McGill Desautels Faculty of Management
Daniel Andrei, Financial Derivatives FINE 448, Fall 2025

Midterm

October 2025

Date: _____

Student Name: _____

Required Signature:[1] _____

- **Review all instructions** on this cover page before you begin.
- This is an **open-book** and **open-note** midterm. You may use calculators, computers, and any documentation you need.
- **Communication with anyone other than the me is strictly prohibited** during the midterm.
- To be perfectly clear, while you may type questions into online resources (like search engines or AI tools), you are **strictly forbidden from capturing or transmitting any image or video of this exam booklet**. Submitting a photo of a question to an AI service or to any person is a form of prohibited communication and will result in an immediate grade of zero.
- Your calculated answer may differ slightly from the options due to rounding. **Please select the choice that is mathematically closest to your result.**
- Each question has **only one correct answer**.

TIME LIMIT: 60 minutes

TOTAL POINTS: 100

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By signing the exam: (*i*) you certify your presence, (*ii*) you state that you neither gave nor received **unauthorized** help during the examination, and (*iii*) you acknowledge that you have read, understood, and agree to abide by all instructions on this cover page, including the specific rules governing communication and the use of electronic devices.

1 (1 point) In a binomial tree, the number of unique paths after 4 periods is 16.

a. True

b. False

2 (1 point) Consider a stock index currently trading at \$400. The risk-free rate is 8% per annum (continuously compounded) and the dividend yield is 4% per annum. The correct futures price for a four-month contract is \$405.37.

a. True

b. False

3 (1 point) A one-month European call on a non-dividend stock sells for \$4.50. Its strike price is \$60 while the underlying stock trades at \$65. The risk-free rate is 5% per annum. An arbitrage opportunity exists.

a. True

b. False

4 (1 point) A one-month European put on a non-dividend stock is priced at \$4.00. The strike is \$52, the stock is trading at \$48, and the risk-free rate is 6% per annum. An arbitrage opportunity exists.

a. True

b. False

5 (1 point) Backwardation is the situation where the futures contract price is lower than the spot price for a commodity.

a. True

b. False

6 (1 point) Keystone Inc. common stock trades at \$42 per share. A \$40-strike call option is out-of-the-money today.

a. True

b. False

7 (1 point) Suppose that "QuantumLeap Gaming," a video game company, has been heavily shorted by several large institutional investors who anticipate poor future earnings. However, a wave of coordinated buying from retail investors triggers a rapid increase in the stock's price. This forces the short sellers to start buying back shares to cover their positions and limit their losses. This phenomenon, known as a short squeeze, will cause the stock's value to decrease significantly as the short sellers exit their positions.

a. True

b. False

8 (1 point) An investor, believing that shares of XYZ Corp. are unlikely to fall below $80 in the near future, writes a put option with a strike price of $80. This position means the investor is now exposed to potential financial loss if the stock's price declines.

a. True

b. False

9 (1 point) An investor, feeling bullish on ABC Inc., buys a call option with a strike price of $100. At the contract's expiration, the stock price for ABC Inc. is only $95. The investor is nevertheless obligated to buy the shares for the $100 strike price.

a. True

b. False

10 (1 point) An analyst builds a three-period binomial tree to value a stock option. The model functions by assuming the stock price can only change at the end of each of the three distinct periods. This type of framework is classified as a continuous-time model.

a. True

b. False

11 (1 point) An investor buys a call option, paying a premium. Soon after, the underlying stock's price falls dramatically, making the option deeply out-of-the-money. As a result, the market value of the option contract itself can become negative.

a. True

b. False

12 (1 point) Shares of a non-dividend-paying stock are currently trading for $50. A European call option on this stock is priced in the market at $52. This market pricing represents a valid, arbitrage-free equilibrium.

a. True

b. False

13 (1 point) To establish the fundamental no-arbitrage bounds for an option's price—such as $C \geq \max(0, S_0 - Ke^{-rT})$—an analyst must first assume that the underlying stock's returns follow a specific probability distribution, like the log-normal distribution.

a. True

b. False

14 (1 point) An analyst expects that after a major news announcement, the stock of XYZ Corp. will become significantly more volatile. Based on this expectation alone, the analyst should conclude that the prices of both call and put options on the stock will decrease.

a. True

b. False

15 (1 point) A European put option on a stock has a strike price of \$70. In a valid, arbitrage-free market, it is possible for this put option to trade at a price of \$75.

a. True

b. False

16 (1 point) An investor wants the right, but not the obligation, to purchase a commodity at a fixed price in the future. The appropriate derivative for this purpose is a long position in a forward contract.

