

Econometrics
Problem Sheet 6
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1. An analyst at CAPM Research Inc. is projecting a return of 21% on Portfolio A. The market risk premium is 11%, the volatility of the market portfolio is 14%, and the risk-free rate is 4.5%. Portfolio A has a beta of 1.5. According to the capital asset pricing model, which of the following statements is true?

- a. The expected return of Portfolio A is greater than the expected return of the market portfolio.
- b. The expected return of Portfolio A is less than the expected return of the market portfolio.
- c. The return of Portfolio A has lower volatility than the market portfolio.
- d. The expected return of Portfolio A is equal to the expected return of the market portfolio.

2. Suppose Portfolio A has an expected return of 8%, volatility of 20%, and beta of 0.5. Suppose the market has an expected return of 10% and volatility of 25%. Finally, suppose the risk-free rate is 5%. What is Jensen's alpha for Portfolio A?

- a. 10.0%
- b. 1.0%
- c. 0.5%
- d. 15%

3. Which of the following statements about the Sharpe ratio is false?

- a. The Sharpe ratio considers both the systematic and unsystematic risks of a portfolio.
- b. The Sharpe ratio is equal to the excess return of a portfolio over the risk-free rate divided by the total risk of the portfolio.
- c. The Sharpe ratio cannot be used to evaluate relative performance of undiversified portfolios.
- d. The Sharpe ratio is derived from the capital market line.

4. A portfolio manager returns 10% with a volatility of 20%. The benchmark returns 8% with risk of 14%. The correlation between the two is 0.98. The risk-free rate is 3%. Which of the following statements is correct?

- a. The portfolio has higher SR than the benchmark.
- b. The portfolio has negative IR.
- c. The IR is 0.35.
- d. The IR is 0.29.

5. In perfect markets, risk management expenditures aimed at reducing a firm's diversifiable risk serve to

- a. Make the firm more attractive to shareholders as long as costs of risk management are reasonable.
- b. Increase the firm's value by lowering its cost of equity.
- c. Decrease the firm's value whenever the costs of such risk management are positive.
- d. Has no impact on firm value.

6. By reducing the risk of financial distress and bankruptcy, a firm's use of derivatives contracts to hedge its cash flow uncertainty will

- a. Lower its value due to the transaction costs of derivatives trading.
- b. Enhance its value since investors cannot hedge such risks by themselves.
- c. Have no impact on its value as investors can costlessly diversify this risk.
- d. Have no impact as only systematic risks can be hedged with derivatives.

7. An investor buys a Treasury bill maturing in one month for \$987. On the maturity date the investor collects \$1,000. Calculate effective annual rate (EAR).

- a. 17.0%
- b. 15.8%
- c. 13.0%
- d. 11.6%

8. Lisa Smith, the treasurer of Bank AAA, has \$100 million to invest for one year. She has identified three alternative one-year certificates of deposit (CDs), with different compounding periods and annual rates. CD1: monthly, 7.82%; CD2: quarterly, 8.00%; CD3: semiannually, 8.05%; and CD4: continuous, 7.95%. Which CD has the highest effective annual rate (EAR)?

- a. CD1.
- b. CD2.
- c. CD3.
- d. CD4.

9. Consider a savings account that pays an annual interest rate of 8%. Calculate the amount of time it would take to double your money. Round to the nearest year.

- a. 7 years.
- b. 8 years.
- c. 9 years.
- d. 10 years.

10. A five-year corporate bond paying an annual coupon of 8% is sold at a price reflecting a yield to maturity of 6%. One year passes and the interest rates remain unchanged. Assuming a flat term structure and holding all other factors constant, the bond's price during this period will have

- a. Increased.
- b. Decreased.
- c. Remained constant.
- d. Cannot be determined with the data given.

11. A zero-coupon bond with a maturity of 10 years has an annual effective yield of 10%. What is the closest value for its modified duration?

- a. 9 years.
- b. 10 years.
- c. 99 years.
- d. 100 years.

12. A portfolio manager has a bond position worth USD 100 million. The position has a modified duration of eight years and a convexity of 150 years. Assume that the term structure is flat. By how much does the value of the position change if interest rates increase by 25 basis points?

