

## **ELECTIVE COURSE**

### **Course Title:**

QUANTITATIVE FINANCE

### **Course Description:**

Quantitative Finance is an interesting area that has a lot of applications in the domain for finance/ banking. Quantitative roles have been around for a while now, and they will continue to be in demand from the industry. Further, many concepts covered under Quant Finance integrate well with ideas in data analytics too. Therefore, candidates with expertise around this subject along with hands on skills will be able to work in good roles in the areas of quantitative analytics/ risk / pricing in banks/financial institutions. There is an increasing overlap between the areas of data sciences and quantitative finance.

### **Instructor Information:**

Name: Prof. Ameya Abhyankar

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### **Pre-requisite:**

Familiarity with:

- Financial instruments – cash products and derivatives (structure, valuation principles)
- Python, Excel, VBA is an advantage

### **Course Objectives:**

Successful completion of course makes the students well equipped with the concepts of:

- Fixed income fundamentals
- Understanding spot rates and forward rates
- Knowledge of swaps, valuation and their application
- Options pricing theory
- Discrete and continuous time options pricing models
- Interest rate options
- Fundamentals of capital requirements
- Foundations of mathematical finance
- Understand the structure of a risk management function and related enterprise policies
- Volatility smiles for options
- Credit derivatives and counterparty risk management

### **Course Content:**

1. Fixed Income and rates analytics
  - Fixed income foundations; bond pricing etc.
  - Bootstrapping and forward rates
2. Forward Rate Agreements (FRA)

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- Concept of forward rates
  - Pricing and valuation of FRA
  - Applications of FRA
3. Swaps
- Idea of swaps
  - Interest rate and currency swaps
  - Swaps valuation
4. Options fundamentals and trading strategies
- Put call parity and arbitrage relation
  - Vanilla options trading strategies
5. Binomial Model – Treatment for No-arbitrage and Risk Neutrality
- Recap of relevance of binomial model
  - Understand the concept of a hedge portfolio
  - Idea of Risk Neutral valuation
  - Numerical samples for binomial model
6. Black Scholes Option Pricing model (BSM)
- Understand continuous time option pricing models
  - Assumptions and Enhancements to BSM model
  - Black Scholes partial differential equation (PDE)
7. Introduction to Interest Rate Options (IRO)
- Concept of IRO
  - Discrete time models for IRO pricing
  - Black model for Caps, Floors
8. Volatility and smiles
- Concept of Volatility
  - Introduction to a few popular models for volatility – EWMA, GARCH etc.
  - Concept of volatility smile
9. Introduction to Numerical Methods
- Binomial Trees
  - Understand Monte Carlo approach for option pricing
  - Introduction to the idea of finite difference scheme
10. Foundations of regulatory capital for banks
- Capital adequacy
  - CVA, off-balance sheet
  - Illiquidity adjustments etc.

## **ELECTIVE COURSE**

- Basics: LCR, NSFR, liquidity risk

### 11. Introduction to Credit Risk

- Concept of credit risk
- Structural models and intensity models
- Credit Default Swaps etc.
- Exposure monitoring techniques in banks

### 12. Central Clearing Houses (CCPs)

- The idea of having CCPs
- Approach for guaranteeing clearing & settlement of transactions
- Processes for handling of any defaults by members

## **References:**

Following reference books will be useful during the foundation as well as core portion of this course.

- Options, Futures and Other Derivatives by John C Hull
- Paul Wilmott of Quantitative Finance, by Paul Wilmott
- Any other relevant resource online/other reference books

Additionally, students are advised to familiarize themselves with developments in capital markets and with the products that trade (key resources include: NSE, Bloomberg, FBIL, FIMMDA etc.). Also, it would be helpful to keep track of the announcements on RBI/SEBI websites as they directly impact the banking system/capital market in the country. Further,

students are encouraged to do practical hands-on implementation in Excel/VBA/Python or any other tool in their own time, in order to be comfortable on the implementation of various concepts discussed in class.

Throughout the duration of the course, candidates are expected to be updated on the developments in the finance, capital markets domain. The same will add value to discussions in class and help students get a good grasp of the subject. A few resources recommended:

- ET/FT,
- Bloomberg markets website,
- Risk magazine (there are a few free articles),
- Economist (slightly older issues can be accessed for free)