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Statistics 8281-10: Advanced Time Series Analysis Fall, 2021

6:10 - 8:40 Wednesdays

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Course Description: This class offers an introduction to time series methods from both a theoretical and applied perspective. Topics to be discussed in this class are: exploratory techniques for time series (autocorrelations, periodogram, etc.); time series regression models; Autoregressive Moving Average (ARMA) models; Box-Jenkins methodology; forecasting in time series; seasonality; diagnostics of time series models, and state-space models (Kalman filter/smoother). Special topics include Bayesian approaches, hidden Markov models, ARCH-GARCH and stochastic volatility models. The methodology will be illustrated with the analysis of different data sets arising in the context of the physical sciences, psychology, economics and finance, etc.

Prerequisite(s): Mathematical Statistics (STAT 6201/6202) or equivalent. Previous experience with linear regression (STAT 6214/2218) and statistical computing is a plus but not required.

Required Text: *Time Series Analysis and Its Applications* by Shumway & Stoffer, 4th Edition

Reference Texts: *Time Series: Theory and Methods* by Brockwell & Davis, 2nd Edition *Introduction to Time Series and Forecasting* by Brockwell & Davis, 2nd Edition

Course Objectives: At the completion of this course, students will be able to apply time series methods (AR, MA, ARMA, ARCH-GARCH models) to analyze data, interpret the fit of a time series models, perform diagnostics to the fit, use the model to obtain predictions and make inferences on the data. Students will also be able to identify the limitations of time series methods in certain situations and suggest alternative strategies.

Grading: HW Assignments 30%; Midterm Exam 30%; Final Exam and/or Project 40%.

Homework Assignments: Homework will be assigned about every other week. Late assignments will not be accepted. Students are expected to write up their own solutions to all assigned problems. If two homework submissions are very similar, students may be questioned about their solutions.

- **Midterm Exam:** The exam will be given during class time. The date of the midterm is on the class schedule.
- **Final Exam:** In accord with university policy, the final exam will be given during the final exam period and not the last week of the semester. The exam will be cumulative (by nature of the subject) with more of a focus on material covered after the midterm.
- **Project:** Students will complete a data analysis project using the statistical methods discussed in class. Students will locate their own data to analyze and will give a project proposal, present in-class and submit report.

Computing:

- We will use R for analysis. Please download the R software online at: <http://www.r-project.org/>. Short introductions to R and tutorials for R can be found via a simple Google search. If students have trouble finding a tutorial please let the instructor know and they will be provided.
- We will be using Rstudio as a front end for R. Please also download Rstudio (after you download R). It should automatically locate and link with the installation of R you have on your machine. If you have any trouble please let me know.

Academic Integrity:

I personally support the GW Code of Academic Integrity. It states: Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information. For the remainder of the code, see: <http://www.gwu.edu/~integrity/code.html>.

Support for Students Outside the Classroom:

DISABILITY SUPPORT SERVICES (DSS)

Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Marvin Center, Suite 242, to establish eligibility and to coordinate reasonable accommodations. For additional information please refer to: <http://gwired.gwu.edu/dss/>

UNIVERSITY COUNSELING CENTER (UCC) 202-994-5300

The University Counseling Center (UCC) offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include: crisis and emergency mental health consultations, confidential assessment, counseling services (individual and small group), and referrals. Please see: <http://gwired.gwu.edu/counsel/CounselingServices/AcademicSupportServices>

Security:

In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, then evacuation procedures for the building will be followed. After evacuation, students should seek shelter at a predetermined rendezvous location.

University Policy on Religious Holidays:

- Students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance;
- Faculty should extend to these students the courtesy of absence without penalty on such occasions, including permission to make up examinations;

- Faculty who intend to observe a religious holiday should arrange at the beginning of the semester to reschedule missed classes or to make other provisions for their course-related activities.

Blackboard:

All students are required to register for the course in Blackboard, the GWU web-based instructional resource. Course information and materials, including homework assignments and grades will be posted there. It is the students responsibility to check the Blackboard website frequently for up-to-date information.