MPF_RRFI - Lecture 03

How Traders Manage Their Risks (Chapter 8)

Delta

$$\text{Delta} = \frac{\Delta P}{\Delta S} = \frac{\partial P}{\partial S}$$

- ΔS is a small increase in the value of the variable
- ΔP is the resulting change in the value of the portfolio
- Using calculus terminology, delta is the partial derivative of the portfolio value with respect to the value of the variable
- Eliminate *delta* exposure $\rightarrow$ *delta* hedging $\rightarrow$ *delta* neutral portfolio
- Linear products (forward, futures, swap) $\implies$ constant *delta*
- Non-linear products (options, exotics) $\implies$ time-varying *delta*

Gamma

$$\text{Gamma} = \frac{\partial^2 P}{\partial S^2}$$

- *Gamma* is the rate of change of the portfolio's *delta* with respect to the price of the underlying asset (the second partial derivative)

Vega

$$\text{Vega} = \frac{\partial P}{\partial \sigma}$$

- *Vega*, is the rate of change of the value of the portfolio with respect to the volatility, σ, of the underlying asset price

Theta

- *Theta* is the rate of change of the value of the portfolio with respect to the passage of time, with all else remaining the same

Rho

- *Rho* is the rate of change of a portfolio with respect to the level of interest rates

Interest Rate Risk (Chapter 9)

- net interest income $\rightarrow$ liquidity preference theory

Types of rates:

- Treasury rate
- LIBOR
- The OIS rate
- Repo rate

Duration

- Duration measures the sensitivity of percentage changes in the bond's price to changes in its yield.

$$D = -\frac{1}{B}\frac{\Delta B}{\Delta y} - \frac{1}{B}\frac{\partial B}{\partial y} = \frac{\sum_{i=1}^{n} c_i t_i e^{-y t_i}}{B} \implies \Delta B = -DB\Delta y$$

- y is a bond's yield, B is the bond market price

Convexity

- Convexity measures curvature of the bond-yield relationship

$$C = \frac{1}{B}\frac{\partial^2 B}{\partial u^2} = \frac{\sum_{i=1}^{n} c_i t_i^2 e^{-y t_i}}{B} \implies \frac{\Delta B}{B} = -D\Delta y + \frac{1}{2}C(\Delta y)^2$$

Volatility (Chapter 10)

- volatility clustering, long memory
- realized volatility = standard deviation of continuously compounded returns per unit of time
- implied volatility = implied from option prices, Black-Scholes-Merton model

The Exponentially Weighted Moving Average (EWMA) Model

$$\sigma_n^2 = \lambda\sigma_{n-1}^2 + (1-\lambda)u_{n-1}^2$$

- λ is a constant between 0 and 1 (weight)
- σ is volatility
- u is daily percentage return

The GARCH(1,1) Model

$$\sigma_n^2 = \gamma V_L + \alpha u_{n-1}^2 + \beta\sigma_{n-1}^2$$

- V_L is a long-run average variance rate
- γ, α, and β are coefficients

Correlations and Copulas (Chapter 11)

- correlation $\implies$ diversification $\implies$ risk management decisions
- correlation measures only linear dependence
- copulas are often used to the calculation of the distribution of default rates for loan portfolios