- a. USD —2,046.875
- b. USD —2,187.500
- c. USD —1,953.125
- d. USD —1,906.250

13. A portfolio manager uses her valuation model to estimate the value of a bond portfolio at USD 125.482 million. The term structure is flat. Using the same model, she estimates that the value of the portfolio would increase to USD 127.723 million if all interest rates fell by 30bp and would decrease to USD 122.164 million if all interest rates rose by 30bp. Using these estimates, the effective duration of the bond portfolio is closest to:

- a. 8.38
- b. 16.76
- c. 7.38
- d. 14.77

14. Suppose the face value of a three-year option-free bond is USD 1,000 and the annual coupon is 10%. The current yield to maturity is 5%. What is the modified duration of this bond?

- a. 2.62
- b. 2.85
- c. 3.00
- d. 2.75

15. A Treasury bond has a coupon rate of 6% per annum (the coupons are paid semiannually) and a semiannually compounded yield of 4% per annum. The bond matures in 18 months and the next coupon will be paid 6 months from now. Which number of years is closest to the bond's Macaulay duration?

- a. 1.023 years.
- b. 1.457 years.
- c. 1.500 years.
- d. 2.915 years.

16. A and B are two perpetual bonds; that is, their maturities are infinite. A has a coupon of 4% and B has a coupon of 8%. Assuming that both are trading at the same yield, what can be said about the duration of these bonds?

- a. The duration of A is greater than the duration of B.
- b. The duration of A is less than the duration of B.
- c. A and B both have the same duration.
- d. None of the above.

17. A manager wants to swap a bond for a bond with the same price but higher duration. Which of the following bond characteristics would be associated with a higher duration?

- I. A higher coupon rate
- II. More frequent coupon payments
- III. A longer term to maturity
- IV. A lower yield

- a. I, II, and III
- b. II, III, and IV
- c. III and IV

d. I and II

18. When the maturity of a plain coupon bond increases, its duration increases

a. Indefinitely and regularly.

b. Up to a certain level.

c. Indefinitely and progressively.

d. In a way dependent on the bond being priced above or below face value.

19. Which of the following statements is/are true?

I. The convexity of a 10-year zero-coupon bond is higher than the convexity of a 10-year 6% bond.

II. The convexity of a 10-year zero-coupon bond is higher than the convexity of a 6% bond with a duration of 10 years.

III. Convexity grows proportionately with the maturity of the bond.

IV. Convexity is always positive for all types of bonds.

V. Convexity is always positive for straight bonds.

a. I only

b. I and II only

c. I and V only

d. II, III, and V only

20. A bond portfolio has the following composition:

1. Portfolio A: price \$90,000, modified duration 2.5, long position in 8 bonds

2. Portfolio B: price \$110,000, modified duration 3, short position in 6 bonds

3. Portfolio C: price \$120,000, modified duration 3.3, long position in 12 bonds

All interest rates are 10%. If the rates rise by 25 basis points, then the bond portfolio value will decrease by

a. \$11,430

b. \$21,330

c. \$12,573

d. \$23,463

21. The dividend yield of an asset is 10% per annum. What is the delta of a long forward contract on the asset with six months to maturity?

a. 0.95

b. 1.00

c. 1.05

d. Cannot determine without additional information.

22. A 90-day European put option on Microsoft has an exercise price of \$30. The current market price for Microsoft is \$30. The delta for this option is close to

- a. -1
- b. -0.5
- c. 0.5
- d. 1

23. You are given the following information about a European call option: Time to maturity = 2 years; continuous risk-free rate = 4%; continuous dividend yield = 1%; $N(d_1) = 0.64$. Calculate the delta of this option.

- a. -0.64
- b. 0.36
- c. 0.63
- d. 0.64

24. An analyst is doing a study on the effect on option prices of changes in the price of the underlying asset. The analyst wants to find out when the deltas of calls and puts are most sensitive to changes in the price of the underlying. Assume that the options are European and that the Black-Scholes formula holds. An increase in the price of the underlying has the largest absolute value impact on delta for:

- a. Calls deep in-the-money and puts deep out-of-the-money.
- b. Deep in-the-money puts and calls.
- c. Deep out-of-the-money puts and calls.
- d. At-the-money puts and calls.

