

#### ISOM4540 Time Series Analysis and Forecasting (L1) Spring Semester 2025

# **Course Outline**

Instructor	Dr. Jason MW HO
	Senior Lecturer
	Department of Information Systems, Business Statistics, and
	Operations Management (ISOM)
Office Location	LSK 4082B
Office Hours	Tuesday & Thursday, 1400-1500
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Teaching Assistant	Mr. Zhen GUO

# Class Schedule and Location

Email

L1	1200 – 1320 (Tue & Thur)	4 February – 8 May 2025	LSK 1009
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<b>T1</b>	1100 – 1150 (Wed)	19 February – 7 May 2025	LSK G021
		(except April 2)	

#### **Course Description**

Statistics play an important role in every discipline that utilizes data. The diverse areas involving application of Statistics include Science, Medicine, Engineering, Business, among others. Rather than cross-sectional data, we often encounter time series data collected repeatedly across a period of time, for example, daily returns of a stock in the last 2 years and monthly sales of some commodities in a 10-year period. Studying such data helps us address questions like future prospect of an investment in a stock and prediction of production target that will meet the future demand in the business world. This course is designed to equip students with various statistical methods and forecasting techniques tailor-made for handling time series data, in place of other standard statistical techniques built upon certain independence assumptions in the data structure.

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#### Intended Learning Outcomes (ILOs)

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

- ILO1: Master basic theoretical concepts and common statistical methods for analyzing time series data, understand advantages and limitations of these time series methods, and decide which methods are most appropriate to use in a given situation.
- ILO2: Interpret and present statistical results of time series analyses that are either self-produced or provided by others.
- ILO3: Analyze real time series data using R in implementing common methods in time series analyses and forecasting.

#### **Assessment and Grading**

This course will be assessed using criterion-referencing (i.e., grades will not be assigned using a curve).

Assessments:

Assessment Task	Contribution to Overall	Due Date
	Course grade (%)	
In-class participation	5	Week 1 to 13
Homework assignment	20	Week 5, Week 9, and Week 13
Midterm examination	20	27 March 2025
Final examination	55	Spring term examination period;
		exact date to be announced by AR

Mapping of Course ILOs to Assessment Tasks:

Assessment Task	Mapped ILOs	Explanation
In-class participation	ILO1	This task emphasizes on and assesses students'
		understanding of the basic concepts in time series
		analysis and forecasting.
Homework assignment	ILO1, ILO2, ILO3	Homework allows students to solve a real problem
		in business environment, involving formulation of
		the problem in statistical terms, selection of an
		appropriate time series method to apply in a given
		situation upon analyzing any time series data, and
		presentation and interpretation of results of time
		series analysis of the data.
Midterm examination	ILO1, ILO2, ILO3	Midterm examination evaluates students' ability in
		mastering basic concepts and theory in time series
		analysis and forecasting, and interpreting correctly
		results of any time series analysis.
Final examination	ILO1, ILO2, ILO3	Final examination evaluates students' ability in
		mastering basic concepts and theory in time series
		analysis and forecasting, and interpreting correctly
		results of any time series analysis.

More information about each Assessment Tasks:

Assessment Task	More Descriptions	
In-class participation	• Your participation will be assessed according to contributions to in- class discussion and learning via answering some simple questions.	
Homework assignment	<ul> <li>3 sets of homework assignments.</li> <li>All use of generative AI is restricted.</li> <li>Students should form groups of 3 students and contribute equally to completion of the assignments.</li> <li>Students can report any free-riding or irresponsible behavior of group members to TA via email with sufficient supporting evidence. Once verified, students with such behavior will receive a lower individual mark.</li> <li>Group formation in Canvas should be completed by end of Feb</li> </ul>	
Midterm examination	<ul> <li>Closed-book, with help sheet (1 piece of A4-size paper with any content on both sides) allowed.</li> <li>Scheduled on 27 March 2025 (in-lecture, or 6-9pm).</li> </ul>	
Final examination	<ul> <li>Closed-book, with help sheet (2 pieces of A4-size paper with any content on both sides) allowed.</li> <li>Date and venue to be announced.</li> </ul>	

