University of Guelph
Department of Mathematics and Statistics

STAT*4360: Applied Time Series Analysis

Course Outline
Fall 2021

Instructor Information

Instructor Name : Peter Kim
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Office location : MACN515
Office hours : TBA via Zoom

General Information

Class schedule : Online courselink.uoguelph.ca
Campus : Guelph

Credit Weight : 0.50

Prerequisites : STAT*3240

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

Course Description:
This course will be on time series analysis. We will primarily be investigating time series models in both the frequency and time domains. Frequency domain, or spectral analysis is useful for extracting global features of a given time series, where in fact what we would like to deduce is whether a given time series is white noise, a completely random process. Time domain analysis is the actual modeling aspect of time series where the main tool is parameter estimation of an autoregressive moving average process. Frequency and time domain analyses come together in that after parameter estimation is complete in the time domain, frequency domain analysis can tell us whether residuals

have been reduced to white noise which is the most we can expect. Time series computation will be heavily used in this course. The statistical software package R will be utilized. All students will be required to have access to R. Details will be provided.

Learning Resources

Required Resources

Modern Applied Statistics with S, Fourth Edition, W.N. Venables and B.D. Ripley, Springer (VR: Textbook)

Time Series Analysis: With Applications in R, Second Edition. Jonathan D Cryer and Kung-Sik Chan. Springer. (CC: Textbook)

R (Software)

http://www.r-project.org/

The primary statistical software package that will be used in this course is **R**, which is freely available for download. Students are strongly encouraged to install **R** on their personal computers.

Courselink

As there will be no formal lectures, the course delivery will mainly be through the online discussion board

Learning Outcomes

This is an advanced statistical data analysis course involving computational time series.

Course Learning Outcomes

Following this course students will have a firm grasp of:

- analyzing time series data
- determine whether a time series is white noise
- model time series in terms of autoregressive integrated moving average process
- link the association of two time series in terms of time series regression

Teaching and Learning Activities

This course will be online driven with student interaction. These are the relevant chapters out of the textbooks VR and CC.

Chapter 14 of VR has everything one needs for time series computation, but it is somewhat condensed and during non-pandemic days lectures filled in the details. Lectures over Zoom are less than ideal so instead the CC textbook was adopted to help fill in the details. These resources plus online discussion will be more than adequate to learn the material and in particular time series computing.

Topics

Week 1: Introduction to time series. VR pages 387-389. CC chapter 1.

Week 2: Stationary processes. VR section 14.1. CC chapter 2.

Week 3: Spectral analysis. VR pages 392-397. CC chapter 13.

Week 4: Autoregressive moving average (ARMA) models. VR section 14.2. CC chapter 4. Parametrization of MA in VR and CC opposite.

Week 5: ARMA models cont'd.

Week 6: Smoothing the periodogram. VR pages 392-397. CC chapter 14.

Week 7: Smoothing the periodogram cont'd.

Week 8: Autoregressive integrated moving average model. VR section 14.2. CC chapter 5.

Week 9: Autoregressive integrated moving average cont'd.

Week 10: Time series regression. VR section 14.5. CC chapter 11.

Week 11: Time series regression cont'd.

Week 12: Summary and additional topics time permitting.

Assessments

Marking Schemes & Distributions

Assignments: There will be 5 assignments posted that will not be collected for grading but will be discussed online.

Assignment 1 Weeks 1-3

Assignment 2 Weeks 4-5

Assignment 3 Weeks 6-7

Assignment 4 Weeks 8-9

Assignment 5 Weeks 10-12

Midterms: There will be two midterms each worth 25%.

Midterm 1 (online) Oct 22
Midterm 2 (online) Nov 19

Final Exam: A final exam worth 50%.

Final Examination (online) December 9, 2021: 14:30 to 16:30

University Statements

Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via Courselink and/or class email. All University-wide decisions will be posted on the COVID-19 website and circulated by email.

Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

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 book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

Academic Integrity

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 encourages academic integrity. 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.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars https://www.uoguelph.ca/academics/calendars

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.