Stochastic Modelling of Financial Derivatives

Dhruv Bansal, Mayank Goud

June 2025

Total Marks: 120 **Deadline:** 13th June 2025

Week 2: Assignment 2.2

---

1. **Short Forward Contract (10 Marks)**
   You've entered into a short forward contract to sell 1,000 ounces of gold in May 2024 at a fixed forward price of $2,050 per ounce. This means you're betting that gold prices will fall by the time of delivery, allowing you to profit by selling at the higher agreed price.

   You're given a range of possible spot prices for gold in May 2024. Based on each scenario, calculate the profit or loss from this short forward position using the formula:

   $$\text{Profit or Loss} = (\text{Forward Price} - \text{Spot Price}) \times 1,000$$

   Fill in the table:

May-2024 Spot Price ($)	Profit or Loss ($)
1400	
1500	
1560	
1600	
1800	
2050	
2200	
2300	
2400	

2. **Futures Contract Profit/Loss (40 Marks)**
   For each of the following transactions, calculate the profit or loss when the futures position is closed out:

(a) **Corn Futures:** Corn futures trade on the Chicago Board of Trade (which is part of the CME Group). The underlying commodity is corn and each futures contract covers 5,000 bushels of corn (5,000 bushels is about 127 tonnes). You enter one long corn futures contract. The delivery price in your contract (F) is \$5.20 per bushel. When you close out your position, corn futures contracts have a delivery price (F) of \$5.80 per bushel.

(b) **Coffee Futures:** Coffee futures trade on the New York Mercantile Exchange (which is part of the CME Group). The underlying commodity is Arabica coffee and each futures contract covers 37,500 pounds of coffee. You enter one short Arabica coffee futures contract. The delivery price in your contract (F) is \$1.60 per pound. When you close out your position, Arabica coffee futures contracts have a delivery price (F) of \$1.40 per pound.

(c) **SPI200 Futures:** SPI200 futures contracts trade on the ASX and the underlying asset is the S&P/ASX200 market index. The notional dollar of each SPI200 futures contract is SA25 per index point. You enter 40 short SPI200 futures contracts. The delivery price in the futures contract is 7,500 index points. When you close out your position, SPI200 futures contracts have a delivery price (F) of 7,800 index points.

(d) **Stainless Steel Futures:** Stainless steel futures contracts trade on the Shanghai Futures Exchange. The underlying commodity is stainless steel and each futures contract covers 5 metric tonnes of stainless steel. You enter 3 long stainless steel futures contracts. The delivery price in your contract (F) is RMB 15,000 per metric tonne. When you close out your position, stainless steel futures contracts have a delivery price (F) of RMB 13,500 per metric tonne.

3. **Futures vs Spot Contracts (10 marks)**
What distinguishes a futures contract from a spot contract? How does a futures contract work on the commodity exchange? What role does a commodity exchange play in enabling futures contract trading, settlement, and delivery?

4. **European Put Option (30 marks)**
An investor buys a European put on a share for \$3. The stock price is \$42 and the strike price is \$40.

   - Under what circumstances does the investor make a profit?
   - Under what circumstances will the option be exercised?
   - Draw a diagram showing the variation of the investor's profit with the stock price at the maturity of the option.

5. **Portfolio of Forward + Put Option (20 works)**
Describe the terminal value of the following portfolio:

   - A newly entered-into long forward contract on an asset.
   - A long position in a European put option on the asset with the same maturity and a strike price equal to the forward price at setup.

   Show that the European put option has the same value as a European call option with the same strike price and maturity.

6. **Put-Call Parity: Risk-Free Rate (10 marks)**
   The prices of European call and put options on a non-dividend-paying stock with 12 months to maturity, a strike price of \$120, and an expiration date in 12 months are \$20 and \$5, respectively. The current stock price is \$130. What is the implied risk-free rate?