Reading 60

YIELD-BASED BOND CONVEXITY AND PORTFOLIO PROPERTIES

1. (A) **callable bonds.**

   Explanation

   All nonallable bonds exhibit the trait of being positively convex. Callable bonds have negative convexity because once the yield falls below a certain point prices will rise at a decreasing rate, thus giving the price-yield relationship a negative convex shape.

   (Module 60.1, LOS 60.a)

2. (B) **will increase by approximately $117,700.**

   Explanation

   A portfolio's duration can be used to estimate the approximate change in value for a given change in yield. A critical assumption is that the yield for all bonds in the portfolio change by the same amount, known as a parallel shift. For this portfolio the expected change in value can be calculated as: $7,545,000 × 6.24 × 0.0025 = $117,702. The decrease in yields will cause an increase in the value of the portfolio, not a decrease.

   (Module 60.1, LOS 60.c)

3. (B) **less than $36.**

   Explanation

   The bond described will have positive convexity. Because of convexity, the bond's price will decrease less as a result of a given increase in interest rates than it will increase as a result of an equivalent decrease in interest rates.

   (Module 60.1, LOS 60.a)

4. (B) **It is theoretically more sound than the alternative.**

   Explanation

   Compared to portfolio duration based on the cash flow yield of the portfolio, portfolio duration calculated as a weighted average of the durations of the individual bonds in the portfolio is easier to calculate and can be used for bonds with embedded options. Portfolio duration calculated using the cash flow yield for the entire portfolio is theoretically more correct.

   (Module 60.1, LOS 60.c)

5. (C) **both increases and decreases in yield.**

   Explanation

   An estimate of the change in bond prices due to changes in yield will be either too low (from yield decreases) or too high (from yield increases). Both estimates are improved by making positive adjustments for convexity.

   (Module 60.1, LOS 60.b)

6. (B) 19.7.

Explanation

Approximate modified convexity is calculated as [V_{-} + V_{+} – $2V_0$] / [(V_0) (change in YTM)^2]. [105.90 + 97.30 – 2(101.50)] / [101.50(0.01)^2] = 19.70.

(Module 60.1, LOS 60.a)

7. (C) equivalent.

Explanation

Although the calculation incorporates different components, the estimated price change and new bond price will be equivalent under the approach that uses annual duration and convexity versus the approach that uses money duration and convexity. Any differences would be due to rounding.

(Module 60.1, LOS 60.b)

8. (B) callable bond at low yields.

Explanation

A callable bond trading at a low yield will most likely exhibit negative effective convexity.

(Module 60.1, LOS 60.a)

9. (C) –167.

Explanation

Approximate effective convexity is calculated as [V_{-} + V_{+} – $2V_0$] / [(V_0)(change in curve)^2].[96.75 + 94.75 – 2(95.80)] / [(95.80)(0.0025)^2] = –167.01.

(Module 60.1, LOS 60.a)

10. (C) $18,525,000.

Explanation

The money convexity of a bond is equal to its annual convexity times the full price of the bond position. With an annual convexity of 12.35 and the full price of the bond position of $1,500,000, the money convexity is equal to 12.35 × $1,500,000 = $18,525,000. The maturity of the bond does not impact the calculation.

(Module 60.1, LOS 60.b)

11. (A) 89.75.

Explanation

The estimated percent change in the bond's price is –6.5(0.02) + (1/2)(28.0)(0.02)2 = –0.1244. The estimated price is 102.5(1 – 0.1244) = 89.75.

(Module 60.1, LOS 60.b)

12. (C) the slope of the price/yield curve is not constant.

Explanation

Modified duration is a good approximation of price changes for an option-free bond only for relatively small changes in interest rates. As rate changes grow larger, the curvature of the bond price/yield relationship becomes more prevalent, meaning that a linear estimate of price changes will contain errors. The modified duration estimate is a linear estimate, as it assumes that the change is the same for each basis point change in required yield. The error in the estimate is due to the curvature of the actual price path. This is the degree of convexity. If we can generate a measure of this convexity, we can use this to improve our estimate of bond price changes.

(Module 60.1, LOS 60.a)

13. (C) Price increases when yields drop are greater than price decreases when yields rise by the same amount.