a. True

b. False

17 (1 point) While the total profit of a long futures contract held to maturity is the sum of its daily settlements, $\sum_{i=1}^{T}(F_i - F_{i-1}) = F_T - F_0$, the timing of these cash flows differs significantly from a forward contract. Is the following statement accurate: With forward contracts, all gains and losses are accumulated to one payment on the delivery date, whereas futures contracts recognize gains and losses daily?

a. True

b. False

18 (1 point) The theoretical lower bound for a European call option's price is established by the no-arbitrage condition $C \geq \max(S_0 - Ke^{-rT}, 0)$. However, it is argued that during periods of extreme market stress, the actual traded price of an option contract can become negative.

a. True

b. False

19 (1 point) A speculator who is long a futures contract can realize a profit based on the price change, $Profit = N \times (F_{close} - F_{open})$. To lock in this profit or loss, the speculator must almost always hold the contract until its expiration date and take physical delivery of the underlying asset.

a. True

b. False

20 (1 point) The payoff of an Asian call option, often based on an average price formula like $S_{avg} = \frac{1}{n} \sum_{i=1}^{n} S_{t_i}$, incorporates the entire price path of the underlying asset. Because of this path-dependent feature, an Asian option is always more expensive than an otherwise identical standard European option.

a. True

b. False

21 (2 points) An analyst needs to input a continuously compounded rate into a pricing model. The firm's documentation notes that to convert from a continuously compounded rate (r_{cc}) to an effective annual rate (r_{eff}), the formula is $1 + r_{eff} = e^{r_{cc}}$. If the only data available is an effective annual risk-free rate of 9%, what is the correct continuously compounded rate the analyst should use?

a. 10.44%

b. 7.70%

c. 8.62%

d. 11.33%

22 (2 points) A stock index currently stands at 400. The risk-free rate is 6% (continuously compounded) and the dividend yield on the index is 4%. What should be the future price for a four-month contract be?

a. \$406.72

b. \$402.68

c. \$405.37

d. \$408.08

23 (2 points) An equity-linked certificate of deposit promises to repay in 5.5 years initial invested amount and 75% of the gain in the S&P 500 index. Assume a $40,000 initial investment. The level of S&P 500 today is 3,900. What is the final payoff if in 5.5 years the S&P 500 reaches $4,536?

a. $44,892.31

b. $41,856.41

c. $41,965.00

d. $42,784.62

24 (2 points) A bond costs $88 today. It will pay $100 in 3.5 years, with no interim cash flows. What is the continuously compounded annualized rate of return on the bond?

a. 8.99%

b. 6.56%

c. 7.10%

d. 3.65%

25 (2 points) Suppose that over 1 year a stock price increases from $100 to $143. Over the subsequent year it increases from $143 to $187. What is the annual average effective rate of return?

a. 28.45%

b. 31.30%

c. 25.04%

d. 36.75%

26 (2 points) An investor establishes a long straddle position, whose payoff at expiration is given by the formula $|S_T - K|$. The position was created with a strike price of $K = \$100$ and 1-year maturity for a total premium of $23.7343. The risk-free interest rate is 8%, continuously compounded. What is the investor's profit if the underlying price is $S_T = \$68$ at expiration?

a. $6.2890

b. It depends on the value of the underlying today

c. $8.2657

d. -$25.7110

27 (2 points) ABC stock has a bid price of $40.95 and an ask price of $41.05. Assume that the brokerage fee is quoted as 0.4% of the bid or ask price. Suppose you buy 111 shares, then immediately sell 111 shares. What is your round-trip transaction cost?

a. $49.98

b. $34.60

c. $47.51

d. $41.24

28 (2 points) Consider a binomial tree with N time steps designed to model stock price movements. The tree is specifically built to be *non-recombining*, meaning a sequence of moves like 'up-then-down' leads to a different final node than a 'down-then-up' sequence. How many distinct paths, or unique sequences of moves, exist from the initial node at time 0 to the final nodes at time N?

a. $\frac{(N+1)(N+2)}{2}$ paths

b. $2^{N+1} - 1$ paths

c. 2^N paths

d. $N + 1$ paths

29 (2 points) On October 1, 1997, WorldCom Inc. CEO (Bernard Ebbers) sent the following note to the CEO of MCI (Bert Roberts), and it was also released through the typical newswires:

"I am writing to inform you that this morning WorldCom is publicly announcing that it will be commencing an offer to acquire all the outstanding shares of MCI for $41.50 of WorldCom common stock per MCI share. The actual number of shares of WorldCom's common stock to be exchanged for each MCI share in the exchange offer will be determined by dividing $41.50 by the price of WorldCom's stock price in 6 months from now, *but will not be less than 1.0375 shares* (if WorldCom's stock price exceeds $40)."

