DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of *Mathematics and Statistics*

STAT 4390/5390, OCEAN 4210/5210

Time Series Analysis

Winter 2019

Instructor: *Keith Thompson* *keith.thompson@dal.ca* *Oceanography LSC Room 5634*

Lectures: *TR 1:05-2:25pm* *LSC Common Area C238*

Course Description

Time series analysis in both the time and frequency domain is introduced. The course is targeted at applications, as well as introducing the relevant theory. Illustrative examples are drawn primarily from the marine sciences. Topics covered include the nature of time series, stationarity, auto- and cross- covariance functions, auto-regressive moving-average models, and auto- and cross- spectra. Modern state space methods are also covered and include the state and parameter estimation with the Kalman filter and particle filter (time permitting).

Course Prerequisites

- *STAT 3340 - Regression Analysis*
- *STAT 3360 - Probability*
- *STAT 3460 - Intermediate Statistical Theory*

or Permission of the Instructor.

Many of the Oceanography students taking the course will not have all required courses. A fairly high level of mathematical and statistical skill is required to successfully complete the course including (1) Basic concepts in Statistics including random variables, probability distributions, expectation, and regression (2) Familiarity with calculus, matrix algebra, and complex numbers. If you are unsure if you have a suitable background for successful completion of the course, please see me as soon as possible.

Course Objectives/Learning Outcomes

This class deals with the analysis of systems characterized by dependence structure, such as variables recorded over time (but this feature also applies to spatial data). The emphasis is on both theory and application. The main objective of this course is to provide a solid practical grounding in time series analysis. The Learning Outcomes are:

(1) Develop an understanding of the theory underlying time series in the time and frequency domain, as well as for state space models.

(2) Provide an understanding of the practice of time series analysis, including the ability to apply methods to real data sets and to interpret the results.

(3) Provide experience in the use of modern statistical software (e.g. R) for time series analysis.

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Course Materials

The course textbook is "Introduction to Time Series and Forecasting" by Peter J. Brockwell and Richard A. Davis, Third Edition, published by Springer. I will use the same notation and illustrate the theory with worked examples in class.

"Time Series Analysis and Its Applications With R Examples" by Robert H. Shumway and David S. Stoffer may also be useful background reading.

My class notes, assignments, and computer code will be posted on Brightspace.

Assessment

Component	Weight (% of final grade)	Date
Midterm	*30%*	*Tuesday, 25 February 2019 (in class)*
Final exam	*40%*	*(Scheduled by Registrar)*
Assignments	*30%*	*Approximately bi-weekly*

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	**B+** (77-79)	**C+** (65-69)	**D**	(50-54)
A (85-89)	**B** (73-76)	**C** (60-64)	**F**	(<50)
A- (80-84)	**B-** (70-72)	**C-** (55-59)		

Course Policies

• *Assignments: Due in class on their due date. Late assignments will receive a zero grade. Students are not allowed to work together on assignments.*

• *Midterms: Non-attendance will result in a zero grade unless a legitimate excuse is provided, ideally well in advance of the midterm. In such a case, and at the instructor's discretion, a makeup may be scheduled or else the midterm not counted toward the final grade.*

• *Disputes over grading will be resolved by re-grading the entire assignment or exam.*

• *All information relevant to class logistics (e.g., class cancellation, due date changes) will be communicated via messages posted on the course website.*

• *The Student Declaration of Absence form for missed academic requirements (except the final) must be used in this course.*

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Course Content

Introduction: Concepts underlying time series analysis and practical exploratory data analysis.

Time domain: Time series models, links with dynamical systems, auto-regressive moving average models.

Frequency domain: Spectral analysis including auto-spectra and cross-spectra.

State space models: linear methods including the Kalman filter.