Statistics 207
Introduction to Time Series Analysis

Instructor: Raja Velu, rvelu@stanford.edu
Office: Sequoia Hall
Office Hrs: 10:30 - 12:00 pm T Th (By appointment only)

Duration: June 20th - Aug 11th, 2016
Class Time: 9:00-10:20 am T Th
Class Room: Hewlett 101

Office Hrs: 10:30 - 12:00 pm T Th (By appointment only)

Prerequisite: Basic Statistics Course in the level of 200


TAs: TBD

Course Description:
Data in the form of time series arise in various social and physical sciences. The increasing interest in time series analysis in recent years results from its wide spread applicability as a tool for modeling dynamic systems and forecasting and controlling the behavior of the outputs of such systems. This course is intended to present the basic models, methods and concepts of time series analysis to students with a good background in statistics. Some elementary knowledge of basic linear regression analysis would also be helpful. The presentation will be balanced between theory and data analysis, with sufficient theory to understand the basis of the methods and models. Development and assessment of models and forecasts in practical applications will be emphasized. Case studies will be drawn from business and economics, engineering, meteorology, etc., and data will be analyzed by students using existing computer programs (R, Matlab, etc.).

Topics to be covered include stationary stochastic processes; descriptive tools such as autocorrelation, partial autocorrelation, cross correlation; Box-Jenkins autoregressive integrated moving average (ARIMA) models, intervention models; model selection procedures that involve identification, estimation and diagnostic checking of time series; outlier detection ;time series regression analysis with auto correlated errors, dynamic regression models and transfer function models; Theory of prediction and forecasting; State-space model forms and Kalman filtering and smoothing methods, nonlinear and conditional heteroskedastic time series models, and long memory and fractional ARIMA models. Multiple time series analysis; co-integration, testing for unit roots etc. Due to time constraint, some topics, such as statistical methods in the frequency domain, may not be covered in depth.

Grades:
Your grade will be based on the following:

- Assignments 120 points (due 7/7/16, 7/14/16, 7/21/16, 7/28/16, 8/4/16)
- Final Projects 80 points (due 8/9/16)
- Exam 100 points (due 8/11/16)
- Total 300 points
Homework:
There will be five assignments, each consisting of several problems from the text and from other sources. These assignments will be done individually or in teams of two. Each member of the team should do all the assigned problems and then meet as a group to decide on what to submit. Some of the assignments may be done by hand, but most require the use of a computer. The computer output should be submitted on 8-1/2” by 11” paper and should be clearly annotated. Late assignments will NOT be accepted.

Project:
You must complete a class project on a team or individual basis. You should submit a written report on a project of the team’s choosing by Thursday, 8/9/16. The report should not exceed ten pages and should be in a format presentable to a scientist. Some attributes of a well-designed project are:

1. It is of interest to the team members.
2. There are no existing reports or articles that answer your questions.
3. The questions can be addressed using methods learned in the class.
4. The entire project can be done in approximately 40 person hours (for a two-person team).

An initial one-page proposal indicating the questions and the sources of data must be approved by Thursday, 7/21/16.

Computer Software: We will use R, which is available for free download (http://www.cran.r-project.org/).

Tentative Schedule:

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<th>Week of</th>
<th>Topic</th>
<th>Text Chapters</th>
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<td>June 20th</td>
<td>Course Overview, Characteristics of Time Series,</td>
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<td>Time Series Regression</td>
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<td>June 27th</td>
<td>ARIMA Models</td>
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<td>July 7th</td>
<td>ARIMA Models</td>
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<td>July 11th</td>
<td>Spectral Analysis / Filtering</td>
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<td>July 18th</td>
<td>Nonstationary, Garch models, etc.</td>
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<td>July 25th</td>
<td>Transfer Function Models</td>
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<td>Vector Time Series, Cointegration</td>
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<td>Aug 1st</td>
<td>State-Space Models</td>
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<td>Aug 8th</td>
<td>Methods for Frequency Domain</td>
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- Stanford University Academic Honor Code:
  http://www.stanford.edu/dept/vpsa/judicialaffairs/guiding/honorcode.htm

- Students who need any special consideration due to any sort of disability should visit the Student Disability Center(http://www.stanford.edu/group/DRC/)