# FIN 730: Midterm Exam
# Fall 2022

Professor Bjørn Eraker
Wisconsin School of Business

Name: _____

Campus ID: _____

Section: _____

## Instructions

- This is a closed-book, closed-note exam. You are allowed to use your pens/pencils, your calculator only.
- A formula sheet is attached to the back of the exam. If you remove the formula sheet during the exam, please ensure that the stapling of the exam portion of this document remains intact.
- Show all your work in a well-organized fashion if you wish to get full credit.
- Use legible handwriting. If we can't read what you have written, it will not count.
- When you exit the classroom, please refrain from speaking to other students.

I understand and agree to abide by the exam instructions listed above.

Signature: _____

Date: _____

1. You receive \$1900 in 289 days from now. Assume a 365 day-per-year convention and compute the present value using continuous compounding with a 3% discount rate.

$$1900 e^{-0.03 \frac{289}{365}} \approx 1855.4$$

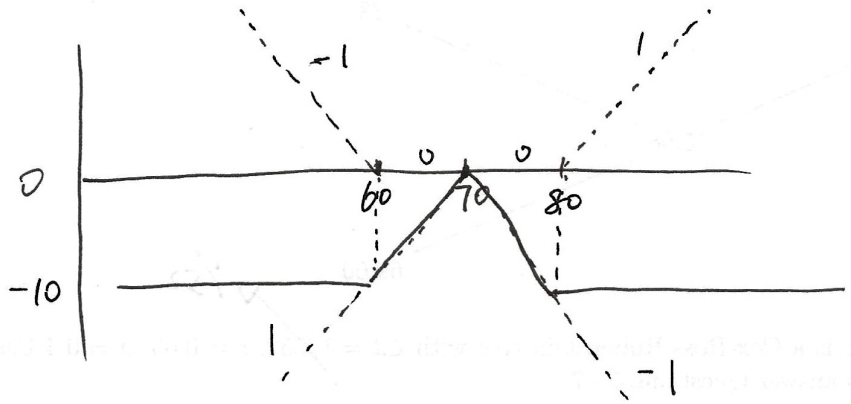
2. You sell (short) a European Put with strike 90. On the expiration date the underlying stock is at 65. What is your payoff?

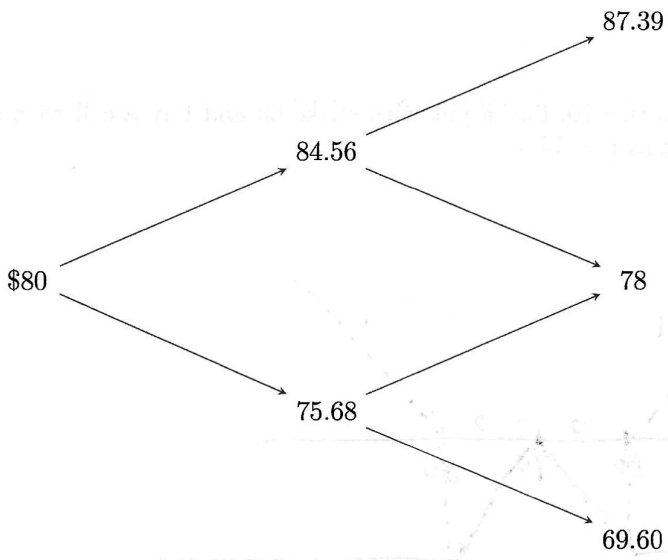
$$-\text{Max}\{K - S_T, 0\} = -\text{Max}\{90 - 65, 0\} = -25$$

3. You sell a straddle with strike 70. The price of the put is \$4 and the call is \$6. On the expiration date the underlying stock is at 60. What is your profit?

$$-|S_T - K| + C + P = -|60 - 70| + 4 + 6 = 0$$

4. You sell a straddle with strike 70, buy a put with strike 60 and buy a call with strike 80. Graph the payoff on this portfolio.





