UNIVERSITY of GUELPH

Course Outline STAT*4360/6761: Fall 2022

General Information

Course Title: Applied Time Series/ Statistical Modelling

Calendar Description:

This course will investigate the nature of stationary stochastic processes from the spectral and time domain points of view. Aspects of parameter estimation and prediction in a computationally intensive environment will be the presentation style. The methods developed in this course will have applicability in many sciences such as engineering, environmental sciences, geography, soil sciences, and life sciences.

Credit Weight: 0.5

Academic Department (or campus): Mathematics and Statistics

Campus: Guelph

Semester Offering: Fall 2022

Class Schedule: Lectures, Tuesday and Thursday 4:00 – 5:20, MINS 101

Instructor Information

Instructor Name: Tony Desmond
Instructor Email: tdesmond@uoguelph.ca

Course Description

This course deals with stochastic modelling and statistical analysis of data, which is collected over time. Such data typically exhibits serial correlation or lack of independence. This feature prohibits the use of standard statistical techniques, which rely rather heavily on an assumption of independence. As a result, time series involves many new ideas and techniques not found in classical statistical modelling. A relatively high level of mathematical sophistication is necessary for a full grasp of the theory. Areas of statistics and mathematics useful in the study of time series are: (1) Stochastic Processes, (2) Regression Analysis, (3) Fourier Analysis, (4) Multivariate Analysis and (5) Difference Equations. In particular, (1) is very important, since a time series may be regarded as a realization of various underlying stochastic processes.

There are numerous areas of application: Finance, Environmental Science, Climatology, Economics etc.

The implementation of time series analysis requires statistical software, and in this course we will be using R. Familiarity with R will be assumed. The best way to acquire familiarity is via the manuals (available online). Also simply working through the required texts is of great value.

Lecture Content

1. Stochastic Processes, Stationarity, Autocorrelation, and its estimation.

2. Autoregressive and Moving Average Processes.

3. Nonstationary Processes: ARIMA Models.

4. Model Building: Identification, Estimation and Diagnostic Checking.

5. Forecasting.

6. Spectral Analysis of Time Series

7. Other Topics: Time Series Models of Heteroscedasticity: ARCH, GARCH and Stochastic Volatility Models. Nonlinear Models.

Learning Outcomes

1. Understand basic time series / stochastic process concepts such as: strong stationarity, 2nd order stationarity, autocorrelation.

2. Explore and understand simple random walk models and how simple parametric models such as autoregressive and moving average models can be used as building blocks for more complex models.

3. Explore and understand how trends, periodicity and non-stationarity can be dealt with,

4. Explore and understand the basic iterative model building philosophy of the Box-Jenkins approach: Identification, Estimation and Diagnostic Checking; Rince and repeat☺

5. Explore and understand the spectral domain approach to time series analysis.

6. Explore and understand newer approaches for modelling financial time series such as GARCH and stochastic volatility models

7. Implement the approaches outlined above using the software package R on real data from various subject matter areas.

Course Assignments, Midterm, and Term Project

4 Assignments, approximately every 2 weeks. Worth 30%.

Midterm: Thursday October 27, 4:00-5:30 in class. Worth 30%

Final Term Project: Due date Wednesday Dec 14, 5pm. Worth 40%.

The term project will involve application of the theory in a subject-matter discipline, such as finance, economics, hydrology/climatology, ecology, public health etc., and will be expected to go beyond the material delivered in lectures. Specific suggestions will be made.

Course Resources

Required Texts:

TIMES SERIES ANALYSIS with applications in R, by CRYER and CHAN, 2ND ED. SPRINGER 2008.

COWPERTWAIT and METCALFE: Introductory Time Series with R, Springer 2009.

VENABLES and RIPLEY: Modern Applied Statistics with S, 4th Ed., Springer. (Especially Chapter 14).

NB: Electronic copies of each of these texts have been placed on reserve in the library.

Additional Recommended Texts:

DIGGLE, P: Time Series: A Biostatistical Introduction, Oxford, 1990.

Course Policies

Late Assignments will not be accepted except under very exceptional circumstances.

Course Policy on Group Work:

Assignment solutions should be your own work, be clear, legible and well organized. You may discuss assignments with other classmates, but the work handed in should be your own.

Course Policy regarding use of electronic devices and recording of lectures

Electronic recording of classes is expressly forbidden without consent of the instructor. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.

University Policies

Academic Consideration

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor in writing, with your name, id#, and e-mail contact. See the academic calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community, faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring.

University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.
When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway. Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.
Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

More information: www.uoguelph.ca/sas

Course Evaluation Information

Please see http://www.mathstat.uoguelph.ca/files/TeachevaluationformF10.pdf

Drop date

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via Courselink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

COVID-19 Safety Protocols:

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, that these guidelines may be updated as required in response to evolving University, Public Health or government directives.

Accommodation due to Illness:

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g. final exam or major assignment).

Mental Health Services:

One out of every five students in Canada experiences some sort of mental health issue at some point in their academic career. If you find yourself facing a mental health crisis, or just need to talk to someone, please consider taking advantage of one of the following resources available to University of Guelph students:

Counselling Services: Visit the Counselling Services website (https://wellness.uoguelph.ca/counselling) to get information on resources available to you, both online and in-person. You can also visit them at Health Services (J.T. Powell Building, ext 53244) where they offer individual and group counselling sessions by appointment or walk-in.

Student Support Network: is located in the Wellness & Education Promotion Centre in the J.T. Powell Building and offers confidential, peer-based, drop-in support.

Good2Talk: (1-866-925-5454) is a free, 24/7 student hotline that provides professional counselling and referrals for mental health, addictions and well-being.

Here 24/7: (1-844-437-3247) specializes in assessment, referral and appointment booking and is

available 24/7 for crisis support.

You are not alone and you will not be judged for asking for help.

Additional Course Information

Additional Course Information will be provided in class.