

RISK MANAGEMENT AND DERIVATIVES 2026

SHANGHAI JIAO TONG UNIVERSITY

SUMMER SCHOOL 2026

QUIZ 2: TOPICS 4–6

Reading time: 10 minutes. **Writing time:** 60 minutes.

Total marks: 100. **Calculators are permitted.**

Instructions: Answer **all** questions. In Section A, circle the letter of the single best answer. In Section B show your working; a correct number with no method earns little credit. Section C is a short essay. Interest rates are **continuously compounded** unless stated otherwise.

Structure:

- **Section A** — Multiple choice: 20 questions, 2.5 marks each (**50 marks**).
- **Section B** — One analytical problem in five parts (**30 marks**).
- **Section C** — One short essay (**20 marks**).

Useful formulas. Conversions $R_c = m \ln(1 + R_m/m)$, $R_m = m(e^{R_c/m} - 1)$; discounting $PV = CF_T e^{-z(T)^T}$; forward rate $f(T_1, T_2) = \frac{z(T_2)T_2 - z(T_1)T_1}{T_2 - T_1}$; forward prices $F_0 = S_0 e^{rT}$, $F_0 = (S_0 - I)e^{rT}$, $F_0 = S_0 e^{(r-q)T}$, $F_0 = S_0 e^{(r+u-y)T}$; currency $F_0 = S_0 e^{(r_{\text{dom}} - r_{\text{for}})T}$; delivery cost of bond $i = \text{quote}_i - F \times CF_i$; invoice price $= F \times CF + \text{accrued}$; accrued interest $= \text{coupon} \times \frac{\text{days since last coupon}}{\text{days in period}}$.

Section A: Multiple Choice

(20 questions $\times$ 2.5 marks = 50 marks)

1. A bank quotes the same stated rate of 4% under four compounding conventions. Which convention gives the largest balance after one year?

- (A) Annual compounding.
- (B) Semiannual compounding.
- (C) Quarterly compounding.
- (D) Continuous compounding.

2. A rate of 6% with semiannual compounding is equivalent to a continuously compounded rate of:

- (A) 6.09%.
- (B) 6.00%.
- (C) 5.91%.
- (D) 5.83%.

3. The two-year *zero rate* $z(2)$ is the rate on:

- (A) a new two-year bond issued at its face value.
- (B) a loan repaid in equal monthly instalments over two years.
- (C) money lent now and repaid in a single amount in two years.
- (D) an average of this year's and next year's short-term rates.

4. The two-year zero rate is 3%. The present value of \$100 received in two years is:

- (A) \$94.18.
- (B) \$94.26.
- (C) \$97.04.
- (D) \$106.18.

5. The one-year zero rate is 2% and the two-year zero rate is 3%. The forward rate for the second year ($f(1, 2)$) is:

- (A) 4.0%.

(B) 2.5%.

(C) 3.0%.

(D) 5.0%.

6. Yield curves usually slope upward. The standard explanation from the lecture is that:

(A) investors always expect inflation to rise steadily over time.

(B) central banks set long rates above the short rates they control.

(C) long bonds trade more actively and are easier to sell quickly.

(D) lenders prefer to lend short, so long rates carry a premium.

7. A stock trades at \$50 and will pay a dividend whose present value is \$2 before a one-year forward contract matures. The one-year rate is 4%. The forward price is closest to:

(A) \$52.04.

(B) \$49.96.

(C) \$50.00.

(D) \$48.00.

8. A futures and a forward on the same asset share the same maturity. The futures price tends to *exceed* the forward price when:

(A) the asset pays a large known income.

(B) the asset's price is strongly *negatively* correlated with interest rates.

(C) the asset's price is strongly *positively* correlated with interest rates.

(D) interest rates are known and constant over the contract's life.

9. A government bond pays a semiannual coupon of \$4.00. Ninety days have passed since the last coupon in a 180-day coupon period. The accrued interest the buyer adds to the clean price is:

(A) \$1.00.

(B) \$2.00.

(C) \$4.00.

(D) \$8.00.

10. Gold trades at \$2,400 per ounce, the six-month interest rate is 3%, and gold pays no income and (here) costs nothing to store. The six-month forward price is:

(A) \$2,436.27.

(B) \$2,400.00.

(C) \$2,473.10.

(D) \$2,364.27.

11. A stock-index futures price can sit *below* the index itself, with no arbitrage available, when:

(A) the dividend yield exceeds the interest rate.

(B) the market expects the index to fall.

(C) the futures contract is mispriced.

(D) index funds are selling futures heavily.

12. A one-year forward on a non-dividend share is quoted well *above* S_0e^{rT} . The arbitrage is to:

(A) buy the forward and short the share.

