

BUSS386 Problem Set 3

Forwards and Futures

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Problem 1 — Classification (15 pts)

For each contract below, state (a) forward or futures; (b) long or short for the named party; (c) exchange or OTC, with one short reason.

- (i) A Korean exporter agrees with its bank to sell USD 10M and receive KRW at ₩1,380 per USD, settling in six months.
- (ii) A retail trader buys five KOSPI 200 contracts on KRX at index level 405.
- (iii) A wheat farmer in Iowa locks in the October sale price of 50,000 bushels at \$5.80/bushel by trading at the Chicago Board of Trade.
- (iv) A jewellery maker enters a three-month contract directly with a Seoul bullion dealer to buy 1,000 oz of gold at \$2,300/oz.
- (v) An asset manager holding a \$50M S&P 500 ETF position takes a position in CME e-mini futures to neutralize equity risk.

Problem 2 — Margin accounts and daily settlement (20 pts)

You take a *long* position of one KOSPI 200 futures contract on Day 0 at index level $F_0 = 405.0$. Contract multiplier: ₩250,000 per index point. Initial margin: ₩10,000,000. Maintenance margin: ₩7,500,000. Daily settlement closes at the following index levels:

Day	0	1	2	3	4
Index close	405.0	408.0	402.0	393.0	397.0

- (a) Compute the daily mark-to-market gain/loss (in KRW) for Days 1–4.
- (b) Compute the end-of-day margin-account balance for each day, before any margin call.
- (c) Identify the day a margin call is triggered, and compute the deposit required to restore the balance to the initial margin.
- (d) Suppose you close the position on Day 4 at the closing index. Compute (i) the total cash you have deposited, (ii) the total cash returned to you when the position is closed, and (iii) your overall P&L on the trade.

Problem 3 — Long hedge with futures (20 pts)

Korean Air expects to buy 200,000 barrels of jet fuel on 15 May. On 1 March, the May jet-fuel futures price is \$90/bbl, and each contract is for 25,000 bbl. Assume the hedge is *perfect* (futures expiry coincides with the purchase date, and the underlying is exactly the same fuel).

- What futures position should Korean Air take? How many contracts?
- Compute the total cost on 15 May (in dollars) under each of these spot prices: $S_T \in \{\$84, \$90, \$96\}$ per barrel.
- In one sentence, explain why the total cost in (b) does not depend on S_T .
- One sentence: name one realistic reason this hedge might *not* be perfect in practice.

Problem 4 — Basis risk on USD/KRW (25 pts)

On 1 March, Samsung Electronics signs a contract to receive USD 10,000,000 on *31 May* from a US customer. KRX lists USD/KRW futures expiring on the last business day of *March, June, September, and December*. Each contract is on USD 50,000.

Today (1 March):

- Spot USD/KRW $S_0 = 1,380$ (KRW per USD).
- June USD/KRW futures price $F_{\text{Mar}} = 1,390$.

- What futures position does Samsung take, and how many contracts?
- On 31 May, the spot is $S_{\text{May}} = 1,340$ and the June futures is $F_{\text{May}} = 1,370$. Compute (i) the futures P&L (in KRW), (ii) the gross KRW received from converting USD at spot, and (iii) the effective per-USD rate after the hedge.
- Suppose, hypothetically, Samsung had received the USD on *30 June* (futures expiry) instead. What would the effective per-USD rate have been?
- In one or two sentences, explain in plain English what *basis risk* means in this trade and why the answers in (b) and (c) differ.

Problem 5 — Cross hedge / minimum-variance hedge ratio (20 pts)

A Korean airline expects to purchase *4,000,000 gallons* of jet fuel in three months. Jet-fuel futures are not liquid, so it hedges with NYMEX heating-oil futures. From recent data:

- Standard deviation of monthly change in jet-fuel spot price: $\sigma_S = 0.025$ (\$/gallon).
- Standard deviation of monthly change in heating-oil futures price: $\sigma_F = 0.030$ (\$/gallon).
- Correlation $\rho = 0.85$.
- Heating-oil contract size: 42,000 gallons.

- Compute the minimum-variance hedge ratio h^* .
- How many heating-oil futures contracts should the airline trade, and on which side (long/short)?

- (c) Compute the *hedge effectiveness* (the fraction of variance eliminated by the hedge).
- (d) In one sentence, why is the hedge effectiveness in (c) strictly less than 100%?

Total: 100 pts.