STA457H1S/2202H1S
Time Series Analysis

Instructor: K. Knight (office: Sidney Smith 5016G; e-mail: `keith@utstat.utoronto.ca`) My office is at the west end of the 5th floor.

Office hours: Tuesdays from 10am to noon, or by appointment. Do not hesitate to contact me by e-mail as many problems you might encounter can be easily resolved this way.

Textbook: R. Shumway and D. Stoffer: *Time Series Analysis and Its Applications: With R Examples.* Springer. This book is available at the University of Toronto Bookstore and is also available for free download from Springerlink:

`link.springer.com/book/10.1007/978-1-4419-7865-3`

The textbook will be supplemented by handouts, which will be available through the course's Blackboard site `portal.utoronto.ca`.

The following books are also good references for this course:

- C. Chatfield: *The Analysis of Time Series: an Introduction (5th edition).*
- M. Kendall and J.K. Ord: *Time Series (3rd edition).*
- P. Brockwell and R. Davis: *Introduction to Time Series and Forecasting.*
- P. Brockwell and R. Davis: *Time Series: Theory and Methods.*
- A.C. Harvey: *Time Series Models.*
- P. Diggle: *Time Series: a Biostatistical Introduction.*

All of these books are available in the University of Toronto library system. The second book by Brockwell and Davis is very useful if you are interested in understanding more fully the theory behind time series analysis.

Prerequisites: STA302H (or equivalent) is listed in the calendar as a prerequisite for STA457H1S. If you do not have this prerequisite, you should see the undergraduate coordinator in the Department of Statistical Sciences to obtain a waiver form. Graduate students enrolled in STA2202H1S are exempt from this prerequisite but should be familiar with regression analysis before taking this course.

Evaluation: The main emphasis of the course will be the application of time series methods; however, a solid knowledge of some basic statistical theory is also necessary to understanding the rationale behind the methodology. The course grade will be made up of 3 parts: homework assignments (30%), midterm exam (30%) and a final exam (40%).

- Homework assignments will involve both data analysis and theory problems. Two assignments will be handed in before the midterm and two after.

- Students enrolled in STA2202H1S will typically be required to do some additional work on the homework assignments as well as on the final exam.
- The midterm exam is scheduled for Monday February 29; the exam times and location will be announced later. If this exam is missed due to illness or any other circumstances (with appropriate documentation), the weight from the midterm will be carried over to the final exam.
- The final exam will be held during the April exam period at a date and time to be announced later.
- **Students should familiarize themselves with the University's policieson academic integrity, which can be found at `www.artsci.utoronto.ca/osai/students`.**

Computing: We will use the software package R extensively in this course both for data analysis as well as some numerical computation. R is free software and can be downloaded (for Windows, Mac, and Linux operating systems) from `cran.utstat.utoronto.ca`. Of interest to many of you will be RStudio, which provides a very nice environment for using R; information on RStudio (including downloads) can be found at `www.rstudio.com`.

A useful book that gives a good introduction to R programming is

A First Course in Statistical Programming with R by Braun and Murdoch (Cambridge University Press)

The textbook for this course also provides a lot of examples of R code as will the handouts for the course.

Syllabus: There are two basic approaches to time series analysis: time domain and frequency domain. Many time series analysis books emphasize one approach, most commonly the time domain approach, often to the exclusion of the other, usually because the intended audience; statisticians and econometricians tend to favour the time domain approach while engineers favour the frequency domain. Unfortunately, a very distorted view of time series sometimes results from an overemphasis on one approach. This course will attempt to present both approaches on an equal footing; the main goal of the course is to gain an appreciation of the issues involved in the analysis of time series. The order in which topics are covered will be roughly as follows:

1. Basic descriptive methods: correlogram, partial correlogram and periodogram; methods for removing trend and seasonality.
2. Theory of stationary stochastic processes, spectral decomposition, filtering and smoothing, time series models.
3. Identification of and estimation in time series models, tests for white noise, tests for "unit roots", forecasting, seasonal adjustment.
4. Spectral analysis, nonparametric and parametric spectral estimation.
5. Special topics as time permits: GARCH models, bivariate time series models, cointegration, incorporating time series structure into regression models, signal estimation.

UNIVERSITY OF TORONTO

TIME SERIES ANALYSIS STA457H1 S

COURSE OUTLINE

INSTRUCTOR: Jen-Wen Lin, Ph.D.
OFFICE HOURS/LOCATION: 05:20—05:55pm/SS6027, or by appointment
CLASS TIME/PLACE: Wednesday 6-9 pm, BA1130
EMAIL: uofttimeseries@gmail.com and jenwen.lin@utoronto.ca
TEACHING ASSISTANT:
(1) Boris Garbuzov, boris.garbuzov@mail.utoronto.ca (midterm test)
(2) Tianyi Jia, tianyi.jia@mail.utoronto.ca (tutorial)
(3) Xu Zhao, xzxu.zhao@mail.utoronto.ca (final exam)

COURSE DESCRIPTION

This course provides an introduction to time series analysis with finance applications. The techniques can also be applied to other disciplines. After finishing this course, students are expected to gain hands-on knowledge on how to analyze and model time series data. Topics in this course include fundamental concepts of time series, Box-Jenkins methods (ARIMA models), and multivariate time series analysis (transfer function model, co-integration, etc.), and State space model and Kalman filter.

WEIGHTING SCHEME

Students' marks in this course will be calculated using the following formula

$$Max\ (Scheme\ 1, Scheme\ 2),$$

where

1. Scheme 1: 40%×midterm score+60%×final score, and
2. Scheme 2: 40%×final score+60%×midterm score.

- If students miss the midterm test with a legitimate reason, his/her weight on the midterm test will be shifted to final exam.

TEXTBOOK

Shumway and Stoffer (2010), Time Series Analysis and Its Applications: With R Examples (Springer Texts in Statistics)

TUTORIAL SESSION

- Teaching assistant: Tianyi Jia, tianyi.jia@mail.utoronto.ca
- Date and Topic

Date	Day of the week	Time	Lecture topic
Jan 25	Monday	2-4pm	Box-Jenkins approach
Jan 26	Tuesday	2-4pm	Box-Jenkins approach
February 08	Monday	2-4pm	Midterm practice
February 09	Tuesday	2-4pm	Midterm practice
February 22	Monday	2-4pm	Office hour
February 23	Tuesday	2-4pm	Office hour
March 14	Monday	2-4pm	TFN and VAR
March 15	Tuesday	2-4pm	TFN and VAR
April 04	Monday	2-4pm	Final practice
April 05	Tuesday	2-4pm	Final practice

- Location: TBA