

MID-SEMESTER

Study Guide

Weeks 1-6 | Derivatives | Forwards | Futures | Hedging | Swaps | Options

What this edition contains

Clear derivatives notes with formulas, worked examples, tables, calculation routines and decision rules. Dedicated multiple-choice mock tests, answer keys and practice-question sections have been removed.

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Preview only

This sample contains representative notes and the topic list. It contains no quiz or mock-test questions.

Topics covered

Weeks 1-6 derivatives content included in these notes.

- 1 Derivative fundamentals: forwards, futures, swaps and options; hedgers, speculators and arbitrageurs; OTC versus exchange-traded markets.
- 2 Forward contracts: long and short positions, profit, delivery price, FX quotation discipline and contract value.
- 3 Futures markets: clearing, convergence, daily marking to market, initial and maintenance margin, variation margin, volume and open interest.
- 4 Futures hedging: hedge direction, basis risk, effective price, contract selection, cross hedges, minimum-variance hedge ratios and beta overlays.
- 5 Forward and futures pricing: continuous compounding, known income, dividend yield, currencies, storage costs, convenience yield and arbitrage.
- 6 Swaps: cash-flow transformation, comparative advantage, quality spread differential, dealer quotes, interest-rate swap valuation and currency swaps.
- 7 Option mechanics: calls and puts, payoff versus profit, moneyness, break-even, time value, exercise styles, contract adjustments and writer margin.
- 8 Final revision priorities, core formulas, decision rules and calculation checks.

Scope note

This edition is notes-only. Multiple-choice mock tests, answer keys and practice-question pages are not included.

Week 1 - Why derivatives exist

Derivative types, market structure, users and forward contracts.

1. The organising idea

A derivative is an instrument whose value depends on an underlying variable. The four families are forwards, futures, swaps and options. Forwards, futures and swaps create obligations and normally have linear payoffs. Options grant rights and create kinked payoffs. This obligation-versus-right distinction organises the entire unit.

Instrument	What it does	Usual venue	Initial economics
Forward	Private agreement to transact later at delivery price K	OTC	Usually zero initial value
Futures	Standardised, cleared version of the forward promise	Exchange	Margin is a performance deposit
Swap	Exchanges one cash-flow stream for another	OTC	New mid-market swap starts near zero value
Option	Buyer receives a right to buy (call) or sell (put)	OTC or exchange	Buyer pays a premium

2. Three market participants

- **Hedger:** reduces or reshapes a risk already held. The aim is certainty, not beating the market.
- **Speculator:** deliberately accepts market risk in pursuit of profit.
- **Arbitrageur:** constructs a strategy with a positive cash flow at one or more dates, no negative cash flow at any date, and no net investment at risk.

Hedging does not eliminate risk
A hedge transfers price risk and may replace it with basis, quantity, liquidity, counterparty or margin cash-flow risk. Over-hedging converts the excess position into speculation.

3. OTC versus exchange-traded markets

Feature	OTC	Exchange
Terms	Customised	Standardised
Counterparty	Bilateral dealer relationship	Clearing house after novation
Exit	Negotiate or enter an offsetting contract	Offset with the opposite trade in the same series
Pricing	Dealer bid and offer	Exchange order book and settlement price
Credit protection	Documentation, collateral and possibly clearing	Margin plus clearing guarantee

Market-maker rule: the dealer buys at the bid and sells at the offer. The offer exceeds the bid, and the spread compensates the dealer.

4. Measuring market activity

Measure	Meaning
Market value	Current replacement or trading value of the claims
Notional value	Scale of underlying exposure referenced by the contract
Volume	Contracts traded during a period - a flow
Open interest	Live contracts outstanding at a point in time - a stock

5. Forward contracts

Week 2 - Futures market machinery

Standardisation, daily settlement, margin, clearing and market statistics.

1. Why futures can be closed by offset

The exchange standardises the asset, quality, contract size, delivery months, quotation units and settlement rules. Contracts in the same series are therefore interchangeable. A long closes by selling the same series; a short closes by buying it. The clearing house becomes counterparty to both sides through novation.

