

**COURSE OUTLINE: BA2202 Mathematics of Finance**

<b>Academic Year</b>	2022/2023	<b>Semester</b>	1
<b>Course Coordinator</b>	Shinichi Kamiya		
<b>Course Code</b>	BA2202		
<b>Course Title</b>	Mathematics of Finance		
<b>Pre-requisites</b>	-		
<b>No of AUs</b>	4		
<b>Contact Hours</b>	4 x 13 = 52 hours		
<b>Proposal Date</b>	27 Sept 2021		

**A) Course Aims/Description**

The aim of this course is to equip actuarial science students with the knowledge of the theory and practical applications of the mathematics of finance in the various aspects of actuarial work. Specifically, this course aims to cover topics listed in the IFoA 2019 Curriculum CM1: Section 2-3 and CM2: Section 1-3. Partial credits for exemptions of CM1 and CM2 modules will be given to completion of this course.

**B) Intended Learning Outcomes (ILO)/Objectives**

By the end of this course, you should be able to:

- ILO 1. Differentiate between different types of discount and interest rates, and when to use them.
- ILO 2. Evaluate the PV and FV of simple annuities.
- ILO 3. Evaluate and construct loan repayment schedules.
- ILO 4. Use several performance measures of projects and investments.
- ILO 5. Evaluate investment instruments.
- ILO 6. Calculate forward rates and measure the duration and convexity of cash flows.
- ILO 7. Evaluate stochastic interest models under several assumptions.
- ILO 8. Explain the concepts of rational expectations theory and behavioural economics.
- ILO 9. Estimate investment risk using risk measures.

**C) Course Content**

The following topics will be covered in this course.

- Cash flow Models
- Time Value of Money
- Theory of Interest Rates
- Level Annuities and varying Annuities
- Equations of Value
- Loan Schedules
- Project Appraisal
- Financial instruments
- Term Structure of Interest Rates and interest rate risk
- Stochastic Interest Rate Models
- Simple Distribution Functions
- Theories of Financial Market Behaviour
- Measures of Investment Risk

**D) Assessment (includes both continuous and summative assessment)**

Component	ILO Tested	NBS Learning Goal (Refer to Appendix 1 for list)	Weightage	Team/Individual	Assessment Rubrics (attach rubrics in appendix)
1. Final Examination	ILO1-9	Acquisition of knowledge, Problem Solving & Decision Making	70%	Individual	N.A
2. Mid-term test	ILO1-6	Problem Solving & Decision Making	10%	Individual	Problem Solving & Decision Making
3. Class participation	ILO1-9	Oral Communication	10%	Individual	Class participation
4. Class presentation	ILO1-9	Written/oral Communication	10%	Individual	Class presentation
Total			100%		

**E) Formative feedback**

Feedback is central to this course. You will receive both written and verbal feedback from me about your mid-term test. You will also receive written feedback in response to your presentation.

**F) Learning and Teaching approach**

Approach	How does this approach support you in achieving the learning outcomes?
Seminars	The interactive lecture session where there is ample opportunities for open discussion on the conceptual questions raised in the class allows you to think critical and share their ideas and concept with the class.
In-Class activities	Some learning outcomes for this course are skills which are practical and can be used immediately. To understand that the materials are relevant to practice, you work with some problems of financial transactions such as mortgages.

**G) Reading and References**

- IFoA Subject CT1 – Financial Mathematics. Exam paper and examiners' reports are available at: <https://www.actuaries.org.uk/studying/prepare-your-exams/past-exam-papers-and-examiners-reports>
- IFoA Actuarial Mathematics: <https://www.actuaries.org.uk/studying/curriculum-2019/actuarial-mathematics>

- Financial Mathematics for Actuaries: Updated Edition. Wai-Sum Chan and Yiu-Kuen Tse; McGraw-Hill, 2013.
- An introduction to the mathematics of finance. A deterministic approach (2nd ed). Stephen Garrett; Butterworth-Heinemann, 2013

## H) Course Policies and Student Responsibilities

### (1) General

You are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled quizzes and tests by due dates. You are expected to take responsibility to follow up with course notes, quizzes and course related announcements for seminar sessions they have missed. You are expected to participate in all seminar discussions and activities.

### (2) Absenteeism

Absence from class without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

If you miss a lecture, you must inform the course instructor via email prior to the start of the class.