25. A bank has sold USD 300,000 of call options on 100,000 equities. The equities trade at 50, the option strike price is 49, the maturity is in three months, volatility is 20%, and the interest rate is 5%. How does the bank delta-hedge?

- a. Buy 65,000 shares.
- b. Buy 100,000 shares.
- c. Buy 21,000 shares.
- d. Sell 100,000 shares.

26. Suppose an existing short option position is delta-neutral, but has a gamma of 600. Also assume that there exists a traded option with a delta of 0.75 and a gamma of 1.50. In order to maintain the position gamma-neutral and delta-neutral, which of the following is the appropriate strategy to implement?

- a. Buy 400 options and sell 300 shares of the underlying asset.
- b. Buy 300 options and sell 400 shares of the underlying asset.
- c. Sell 400 options and buy 300 shares of the underlying asset.
- d. Sell 300 options and buy 400 shares of the underlying asset.

27. Ms. Zheng is responsible for the options desk in a London bank. She is concerned about the impact of dividends on the options held by the options desk. She asks you to assess which options are the most sensitive to dividend payments. What would be your answer if the value of the options is found by using the Black-Scholes model adjusted for dividends?

- a. Everything else equal, out-of-the-money call options experience a larger decrease in value than in-the-money call options as expected dividends increase.
- b. The increase in the value of in-the-money put options caused by an increase in expected dividends is always larger than the decrease in value of in-the-money call options.
- c. Keeping the type of option constant, in-the-money options experience the largest absolute change in value and out-of-the-money options the smallest absolute change in value as expected dividends increase.
- d. Keeping the type of option constant, at-the-money options experience the largest absolute change in value and out-of-the-money options the smallest absolute change in value as a result of dividend payment.

28. Which of the following statements is true regarding options Greeks?

- a. Theta tends to be large and positive when buying at-the-money options.
- b. Gamma is greatest for in-the-money options with long maturities.
- c. Vega is greatest for at-the-money options with long maturities.
- d. Delta of deep in-the-money put options tends toward +1.

29. Steve, a market risk manager at Marcat Securities, is analyzing the risk of its S&P 500 index options trading desk. His risk report shows the desk is net long gamma and short vega. Which of the following portfolios of options shows exposures consistent with this report?

- a. The desk has substantial long-expiry long call positions and substantial short-expiry short put positions.
- b. The desk has substantial long-expiry long put positions and substantial long-expiry short call positions.
- c. The desk has substantial long-expiry long call positions and substantial short-expiry short call positions.
- d. The desk has substantial short-expiry long call positions and substantial long-expiry short call positions.

30. Which of the following statements is incorrect?

- a. The vega of a European-style call option is highest when the option is at-the-money.
- b. The delta of a European-style put option moves toward zero as the price of the underlying stock rises.
- c. The gamma of an at-the-money European-style option tends to increase as the remaining maturity of the option decreases.
- d. Compared to an at-the-money European-style call option, an out-of-the-money European-style option with the same strike price and remaining maturity has a greater negative value for theta.

31. How can a trader produce a short vega, long gamma position?

- a. Buy short-maturity options, sell long-maturity options.
- b. Buy long-maturity options, sell short-maturity options.
- c. Buy and sell options of long maturity.
- d. Buy and sell options of short maturity.

32. An option portfolio exhibits high unfavorable sensitivity to increases in implied volatility and while experiencing significant daily losses with the passage of time. Which strategy would the trader most likely employ to hedge the portfolio?

- a. Sell short-dated options and buy long-dated options.
- b. Buy short-dated options and sell long-dated options.
- c. Sell short-dated options and sell long-dated options.
- d. Buy short-dated options and buy long-dated options.

33. An investor is long a short-term at-the-money put option on an underlying portfolio of equities with a notional value of USD 100,000. If the 95% VAR of the underlying portfolio is 10.4%, which of the following statements about the VAR of the option position is correct when second order terms are considered?

- a. The VAR of the option position is slightly more than USD 5,200.
- b. The VAR of the option position is slightly more than USD 10,400.
- c. The VAR of the option position is slightly less than USD 5,200.
- d. The VAR of the option position is slightly less than USD 10,400.