DSA 5303 Financial Engineering Analytics Spring 2018

Reasonable Accommodation Policy:
Any student in this course who has a disability that may prevent him/her from fully demonstrating his/her abilities should contact me personally as soon as possible so that we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

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Textbook: Investment Science 2nd Edition**,** David G. Luenberger Oxford University Press, 2013

References:

1. Options, Futures, and Other Derivatives 9th Edition by John C. Hull , Pearson, 2014
2. Clewlow, L., Strickland, C.: Energy Derivatives: Pricing and Risk Management. Lacima Publ., London (2000)
3. Financial Signal Processing and Machine Learning, Editor(s): Ali N. Akansu, Sanjeev R. Kulkarni, Dmitry Malioutov, Wiley, 2016
4. Cristianini, N., Shawe-Taylor, J.: An Introduction to Support Vector Machines and Other Kernel-Based Learning Methods. Cambridge University Press, Cambridge (2000)
5. Additional readings:

Some chapters from textbooks and some research papers are useful for this course. When available in electronic form, they will be placed in the homepage of the course in portable document format (.pdf).

Description

Financial Engineering is a multidisciplinary field involving the fields of finance, economics, mathematics, statistics, engineering and computer science. The main focus of the course will be on the use of optimization and stochastic models to solve portfolio optimization problems (ii) price derivative securities including energy and weather derivatives and (iii) consider applications of financial engineering including algorithmic trading, financial networks, pricing of real options and the use of machine learning in pricing. Data driven models and big data mining in financial engineering will be also discussed.

Course Objectives

1. To gain an understanding and appreciation of the principles and methodologies relevant to financial engineering and financial data analysis
2. To solve real-life problems with financial engineering techniques.
3. To build a solid theoretical background in financial engineering and investigate the recent topics for future research and study such as machine learning and data mining.

Topics

1. Introduction to Mean Variance
2. Efficient Frontier
3. Mean Variance with a Risk-free Asset
4. Capital Asset Pricing Model
5. Binomial Model for Option Pricing
6. The Black-Scholes Model
7. Risk-Management of Derivatives Portfolios
8. Data Driven Models and Machine Learning in Financial Engineering
9. Financial Networks
10. Applications: Valuation of Natural Gas and Electricity Related Options, Weather Derivatives, Algorithmic Trading, big data and financial risk.

Grading

There will be no test. Grades will be determined by students' solution to problems distributed during the semester. In addition, each student will be required to make an oral presentation and submit a project.

Target Audience

The target audience reflects the diversity and interest of students in the financial engineering field: Engineering, Mathematics and Computer Science students *with interest in Data Analytics and Financial Engineering*

Project Guidelines

1. The project is to be done individually or in groups.

2. Each student should select a project falling in at least one of the following categories:

(i) A direct application of a financial engineering model from a text or journal by collecting data and solving it using the computer.

(ii) Improving and extending the results of a given study for a more realistic solution. Here, you may use the same data available in the study and compare your results to the existing one.

(iii) Developing a new and different financial engineering model for a real problem and present solution approach. Here, you may just use fictitious data to illustrate your methodology.

(iv) Developing or improving a computer program for a financial engineering model.

(v)) Experiments with different financial engineering models on problems.

3. Preliminary Report - Due ?: A two to three page statement explaining the project.

NOTE: Before submitting the report, you may discuss the project informally with me to ascertain whether your project will meet the desired objectives and standards.

4. Final Report – ?: To be limited to 15 pages (excluding computer printout and appendices). Your final report should discuss the model formulation and solution, highlighting the major contribution made by you through the project work, and difficulties encountered, deviation from the preliminary objectives, and significant conclusions.

NOTE: You are welcome to discuss with me the progress of your project from time to time.

5. The following points will be taken into consideration while awarding the project grade:

(i) Complexity of the project.

(ii) Adherence to the project guidelines.

(iii) Presentation of final report.

(iv) Results and major contributions.