Time Series Analysis - ISYE 6402

Instructor: Dr. Nicoleta Serban

Course description:

An introduction to commonly used time series analysis models along with implementation of the models within data examples using the R statistical software.

Course prerequisites:

A sound knowledge about undergraduate or graduate statistics, and regression analysis but also basic programming proficiency, linear algebra and basic calculus.

Honor Codes and Student Conduct:

All course participants (instructor, teaching assistants, staff and learners) are expected and required to abide by the policies of the Georgia Tech Academic Honor Code, and the Student Conduct expectations (http://www.policylibrary.gatech.edu/student- life). Keep in mind:

- Ethical behavior and personal integrity are extremely important in all facets of life.
- Learners are responsible for completing their own original work. **If external resources outside of the course material are to be used, they need to be referenced properly. Lack of reference is a violation of the honor code.**
- Any course participant found in violation of the Georgia Tech Academic Honor Code and/or the Georgia Tech Student Conduct expectations will be subject to any/all consequences listed.

Communication:

Course updates will be sent through the piazza platform on Canvas. Please contact your instructor, teaching assistants, and fellow learners via piazza.

- The course will host a class discussion forum using piazza. Feel free to ask questions and respond to other students' questions to the best of your knowledge. Participation in the discussion forum is recommended but it is not mandatory. Often, discussions with fellow learners are the sources of key pieces of learning.
- We will send announcements about course changes through piazza. Check the piazza forum at least twice weekly for course schedule and/or assignment updates. You are responsible for staying abreast of these changes. Avoid missing deadlines and assignment rework by keeping updated through piazza.
- Communicate with instructors, teaching assistants and fellow learners using your name as listed in the student roster. E-communication can be less constructive or less thoughtful than in-person communication. When someone does not introduce himself or herself, it is easier to be less respectful. To avoid sensitive situations, we are asking everyone to post in piazza with their name. Posts made by Anonymous profiles will not be responded to.
- Please search piazza for your question prior to posting a new one as it may already be answered.
- Instructors and teaching assistants may not be able to address all piazza communications, so we encourage fellow learners to respond to posts. If there is a delay in instructor or teaching assistant response, please be patient and know there may not be a response if we are in a week with heavy volume and/or if the question has already been addressed in a

different post.
- Overall, the discussions will be supervised and monitored by teaching assistants under instructor's guidance.

Netiquette:

Netiquette refers to etiquette that is used when communicating on the Internet. Review the Core Rules of Netiquette.

- When you are communicating via email, discussion forums or synchronously (real-time), please use correct spelling, punctuation and grammar consistent with the academic environment and scholarship.
- *In Georgia Tech's MS in Analytics program, we expect all participants (learners, faculty, teaching assistants, staff) to interact respectfully. Learners who do not adhere to these expectations may be removed from the course.*

Recommended Textbooks:

Three textbooks are highly recommended:

1. Brockwell, P.J. and Davis, R.A. (1991), *Introduction to Time Series and Forecasting*, Springer-Verlag, New York.
2. Shumway, R.H., Stoffer, D.S. (2006), *Time Series Analysis and Its Applications (with R examples)*, Springer-Verlag, New York.
3. Tsay, R.S. (2005), *Analysis of Financial Time Series*, 2nd Edition, Wiley Series in Probability and Statistics.

What students will learn in this course?

By the end of this class, students will learn standard time series analysis topics such as modeling time series using regression analysis, univariate ARMA/ARIMA modelling, (G)ARCH modeling, Vector Autoregressive model along with forecasting, model identification and diagnostics. Students will be given fundamental grounding in the use of some widely used tools, but much of the energy of the course is focused on individual investigation and learning. Active participation in the class is very important. This class is more about the opportunity for individual discovery 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?

- **Homework Assignments:**
  There will be eight assignments, including four assignments focusing on solidifying the concepts through T/F and multiple choice questions and four assignments focusing on data analysis using the R statistical software. These assignments are intended to help you better understand the course material and to prepare for the midterm exams and the final exam. You are allowed (and encouraged) to ask questions about the assignments and collaborate with fellow learners, although you will have to think through potential solutions on your own and submit your own solutions. Do **NOT consult any prior homework solutions or online providing suggested solutions to the homework assignments. It is important to use the homework assignments to practice with the course material and to prepare for the exams. Read carefully all our communication on Honor Code!**

- **Midterm Exams:**
  There will be two midterm exams with problems reviewing the material (lectures and assignments) provided in this course. The exams are designed to help students grasp standard time series analysis methodology, which will further facilitate a deeper understanding in the application context. The exams are open-book since they mainly focus on data analysis although T/F and multiple choice questions will also be included. Please read carefully the Open-Book Policy below.

  Open-Book Policy:
  What we mean by open-book is that students are allowed to refer to course class material, including lectures and homework assignments, any material provided in the course. Open-book includes any notes you may have stored on your computer on the course topics. Only one computer is allowed during exams. Open-book in this course does not include access to the internet, or communication by any means. Use of the internet and/or communication with anyone during the exam will be subject to the Georgia Tech honor code and conduct policies/actions (https://www.policylibrary.gatech.edu/student-life)

- **Final Project:**
  The general goal of the final project is to provide you with experience in applying time series analysis methodology to real data. For this project, you and/or your team will select one of the topics provided for the final project and write a progress and a final report on the analysis of the selected topic. This project will serve as a means for students to demonstrate what they understand and can do with the course material, but it is also recommended to go beyond that. The course material provides fundamentals of time series analysis, however there is much more that you could build on these fundamentals. In grading, we will primarily look for a sensible approach to the problem, and clearly-made connections between your analyses and the substantive questions to be addressed within the project topic. 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 Webster's 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 and cite any external materials you may use.

How will students be evaluated?

The course will be letter graded. The grade for the course will be based on the two midterm exams, a final exam, and assignments during the semester - Midterm 1: 20%, Midterm 2: 25%, Final: 35%, Assignments: 20%.

Course Topics and Schedule:

Please see accompanying documents on Course Outline and Course Schedule.
Technology/Software Requirements:
- Internet connection (DSL, LAN, or cable connection desirable)
- R statistical software (free download; see cran.r-project.org)
- Adobe Acrobat PDF reader (free download; see https://get.adobe.com/reader/)