HONG KONG BAPTIST UNIVERSITY
Faculty of Science

1. **Course Code and Course Title**
MATH 4826 Time Series and Forecasting (3,3,0)

2. **No. of Units**
3

3. **Offering Department**
Department of Mathematics

4. **Pre-Requisite**
MATH3805 Regression Analysis

5. **Co-Requisite / Anti-Requisite (if any)**
Nil

6. **Aims & Objectives**
The course aims at providing students with an understanding of the statistical methods for time series data whose order of observation is crucially important in depicting the background dynamics of the related social, economic, and/or scientific phenomena. The students will learn to use various time series models and techniques such as exponential smoothing, ARIMA, etc., to model and make forecasts. Corresponding programming techniques to facilitate these practices will also be introduced within the platforms of MATLAB or R. Case studies will be provided to make the students acquainted with the elementary techniques.

7. **Course Intended Learning Outcomes (CILOs)**

CILO	By the end of the course, students should be able to:	PILO Alignment
1	Describe basic time series models and their characteristic	1,2
2	Apply regression techniques to model time series data and able to apply exponential smoothing methods and stochastic modeling methods to forecast nonseasonal and seasonal time series	1,2
3	Manipulate the software MATLAB or R and able to plot graph for time series	2,4
4	Write some basic program to model and forecast time series.	2,4
5	Work effectively in a team and able to solve problems independently	1

8. **Teaching & Learning Activities (TLAs)**

CILO No.	TLAs

3,4,5	**Lab Tutorial** Instructor will guide students to study basic knowledge of MATLAB or R and know how to write program by MATLAB or R in the one week's course held on computer lab.
1,2,3,4,5	**Lecture** Instructor will present real time series examples and analyze in class. Students will consolidate the knowledge through discussion within lectures/tutorials.
1,2,3,4,5	**In-class activity** Instructor will guide students to find some time series data from their practical real life and make modeling and analysis for their collected time series dataset.

9 **Assessment Methods (AMs)**

Type of Assessment Methods ABC	Weighting	CILOs to be Address	Description of Assessment Tasks
In-class exercise	20%	1,2,3,4,5	In-class exercise will be given to enable students to practice on basic time series concepts, calculations, algorithms implementation, engage in problem-solving. Each of them allows the students to know what they do well and what they need to work harder on. It also allows the instructor to identify learning needs and problems.
Writing assignments	20%	1,2,3,4,5	Writing assignments with long questions are designed to allow the instructor to keep track of how well the students master the time series knowledge covered during different stages of the course. The questions of assignments include calculations with steps and explanations, proofs, guided questions etc.
Project	20%	1,2,3,4,5	The project is designed to achieve CILO 3-5 by facilitating students working in a team environment and independently to model and forecast time series data. This may involve, but not limited to, in class discussions of rigorous technical problems and their solutions.
Final Examination (2 Hours)	40%	1,2,3,4,5	Final Examination is designed to see how far students have achieved their intended learning outcomes especially in the Knowledge domain. Students should have a thorough understanding of the knowledge and apply them correctly in different context to do well in the exam.

10. **Assessment Rubrics**

CILO: 1 Describe basic time series models and their characteristic

Criteria	Excellent	Good	Satisfactory	Marginal Pass	Fail
Description	Insightful, clear and complete description of the main basic time series models and their characteristic with valid examples, clear indication of what and why, and consideration of relevant contextual factors.	Appropriate and clear description of some of the main basic time series models and their characteristic with some valid examples, indication of what and why, and consideration of relevant contextual factors.	Reasonably clear description of some basic time series models and their characteristic with a few valid examples and indication of what and why, and consideration of relevant contextual factors.	Attempt in description of the basic time series models and their characteristic with limited examples, indication of what and why, and consideration of relevant contextual factors.	Inappropriate description of basic time series models and their characteristic with no examples, indication of what and why, or consideration of relevant contextual factors.

CILO: 2 Apply regression techniques to model time series data and able to apply exponential smoothing methods and stochastic modeling methods to forecast nonseasonal and seasonal time series

Criteria	Excellent	Good	Satisfactory	Marginal Pass	Fail
Application	Insightful and accurate application of the main regression techniques to model time series data and exponential smoothing methods and stochastic modeling methods to forecast non-seasonal and seasonal time series with detailed consideration of the requirements and contextual factors.	Appropriate and accurate application of some of regression techniques to model time series data and exponential smoothing methods and stochastic modeling methods to forecast non-seasonal and seasonal time series with some consideration of the requirements and contextual factors.	Reasonably accurate application of a few regression techniques to model time series data and exponential smoothing methods and stochastic modeling methods to forecast non-seasonal and seasonal time series with some consideration of the requirements and contextual factors.	Attempt in application of the regression techniques to model time series data and exponential smoothing methods and stochastic modeling methods to forecast non-seasonal and seasonal time series with limited consideration of the requirements and contextual factors.	Inappropriate application of the regression techniques to model time series data and exponential smoothing methods and stochastic modeling methods to forecast non-seasonal and seasonal time series with no consideration of the requirements and contextual factors.

