Risk Management and Derivatives 2026
Shanghai Jiao Tong University
Summer School 2026
Final Exam

Reading time: 10 minutes. **Writing time:** 120 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. Swap to the fixed payer $V = B_{\text{float}} - B_{\text{fixed}}$, with B_{float} = notional at a reset date; par swap rate $c^* = \dfrac{1 - DF(n)}{\sum_{t=1}^{n} DF(t)}$; tranche loss $= \min\big(\max(L - \text{attachment}, 0),\ \text{tranche size}\big)$; intrinsic value: call $\max(S - K, 0)$, put $\max(K - S, 0)$; time value = premium − intrinsic; bounds: $\max(S - Ke^{-rT}, 0) \le c \le S$, $\max(Ke^{-rT} - S, 0) \le p \le Ke^{-rT}$; put-call parity $c + Ke^{-rT} = p + S$; early exercise before an ex-dividend date can pay only if $D > K\big(1 - e^{-r\tau}\big)$; naked-call writer margin per share $= \max\big(0.20S + \text{premium} - \text{OTM amount},\ 0.10S + \text{premium}\big)$; bull call spread: max profit $= (K_2 - K_1) -$ net cost, breakeven $= K_1 +$ net cost; straddle breakevens $= K \pm$ total premium.

Section A: Multiple Choice (20 questions × 2.5 marks = 50 marks)

1. A firm enters a three-year interest-rate swap today as the fixed-rate payer. The fixed rate was set at the current market *par* swap rate. At the moment of signing, the value of the swap to the firm is:

(A) positive, because paying fixed is a bet that rates will rise.

(B) about zero, because the two legs have equal present value.

(C) negative, because a fixed payment is always a net cost.

(D) unknown until the first floating fixing is announced.

2. Firm A can borrow fixed at 3.8% or floating at SOFR +0.4%. Firm B can borrow fixed at 5.4% or floating at SOFR +1.0%. If each firm borrows where it is relatively best and they swap, the total gain available to be shared each year is:

(A) 0.6% per year.

(B) 1.6% per year.

(C) 2.2% per year.

(D) 1.0% per year.

3. A bank pays 5% fixed annually and receives SOFR on a notional of $100 million. Two payment dates remain and a floating reset has just occurred. Discount factors are $DF(1) = 0.96$ and $DF(2) = 0.90$. Valuing the swap as two bonds, its value to the bank is:

(A) +$0.7 million.

(B) −$0.7 million.

(C) $0, since swaps are always worth zero.

(D) +$9.3 million.

4. In a fixed-for-fixed *currency* swap, unlike a single-currency interest-rate swap:

(A) principal is never exchanged, exactly as in the single-currency case, so only the coupons differ.

(B) its value is driven by the domestic yield curve alone, since the foreign leg's payments are fixed.

(C) principals are exchanged at the start and at maturity, so the exchange rate and both curves drive its value.

(D) counterparty credit risk is eliminated, because the two currency legs offset each other exactly.

5. A \$100 million mortgage pool is tranched into \$80 million senior, \$15 million mezzanine, and \$5 million equity, with losses applied bottom up. Defaults produce \$14 million of losses on the pool. The mezzanine tranche loses:

(A) 0% of its principal.

(B) 14% of its principal.

(C) 60% of its principal.

(D) 100% of its principal.

6. Two loan pools have the *same* average default rate. In Pool X the loans default nearly independently; in Pool Y they are highly correlated and tend to default together. The senior tranche is:

(A) equally safe in both, because the average default rate is equal.

(B) riskier in Pool Y, because clustered defaults can reach the senior layer.

(C) safer in Pool Y, because correlation spreads defaults over time.

(D) risk-free in both, because senior tranches carry AAA ratings.

7. A tiny pool holds two loans; each defaults with probability 10%. A "senior" piece loses money only if *both* loans default. Moving from independent defaults to perfectly correlated defaults, the probability that the senior piece loses rises:

(A) from 1% to 10%.

(B) from 10% to 20%.

(C) from 5% to 10%.

(D) not at all; it stays at 10%.