Assume zero interest rates. The value of this offer today is

a. Higher than $41.50

b. I don't have enough information to answer this question

c. Equal to $41.50

d. Lower than \$41.50

30 (2 points) You have purchased a butterfly spread with maturity 1 year, for a premium of \$4.3318. The European call options that make up the butterfly spread have strikes \$90, \$100, and \$110. The risk-free interest rate is 5%, continuously compounded. What is your **profit** in one year from now if the underlying price is $S_T = \$102$?

a. It depends on the value of the underlying today

b. \$3.6682

c. \$3.4461

d. -\$4.5539

31 (2 points) Suppose you sell a call with strike K and buy one share of stock. What is your payoff when the option expires?

a. Receive K if $S_t \leq K$ and receive S_t if $S_t > K$

b. Receive S_t if $S_t \leq K$ and receive $-(S_t - K)$ if $S_t > K$

c. Receive S_t if $S_t \leq K$ and receive K if $S_t > K$

d. Receive $S_t - K$ if $S_t \leq K$ and receive K if $S_t > K$

32 (2 points) A put option has a strike of \$36. The price of the underlying is currently \$41. The put is:

a. At the money

b. Out of the money

c. In the money

d. Near the money

33 (2 points) A project is expected to generate a perpetual cash flow stream, with a first cash flow \$18 in one year, expected to grow at 4% annually. Assume a discount rate of 15%. The present value of this project is

a. \$150.00

b. \$173.64

c. \$163.64

d. \$143.64

34 (2 points) Which of the following is potentially obligated to sell an asset at a predetermined price?

a. A call writer

b. A put buyer

c. A put writer

d. A call buyer

35 (2 points) Which one of the following actions will offset a short position in a futures contract that expires in September?

a. Buy any futures contract, regardless of its expiration date

b. Hold the short futures contract until it expires

c. Buy a futures contract that expires in September

d. Sell a futures contract that expires in September

36 (2 points) Which of the following is best described as selling a synthetic asset and simultaneously buying the actual asset?

a. Speculating

b. Diversifying

c. Arbitrage

d. Hedging

37 (2 points) Consider a portfolio manager who has written an at-the-money call option on a stock and collected a premium at initiation. The manager is now evaluating under what market conditions this position will generate a positive profit at expiration, taking into account the future value of the premium received. Under what circumstance can the writer of this at-the-money call option expect to profit?

a. The underlying price remains the same

b. I don't have enough information to answer this question

c. The increase in underlying price is more than the future value of the premium

d. The volatility of the underlying suddenly doubles

38 (2 points) You have purchased a butterfly spread with maturity 1 year, for a premium of \$4.3318. The European call options that make up the butterfly spread have strikes \$90, \$100, and \$110. The risk-free interest rate is 5%, continuously compounded. What is your **payoff** in one year from now if the underlying price is $S_T = \$102$?

a. \$8.00

b. \$2.00

c. \$0.00

d. It depends on the value of the underlying today

39 (2 points) A recombining binomial tree with N steps is structured such that the node reached by an 'up' move then a 'down' move is the same as the node reached by a 'down' then an 'up' move. Despite this recombination of nodes, how many distinct sequences of moves (i.e., paths) can be traced from the root of the tree to the N-th time step?

a. $N + 1$ paths

b. $2^{N+1} - 1$ paths

c. 2^N paths

d. $\frac{(N+1)(N+2)}{2}$ paths

40 (2 points) A risk manager needs to convert a stock's annual volatility for use in a weekly risk model. They recall that volatility scales with the square root of the time horizon, according to the rule $\sigma_T = \sigma_{\text{annual}}\sqrt{T}$, where T is the time period expressed in years. If the stock's annual volatility is 40%, what is the corresponding 1-week volatility?

a. 7.22%

b. 5.55%

c. 3.47%

d. 11.55%

41 (4 points) As the sole shareholder of a firm, your equity is the residual claim. The firm has debt with a face value of D, which is due in one year. At maturity, if the firm's assets (A) are worth more than D, you will pay the debt holders and keep the remaining value (A-D). If the assets are worth less than D, the debt holders take the assets and you receive nothing. This payoff to you as the equity holder is equivalent to holding which of the following portfolios?

a. a long position in the company's assets, a long position in a European put with strike D, and a long position in a zero-coupon bond with face value D

b. a short position in a European call with strike D written on the company's assets

c. a long position in the company's assets, a long position in a European put with strike D, and a short position in a zero-coupon bond with face value D

d. a long position in a European put with strike D written on the company's assets

42 (4 points) Assume no dividends. The stock price is \$98, and the risk-free rate is 6% per annum. Consider a six-month European straddle with a strike price of \$100. If the **volatility is zero**, what is the straddle worth?

a. \$3.82

b. \$1.92

c. \$0.96

d. \$0.00

43 (4 points) Consider an Asian call option with a one-year maturity and a strike price of \$50. The underlying stock, currently trading at \$50, pays no dividends. Using a one-period binomial model with the following parameters, what is the price of the option? (Parameters: $u = 1.2$, $d = 0.8$, $r = 5\%$ continuously compounded).

