DBA3713 Analytics for Risk Management
Semester 2, AY2021/22
[TENTATIVE, SUBJECT TO CHANGE]

Instructor

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Section

TBD

Course Description and Learning Objectives

This module introduces tools in business analytics for quantitative risk management. More specifically, it covers machine learning, statistical modelling, and optimisation methods to model, estimate, and manage risk. Hands-on implementation of these analytics tools will also be covered this module.

Prerequisites

DAO2702 Programming for Business Analytics, or prior knowledge in analytical tools.

(We will use Python as the programming language. Students should also be comfortable with its basic usage before class. We will also use some basic terms in statistics, vector and matrix operations, and economics. We will review these concepts quickly in class. No pre-requisite in finance is required.)

Course Materials

- Class Handouts.
- Textbooks:
  - "Machine Learning in Business: An Introduction to the World of Data Science" by John C. Hull, Wiley, 3rd edition.
  - "Risk Management and Financial Institutions" by John C. Hull, Wiley, 5th edition. (The 4th edition also works.)

- Additional References:
  - "Quantitative Risk Management: Concepts, Techniques and Tools" by AJ McNeil, R. Frey and P. Embrechts, Princeton University Press.
  - "Python for Finance Cookbook: Over 50 recipes for applying modern Python libraries to financial data analysis" by Eryk Lewinson, Packt Publishing.
  - "Investments" by Zvi Bodie, Alex Kane, and Alan Marcus, McGraw-Hill Irwin, 11th edition.

Teaching Assistant

TBD

Grading

There are regular group homework assignments and one group project. Each group should have 3-4 students. There are also two in-class individual projects: the first in Week 7 and the second in Week 13. Below is how to aggregate the grades:

Group Homework:	20 %
Group Project (1):	25 %
In-class Individual Projects (2):	45 %
Participation:	10 %
Total:	100 %

All grade disputes should be submitted in writing within two weeks of an assignment/exam being returned. The instructor reserves the right to regrade the entire assignment/exam.

Honor Code

1. Students are required to adhere to the standards of the NUS Code of Student Conduct, especially regarding *Academic, Professional and Personal Integrity*. Please review the code of student conduct at http://nus.edu.sg/osa/resources/code-of-student-conduct.

2. On group assignments/projects, references to resources that are not in the textbook or class handouts should be *explicitly* mentioned in the write-ups and source codes. Students are not permitted to discuss with other groups, or discuss write-ups from other sections, past quarters/instructors of DBA3713.

Tentative Course Outline

Part I: Introduction (∼0.5 lectures)

Part II: Predictive analytics for risk management (∼5.5 lectures)

1. Review of supervised learning models: logistics regression and decision trees
    - Application: credit decisions using LendingClub data
2. Introduction to Artificial Neural Networks (ANN)
    - Application: derivative pricing and volatility movements
3. Statistical modelling for dynamic volatility
    - Application: monitoring votality for market indices

(Week 7: In-class Individual Project 1)

Part III: Prescriptive analytics for risk management (∼3 lectures)

1. Introduction to decision-making under uncertainty
    - Application: news vendor models and supply chain risk management
2. Interplay between model estimation and decision-making
    - Application: robust parameter estimation and portfolio construction

Part IV: Selected topics in risk analytics (∼2 lectures)

Potential topics (depending on time and student interests)

- Catastrophic risk modelling and estimation
- Dependence and copula models
- Unsupervised learning and risk factors
- Dynamic risk monitoring for nonlinear products

(Week 13: In-class Individual Project 2)
(Reading Week: Group Project Due)