

# RISK MANAGEMENT AND DERIVATIVES 2026

## SHANGHAI JIAO TONG UNIVERSITY

### SUMMER SCHOOL 2026

### QUIZ 3

**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.** Discounting  $PV = CF_T e^{-z(T)T}$ ; discount factor  $d_t = e^{-z(t)t}$ ; par swap rate  $s = \frac{100(1 - d_n)}{\sum_{i=1}^n d_i}$  per 100 of notional; swap value to the fixed payer  $V = B_{\text{float}} - B_{\text{fixed}}$ , and a floating-rate bond is worth par at a reset date; loss fraction of a tranche spanning  $(a, d)$  when the pool loses  $L$ :  $\min(\max(\frac{L-a}{d-a}, 0), 1)$ ; call intrinsic value =  $\max(S - K, 0)$ , put intrinsic value =  $\max(K - S, 0)$ , time value = premium - intrinsic value; naked-call writer margin per share = the greater of  $(0.20 S + \text{premium} - \text{out-of-the-money amount})$  and  $(0.10 S + \text{premium})$ .

## Section A: Multiple Choice

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

1. A two-year interest-rate swap is struck today at the current market swap rate. Setting aside dealer spreads, its value at signing is:

- (A) positive to the fixed payer.
- (B) zero to both parties.
- (C) positive to the fixed receiver.
- (D) equal to the first year's net payment.

2. A two-year annual swap curve gives discount factors  $d_1 = 0.97$  and  $d_2 = 0.94$ . The par swap rate is closest to:

- (A) 1.57%.
- (B) 3.00%.
- (C) 6.00%.
- (D) 3.14%.

3. In a plain-vanilla swap on a notional of \$200 million, the fixed rate is 3.5% and this year's floating benchmark was set at 2.9%. At the year-end payment date:

- (A) the fixed payer pays a single net \$1.2 million.
- (B) the fixed payer pays a single net \$5.8 million.
- (C) the two parties exchange \$7.0 million against \$5.8 million.
- (D) the two parties also exchange the \$200 million notional.

4. At a reset date, a floating-rate bond is worth:

- (A) its face value minus the coupon just set.
- (B) its face value only if the yield curve is flat.
- (C) exactly its face value (par).
- (D) the average of its remaining expected coupons.

5. Firm X can borrow at 3.4% fixed or benchmark +0.4% floating; firm Y at 5.2% fixed or benchmark +1.1% floating. The total comparative-advantage saving a swap between them can share out is:

- (A) 1.8% per year.
- (B) 1.1% per year.
- (C) 0.7% per year.
- (D) 2.5% per year.

6. The lecture's critique of the comparative-advantage argument is that:

- (A) the weaker firm's own credit spread is not fixed by the swap and resets at every loan rollover.
- (B) the two firms can never both want the side of the swap the argument assigns to them.
- (C) the dealer's fee in practice absorbs more than the whole of the apparent saving.
- (D) the argument counts the swap's notional twice, once on each of the two legs.

7. A currency swap differs from a plain-vanilla interest-rate swap in that:

- (A) its floating leg must reset more frequently than once a year.
- (B) it cannot be valued as the difference of two bonds.
- (C) its fixed rate is set by the foreign curve alone.
- (D) principals are exchanged at the start and re-exchanged at maturity.

8. A pool backs three tranches: equity absorbs losses from 0 to 5%, mezzanine from 5 to 20%, senior above 20%. The pool loses 8%. The mezzanine tranche loses:

- (A) 8% of its principal.
- (B) 100% of its principal.
- (C) 20% of its principal.
- (D) 3% of its principal.

9. In a securitisation, the equity tranche is promised the highest yield because:

- (A) it absorbs the pool's first losses, standing in front of every other tranche.
- (B) it has the longest legal maturity of the three tranches.
- (C) it is paid first out of the pool's cash collections each period.

(D) it is the largest tranche and so carries the most principal.

**10.** Two loans each default with probability 30%. A “senior” note loses only if *both* default. If the two defaults are independent, the probability the note is hit is:

(A) 15%.

(B) 9%.

(C) 30%.

(D) 60%.

**11.** Default correlation in a loan pool rises while each loan’s individual default probability is unchanged. The pool’s *expected* loss:

(A) rises, and every tranche becomes riskier.

(B) falls, because diversification improves.

(C) is unchanged, and so is every tranche’s risk.

(D) is unchanged, but the senior tranche becomes riskier.

**12.** An ABS is tranching 5/15/80 (equity/mezzanine/senior), and an ABS CDO with the same 5/15/80 structure is built from the mezzanine tranches. The mortgage pool loses 17%. The CDO’s senior tranche loses:

(A) 0%.

(B) 17%.

(C) 75%.

(D) 80%.