Explanation

A convex price/yield graph has a larger increase in price as yield decreases than the decrease in price when yields increase.

(Module 60.1, LOS 60.a)

14. (B) increase by more than 10.03%.

Explanation

Because of positive convexity, (bond prices rise faster than they fall) for any given absolute change in yield, the increase in price will be more than the decrease in price for a fixedcoupon, noncallable bond. As yields increase, bond prices fall, and the price curve gets flatter, and changes in yield have a smaller effect on bond prices. As yields decrease, bond prices rise, and the price curve gets steeper, and changes in yield have a larger effect on bond prices. Here, for an absolute 150bp change, the price increase would be more than the price decrease.

(Module 60.1, LOS 60.a)

15. (C) 0.8224%.

Explanation

The change in bond price can be calculated using the following formula:

price change = –annual modified duration (Δ YTM) + ½ annual convexity (Δ YTM) squared

For a 25 basis point decrease in yields, the calculation is equal to $(-3.27 \times -0.0025) + (0.5 \times 15.74 \times -0.0025^2) = .008224$, or 0.8224%.

(Module 60.1, LOS 60.b)

16. (B) 90.859.

Explanation

The change in bond price can be calculated using the following formula:

price change = –annual modified duration (Δ YTM) + ½ annual convexity (Δ YTM) squared

For a 50 basis point increase in yields, the calculation is equal to (–3.27 × 0.005) + (0.5 × 15.74 × 0.005^2) = –1.615%. The expected new price will, therefore, be equal to 92.35 × (1 – 0.01615, or .98385) = 90.859.

(Module 60.1, LOS 60.b)

17. (B) parallel shifts of the benchmark yield curve.

Explanation

Portfolio duration as a weighted average of the individual bonds' durations is calculated assuming parallel shifts in the yield curve. Cash flow yield is used to calculate duration based on the weighted average time until a bond portfolio's cash flows are scheduled to be received.

(Module 60.1, LOS 60.c)

18. (A) a linear approximation of the actual price-yield function for the portfolio.

Explanation

Duration is a linear approximation of a nonlinear function. The use of market values has no direct effect on the inherent limitation of the portfolio duration measure. Duration assumes a parallel shift in the yield curve, and this is an additional limitation.

(Module 60.1, LOS 60.c)

19. (A) fall, the bond's price increases at a decreasing rate.

Explanation

Negative convexity occurs with bonds that have prepayment/call features. As interest rates fall, the borrower/issuer is more likely to repay/call the bond, which causes the bond's price to approach a maximum. As such, the bond's price increases at a decreasing rate as interest rates decrease.

(Module 60.1, LOS 60.a)

20. (A) negative convexity at low yields for the callable bond and positive convexity for the option-free bond.

Explanation

Since the issuer of a callable bond has an incentive to call the bond when interest rates are very low in order to get cheaper financing, this puts an upper limit on the bond price for low interest rates and thus introduces negative convexity between yields and prices.

(Module 60.1, LOS 60.a)

21. (A) a bond with greater convexity.

Explanation

Duration is a linear measure of the relationship between a bond's price and yield. The true relationship is not linear as measured by the convexity. When convexity is higher, duration will be less accurate in predicting a bond's price for a given change in interest rates. Shortterm bonds generally have low convexity.

(Module 60.1, LOS 60.a)

22. (B) the change in the price of the bond when its yield changes by 0.01%.

Explanation

PVBP represents the change in the price of the bond when its yield changes by one basis point, or 0.01%. PVBP = duration × 0.0001 × bond value. This calculation ignores convexity because for a small change in yield, the curvature of the price-yield relationship typically has no material effect on the PVBP.

(Module 60.1, LOS 60.c)

23. (B) 6.07.

Explanation

The duration of a bond portfolio is the weighted average of the durations of the bonds in the portfolio. The weights are the value of each bond divided by the value of the portfolio:

portfolio duration = 8 × (1050 / 3000) + 6 × (1000 / 3000) + 4 × (950 / 3000) = 2.8 +2 + 1.27 = 6.07.

(Module 60.1, LOS 60.c)