STAT 551: Time Series Analysis

Instructor: Petrutza C. Caragea

Course Outline and Information, Fall 2009

Objective: This class will introduce you to the theory and methods of time series analysis. Although the emphasis will be on practical modeling and prediction techniques for data collected sequentially in time, the theory of covariance-stationary stochastic processes will also be developed (this is the mathematical basis for the aforementioned techniques). Both time and frequency domain methods will be discussed.

Prerequisite: STAT 542 or STAT 447. Equivalently, a multivariate calculus-based course in probability theory covering expectation and moments, random variables and vectors, multivariate distributions, elementary limit theorems, basic statistical methods—point estimation, hypothesis testing, regression, and some matrix algebra.

- Meeting times: TTh 11:00-12:20 p.m. in Pearson Hall, Room 1106
- Contact information: Office: 2409 Snedecor Hall, Phone: 294-5582. email: pcaragea@iastate.edu (ALWAYS include ”Stat 551” in the Subject of your email related to class) Course URL: www.public.iastate.edu/~pcaragea/stat551 Office hours: After class, Thursday 3-4 p.m. and by appointment.
- TA: Lawrence Mosely email: lmosley@iastate.edu; Office hours: Tuesday 2-3 p.m., Wed. 10-11 a.m. in Snedecor 3414
- Computing: We will use R: a language and environment for statistical computing. The class web site contains information on how to install R and how to get started.

- Topics Outline:
  - Introduction and examples.
  - Stationary and non-stationary time series.
  - Estimation and removal of trend and seasonality, testing an estimated noise sequence.
  - Stationary processes, linear processes, introduction to ARMA processes, properties of the sample mean and autocorrelation function.
  - Forecasting time series.
  - ARMA models. ARIMA models. Transfer and Intervention models.
  - Introduction to spectral theory and linear filtering. Spectral densities of ARMA processes.
  - Special topics (as time permits): state space models and Kalman filtering, multivariate time series, ...
- **Computation:** The language used in this class is R, which has the advantages that it is available at no cost and includes easily obtained modules that perform many of the basic computations needed for practical time series analysis. Although previous experience with R is not required, I will not have much time to spend on basic programming instruction. I strongly encourage you to read the material posted on the web site and practice on your own if you don’t have much experience with this statistical package. There is no lab associated with this class.

- **Assignments:** There will be regular assignments throughout the semester (anywhere between 4 and 10). You are allowed to consult with your colleagues while working on the homework, but the write-up has to be done individually. We will accept no late homework, so plan ahead and submit them on time. I will announce the collection times with every homework. They may vary, depending on the length of the assignment.

- **Class project:** You will be required to prepare a final project at the end of the semester. You will be provided specific instructions on what is expected of you within three weeks from the start of the semester. The project will be an application of the material learned in class applied to a data set found by you. You will need to submit a proposal for the project describing the data set and the questions to be addressed by the end of October (exact date to be announced.) The project will be turned in before the end of the semester and presented orally. Submission times, project and presentation guidelines will be posted on the course web site ahead of time.

**WE WILL RESERVE SEVERAL CLASSES AND THE FINAL EXAM TIME FOR PROJECT PRESENTATIONS, DEPENDING ON HOW MANY PROJECTS WILL BE PRESENTED. OUR FINAL EXAM DATE IS TENTATIVELY SCHEDULED FOR MONDAY, DECEMBER 14, FROM 9:45 TO 11:45, BUT THIS IS STILL SUBJECT TO CHANGE. YOU WILL NEED TO ATTEND ALL PRESENTATIONS, SO PLEASE MAKE SURE YOU DO NOT MAKE ANY TRAVEL PLANS UNTIL THE FINAL EXAM DATE IS FINALIZED BY ISU.**

- **Exams:** There will be one in class mid-term exam, tentatively scheduled to take place on Thursday, October 15.

- **Class participation:** There will be ample opportunities to participate in our class discussions, prepare and conduct paper discussions, implement and present results for algorithms discussed in class.

- **Grade formula:** Exam (30%); Project (30%); Homework (35%); Class participation (5%).

Guaranteed minimum final grade: A ≥ 94 ≥ A− ≥ 90 ≥ B+ ≥ 87 ≥ B ≥ 83 ≥ B− ≥ 80 ≥ C+ ≥ 77 ≥ C ≥ 73 ≥ C− ≥ 70 ≥ 94 A; ≥ 90 A−; ≥ 87 B+; ≥ 83 B; ≥ 80 B−; ≥ 77 C+; ≥ 73 C; ≥ 70 C−.

- Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. If you have a disability and anticipate needing accommodations in this course, please contact your instructor (P. Caragea) within the first two weeks of the semester. Retroactive requests for accommodations will not be honored. Before meeting with your instructor for this class (P. Caragea), you will need to obtain a SAAR form with recommendations for accommodations from the Disability Resources Office, located in Room 1076 on the main floor of the Student Services Building. Their telephone number is 294-7720.