Midterm Exam — Version A
FIN4750: Options, Liuren Wu, Spring 2019

Write your answers on this test book, use bluebook to show necessary steps.
Assume a continuously compounding dollar interest rate of 4% for all maturities, whenever applicable.
When I say 1 contract, I mean 100 shares. When I say 1 option/forward/futures, I mean 1 share.

1. (3x5=15 pts) You are long 2 contracts of gold futures with a delivery price \( K \) of $1300 and 1-year expiry.
   
   \[ 200 \text{ (}S_T-K\text{)} = 60000 \]
   
   \[ 200\frac{S_T}{100} - 1300 = 40000 \]
   
   (a) What will be your payoff at expiry if the gold price 1-year later \((S_T)\) is (i) $1000 (_____), (ii) $1400 (_____), (iii) $1500 (_____)?
   
   \[ 1400e^{0.04} = 1457.135 \]
   
   (b) If the current gold price is $1400, (i) what is the current 1-year gold futures price (_____)? (ii) what is the current value of your gold position (_____)?

2. (3x5=15 pts) You are short 3 contracts of pound forward with a delivery price of \( K \) of $1.40 (dollar per pound) and 3-year expiry.

   (a) If the current pound price is $1.30, and the pound interest rate is 4%, (i) what is the current 3-year forward price on pound? (_____)
   (ii) What is the current value of your short forward position? (_____)

   (b) What will be the payoff of your forward position if 3-year later at the forward expiry the pound price is (i) $1.30 (_____), (ii) $1.40 (_____), (iii) $1.50 (_____)?

3. (3x3=9 pts) If you are long 1 share of a call option on TSLA at a strike \((K)\) of $300 and 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 (_____), (ii) $310 (_____), (iii) $400 (_____)?

4. (3x3=9 pts) If you are short 1 share of a put option on TSLA at a strike \((K)\) of $300 and 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 (_____), (ii) $310 (_____), (iii) $400 (_____)?

5. (3x3=9 pts) If you are short 1 share of a call option on TSLA at a strike \((K)\) of $300 and 1-year maturity, and you are also long 1 share of a put option on TSLA at the same strike and maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 (_____), (ii) $310 (_____), (iii) $400 (_____)?

6. (3x3=9 pts) If you are long 1 share of a call option and 1 share of a put option on TSLA at the same strike \((K)\) of $300 and 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 (_____), (ii) $310 (_____), (iii) $400 (_____)?

7. (3x3=9 pts) If you are short 1 share of a call option on TSLA at a strike \((K)\) of $300 and also short 1 share of a put option on TSLA at the strike of $250, both at 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 (_____), (ii) $310 (_____), (iii) $400 (_____)?
8. (2x4=8 pts) Choose one of the following commonly used combos (strategies) on the S&P 500 index for each of the following questions and specify whether you need to be long or short in the contract:
(i) straddle, (ii) strangle, (iii) bull spread, (iv) risk reversal, (v) butterfly
(a) You think the stock market volatility will be higher than what most people expect. (long straddle)
(b) You think the stock market will go up, but not sure whether some crazy things can happen to make your forecast very wrong. (long bull spread)
(c) You think the stock market will either go up a lot or crash, more than any other people think possible. (long strangle)
(d) You think the stock market has a high chance of a crash, but little chance of going up a lot. (short risk reversal)

9. (9 pts) TSLA's current stock price is $280 and pays no dividend. If a market maker is quoting a one-year forward at $285 (with no bid-ask spread or other trading cost), what can you do to lock in an arbitrage profit?
\[ F = 280 \times e^{0.04 \times 1} = 291.43 > 285 \]
Long forward at 285, Short replication (short sell stock)
At expiry, Stock position cancel.
Net 291.43 - 285 = $6.43

10. (8 pts) Use any combination of bond, forward, calls, puts to replicate the following payoff structure.

*long $70 par zero-coupon bond*
*short 2 call at K = 80*
*long 4 call at K = 100*
*short 2 call at K = 120*
Write your answers on this textbook, use bluebook to show necessary steps.