(B) buy both the share and the forward.

(C) short the share and lend the proceeds.

(D) borrow, buy the share, and sell the forward.

13. The dollar interest rate is above the yuan interest rate, and the one-year forward price of the dollar (in yuan) is below today's spot rate. This forward discount tells us that:

(A) the market is forecasting a weaker dollar over the year.

(B) the interest gap between the two currencies is being priced in.

(C) the central bank has fixed the forward rate by decree.

(D) dollar deposits carry more default risk than yuan deposits.

14. For a consumption asset such as crude oil, only the upper bound $F_0 \leq S_0 e^{(r+u)T}$ can be enforced by arbitrage, because:

- (A) storage costs are too high and too variable to measure.
- (B) firms will not sell or lend the physical asset they need.
- (C) short selling commodities is prohibited everywhere.
- (D) futures markets in consumption assets are too small to use.

15. The *convenience yield* on a commodity is:

- (A) the interest earned on the margin account.
- (B) the dividend the commodity pays its holder.
- (C) the benefit of holding the physical asset itself.
- (D) the fee charged by the warehouse.

16. A commodity futures market is in contango ($F_0 > S_0$) when:

- (A) the convenience yield exceeds interest plus storage.
- (B) the spot price is expected to rise.
- (C) interest plus storage exceeds the convenience yield.
- (D) the commodity pays its holder a high income.

17. A government bond is quoted at 100.40. The buyer actually pays:

- (A) the quoted price minus accrued interest.
- (B) the quoted price plus accrued interest.
- (C) exactly the quoted price.
- (D) the face value plus one coupon.

18. In a Treasury bond futures contract with a 3% notional coupon, a deliverable bond has a conversion factor greater than 1 exactly when:

- (A) its remaining maturity exceeds ten years.
- (B) it currently trades above its face value.
- (C) its yield exceeds the notional coupon.

(D) its coupon exceeds the notional coupon.

19. The futures price is $F = 100$. Two bonds are deliverable: bond X, quoted at 110.00 with conversion factor 1.05; and bond Y, quoted at 98.00 with conversion factor 0.95. The cheapest to deliver is:

(A) bond Y, at a delivery cost of 3.00.

(B) bond X, at a delivery cost of 5.00.

(C) bond X, at a delivery cost of 3.00.

(D) bond Y, at a delivery cost of 5.00.

20. A Treasury-bond futures contract settles at a futures price of 98.00. The short delivers a bond with conversion factor 1.10 and accrued interest \$0.50 (per \$100 face). The invoice price the short receives is:

(A) \$98.50.

(B) \$98.00.

(C) \$107.80.

(D) \$108.30.

Section B: Analytical Problem (30 marks)

A treasury desk faces the following market this morning. Zero rates, continuously compounded: $z(0.5) = 2.0\%$, $z(1) = 2.5\%$, $z(2) = 3.0\%$. Gold trades at $S_0 = \$2,400$ per ounce, pays no income, and (for this problem) costs nothing to store. The desk also holds a government bond portfolio.

- (a) **[6 marks]** Compute the present value of \$104 received in two years. Then compute the forward rate for the second year, $f(1,2)$, and explain in one sentence why it is higher than both zero rates.
- (b) **[6 marks]** The desk can buy a government bond today for \$100.00. The bond will pay a \$3 coupon in six months, and nothing else before a one-year forward on it matures. Using the zero rates above, compute the one-year forward price of the bond, and explain in one sentence why the coupon lowers the forward.
- (c) **[6 marks]** Compute the six-month forward price of gold.
- (d) **[6 marks]** A dealer quotes a six-month gold forward at \$2,460. Describe the arbitrage step by step, and compute the riskless profit per ounce at delivery.
- (e) **[6 marks]** A colleague argues: “the six-month forward price is the market’s forecast of the gold price in six months.” Using your answers to parts (c) and (d), explain in two or three sentences why this reading is wrong.

Section C: Essay (20 marks)

Read the scenario and write a short essay of **about half a page** (roughly 5 to 8 sentences). Marks are for clear economic reasoning, not length.

*A trader is **short** one Treasury-bond futures contract. As delivery nears, she realises the contract lets her choose which of several eligible bonds to hand over, and that the choice is worth real money. A colleague objects: “the conversion-factor system exists precisely to make every deliverable bond equally good to deliver, so your choice cannot matter.”*

Question [20 marks]. Using the tools of this course, explain (i) what the conversion factor is trying to do and why it does *not* make all bonds equally cheap to deliver; (ii) how the short decides which bond is cheapest to deliver; and (iii) why this delivery choice is valuable to the short and how it feeds into the futures price.