module 61.1, LOS 61.b)**

**18. (A) decrease by $124, price will increase by $149.**

**Explanation**

As yields increase, bond prices fall, the price curve gets flatter, and changes in yield have a smaller effect on bond prices. As yields decrease, bond prices rise, the price curve gets steeper, and changes in yield have a larger effect on bond prices. Thus, the price increase when interest rates decline must be greater than the price decrease when interest rates rise (for the same basis point change). Remember that this applies to percentage changes as well.

**(Module 61.1, LOS 61.b)**

**19. (B) -1.820%.**

**Explanation**

The formula for the percentage price change is: –(duration)(ΔYTM). Therefore, the estimated percentage price change using duration is: –(7.26)(0.25%) = –1.82%.

**(Module 61.1, LOS 61.b)**

**20. (A) the bond contains embedded options.**

**Explanation**

Effective duration takes into consideration embedded options in the bond. Modified duration does not consider the effect of embedded options. For option-free bonds, modified duration will be similar to effective duration. Both duration measures are based on the value impact of a parallel shift in a flat yield curve.

**(Module 61.1, LOS 61.a)**

**21. (B) Key rate duration.**

**Explanation**

Price sensitivity to a non-parallel shift in the yield curve can be estimated using key rate durations. Modified duration and effective duration measure price sensitivity to a parallel shift in the yield curve.

**(Module 61.1, LOS 61.c)**

**22. (C) increase by 7.5%.**

**Explanation**

Percentage Price Change = –(duration) (ΔYTM) + (½)convexity $(\Delta YTM)^2$

therefore

Percentage Price Change = –(7) (–0.01) + (½)(100) $(-0.01)^2$=7.5%.

**(Module 61.1, LOS 61.b)**

**23. (B) $1,041.25.**

**Explanation**

$$\frac{\Delta P}{P} = -\text{Duration}(\Delta \text{YTM})\frac{1}{2}\text{covexity}(\Delta \text{YTM})^2$$

$$\frac{\Delta P}{P} = (-)(8)(-0.005) + \frac{1}{2}(100)(-0.005)^2$$
$$= +0.0400 + 0.00125$$
$$= +0.04125, \text{ or up} +4.125\%$$

The price would thus be \$1,000 × 1.04125 = \$1,041.25.

**(Module 61.1, LOS 61.b)**

**24. (C) 4.33%.**

**Explanation**

The estimated percentage price change is equal to the duration effect plus the convexity effect. The formula is: [–duration × (ΔYTM)] + ½[convexity × $(\Delta YTM)^2$ ]. Therefore, the estimated percentage price change is: [–(5.61)(–0.0075)] + [(½)(43.84)$(-0.0075)^2$ ] = 0.042075 + 0.001233 = 0.043308 = 4.33%.

**(Module 61.1, LOS 61.b)**

**25. (A) 0.965%.**

**Explanation**

Modified duration indicates the expected percent change in a bond's price given a 1% (100 bp) change in yield to maturity. For a 50 bp (0.5%) increase in YTM, the price of a bond with modified duration of 1.93 should decrease by approximately 0.5(1.93%) = 0.965%.

**(Module 61.1, LOS 61.b)**

**26 (B) -17.58%.**

**Explanation**

The estimated price change is:

-(duration)($\Delta$YTM)+½(convexity)×($\Delta$YTM)$^2$ = -10.62 × 0.02 + (½)(182.92)(0.02$^2$) =-0.2124 + 0.0366 = -0.1758 or –17.58%.

**(Module 61.1, LOS 61.b)**

**27. (A) effective duration.**

**Explanation**

Effective duration is appropriate for bonds with embedded options because their future cash flows are affected by the level and path of interest rates.

**(Module 61.1, LOS 61.a)**

**28. (B) Effective Duration — Modified Duration or Effective Duration**

**Explanation**

Effective duration is that effective duration is used for bonds with embedded options. Modified duration assumes that all the cash flows on the bond will not change, while effective duration considers expected cash flow changes that may occur with embedded options.

**(Module 61.1, LOS 61.a)**



**29. (A) estimates of empirical and analytical durations should be similar.**

**Explanation**

A portfolio consisting solely of short-term U.S. government bonds should closely resemble the performance of its government benchmark yield. As a result, estimates of empirical duration should be similar to the portfolio's analytical durations.

**(Module 61.1, LOS 61.d)**