DBA3713 Analytics for Risk Management
Semester 2, AY2023/24
[PRELIMINARY]

Instructor

Name:	Feng Yifan
Department:	Analytics & Operations
Office:	Mochtar Riady Building, BIZ1 #8-68
E-mail:	yifan.feng@nus.edu.sg
Office Hours:	By appointment.

Section

BIZ1-0304, 12:00 - 15:00, Wednesdays

Course Description and Learning Objectives

This course 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 in this course.

Prerequisites

DAO2702 Programming for Business Analytics

(The only enforced requirement is that students should also be comfortable with the basic usage of Python since we will use it as the programming language. Apart from that, knowledge of finance at the level of FIN2704, machine learning at the level of DBA3803, and analytical tools at the level of DAO1704 is encouraged but not enforced. We will make the course self-contained and review all relevant concepts in class.)

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.
  - "Investments" by Zvi Bodie, Alex Kane, and Alan Marcus, McGraw-Hill Irwin, 11th edition.

Teaching Assistant

Name: HAO, Wu
E-mail: whao@u.nus.edu

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 use write-ups from other sections, past quarters/instructors of DBA 3713.

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 with machine learning
    - Data: LendingClub loan data
2. Introduction to Neural Networks (NN)
    - Application: derivative pricing and volatility movements
    - Data: Option price data on S&P 500 indices
3. Statistical modelling for dynamic volatility
    - Application: monitoring votality for market indices
    - Data: Daily market index data (e.g., S&P 500, VIX)

(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 (*if time permits*)
2. Interplay between model estimation and decision-making
    - Application: robust parameter estimation and portfolio construction
    - Data: Equity data (e.g., French library on asset returns)

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

Potential topics (depending on time and student interests)

- Catastrophic risk modelling and estimation (e.g., risk measures, extreme value theory)
    - Application: regulations for financial institutions
- Dependence and copula models
    - Application: credit defaults for a portfolio of borrowers
- Dynamic risk monitoring for nonlinear products
    - Application: dynamic portfolio management for financial trading
- Descriptive analytics and unsupervised learning
    - Application: identification of risk factors

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