**Quant Interview**

**Basic Maths**

* **Markovian -** Memoryless property of stochastic process
* **Martingale -** Conditional expectation of next value is the present value
* **Risk Neutral –** Price equal to the discounted expectation of the price under the risk neutral measure

**SDE**

* Find the SDE simple, write function f(s) = ln(s) then Taylor expansion
* GBM SDE can be solved analytically
* Otherwise use Euler or Milstein, numerical solutions for SDE’s

**Swap**

* Non linear function of the underlying forward rates

**Forward Rate Curve**

* Term structure of rates embodied in shape of forward curve

**LIBOR**

* Offered rate – how much they would charge to lend money or **how much you would pay on deposits**

**Rates**

* Fixed income instruments depend on a segment of the forward curve (swap for instance)
* Pricing requires stochastic evolution of entire forward curve
* Two types of models
  + Short rate models (HW1F for instance)
  + Models that capture entire forward curve dynamics (HJM, LMM)

**Hull White**

* Evolution of instantaneous short rate, distribution of short rate is normal
* Exact fitting of initial term structure through Φ(t)
* Calibration:
  + Determine term structure
  + Generate HW
  + Use **Jamshidian S**waption engine to price, create swaption
  + Use **Levenberg-marquardt** algo as calibration method
  + Determine a and σ
* f(t) is instantaneous short rate given by:   ft,T= -ddtln⁡(Pt,T)

**LMM**

* Capture dynamics of the entire forward curve (FRA’ing the curve)
* Term structure in shape of forward curve
* Deterministic volatility and correlation structure
* Arbitrage free – choose numeraire to be a zero coupon bond
* Dimension reduction, reduce to say 4 Brownians
* Numerical solution of SDE (Euler or Millstein)

**Volatility**

* Volatility can be constant, have term structure, local (equity) or stochastic
* Dynamics of underlying
  + Normal - σ - absolute
  + Lognormal - σF - relative
  + Constant elasticity of variance (CEV) - σFβ – captures smile

**SABR Model**

* Stochastic Volatility Model attempts to capture the smile in derivatives markets
* dF= F dW
* dσ= νσdX
* EdWdX= ρdt
* Alpha = ATM vol, beta/rho = skew, nu = curvature
* Limitations = constant parameters, no jumps

**Credit**

* **Hazard rate = instantaneous risk of default = default intensity**
* Evolution of instantaneous hazard rate?? Flat, piecewise linear, piecewise constant, parametric
* **Cox process** – Poisson process with stochastic hazard rate
* **Merton Jump Diffusion model** – standard GBM with Poisson process

**SFT**

* Broad term, covers everything from repo to longer term
  + GC Collateral market (lots of eligible collateral, all IG)
  + Exact asset for longer term
* Haircuts, Contractual haircut (post 1m asset to get 900k cash)

**Repo**

* o/n UST rate – weighted average of all trades is SOFR print
* Other collateral will have basis
* Term market – no weighted average, driven by IRS market
* All OTC

**IMM**

* Permitted to use for derivatives, SFT or both, no other sub divisions allowed
* Model them as non cash collateral in derivatives IMM, a requirement

**Underlying Scenario Generations, no derivatives so all need to model**

* Credit - Merton Jump Diffusion, Cox
* Equity - Basic diffusion
* Rates – HW1F, LMM
* FX Component – joint diffusion
* Securitisations – model the spread directly

**Effective Modelling**

* MPoR – 5 days
* Discretisation scheme, every day for a few days, then weekly, then monthly?
* Trade off, accurately capture profile, any events etc etc
* EPE maintains size up to maturity (we discussed before, still need to liquidate so MPoR always applies until trade dead
* How to account for coupon payments, unexpected jumps that unlikely to occur during MPoR period, if modelled early could lead to spike which is carried through life of trade due to EEE

**Challenges**

* Not knowing what the security will be post time as there will be **substitution rights**
* Exposure spikes caused by coupons (dirty price drops, do I need to post more margin)

**Implied, local and stochastic volatility**

* Implied volatility one to one mapping between option price and specific model quantity (BS)
* Local Volatility one to one mapping with all vanilla option prices/ 1D Markhovian process
  + Instantaneous variance of the log returns depends on spot price
* Stochastic Volatility 2D diffusion framework
  + Instantaneous variance of log returns is separate stochastic factor