SDSC3023: DATA SCIENCE APPLICATIONS IN PORTFOLIO RISK ANALYSIS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Data Science Applications in Portfolio Risk Analysis

Subject Code
SDSC - School of Data Science
Course Number
3023

Academic Unit
School of Data Science (DS)

College/School
School of Data Science (DS)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA1503 Linear Algebra with Applications,MA2506 Probability and Statistics or MA2510 Probability and Statistics

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to equip students with a comprehensive understanding of portfolio risk analytics from a data science perspective. After building foundational concepts such as estimating portfolio returns and risk, we will shift focus on the various estimation techniques for of covariance matrices including statistically-motivated factor models, economically-motivated factor models, and dimensionality reduction estimators. With a solid grasp on covariance matrix estimation, the students will then be trained to think in terms of dynamic volatilities and correlations and taught machine learning approaches to forecast these quantities. Portfolio return distribution estimates and forecasts make up the final part of the course, which touches on topics such as tail risk, Value-at-Risk, expected shortfall, and nonlinear dependence between asset returns.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Articulate the core principles governing portfolio risk analysis and covariance matrix estimation.	15	x		
2	Explain covariance matrices and return distributions using statistical and machine learning techniques.	25	x	x	
3	Estimate portfolio tail risk and nonlinear dependence across assets.	15	x	x	
4	Apply statistical and machine learning methods to analyzing asset returns and portfolio risk.	25	x	x	
5	Evaluate the various types of risk associated with investment portfolios.	20	x	x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will participate in large class activities are mainly in the form of lectures covering issues in analyzing and managing portfolio risk and the difference methods used to address them. Students are expected to participate actively in class discussions.	1, 2, 3, 4, 5	3 hours/week

2	Tutorials	Students will engage in small group activities in the form of tutorials in which discussions revolve around implementation of various statistical and machine learning techniques discussed in class.	2, 3, 4, 5	In or after class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Group Project (Report and Presentation)	1, 2, 3, 4, 5	50	
2	Homework assignments	3, 4, 5	10	

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Additional Information for ATs

Note: To pass the course, apart from obtaining a minimum of 40% in the overall mark, a student must also obtain a minimum mark of 30% in both continuous assessment and examination components.

Assessment Rubrics (AR)

Assessment Task

Group Project

Criterion

The group project urges the students to use the concepts discussed in class to analyze real-world problems in portfolio risk analytics.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not evenreaching marginal levels

Assessment Task
Homework assignments

Criterion
The homework assignments allow the students to practice what is learned from the lectures and assess the degree of their understanding of thesubject in the form of short exercises.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Criterion
The final examination covers all the topics taught in the course.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reachingmarginal levels

Additional Information for AR
The examination, midterm test, and homework assignments will be marked according to the respective marking schemes. The marking schemes will be designed at the time they are set. The grades will then be awarded according to the marks attained.

Part III Other Information

Keyword Syllabus

- Measuring return and portfolio risk
- Risk-return and portfolio optimization
- Factor models
- Covariance matrix estimation
- Systematic risk factors
- Time-varying volatility
- Volatility forecasting
- Portfolio return distributions
- Nonlinear dependence
- Tail risk
- Value-at-Risk

Reading List

Compulsory Readings

	Title
1	Portfolio Risk Analysis, Gregory Connor, Lisa Goldberg, Robert Korajczyk, Princeton University Press
2	The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, Springer

Additional Readings

	Title
1	Online learning material is provided via University computer network.