2. Convergence and settlement

$$\text{At maturity: } F_T = S_T$$

Physical delivery or a cash-settlement rule forces convergence. If a deliverable futures price exceeded spot at expiry, an arbitrageur could buy spot, short futures and deliver. If futures were below spot, the reverse trade would remove the gap.

3. Margin terminology

Term	Meaning
Initial margin	Deposit required to open the position
Maintenance margin	Lower threshold that triggers a margin call
Variation margin	Top-up that restores the account to initial margin
Settlement price	Daily reference price used for marking to market
Performance bond	Margin secures performance; it is not a down payment on the asset

$$\text{Long daily P/L} = N \times Q \times (F_t - F_{t-1}) \quad | \quad \text{Short daily P/L} = - \text{Long daily P/L}$$

Margin ledger algorithm

- Step 1: calculate total exposure per price unit: contracts x units per contract.
- Step 2: measure today's move from yesterday's settlement price.
- Step 3: apply the long or short sign and update the account balance.
- Step 4: if balance is below maintenance, top up to initial margin.
- Step 5: begin the next day from the post-call balance. Do not count the earlier loss again.

Margin-ledger trap

A frequent error is double-counting the loss that caused a previous margin call. Once the call is paid, the account has been restored. The next day's movement starts from the previous settlement price and post-call balance.

4. Volume and open interest

Buyer	Seller	Volume	Open-interest effect
Opens	Opens	Increases	New long and new short create contracts
Opens	Closes	Increases	No change - ownership transfers
Closes	Opens	Increases	No change - ownership transfers
Closes	Closes	Increases	Decreases - live contracts disappear

Open interest counts one side only: total live longs equals total live shorts. Volume can exceed open interest because the same contract can change hands repeatedly.

Week 3 - Hedging with futures

Direction, basis risk, minimum-variance hedges and equity beta overlays.

1. Direction before arithmetic

Exposure	Adverse move	Futures position
Will sell the asset later	Price falls	Short futures
Will buy the asset later	Price rises	Long futures
Owens an equity portfolio and wants less market risk	Market falls	Short index futures
Wants to add market exposure without buying shares	Market rises before purchase	Long index futures

FX labels depend on the quotation. Always name both currencies. An importer owing US dollars must obtain US dollars later, so it needs a position that gains when USD becomes more expensive in Australian-dollar terms.

2. Basis and the effective price

$$\text{Basis: } b_t = S_t - F_t$$

$$\text{One-for-one effective price} = F_1 + b_2$$

$$\text{General hedged outcome} = S_2 - h(F_2 - F_1)$$

Basis movement	Short hedger	Long hedger
Strengthens - b rises	Benefits	Hurt
Weakens - b falls	Hurt	Benefits

Positive is not the same as stronger

A closing basis of +0.03 does not prove the basis strengthened. You need the initial basis as well. Strengthening describes a change, not the sign of one observation.

3. Contract selection

- Underlying: choose the contract with the strongest economic relationship and price-change correlation.
- Maturity: choose a liquid delivery month at or just after the exposure date.
- Cross hedge: use a related futures contract when no exact contract exists.
- Long exposure: a sequence of short-dated contracts may be rolled, but this adds repeated basis and cash-flow timing risk.

4. Minimum-variance hedge ratio

$$h^* = \rho \times \sigma_S / \sigma_F$$

$$\text{Contracts: } N^* = h^* \times Q_A / Q_F \quad | \quad \text{Hedge effectiveness} = \rho^2$$

- h^* is the slope from a regression of spot price changes on futures price changes.
- In a simple one-factor regression, R-squared is the estimated fraction of variance removed.
- If futures are more volatile than the exposure, fewer futures units are needed.

Week 5 - Swaps

Cash-flow transformation, comparative advantage, dealer quotes and valuation.

1. Plain-vanilla swap mechanics

- An interest-rate swap exchanges fixed and floating interest on a notional principal.
- The notional is a calculation reference and normally does not change hands in an interest-rate swap.
- Only the net interest difference is paid at settlement.
- For BBSW-style term rates, the floating rate is set at the start of the period and paid at the end. The next floating payment is therefore known.
- Pay-fixed/receive-floating gains when floating rates rise relative to the contracted fixed rate.

