Math 461
Time Series Analysis
Lectures: MWF, 10:00-11:00, Mallinckrodt 302
Washington University in St. Louis, Fall 2017

Instructor: José E. Figueroa-López

- Office: Cupples I 203A, Phone: (314)935-7539.
- Office hours: MW 4:10 - 5:00 p.m., F 3:10-4:00, or by appointment.
- e-mail: figueroa@math.wustl.edu (Put "MATH461" as the subject when you email me).

Background Information and Motivation

An understanding of time series models and an ability to analyze time series data are fundamentally important skills for any statistician. These skills are particularly important for students interested in economic or financial data, but the concepts and techniques are broadly applicable in any field where data consists of observations made over time. Such data is characterized by a particular type of dependence structure, and require special models and tools. It is often of interest to predict future values of relevant variables based on the present and past values, or in response to an intended policy change. In the time series setting, this is known as forecasting. This course will introduce the concepts and applied tools for the analysis of time series data and will better prepare you for careers which involve statistical modeling and data analysis.

Course Topics

Generalities of time series and Exploratory Data Analysis: data types, trend, seasonality, nonstationarity and stationarity; Time-series in the time domain and autocorrelation; autoregressive integrated moving average (ARIMA) models; model selection methods; forecasting; frequency domain and spectral analysis; State-Space Models and Kalman Filter; Nonlinear time series; multivariate time series. More advanced topics if time allows it.

References

- The Analysis of Time Series. An Introduction. C. Chatfield, 6th Edition, Chapman & Hall. (**Required**).
- Time Series Analysis and Its Applications (with R examples). R.H. Shumway and D.S. Stoffer, 4th Edition, Springer. (**Required**). Available for free download on SpringerLink through our library.
- Introduction to Time Series and Forecasting. P.J. Brockwell and R.A. Davis, Second Edition, Springer. (**Recommended**). Available for free download on SpringerLink through our library.
- Time Series Analysis With Applications in R. J.D. Cryer and K. Chan. (**Recommended**). Available for free download on SpringerLink through our library.

Prerequisites:

Math 493 and either Math 3200 or 494; or permission of the instructor. Some programming experience in R is useful but not essential.

Course website:

All homework assignments, handouts, and other information will be available on **Blackboard** (http://bb.wustl.edu/).

Exams:

- **One midterm exam** and **a comprehensive final** will test your grasp of the material covered in class. The date for the midterm exam is (tentatively) set as Friday **Oct. 20**. The final is scheduled for **Dec. 20, 1:00 - 3:00 p.m.**
- All exams are close-notes and close-book. A one-sided letter-sized page with **only formulas/equations** may be brought to the midterm. Two one-sided pages with formulas can be brought to the final. These notes would be collected (make copies).
- Exam questions can be done by hand with the help of a basic scientific (non-graphing) calculator.
- You should always bring your Washington University Photo ID to exams. Proctors will check student's IDs.
- Make-up exams are strongly discouraged. If you are aware of a conflict, please inform the instructor before the exam.

Homework

- There will be about 8 HWs; Only a few selected problems will be graded and counted towards your HW score.
- The lowest HW score will be dropped;
- Written homework should be submitted at the BEGINNING of class. NO LATE HOMEWORK WILL BE ACCEPTED.
- You will receive no credit for solutions with no work or justifications. The grader and instructor reserves the right to deduct points for messy papers.
- While it is acceptable to briefly discuss individual assignments among students, the student's work that is turn in for grading must reflect his/her understanding of the material ("almost" identical solutions will not be tolerated).

Final Project

In a team setting, students will develop a final project. Each team will present the topic in class and write a team report, both of which will be done during the final week of classes. The topic would be chosen by the students in collaboration with the instructor. This could be based on a research paper or an in depth exploration of an advanced topic related to the course. The topic should be chosen after the midterm or even earlier.

Tentative grading procedure (The following is tentative; any changes will be announced in advanced.)

- The final letter grade is given according to the following scale:

$[95, 100]$	A+	$[83, 85)$	B+	$[65, 75)$	C
$[87, 95)$	A	$[77, 83)$	B	$[60, 65)$	D
$[85, 87)$	A-	$[75, 77)$	B-	< 60	Fail

- Weights:

Midterm Exam	30%
Final Exam	35%
Homeworks	22%
Final Project	13%

- If you register for "Pass/Fail" (or "Credit/No Credit"), you must achieve at least 65 to pass, which is the lowest score for a C.

Attendance:

Class attendance is **strongly** recommended. Experience has shown that students who attend class regularly perform better.

Important Regrading Policy:

Students have only one week to request the regrading of an assignment or an exam after the time that this has been returned to the class.

Further Information About Computing

- R is a free, open-source software package/programming language for statistical computing. Students are required to use R to complete all assignments. R is a free software that can be downloaded from **http://cran.r-project.org/**. It works under major operating systems, including Windows, Linux and Mac OS.
- Many students and other R users prefer to have a prettier interface. One popular user interface is RStudio. This is purely for aesthetics; it is not necessary for anything we will do in R. You can download RStudio for free from http://www.rstudio.com/.
- R **Markdown** (from RStudio) is also another interface to work with R. It would allow you embed your R code and the calculations it produces, in ordinary text. It can also contain figures and equations, etc. Usage R Markdown for your assignments is encouraged. If you use it, you need to submit both your "knitted" file (HTML or PDF, not Word), and the original .Rmd file.
- In case, you choose not to use R Markdown for your HW assignments, you need to submit both a readable write-up, in PDF, and a raw text file containing your R code. Please, commented so that it is clear which pieces of code go with which problem.
- **More R Help Resources are provided in the course's website on Blackboard**

I hope you will enjoy this course. Have a nice semester.