

1. Derivative Basics & Markets

- **Derivative:** contract whose payoff derives from an underlying asset, rate, or index.
- **Types:** forward commitments (forwards, futures, swaps) vs. contingent claims (options, credit derivatives).
- **Underlyings:** equities, fixed income / interest rates, foreign exchange (FX), commodities, credit, cryptocurrencies, weather.
- **Venues:** OTC (dealer-based, customized, counterparty risk) vs. ETD (exchange-traded, standardized, clearinghouse, daily mark-to-market).
- **Benefits:** risk transfer, price discovery, operational efficiency, leverage.  
**Risks:** leverage losses, basis risk, liquidity risk, counterparty risk, systemic risk.

2. Forwards & Futures

- Forward price (no inc/cost):  $F_0 = S_0(1 + r)^T$ ; value to long at  $t$ :  $V_t = S_t - F_0(1 + r)^{-(T-t)}$ .
- Futures: exchange-traded forward; daily variation margin, initial & maintenance margin, marking-to-settlement price.
- Convexity bias:  $F_{fut} > F_{fwd}$  if futures price positively correlated with rates.
- Open interest = outstanding contracts; volume = trades per day.

3. Swaps

- Fixed-for-float IR swap equivalent to strip of forwards.
- Swap rate set so PV(fixed legs)=PV(float legs) → value = 0 at initiation.
- Value to fixed-payer at  $t$ :  $V_t = B_{float,t} - B_{fixed,t}$ .
- Types: plain-vanilla IR, currency (notional exchange), equity, total-return swap, CDS (protection buyer pays premium).

4. Options — Payoff & Greeks

- Call payoff:  $\max(0, S_T - X)$ ; Put payoff:  $\max(0, X - S_T)$ .
- Option value = intrinsic value + time value; time value → 0 at expiry.
- Moneyness: ITM ( $S > X$  for call), ATM, OTM.
- Greeks (sensitivities):  $\Delta = \frac{\partial V}{\partial S}$ ,  $\Gamma = \frac{\partial^2 V}{\partial S^2}$ , Vega ( $\nu$ ) w.r.t. volatility,  $\Theta$  w.r.t. time,  $\rho$  w.r.t. interest rate.
- European put–call parity:  $c_0 + X(1 + r)^{-T} = p_0 + S_0$ .

5. Option Valuation Models

- One-period binomial: risk-neutral  $q = \frac{(1 + r) - d}{u - d}$ ,  
 $V_0 = \frac{qV_u + (1 - q)V_d}{1 + r}$ .
- Black-Scholes-Merton (inputs:  $S_0, X, T, r, \sigma, q$ );  
 $c = S_0 e^{-qT} N(d_1) - X e^{-rT} N(d_2)$ .
- Put via PCP; Implied volatility solve  $\sigma$  s.t. model price = market.

6. Cost of Carry & Pricing w/ Income

- Forward price with benefits & costs:  $F_0 = S_0 e^{(r+c-y)T}$  where  $y$  = income yield,  $c$  = storage/carry cost.
- Convenience yield reduces net cost for commodities.
- Cash-and-carry arbitrage if quoted  $F_q > F_0$  (sell forward, buy spot & carry).

7. Credit Derivatives & CDS

- CDS spread set so  $PV(\text{prem leg}) = PV(\text{prot leg})$ .  $PV(\text{prot}) = LGD \times PD_{risk-neutral}$  discounted.
- Upfront % = (quoted spread – c)DV01.
- Basis trade: buy bond + buy protection if bond spread  $\downarrow$  CDS.

8. Margining & Collateral

- Futures: initial, variation, maintenance, marking-to-market daily.
- OTC cleared: variation margin + initial (VaR + add-ons); CSA governs collateral (haircuts).
- Option writers may post margin based on SPAN risk grids.

9. Strategies & Payoff Diagrams

- Bull Call Spread: long call at strike  $X_1$ , short call at higher strike  $X_2$ .
- Bear Put Spread, Straddle (long call + put at-the-money), Strangle (out-of-the-money options), Butterfly, Collar (protective put + covered call).
- Delta-hedged option: number of contracts =  $-\frac{\Delta_{opt}}{\Delta_{under}}$ .

10. Risk Management Applications

- Duration hedging with futures:  
 $N = \frac{(BPV_{target} - BPV_{port})}{BPV_{ctd}} \times CF$ .
- Equity beta hedge:  $N = \frac{\beta_P}{\beta_{fut}} \times \frac{V_P}{V_{fut}}$ .
- Currency hedge: sell fwd or buy put; dynamic hedging vs passive.

11. Regulation & Accounting

- Central clearing mandate (EMIR/Dodd-Frank) for standardised swaps; margin rules for uncleared.
- Hedge accounting: fair-value vs cash-flow hedge effectiveness (80-125%) reduces P&L volatility.
- IFRS 9: recognise derivative assets/liabilities at FV through P&L.

12. Exotic & Structured Products

- Exotic options: barrier (knock-in/out), Asian (avg), lookback, digital, chooser.
- Swaptions (payer/receiver), caps/floors (portfolio of FRAs), collar.
- Structured notes: bond + embedded derivative (e.g., reverse convertibles).

Tulga-Ochir Sugar — Derivative Personal Cheat Sheet (not exhaustive)