SDSC4107: FINANCIAL ENGINEERING AND ANALYTICS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Financial Engineering and Analytics

Subject Code
SDSC - Data Science
Course Number
4107

Academic Unit
Data Science (DS)

College/School
College of Computing (CC)

Course Duration
One Semester

Credit Units
3

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

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MA2506 Probability and Statistics or MA2510 Probability and Statistics

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course introduces students the fundamental concepts and techniques of financial engineering, including discussions of financial markets and institutions, typical financial securities and their derivatives including futures, forwards, swaps, and options, concepts of arbitrage pricing, portfolio theory, derivative pricing theory, valuation methods, and data analytical tools for investment and security analysis. The goal of the course is to develop intuitive understanding of these concepts and techniques and apply them in the context of financial and business analytics.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain clearly notions of money and interest rates, risk and return, and various types of financial securities and their valuation methods.	10	x		
2	Use basic tools of financial engineering to valuate financial assets.	30	x	x	
3	Design mathematical and statistical tools to manage financial risk, optimize investment portfolios, and design and value financial products.	30	x	x	
4	Formulate options and valuations problems using the language of financial engineering theory, and demonstrate the ability of using the theory to solve these problems.	30	x	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 and in-class discussions	Students will engage in formal lectures, in-class exercises, in-class Q&A and discussions will be used to implement CILOs 1-4.	1, 2, 3, 4	3 hours/week

2	Project	Students will participate in a term project to consolidate their learning. In the term project, students will apply the financial tools discussed in the course to practical problems in financial engineering.	3, 4	in/after class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignment	1, 2, 3	15	
2	Project	3, 4	25	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

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

Assessment Rubrics (AR)

Assessment Task

Assignment

Criterion

Submitted written work

Excellent (A+, A, A-)

For all 4 CILOs, strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Good (B+, B, B-)

For at least 3 out of 4 CILOs, evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with literature.

Fair (C+, C, C-)

For at least 3 out of the 4 CILOs, evidence that student is profiting from the university experience; understanding of the subject; ability to develop solutions to simple problems in the material

Marginal (D)

For at least 3 out of the 4 CILOs, sufficient familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; limited, or irrelevant use of literature.

Assessment Task

Project

Criterion

Project presentation

Excellent (A+, A, A-)

For all 4 CILOs, strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Good (B+, B, B-)

For at least 3 out of 4 CILOs, evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with literature.

Fair (C+, C, C-)

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Assessment Task

Examination

Criterion

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Part III Other Information

Keyword Syllabus

Risk, Return, Time Value of Money
Discounting of Cash Flows, Compounding Rules
Rate of Interest, Bonds, Duration, Convexity, Term Structure of Interest Rate
Concepts of Arbitrage, No Arbitrage Pricing
Futures, Forwards, and Swaps
Options, Callable Securities
Pricing of Derivatives, Black-Scholes model, Greeks
Portfolio theory, Markovitz Model
Risk Analytics, Market Risk, Credit Risk, Value-at-Risk

Reading List

Compulsory Readings

	Title
1	John C. Hull (2015), Options, Futures, and Other Derivatives, 6th edition, Prentice Hall
2	Anthony Saunders and Marcia Millon Cornett (2013), Financial Institutions Management: A Risk Management Approach, 8th edition, McGraw Hill
3	Additionally, lecture notes and slides provided by the instructor.

Additional Readings

	Title
1	Z. Bodie, A. Kane and A. Marcus (2013), Essentials of Investments, 9th Edition, McGraw-Hill
2	D. G. Luenberger (1997), Investment Science, Oxford University Press.
3	Frederic S. Mishkin and Stanley G. Eakins (2015), Financial Markets and Institutions, 8th Edition, Pearson International, Prentice Hall
4	David Ruppert and David S. Matteson (2015), Statistics and Data Analysis for Financial Engineering, 2nd edition, Springer
5	Paul Glasserman (2003), Monte Carlo Methods in Financial Engineering, Springer
6	Riccardo Rebonato (2014), Volatility and Correlation, 2nd edition, Wiley
7	Antoon Pelsser (2000), Efficient Methods for Valuing Interest Rate Derivatives, Springer Finance
8	Dominic O’ Kane (2008), Modelling Single-name and Multi-name Credit Derivatives, Wiley
9	Philip Schonbucher (2003), Credit Derivative Pricing Models, 1st edition, Wiley
10	Relevant online learning material will be provided by the instructor.