CILO: 3 Manipulate the software MATLAB or R and able to plot graph for time series

Criteria	Excellent	Good	Satisfactory	Marginal Pass	Fail
Manipulation	Insightful and accurate manipulation of the main	Appropriate and accurate manipulation of some of the the	Reasonably accurate manipulation of a few software	Attempt in manipulation of the software Matlab orR and	Inappropriate manipulation of the software Matlab or R

	software MATLAB or R and able to plot graph for time series with detailed consideration of the requirements and contextual factors.	software MATLAB or R and able to plot graph for time series with some consideration of the requirements and contextual factors.	MATLAB or R and able to plot graph for time series with some consideration of the requirements and contextual factors.	able to plot graph for time series with limited consideration of the requirements and contextual factors.	and able to plot graph for time series with no consideration of the requirements and contextual factors.

CILO: 4 Write some basic program to model and forecast time series.

Criteria	Excellent	Good	Satisfactory	Marginal Pass	Fail
Execution	Sophisticated execution of some basic program to model and forecast time series with accuracy, reasoning and thorough consideration of assumptions, demonstrating high level of understanding.	Appropriate execution of some basic program to model and forecast time series with considerable accuracy, reasoning and consideration of assumptions.	Reasonable execution of a few some basic programs to model and forecast time series with some accuracy, reasoning and consideration of assumptions.	Attempt in execution of some basic program to model and forecast time series with limited accuracy, reasoning and consideration of assumptions.	Inappropriate solution of problem with no discussion, justification, verification or appraisal of the underlying logic, mechanisms, theories, or relationships among elements.

CILO: 5 Work effectively in a team and able to solve problems independently

Criteria	Excellent	Good	Satisfactory	Marginal Pass	Fail
Solution	Thorough and elegant solution of problem with valid discussions, justifications, verifications, and appraisals of the underlying logic, mechanisms, theories, and relationships among elements.	Appropriate solution of problem with some valid discussions, justifications, verifications and appraisals of the underlying logic, mechanisms, theories, and relationships among elements.	Reasonable solution of problem with a few valid discussions, justifications, verifications and appraisals of the underlying logic, mechanisms, theories, and relationships among elements.	Attempt in solving the problem with limited discussions, justifications, verifications and appraisals of the underlying logic, mechanisms, theories, and relationships among elements.	Inappropriate solution of problem with no discussion, justification, verification or appraisal of the underlying logic, mechanisms, theories, or relationships among elements.

11. Course Intended Learning Outcomes and Weighting

Content	CILO No.	Teaching (in hours)
I. Application of Regression Model in Forecasting	1,2,3,4,5	6
II. Regression and Smoothing Methods	1,2,3,4,5	12

III. Stochastic Models	1,2,3,4,5	15
IV. Case Studies	1,2,3,4,5	6

12. **Textbooks / Recommended Remarks**

Textbook

1. Lecture notes prepared by the instructor

References

1. P.J. Brockwell and R.A. Davis, Introduction to Time Series and Forecasting, Springer, 1996.
2. Shumway, Robert H, and David S. stoffer, (2016) Time series analysis and its applications, with R examples, 4th Edtion, New York: Springer, 2000.
3. Yaffee, Robert A. Introduction to time series analysis and forecasting : with applications of SAS and SPSS, San Diego, Academic Press, 2000.
4. Chan, Ngai Hang, Time series : applications to finance, New York : Wiley-Interscience, 2002.
5. Ruey S. Tsay, (2010). Analysis of Financial Time Series, 3th edition, Wiley
6. B. Abraham and J. Ledolter, Statistical Methods for Forecasting, Wiley, 1983.

Software

1. MATLAB or R

13. **Course Content**

	Topics	Hours
I	Application of Regression Model in Forecasting	6
	A Review of regression analysis	
	B Errors with serial correlation	
	C Weighted least squares	
II	Regression and Smoothing Methods	12
	A Local constant mean model and simple smoothing	
	B Discounted least squares and general exponential smoothing	
	C Local trends and exponential smoothing	
	D Predication intervals for future values	
	E Modeling seasonality in constant mean model	
	F Globally and locally constant seasonal models	
III	Stochastic Models	15
	A Stationary process and ARMA model	

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