Math 545L: Introduction to Time Series
Spring 2019

Instructor: Stanislav Minsker, KAP 406E [email: minsker@usc.edu]
Grader: to be announced
Classroom: KAP 163, time: MWF 9 – 9:50am
Office hours: Monday 1-2pm, Wednesday 2-3pm, or by appointment.

General Information

This course is a graduate-level introduction to the theory and methods of the analysis of time series data. We will focus primarily on the "time domain" analysis of such data, but will touch upon the "frequency domain" analysis toward the end of the course. In addition to understanding the mathematics of the methodology, we will see applications to real data sets through examples and data analysis assignments.
Course information, assignments, selected solutions, and grades will be posted on Blackboard.

Prerequisites

Knowledge Multivariable Calculus, Probability Theory, and Linear Algebra at the level of MATH 225, MATH 226 and MATH 208.

List of covered topics

- Time series as stochastic processes, including
  - stationarity
  - Gaussian processes
  - the multivariate normal distribution
- Hilbert spaces, including
  - the projection theorem
  - linear regression
  - best linear prediction in $L^2(\Omega, \mathcal{F}, P)$
- ARMA(p, q) processes
- Prediction of stationary processes, including
  - ARMA processes
  - Gaussian processes
- Estimation of the mean and autocovariance functions
- Estimation for ARMA models, including
  - Maximum likelihood
  - Least squares
- Model building and forecasting with ARIMA processes, including non-stationary time series

Assignments

Homework will be assigned about every other week, in the form of problem sets and data analysis problems. Data assignments can be performed with your favorite software, including R (recommended), Matlab, and Python.

Important note: assignments should be turned in at the beginning of the lecture on the due date – no credit will be given for assignments turned in any other way unless specified otherwise. If you can not attend the lecture, please contact me in advance and explain the reason.

Exams

Two midterm exams will take place during the lectures on Wednesday, February 20, and Friday, April 5. The final exam is on Friday, May 3, 8-10am, in KAP 163 (our usual classroom). The final exam will be comprehensive, with the emphasis on the material covered after the second midterm.

Grading Grades will be based on 20% assignments, 25% midterm exams (each) and 30% final exam. Grades will be computed on the following scale: $[90\%, 100\%] = A$, $[85\%, 90\%) = A-$, $[80\%, 85\%) = B+$, $[75\%, 80\%) = B$, $[70\%, 75\%) = B-$. Adjustments could be made based on the overall class performance (meaning that it could become easier to get an A, not harder).

Please see the registration calendar for additional information, including the last day to drop the course: http://classes.usc.edu/term-20161/calendar/.

Textbook and useful references

Required textbook: *Time Series – Theory and Methods*, 2nd edition, by Brockwell & Davis will be our main reference for the class, and problems will be assigned out of it. Our goal will be to cover chapters 1-3, 5, and 7-9 of the book.

Another book by Brockwell & Davis, "Introduction to Time Series and Forecasting", can be used as a complementary source of information as it explains some topics in a less technical way.

A reference for performing time series analysis in R is *Introductory Time Series with R* by Copertwait & Metcalfe. The book by Copertwait & Metcalfe and the second book by Brockwell & Davis are *not* required. Additional references will be provided whenever necessary.

Students Requiring Special Accommodation

Any student requesting academic accommodations based on special needs is required to register with DSP each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to the instructor as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. till 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect ones own academic work from misuse by others as well as to avoid using anothers work as ones own. All students are expected to understand and abide by these principles. The Student Guidebook contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in

Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.