2. Transforming a liability or asset

Starting position	Swap	Result
Floating loan: BBSW + margin	Pay fixed R; receive BBSW	Fixed cost R + margin
Fixed-rate loan	Receive fixed; pay BBSW	Floating cost after cancelling fixed legs
Fixed-rate asset	Pay fixed; receive BBSW	Floating investment return
Floating-rate asset	Pay BBSW; receive fixed	Fixed investment return

Three-line cash-flow rule

Write the original loan or asset, the swap receipt and the swap payment on separate lines. Then cancel matching BBSW or fixed amounts. This prevents the crossed-sign errors that dominate swap questions.

3. Comparative advantage

Total potential gain (QSD) = fixed-rate difference - floating-rate difference

Each firm borrows where it has the comparative advantage, then swaps into the desired exposure. Subtract any intermediary fee before dividing the remaining gain. The argument works only when the firms' desired final exposures cross their comparative borrowing advantages.

4. Dealer bid and offer

Pay floating -> receive the fixed bid | Receive floating -> pay the fixed offer

The mid is the theoretical par swap rate that makes a new frictionless swap worth zero. A client transacts at the bid or offer, not automatically at the mid.

5. Interest-rate swap valuation

Fixed receiver: $V = B_{fix} - B_{fl}$ | Fixed payer: $V = B_{fl} - B_{fix}$

Add the notional to both legs at maturity. The added principals cancel economically, but each leg becomes a bond. Discount the fixed coupons plus principal with the appropriate zero rates.

Between resets: $B_{fl} = (L + k^*)e^{-r^*t^*}$

Immediately after a matched reset, the floating-rate note is worth par L. Between resets, the next coupon k^* is already known, and immediately after that payment the continuation value resets to par. For semi-annual payments, calculate a full six-month coupon using annual rate divided by two, then discount over the remaining time from today.

Week 6 - Option mechanics and markets

Rights, payoff versus profit, moneyness, contract terms and writer margin.

1. Rights and exercise style

Term	Meaning
Call	Right to buy the underlying at strike K
Put	Right to sell the underlying at strike K
American	May be exercised at any time up to expiry
European	May be exercised only at expiry
Writer	Receives the premium and carries the exercise obligation

An American option is worth at least as much as an otherwise identical European option because it contains every European exercise opportunity plus additional choices. Detailed optimal early-exercise rules are left for later option-pricing study.

2. Four elemental positions

Position	Profit at expiry	Best case	Worst case	Break-even
Long call	$\max(ST - K, 0) - c$	Unlimited	-c	$K + c$
Short call	$c - \max(ST - K, 0)$	+c	Unlimited loss	$K + c$
Long put	$\max(K - ST, 0) - p$	$K - p$	-p	$K - p$
Short put	$p - \max(K - ST, 0)$	+p	$-(K - p)$	$K - p$

Core Week 6 distinction

Payoff is not profit. An in-the-money option may be exercised and still lose money because its payoff may not recover the premium. Always calculate exercise, then payoff, then premium, then contract scale.

3. Moneyness and premium decomposition

Option	In the money	At the money	Out of the money
Call	$S > K$	S approximately K	$S < K$
Put	$S < K$	S approximately K	$S > K$

$$\text{Premium} = \text{intrinsic value} + \text{time value}$$

$$\text{Call intrinsic} = \max(S - K, 0) \quad | \quad \text{Put intrinsic} = \max(K - S, 0)$$

For standard American exchange-traded examples, time value is non-negative and usually greatest near the money. Do not automatically extend this spot-intrinsic statement to every European option; the formal bounds come later.

4. Option versus forward hedging

Forward hedge	Option hedge
Locks the transaction price in both directions	Protects the adverse direction while retaining favourable moves
Normally no initial premium	Premium paid up front
Can create regret if the unhedged outcome would have been better	Maximum hedge cost is known premium, but total loss of premium can be likely

5. Contract adjustments