Assume a continuously compounding dollar interest rate of 6% for all maturities, whenever applicable.

When I say 1 contract, I mean 100 shares. When I say 1 option/forward/futures, I mean 1 share.

1. (3x5=15 pts) You are long 2 contracts of pound forward with a delivery price of \((K)\) of $1.40 (dollar per pound) and 3-year expiry.
   (a) If the current pound price is $1.30, and the pound interest rate is 6%, (i) what is the current 3-year forward price on pound? \(\text{(1.30)}\) (ii) What is the current value of your short forward position? \(-16.7154\)
   \[\text{F} = \text{F}_0 \times (1 + f)^t, \quad \text{F} = 1.40 \times (1 + 0.06)^3 = 1.3\]
   \[\text{Value} = 2 \times 100 \times (1.40 - 1.30) = 200 \times (1.40 - 1.30) = 200 \times (1.30 - 1.40) = -200\]

2. (3x5=15 pts) You are short 3 contracts of gold futures with a delivery price \((K)\) of $1300 and 1-year expiry.
   (a) What will be your payoff at expiry if the gold price 1-year later \((S_T)\) is (i) $1000 \((-90K)\) (ii) $1400 \((-30K)\) (iii) $1500 \((-60K)\)
   \[\text{F} = \text{F}_0 \times e^{0.06t}, \quad \text{F} = 1300 \times e^{0.06} = 1486.57\]

3. (3x3=9 pts) If you are short 1 share of a call option on TSLA at a strike \((K)\) of $290 and 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 \((-10)\) (ii) $310 \((-20)\) (iii) $400 \((-5)\)

4. (3x3=9 pts) If you are long 1 share of a put option on TSLA at a strike \((K)\) of $290 and 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 \((-20)\) (ii) $310 \((-10)\) (iii) $400 \((-5)\)

5. (3x3=9 pts) If you are long 1 share of a call option on TSLA at a strike \((K)\) of $290 and 1-year maturity, and you are also short 1 share of a put option on TSLA at the same strike and maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 \((-20)\) (ii) $310 \((-20)\) (iii) $400 \((-110)\)

6. (3x3=9 pts) If you are short 1 share of a call option and 1 share of a put option on TSLA at the same strike \((K)\) of $290 and 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 \((-20)\) (ii) $310 \((-20)\) (iii) $400 \((-110)\)

7. (3x3=9 pts) If you are long 1 share of a call option and have a put option on TSLA at the strike of $250, both at 1-year maturity, what will be your payoff is 1-year later TSLA price goes to (i) $270 \((-20)\) (ii) $310 \((-20)\) (iii) $400 \((-110)\)
8. (2x4=8 pts) Choose one of the following commonly used combos (strategies) on the S&P 500 index for each of the following questions and specify whether you need to be long or short in the contract:
(i) straddle, (ii) strangle, (iii) bull spread, (iv) risk reversal, (v) butterfly

(a) You think the stock market will either go up a lot or crash, more than any other people think possible.
   
   
   
   (iii) long strangle

(b) You think the stock market volatility will be higher than what most people expect.
   
   
   
   (i) long straddle

(c) You think the stock market has a high chance of a crash, but little chance of going up a lot.
   
   
   
   (v) short risk reversal

(d) You think the stock market will go up, but not sure whether some crazy things can happen to make your forecast very wrong.
   
   
   
   (ii) long bull spread

9. (9 pts) TSLA's current stock price is $300 and pays no dividend. If a market maker is quoting a one-year forward at $310 (with no bid-ask spread or other trading cost), what can you do to lock in an arbitrage profit?

   \[ F = 300 \times e^{0.04 \times 1} = 318.55 > 310 \]  
   Long forward at 310, short stock at 330

   At expiry, stock positions cancel.  
   Net \[ 318.55 - 310 = 8.55 \]

10. (8 pts) Use any combination of bond, forward, calls, puts to replicate the following payoff structure.

   ![Diagram]

   Long 20 pay zero-bond
   Long 2 call at \( K = 80 \)
   Short 4 call at \( K = 100 \)
   Long 2 call at \( K = 120 \)