Week-2 Assignment: Stochastic Modelling of Financial Derivatives

Ikrima Badr Shamim Ahmed (Questions 1,2)
Aayushman Kumar (Questions 3,4)
Satyansh Sharma (Questions 5,6)

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Question 1

If I sold 1 000 oz of gold forward at \$2 050 per ounce. At settlement I'll have to buy gold at the spot price S and deliver it at my contract price. That means my payoff is

$$F - S = 2050 - S,$$

and since it's 1 000 oz, my total P/L is

$$(2050 - S) \times 1000.$$

Table:

Spot S (\$)	P/L \$$(2050 - S) \times 1000$
1400	650 000
1500	550 000
1560	490 000
1600	450 000
1800	250 000
2050	0
2200	-150 000
2300	-250 000
2400	-350 000

Question 2

For futures, the profit or loss is just the price change times the contract size Q. If you're long it's

$$(F_{\text{close}} - F_{\text{entry}}) \times Q,$$

and if you're short it's

$$(F_{\text{entry}} - F_{\text{close}}) \times Q.$$

Solution:

(a) Corn (long 1 contract = 5 000 bushels): $(5.80 - 5.20) \times 5000 = \$3\,000$.

(b) Coffee (short 1 contract = 37 500 lb): $(1.60 - 1.40) \times 37\,500 = \$7\,500$.

(c) SPI 200 (short 40 contracts, A$25 per point): $(7800 - 7500) \times 25 \times 40 = \text{A}\$300\,000$.

(d) Stainless steel (long 3 contracts, each 5 t at RMB per tonne): $(13\,500 - 15\,000) \times 5 \times 3 = -\text{RMB } 22\,500$.

Question 3

The difference between spot and futures is as follows:

- A *spot* trade means you exchange cash for the asset right now at the market price S_0.
- A *futures* contract locks in a price today for delivery at some future date.

The exchange helps by standardising contracts, clearing trades through a central counterparty with daily mark-to-market, enforcing margin rules, and arranging settlement.

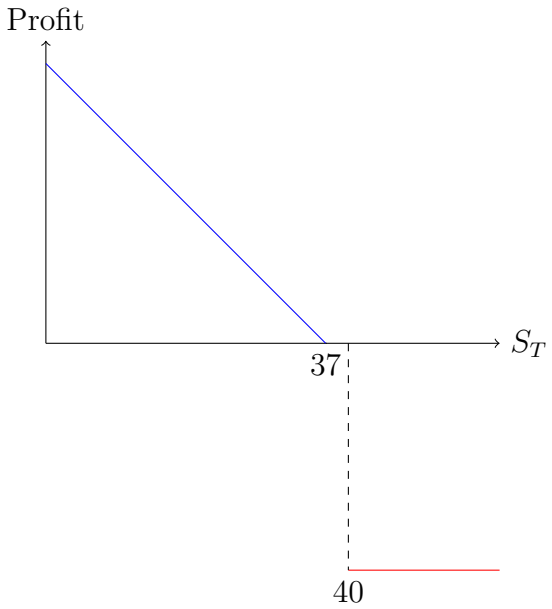
Question 4

We bought a European put option with strike $K = 40$, paid a premium of 3, and the stock is currently at 42. At expiry:

$$\text{Payoff} = \max(40 - S_T, 0), \quad \text{Profit} = \max(40 - S_T, 0) - 3.$$

To break even, we need $40 - S_T = 3$ so $S_T = 37$. That means you make money only if $S_T < 37$. You'd definitely exercise if $S_T < 40$.

Profit diagram:



Question 5

This shows that being long a forward and long a put with the same strike F_0 is like holding a call. At expiry:

$$(S_T - F_0) + \max(F_0 - S_T, 0) = \max(S_T - F_0, 0),$$

which matches exactly the payoff of a European call with strike F_0.

Question 6

Using put-call parity for a non-dividend stock,

$$C - P = S_0 - Ke^{-rT}.$$

Plugging in $C = 20$, $P = 5$, $S_0 = 130$, $K = 120$, $T = 1$:

$20-5 = 130-120e^{-r} \implies 120e^{-r} = 115 \implies e^{-r} = 0.95833 \implies r = -\ln(0.95833) \approx 0.0425 = 4.25\%$