**13.** A AAA senior tranche and a AAA corporate bond carry the same estimated default probability. The argument from the lecture that the tranche should nonetheless *yield more* is that:

(A) it fails only in a systematic catastrophe, while the corporate bond fails idiosyncratically.

(B) its promised cash flows arrive later on average than the corporate bond’s coupons.

(C) its rating is reviewed less often than the rating of a comparable corporate bond.

(D) it is exempt from the risk-retention rules that cover ordinary corporate issuers.

14. A stock trades at \$73. A call with strike \$70 is quoted at \$5.20. Its time value is:
- (A) \$3.00.
  - (B) \$2.20.
  - (C) \$5.20.
  - (D) \$8.20.
15. Across the strikes of one expiry, time value is largest:
- (A) deep in the money.
  - (B) deep out of the money.
  - (C) at the money.
  - (D) at whichever strike has the highest open interest.
16. You paid \$4 for a call with strike \$50. At expiry the stock trades at \$52. You should:
- (A) abandon the option, since the trade has lost money overall.
  - (B) exercise only if the stock is above \$54, the breakeven price.
  - (C) abandon the option and write off the premium against the loss.
  - (D) exercise, collect the \$2 payoff, and accept a \$2 overall loss.
17. Which position has a *bounded* maximum gain but an *unbounded* maximum loss?
- (A) A long call.
  - (B) A naked short call.
  - (C) A long put.
  - (D) A short put.
18. A stock trades at  $S = \$56$ . A client writes one naked call, strike \$60, premium \$2.10, contract size 100 shares. Using the margin rule in the formulas box, the margin per contract is:
- (A) \$930.
  - (B) \$770.
  - (C) \$210.

(D) \$1,330.

**19.** You hold one call, strike \$80, on 100 shares. The company announces a 2-for-1 stock split and the share price halves from \$88 to \$44. After the standard adjustment, your position is:

(A) worthless, since \$44 is below the \$80 strike.

(B) an \$80 strike on 200 shares.

(C) a \$40 strike on 100 shares.

(D) a \$40 strike on 200 shares.

**20.** Option buyers post no margin while option writers post margin daily. The reason is that:

(A) buyers are screened for creditworthiness before they are allowed to trade.

(B) buyers' positions are individually too small for the clearing house to track.

(C) the buyer's worst case is pre-paid in full; the writer's has no ceiling.

(D) exchanges keep a convention inherited from the era of paper certificates.

## Section B: Analytical Problem (30 marks)

A markets desk at a mid-sized bank faces three books this morning. Zero rates, continuously compounded:  $z(1) = 2.0\%$ ,  $z(2) = 3.0\%$ . Swap payments are annual. The desk must price a client swap, assess a securitisation offer, and clear a client's option orders.

- (a) [6 marks] Compute the discount factors  $d_1$  and  $d_2$  and the two-year par swap rate. Explain in one sentence why a swap struck at that rate is worth zero at signing.
- (b) [6 marks] A client swap struck some time ago pays 4.0% fixed annually against the floating benchmark on a notional of \$100 million. Exactly one exchange remains, in one year, and the floating rate has just been reset. Value the swap to the fixed *payer* as the difference of two bonds, state the dollar value on the full notional, and interpret the sign in one sentence.
- (c) [6 marks] The desk is offered the mezzanine tranche of a mortgage securitisation tranching equity 0–5%, mezzanine 5–20%, senior 20–100% of pool losses. In the stress scenario the pool loses 11%. Compute the percentage loss of each tranche in that scenario, and state the pool loss at which the mezzanine tranche is wiped out.
- (d) [6 marks] On the options book, the underlying stock trades at \$62. Two calls are quoted: strike \$60 at \$4.10, and strike \$65 at \$1.60 (contract size 100 shares). Decompose each premium into intrinsic value and time value, and state each option's moneyness.
- (e) [6 marks] The client now writes one naked call, strike \$65, at the quoted \$1.60. Using the margin rule in the formulas box, compute the margin per contract and compare it with the premium received. Then explain in one or two sentences why the *buyer* of the same call posts no margin at all.

## 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.

*An investment committee is offered the senior tranche of a residential-mortgage securitisation, rated AAA and attaching at 20% of pool losses. One member argues: “this is as safe as a AAA corporate bond, and it pays the same. The pool holds ten thousand loans; they cannot all fail at once, and losses must burn through the equity and mezzanine tranches before they ever reach us.”*

**Question [20 marks].** Using the tools of this course, explain (i) how pooling and tranching manufacture a AAA security out of risky loans, and what the 20% attachment point does; (ii) why the senior tranche’s safety is governed by *default correlation* rather than by the average quality of the loans; and (iii) what the 2007–08 episode revealed about the committee member’s argument.