## Final Grade Descriptors:

Grade	Short Description (Overall mark out of 100)	Explanation
A	Excellent Performance (>85)	Demonstrates a comprehensive grasp and understanding of fundamental statistical concepts, selection and application of appropriate techniques and methods in analyzing time series data, and presentation and interpretation of results of time series analysis.
В	Good Performance (>65)	Shows a high level of understanding of fundamental statistical concepts, selection and application of appropriate techniques and methods in analyzing time series data, and presentation and interpretation of results of time series analysis.
С	Satisfactory Performance (>50)	Possesses adequate knowledge of fundamental statistical concepts, selection and application of appropriate techniques and methods in analyzing time series data, and presentation and interpretation of results of time series analysis.
D	Marginal Pass (>40)	Has threshold knowledge of fundamental statistical concepts, selection and application of appropriate techniques and methods in analyzing time series data, and presentation and interpretation of results of time series analysis.
F	Fail	Demonstrates a lack of understanding of fundamental statistical concepts, insufficient knowledge in selection and application of appropriate techniques and methods in analyzing time series data, and poor skills in presentation and interpretation of results of time series analysis.

### **Communication and Feedback**

- Channel your enquiries in regards to
  - $\circ$  administration and logistics of the course (e.g., issues about in-class participation, submission and grading of homework assignments, absence in exams, free-riding issue, etc.) to <u>TA</u>.
  - $\circ$  teaching and learning materials discussed in lectures to <u>course instructor</u>.
- Marks and feedbacks for individual assessed tasks will be communicated via Canvas within two weeks of submission.
- Any discrepancies in assessment marks posted in gradebook of Canvas should be reported to <u>TA</u> without any delay.

### Late submission Policy

To ensure fairness to students who submit homework assignments on time, a penalty for late submission according to records in Canvas (with no exception due to whatsoever reason) is listed as follows:

- Late submission within 6 hours: 25% penalty will be applied.
- Late submission between 6 to 24 hours: 50% penalty will be applied.
- Late submission for more than 24 hours will not be accepted.

### **Course Materials**

- Class slides, and other teaching materials available on course Canvas in HKUST iLearn (<u>https://ilearn.ust.hk/iLearn/home.html</u>), or HKUST iLearn App on App Store or Google Play
- Reference Textbooks:
  - *Forecasting: Principles and Practice* (2<sup>nd</sup> ed), Rob J Hyndman and George Athanasopoulos, OTexts (2018). Access the online textbook: <u>https://otexts.com/fpp2/</u>
  - Introductory Time Series with R (Use R!), Paul S.P. Cowpertwait and Andrew V. Metcalfe, Springer (2009).
  - *Time Series Analysis and Its Applications (With R Examples)*, Robert H. Shumway and David S. Stoffer, Springer (2017).
- Required software: R
- R markdown files discussing R commands and analysis outputs in class slides

#### **Course AI Policy**

**Restrict all use of generative AI for assessment**: You are prohibited from using generative artificial intelligence (AI) to produce any materials or content related to all take-home assessments, such as homework assignments.

#### **Academic Integrity**

Students are expected to strictly adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to <u>Academic Integrity</u> <u>HKUST - Academic Registry</u> for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

# **Course Plan**

Module/Activity	Date
Module 1. Introduction	Feb 4
Module 2. Time Series Features	Feb 6, 11, 13
Module 3. The Forecaster's Toolbox	Feb 18, 20
Module 4. Time Series Decomposition	Feb 25
Module 5. Time Series Regression Models	Feb 27; Mar 4, 6, 11, 13
Module 6. Exponential Smoothing	Mar 18, 20, 25
<b>Midterm Examination on Modules 1-5</b>	Mar 27
Module 7. ARMA Models	Apr 8, 10, 15, 17, 22
Module 8. ARIMA Models	Apr 24, 29; May 6, 8