The option's payoff is based on the **arithmetic average** of the initial and final stock prices: $\max\left(\frac{S_0+S_1}{2} - K, 0\right)$.

a. \$3.14

b. \$2.50

c. \$2.99

d. \$5.00

44 (4 points) Assume no dividends. The stock price is \$95. The risk-free interest rate is 6% per annum. Consider a six-month European put with strike \$100. If the **volatility is zero**, what is the put worth?

a. \$2.11

b. \$5.00

c. \$2.05

d. \$0.00

45 (4 points) An equity-linked certificate of deposit promises to repay in 5.5 years initial invested amount and 50% of the gain in the S&P 500 index. Assume a $40,000 initial investment. The level of S&P 500 today is 3,900, and the interest rate is 5%, continuously compounded. What is the portfolio that replicates the final payoff of this certificate of deposit?

a. Lend $26.585.02 and purchase 6.73 calls on the S&P 500 with strike $3,900 and maturity 5.5 years.

b. Lend $30,382.88 and purchase 7.69 calls on the S&P 500 with strike $3,900 and maturity 5.5 years.

c. Lend $30,382.88 and purchase 7.06 calls on the S&P 500 with strike $4,250 and maturity 5.5 years.

d. Lend $30,382.88 and purchase 5.13 calls on the S&P 500 with strike $3,900 and maturity 5.5 years.

46 (4 points) You have purchased a butterfly spread (long one call with strike $90, short two calls with strike $100, and long one call with strike $110), with maturity 1 year. The value of the butterfly spread today is $3.19, and the risk-free rate (continuously compounded) is 8%. You will make a positive profit if the price of the underlying at maturity is

a. below $93.46 or above $106.54

b. between $96.54 and $103.46

c. between $95.46 and $105.54

d. between $93.46 and $106.54

47 (4 points) Consider the pricing of an option on a stock that pays no dividends. The stock's current price is $S_0 = \$1000$, and the continuously compounded risk-free rate is $r = 5\%$. The following table provides 8 simulated risk-neutral price paths for the stock over the next four years:

$t_1 = 1$	$t_2 = 2$	$t_3 = 3$	$t_4 = 4$
800	930	1010	1200
1070	1200	880	1050
910	850	650	770
1030	1170	1180	1320
950	1120	1190	870
1100	870	780	1130
1120	1030	1250	1150
890	970	1450	1230

Using these paths, calculate the price of an up-and-in European call option with a strike of $K = \$1000$, a barrier of \$1400, and an expiration of $T = 4$. The barrier's status is checked at the end of each year ($t_1, t_2, t_3,$ and t_4).

a. \$86.23

b. \$23.54

c. \$51.17

d. \$97.22

48 (4 points) Apex Corp. does not pay dividends and its current price is \$101. Consider a European call option on the stock of Apex Corp., with a \$100 strike and 2 years to expiration, and a European put option on the stock of Apex Corp., with a \$100 strike and 2 years to expiration. The continuously compounded risk-free interest rate is 10%. You wish to determine option prices with a two-period binomial tree, with $u = 1.4623$ and $d = 0.8025$. At $t = 1$, if the Apex Corp. stock goes down, you obtain a call price of \$7.689. What would be the price of the put option in that case?

a. \$19.012

b. \$17.120

c. \$20.714

d. \$15.858

49 (4 points) You have purchased a straddle (long one call with strike \$100 and long one put with strike \$100), with maturity 1 year. The value of the straddle today is \$10.85, and the risk-free rate (continuously compounded) is 8%. You will make a positive profit if the price of the underlying at maturity is

a. below \$90.00 or above \$110.00

b. below \$88.25 or above \$111.75

c. between \$89.15 and \$110.85

d. below \$85.00 or above \$115.00

50 (4 points) Suppose that you take a long position in one futures contract on gold. The contract size is 100 ounces. The initial margin is \$6,000 and the maintenance margin is \$4,500. What price change would lead to a margin call?

a. The price of gold must increase by \$15

b. The price of gold must decrease by \$10

c. The price of gold must decrease by \$15

d. The price of gold must increase by \$10