Time Series Analysis - ISYE 6402

Instructor:
Dr. Nicoleta Serban
Office: 438 Groseclose, ISyE
E-mail: nserban@isye.gatech.edu
Office Hours: Tuesday 4-5pm

Instructor Assistant:
E-mail:
Office: , Main building, ISyE
Office Hours: Wednesday 4-5pm

Class Schedule
9:35 am - 10:55 am Tuesday and Thursday (IC 215)

Class Email isye6402a@mail.isye.gatech.edu
Questions and replies for homework assignments, exams, etc. will be submitted via class email.

Class Web Address https://t-square.gatech.edu
Most of our class material will be submitted via class email including
- Course syllabus
- Slides of class notes
- Homework assignments and solutions
- Your course grades

Honor Code For any questions involving Academic Honor Code issues, please consult me, my teaching assistants, or www.honor.gatech.edu.

Course prerequisites: A sound familiarity with undergraduate or graduate statistics and probability.

Textbook: The course material will be based on a set of slides being prepared by the instructor, but two primary textbooks are highly recommended:


Other recommended books:


What students will learn in this course?

By the end of the this class, students will learn standard time series analysis topics such as univariate ARMA/ARIMA modelling, state-space models, (G)ARCH modeling, forecasting, model identification and diagnostics and multivariate time series. Students will be given fundamental grounding in the use of some widely used tools, but much of the energy of the course is focus on individual investigation and learning. Active participation in the class is very important. This
class is more about the opportunity for individual and team discoveries than it is about mastering a fixed set of techniques. **What activities will the course involve students in to help them practice and demonstrate their learning?**

**Midterms:** There will be two midterm exams with problems reviewing the material (lectures and assignments) provided in this course throughout the full semester. The exams are close notes (including homeworks) and books but a two (one-sided) pages with formulas will be allowed. The midterms are designed to help students grasp standard time series methodology which will further facilitate a deeper understanding in the application context. Integration of methodological and applied statistics is essential to a rigorous data analysis.

- **Dates:**
  - Midterm 1: February 17th
  - Midterm 2: April 7th

**Assignments:** Assignments will include both theoretical and computer problems; the latter problems will ask you carry out analysis of data sets and simulations using computer software. Keep in mind that you should not hand in raw computer output. Conclusions and interpretation of results are more important than good printouts. These assignments are intended to help you prepare for the midterm exams and final project. You are allowed (and encouraged) to work together with other students on homework, as long as you write up and turn in your own solutions. You are also allowed (and encouraged) to ask me questions, although you should try to think about the problems before asking. Late Homework will not be accepted.

**Project:** This project is a requirement you must fulfill in order to pass this course. The general goal of the project is to provide you with experience in applying time series theory to real data. For this project, you and your team must find a data set on your own. The data cannot be a data set found in a textbook or been analyzed in detail and results published. This project will serve as a means for students to demonstrate what they understand and can do with the content of the course. There will be an oral presentation of the project (≈ 15 minutes). In grading, I will primarily look for a sensible approach to the problem, and clearly-made connections between your analyses and the substantive questions. You can use any computing equipment and any computing resources in the school, any written source material you can find, in or out of the school. However, replicating results which have been already published without referencing to the source of publication is subject to plagiarism. Plagiarizing is defined by Websters as “to steal and pass off (the ideas or words of another) as one’s own : use (another’s production) without crediting the source.” Be sure to document carefully your project work.

- **Deadline to submit an abstract of the project:** March 3rd, 2010.
- **Deadline to submit the project work (report and presentation):** April 28th, 2010.
- **Class presentation dates:** April 21st, April 26th and April 28th.

**How will students be evaluated?**

The course will be letter graded. The grade for the course will be based on two midterms, a final project that will be presented in class, and assignments during the semester - Midterm 1 25%, Midterm 2 25%, Project, presentation and class participation: 35%, Assignments: 15%.

The final project grade is 40% the presentation grade and 60% the report grade. The presentations and the reports will be graded by students in this class. Each project team will assign grades
for all the presentations including its own presentation. The average over all the team grades will be the presentation grade. Each team will be in charge of reading and grading two or more reports. The report grade will be a weighted average between students’ grade and the instructor grade. Please refer to grading guidelines documents.

**Objectives:** A tentative list of specific topics in this course is as follows:

**Part 1: Introduction**
1. Review of Basis Statistical Concepts
2. Trend and Seasonality
3. Autocovariance and Autocorrelation Functions
4. Linear Processes
5. Prediction for a Stationary Time Series

**Part 2: ARMA models**
1. Exploratory Analysis using ACF and PACF
2. Parameter Estimation
3. Residuals and Diagnostics
4. ARIMA models: Forecasting
5. ARIMA models: Unit root non-stationarity tests
6. Seasonal Models: SARIMA

**Part 3: Multivariate Time Series Analysis**
1. Weak Stationarity and Cross-correlation
2. Vector Autoregressive (VAR) Models
3. Structural VAR Models

**Part 4: Nonlinear Models**
1. The ARCH Model
2. The GARCH Models
3. High-Frequency Data

**Part 5: State-Space Models**
1. State-Space Representation for an ARMA model
2. Prediction and the Kalman Recursion
3. The Gaussian Likelihood
4. Generalized State-Space Models
5. The Particle Filter