8. A structurer pools the mezzanine tranches of one hundred mortgage securitisations from one hundred different cities, re-tranches the pool, and wins a AAA rating for the new senior layer by assuming the inputs default nearly independently. House prices then fall across the whole country at once. The senior layer suffers because:

(A) under stress the waterfall reverses and pays the new pool's equity layer ahead of its senior layer.

(B) defaults in one city trigger cross-default clauses written into the other ninety-nine securitisations.

(C) the new senior layer was sized larger than mortgage collateral can support in any national downturn.

(D) the hundred inputs share one national housing factor, so they default together and never diversify.

9. A stock trades at $S = \$48$. A call with strike $K = \$45$ is quoted at \$4.50. The call's *time value* is:

(A) \$3.00.

(B) \$1.50.

(C) \$4.50.

(D) \$0, because an in-the-money option has no time value.

10. A trader *writes* one put contract (100 shares) with strike $K = \$50$ for a premium of \$3.80 per share and holds to expiry. The stock finishes at $S_T = \$44$. The writer's total profit or loss is:

(A) a loss of \$220.

(B) a gain of \$380.

(C) a loss of \$600.

(D) a gain of \$220.

11. An investor holds one call contract (100 shares), strike \$80, on a stock trading at \$88. The company announces a 2-for-1 stock split, after which the shares trade near \$44. Under the standard exchange adjustment, the investor now holds:

(A) a worthless call, since the post-split price of \$44 sits below the \$80 strike.

(B) no position at all, since outstanding contracts are cancelled when a stock splits.

(C) a call with strike \$40 on the same 100 shares, worth half what it was before.

(D) a call with strike \$40 on 200 shares, with the position's value fully preserved.

12. You wrote an American call, strike \$35, on a stock now at \$40. The stock pays a \$1.50 dividend and goes ex-dividend tomorrow; your call has \$0.40 of time value left. Which statement is correct?

(A) You decide when you are assigned, so you can safely wait until the expiry date.

(B) You cannot be assigned before expiry, since exercise settles only at maturity.

(C) Assignment tonight is likely, since the dividend to be captured exceeds the remaining time value.

(D) The large dividend protects the writer, making early exercise unattractive and assignment unlikely.

13. A European call has strike $K = \$48$ on a non-dividend stock at $S = \$50$, with $r = 6\%$ and $T = 0.5$ years, so $Ke^{-rT} = \$46.58$. A dealer quotes the call at \$1.80. With no option model at all, you can conclude:

(A) the quote is below the no-arbitrage floor $S - Ke^{-rT} = \$3.42$, so a riskless profit is available.

(B) the quote is plausible, since the call is only \$2.00 in the money.

(C) the quote is too high, since a call can never be worth more than its intrinsic value.

(D) nothing can be concluded, since an option's value depends on the stock's volatility.

14. For a stock with $S = \$50$, $K = \$48$ and $Ke^{-rT} = \$46.58$, the market quotes the European call at $c = \$5.90$ and the European put at $p = \$2.00$. Checking put-call parity:

(A) the put side is dear by about \$0.48.

(B) the call side is dear by about \$0.48.

(C) parity holds to within rounding, so no trade is available.

(D) the call side is dear by \$3.90, the difference $c - p$.

15. An American call has strike $K = \$50$ and $r = 6\%$. The stock is about to go ex-dividend with $D = \$2.00$; after the ex-dividend date, $\tau = 0.25$ years remain to expiry. Using the early-exercise test $D > K(1 - e^{-r\tau})$:

(A) the critical dividend is $\approx$ \$0.74, but an American call should never be exercised early whatever the dividend.

(B) the critical dividend is $\approx$ \$1.48, and \$2.00 exceeds it, so early exercise may be optimal.

(C) the critical dividend is $\approx$ \$2.91, and \$2.00 is below it, so early exercise is not optimal.

(D) the critical dividend is $\approx$ \$0.74, and \$2.00 exceeds it, so exercising just before the ex-dividend date may be optimal.

16. Higher volatility raises the value of *both* calls and puts because:

(A) higher volatility raises the expected return that the stock must pay its holders.

(B) it makes finishing in the money more likely, and that probability is what the premium measures.

(C) the holder's downside is capped at the premium while larger favourable moves pay in full.

(D) it raises the present value of the strike, which appears on both sides of parity.