## I) Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

## J) Course Instructors

Instructor	Office Location	Phone	Email	Consultation Hours
Shinichi Kamiya	S3-B1B-64	69705718	skamiya@ntu.edu.sg	Thur till 2pm

**K) Planned Weekly Schedule (subject to change)**

<b>Week</b>	<b>Topic</b>	<b>ILO</b>	<b>Readings/ Activities</b>
1 (11/08/22)	<ul style="list-style-type: none"> <li>Cash flow Models</li> <li>Time Value of Money</li> </ul>	ILO 1	Handouts
2 (18/08/22)	<ul style="list-style-type: none"> <li>Theory of Interest Rates</li> </ul>	ILO 2	Handouts
3 (25/08/22)	<ul style="list-style-type: none"> <li>Level Annuities</li> <li>Varying Annuities</li> </ul>	ILO 2	Handouts
4 (1/09/22)	<ul style="list-style-type: none"> <li>Loan Schedules</li> </ul>	ILO 3	Handouts
5 (8/09/22)	<ul style="list-style-type: none"> <li>Project Appraisal</li> </ul>	ILO 4	Handouts
6 (15/09/22)	<ul style="list-style-type: none"> <li>Financial instruments</li> </ul>	ILO 5	Handouts
7 (22/09/22)	<ul style="list-style-type: none"> <li>Term Structure of Interest Rates</li> </ul>	ILO 6	Handouts
(29/9/22)	Recess week		
8 (6/10/22)	Mid-Term Test		
9 (13/10/22)	<ul style="list-style-type: none"> <li>Stochastic Interest Rate Models</li> <li>Simple Distribution Functions</li> </ul>	ILO 7	Handouts
10 (20/10/22)	<ul style="list-style-type: none"> <li>Theories of Financial Market Behaviour</li> <li>Rational Expectations Theory</li> </ul>	ILO 8	Handouts
11 (27/10/22)	<ul style="list-style-type: none"> <li>Theories of Financial Market Behaviour</li> <li>Behavioural Economics</li> </ul>	ILO 8	Handouts
12 (3/11/22)	<ul style="list-style-type: none"> <li>Estimate investment risk using risk measures</li> </ul>	ILO 9	Handouts
13 (10/11/22)	Review		

**ANNEX A: ASSESSMENT CRITERIA****Assessment Measure (Rubric)**

Learning Goal	Course Learning Objective	Assessment Method
Problem Solving & Decision Making	Develop problem solving skills using concepts and appropriate methods, to analyse and evaluate alternative solutions and make appropriate recommendations.	Mid-Term Test

Traits	1 Below Expectation	2 Met Expectation	3 Above Expectation
ILO 1. Differentiate between different types of discount and interest rates, and when to use them.	Misunderstand the question or miss out significant parts of the calculations required	Achieves most of the learning objectives. Has a framework for problem solving and analysis.	Successfully obtain answers quickly even for complex problems that require several steps.
ILO 2. Evaluate the PV and FV of simple annuities.	Misunderstand the question or miss out significant parts of the calculations required	Achieves most of the learning objectives. Has a framework for problem solving and analysis.	Successfully obtain answers quickly even for complex problems that require several steps.
ILO 3. Evaluate and construct loan repayment schedules.	Misunderstand the question or miss out significant parts of the calculations required	Achieves most of the learning objectives. Has a framework for problem solving and analysis.	Successfully obtain answers quickly even for complex problems that require several steps.
ILO 4. Use several performance measures of projects and investments	Misunderstand the question or miss out significant parts of the calculations required	Achieves most of the learning objectives. Has a framework for problem solving and analysis.	Successfully obtain answers quickly even for complex problems that require several steps.
ILO 5. Evaluate investment instruments.	Misunderstand the question or miss out significant parts of the calculations required	Achieves most of the learning objectives. Has a framework for problem solving and analysis.	Successfully obtain answers quickly even for complex problems that require several steps.
ILO 6. Calculate forward rates and understand the concepts of duration, convexity.	Misunderstand the question or miss out significant parts of the calculations required	Achieves most of the learning objectives. Has a framework for problem solving and analysis.	Successfully obtain answers quickly even for complex problems that require several steps.

**Class Participation Rubric**

Traits	Performance		
	<5 Below Expectation	6 Met Expectation	>6 Above Expectation
Verbal demonstration of understanding of basic topics by answering questions	Lack of understanding of basic concepts covered in class	Sufficient understanding of basic concepts covered in class	Contributions to class by constructive and insightful answers
Verbal demonstration of understanding of basic topics by asking questions and providing comments	No contributions/ Contributions lack substance	Contributions demonstrate knowledge of subject matter	Contributions to class by constructive and insightful questions and feedbacks

**Class presentation Rubric**

Traits	Performance		
	<5 Below Expectation	6 Met Expectation	>6 Above Expectation
Contribution quality: Verbal demonstration of own workings for assigned exercise questions	Lack of clear and concise explanation of own workings	Sufficient explanation of own workings	Clear and concise explanation of workings that helps other students' understanding
Contribution quality: Quantitative demonstration of own workings for assigned exercise questions	No contributions/ Contributions lack substance	Sufficiently demonstrate knowledge of subject matter	Clear understanding of subject matter that helps other students' understanding (e.g., provide alternative solutions)