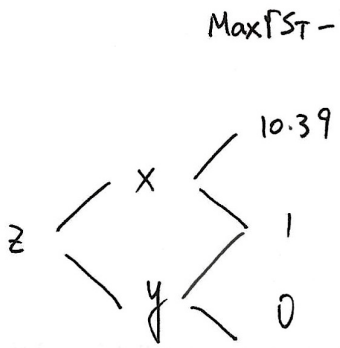

The above tree is a Cox-Ross-Rubenstein tree with $\Delta t = 1/252$, $r = 0.03$, $\sigma = 0.4$ Use these values to answer Questions 5 - 7.

$$u = e^{\sigma\sqrt{\Delta t}} = e^{0.4\sqrt{1/52}}$$

$$d = 1/u$$

$$p = \frac{e^{0.03 \cdot \frac{1}{52}} - d}{u - d} \approx 0.4913$$

5. Use the Binomial tree to compute the value of a European Call option with strike 77.

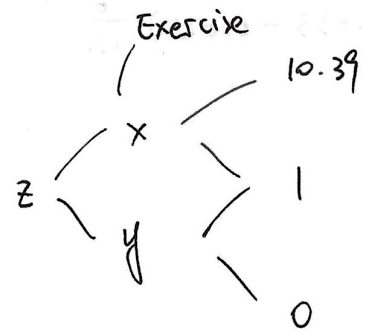



$$x = \left(p \cdot 10.39 + (1-p) \cdot 1\right) e^{-0.03 \cdot \frac{1}{52}} \approx 5.6104$$

$$y = (p \cdot 1 + (1-p) \cdot 0)\, e^{-0.03 \cdot \frac{1}{52}} \approx 0.4911$$

$$z = (p \cdot x + (1-p) y)\, e^{-0.03 \cdot \frac{1}{52}} \approx 3.0046$$

6. Use the Binomial tree to compute the value of an American Call option with strike 77.




$$x = \text{Max}\{5.6104,\ 84.56 - 77\} = 7.56$$

$$y = \text{Max}\{0.4911,\ 75.68 - 77\} = 0.4911$$

$$z = \text{Max}\{(px + (1-p)y)\, e^{-0.03 \cdot \frac{1}{52}},\ 80 - 77\}$$

$$= \text{Max}\{3.962,\ 3\}$$

$$= 3.962$$

7. The stock price tree above includes a dividend payment in the final period. What is the dividend payment?

$$u = e^{0.4\sqrt{1/52}} \approx 1.057$$

$$S_{uu} = S_0 u^2 \approx 89.39$$

$$89.39 - 87.39 = 2$$

8. The S&P index is at 3700. The continuous compounding interest rate is at 3.3%, and the dividend yield on the S&P 500 is 1.5%. What is the futures price for 6 month maturity S&P 500 futures?

$$F = S e^{(r-q)(T-t)} = 3700\, e^{(0.033 - 0.015)\frac{6}{12}}$$

$$\approx 3733.45$$

The following prices are relevant for Questions 9 to 13

| CALL | | Strike | PUT | |
|---|---|---|---|---|
| Bid | Ask | | Bid | Ask |
| 13.7 | 13.8 | 60 | 3.7 | 3.8 |
| 8.3 | 8.4 | 70 | 8.3 | 8.4 |
| 4.75 | 4.85 | 80 | 14.75 | 14.85 |

9. Suppose you sell the 70 strike straddle, buy the 60 strike put, and buy the 80 strike call (same as Question 4). What is your cash flow when initiating the trade? Assume that you cross the market with limit orders or use market orders.

$$+8.3 + 8.3 - 3.8 - 4.85 = 7.95$$

10. Suppose the stock price is at 86 at the expiration of the options. Find your profit.

$$\text{Payoff} = -|86-70| + \text{Max}\{86-80, 0\} + \text{Max}\{60-86, 0\}$$

$$= -16 + 6 + 0 = -10$$

$$\text{Profit} = -10 + 7.95 = -2.05$$

11. Use midpoints to find out what the stock price is. Assume a zero interest rate.

Using Put-Call Parity

$$S = C - P + Ke^{-rT}$$

$$= 8.35 - 8.35 + 70$$

$$= 70$$

12. What is the lowest payoff you can receive on the position in Question 9.

See the plot in Q4

$-10$

13. With the answers to Questions 9 and 12 in mind, derive a no-arbitrage condition for price of the portfolio.

Denote the straddle strike to be $K_S$, call strike to be $K_C$ and put strike to be $K_P$

$$0 \le P \le \text{Max}\{K_C - K_S,\ K_S - K_P\} = 10$$