17. A trader buys a call with strike \$50 for \$4.00 and writes a call with strike \$55 for \$2.00, same stock and expiry. The maximum profit per share at expiry is:

(A) \$5.00.

(B) \$3.00.

(C) \$2.00.

(D) \$7.00.

18. A trader buys a straddle at strike \$50: the call costs \$3.00 and the put \$2.50. The expiry breakeven prices are:

(A) \$44.50 and \$55.50.

(B) \$47.00 and \$53.00.

(C) \$47.50 and \$52.50.

(D) \$44.50 only, since a straddle profits only from falls.

19. An investor owns a share bought at \$50 and writes a one-month call with strike \$55 for a \$2.00 premium (a covered call). The stock finishes the month at \$62. Compared with simply holding the share, the covered call ended:

(A) \$2.00 per share better, since the premium collected is pure additional income.

(B) exactly level, since the premium always compensates for the surrendered upside.

(C) \$7.00 per share worse, since the writer loses the entire move above the strike.

(D) \$5.00 per share worse, since \$7.00 of upside was sold for a \$2.00 premium.

20. An investor owns a share at \$50 and sets up a zero-cost collar: buying a put with strike \$46 for \$1.20 and writing a call with strike \$56 for \$1.20. Ignoring interest, the position's profit per share at expiry is:

(A) floored at −\$4.00 with unlimited upside above \$56.

(B) floored at −\$5.20 and capped at +\$4.80.

(C) floored at −\$4.00 and capped at +\$6.00.

(D) floored at \$0, since a zero-cost collar cannot lose money.

Section B: Analytical Problem (30 marks)

You are on the equity-derivatives desk of a London bank. A client, Harcourt Capital, holds **100,000 shares** of the non-dividend US stock ATLAS, trading at $S = \$80$. Six-month ($T = 0.5$) European options on ATLAS are quoted per share below; each listed contract covers 100 shares. The riskless rate is $r = 4\%$ (continuously compounded); you may use $Ke^{-rT} = \$78.42$ for the \$80 strike.

strike K	call	put
72	–	2.10
80	7.90	5.80
84	–	7.80
90	2.90	–

(a) **[6 marks]** Split the \$84 put's premium and the \$80 call's premium into intrinsic value and time value, and state each option's moneyness. Where on a board is time value largest, and do these two quotes agree with that rule?

(b) **[6 marks]** Audit the \$80 strike against put-call parity. Compute the parity-fair call price from the put quote, state the size of the violation, and describe the four-leg conversion trade that exploits it, giving the cash banked today per share and showing that the position owes nothing at expiry whether S_T finishes above or below \$80.

(c) **[6 marks]** Instead of paying for protection, the client first proposes *writing* the \$90 call naked, one contract, at \$2.90. The broker margin per share is the greater of (i) $0.20S + \text{premium} - \text{OTM amount}$ and (ii) $0.10S + \text{premium}$. Compute both methods, the margin per contract, and the ratio of margin to premium received. What does this ratio tell the client about the trade?

(d) **[6 marks]** The client instead sets up a zero-premium-style collar on the whole holding: buy the \$72 put at \$2.10 and write the \$90 call at \$2.90 (per share, scaled to 100,000 shares). Compute the net premium, the floor profit and the cap profit per share, the breakeven price, and the worst-case and best-case outcomes in dollars on the full position.

(e) **[6 marks]** The \$8 million position is financed with a floating-rate loan, and the client asks you to swap it to fixed for two years (annual payments, annual compounding). Discount factors are $DF(1) = 0.97$ and $DF(2) = 0.93$. Compute the par swap rate, state the value of the swap at inception if it is struck at that rate, and explain in one sentence why the floating leg can be valued without forecasting SOFR.

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 pension fund buys two-month put options to protect its equity portfolio. The market subsequently rises and the puts expire out of the money. Several trustees call the premium "wasted" and propose using short stock-index futures next time because futures require no premium.

Question [20 marks]. Explain why the puts expiring worthless does not mean that the hedge failed. Compare a protective put with a short-futures hedge in terms of downside protection, upside participation, initial cost, and margin cash flows. Using put-call parity, explain what the put premium purchases, and advise when the fund should prefer each hedge.