



MATHEMATICAL PORTFOLIO THEORY

PROF. SIDDHARTHA PRATIM CHAKRABARTY
DEPARTMENT OF MATHEMATICS
IIT GUWAHATI

TYPE OF COURSE : New | Elective | PG
COURSE DURATION : 12 weeks (20 Jul' 20 - 9 Oct' 20)
EXAM DATE : 18 Oct 2020

PRE-REQUISITES : Basic probability theory at undergraduate level.

INTENDED AUDIENCE : Advanced undergraduate as well as postgraduate students in Mathematics, Statistics, Engineering and Management (with requisite background in Mathematics).

INDUSTRIES APPLICABLE TO : This course would be useful to finance industry, particularly companies involved in asset management.

COURSE OUTLINE :

This course will give an introduction to the mathematical approaches used for design and analysis of financial portfolios. It would be useful to participants who want to get a basic insight into mathematical portfolio theory, as well as those who are looking at a career in finance industry, particularly as asset managers.

ABOUT INSTRUCTOR :

Prof. Chakrabarty has more than ten years of teaching experience (in addition to research experience) in the areas of financial engineering, computational finance, portfolio theory and financial risk management and has offered several courses to the B.Tech. and M.Sc. students of IIT Guwahati.

COURSE PLAN :

- Week 1:** Basics of Probability Theory: Probability space and their properties; Random variables; Mean, variance, covariance and their properties; Binomial and normal distribution; Linear regression
- Week 2:** Basics of Financial Markets: Financial markets; Bonds and Stocks; Binomial and geometric Brownian motion (gBm) asset pricing models
- Week 3:** Mean-Variance Portfolio Theory: Return and risk; Expected return and risk; Multi-asset portfolio; Efficient frontier
- Week 4:** Mean-Variance Portfolio Theory: Capital Asset Pricing Model; Capital Market Line and Security Market Line; Portfolio performance analysis (Continued)
- Week 5:** Non-Mean-Variance Portfolio Theory: Utility functions and expected utility; Risk preferences of investors
- Week 6:** Non-Mean-Variance Portfolio Theory: Portfolio theory with utility functions; Safety-first criterion (Continued)
- Week 7:** Non-Mean-Variance Portfolio Theory: Semi-variance framework; Stochastic dominance (Continued)
- Week 8:** Optimal portfolio and consumption: Discrete time model; Dynamic programming
- Week 9:** Optimal portfolio and consumption: Continuous time model; Hamilton-Jacobi-Bellman partial differential equation (Continued)
- Week 10:** Bond Portfolio Management: Interest rates and bonds; Duration and Convexity; Immunization
- Week 11:** Risk Management: Value-at-Risk (VaR); Conditional Value-at-Risk (CVaR); Methods of calculating VaR and CVaR
- Week 12:** Applications based on actual stock market data: Applications of mean-variance portfolio theory; Applications of non-mean-variance portfolio theory; Applications of VaR and CVaR