FRE6711 Quantitative Portfolio Management

Papa Momar Ndiaye
pmomar@gmail.com, pmn248@nyu.edu

1 Course Overview

This course focuses on the quantitative foundations of portfolio management. The course builds on the economic theory of choice under uncertainty. The Markowitz mean-variance framework is developed in detail as the main approach to characterize the opportunity set and the efficient frontier of portfolios, from which the optimum portfolio is selected. It discusses the issues related to the implementation of these models in practice to different types of portfolios. It will also introduce the topics of sensitivity to uncertain inputs and portfolio robust design and Black-Litterman allocation. R, Matlab and Python will be used interactively during the lectures. The final evaluation will be given as the design and backtesting of a investment strategy using modern portfolio theory.

2 Student Learning Outcomes

After successful completion of this course, students will

- Understand the basics of Utility functions such as Absolute Risk Aversion (ARA) and Certainty Equivalent of Risky (CER) of risky gamble;
- Understand the fundamentals allocation models such as Markowitz and its relation to the CAPM and APT Solve Optimal Decision Problems arising in Modern Portfolio Theory and implement the solution using a high level language such as R, Matlab or Python;
- Solve Markowitz efficient portfolios problems and use the One-fund Theorem and the Two-fund theorem to build efficient Portfolios with Target Return or Target Risk;
- Apply Markowitz Allocation to design, implement and backtest Optimal Portfolios

3 Organization

- Lecture periods: 2 1/2 hours
- Laboratory periods: 0 hours
- Recitation periods: 0 hours
- Credits: 1.5

3.1 Prerequisites

Matriculation into a graduate program sponsored by the Department of Finance & Risk Engineering, or permission of the Department & FRE-GY 6083

3.2 Recommended Texts

- Francis and Kim, *Modern Portfolio Theory* Wiley Finance
- Bernd Scherer, *Portfolio Construction and Risk Budgeting*, 4th Edition, (Risk-books)
- David G. Luenberger, *Investment Science*, (Oxford)
- Simon Hubbert, *Essential Mathematics for Market Risk Management*, (The Wiley Finance Series)

3.3 Grading

There will be about 3 homework assignments, 3 quizzes and 1 final project.

- 10% Class Participation
- 30% Homework
- 20% Quizzes
- 40% Final Project

4 Tentative Schedule

FRE 6711 Syllabus	
Week 1	Introduction Utility Functions. Risk Aversion - Certainty Equivalent - Risk Premium
Week 2	Review of Algebra and Calculus and Probability for Portfolio Non Linear Optimization and Quadratic Optimization KKT conditions and sensitivity analysis
Week 3	Markowitz Mean-Variance Optimization Geometry of Efficient Frontiers, Tangent Portfolio, CML, CAPM Diversification, Risk Decomposition, Beta as Risk Measure
Week 4	Multi-factor Models for Asset Pricing and Risk Arbitrage Pricing Theory Alternative Risk Measures: VaR, CVAR, ... Portfolio Characteristics
Week 5	Robust Allocation Models Black-Litterman Allocation
Week 6	Market Neutral Portfolio Strategies Active Portfolio Strategies Performance Measurement and Attribution
Week 7	Portfolio Backtesting and Stress-Testing Presentation of the Final Project