Statistics 510 - Applied Time Series Analysis

Spring 2017

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Textbook: *Time Series and Its Applications With R Examples, 3rd Ed.*, by R. Shumway and D. Stoffer

Penn State Library has an electronic version of our textbook freely available for download. You may search for Shumway and Stoffer and download the pdf files at http://link.springer.com.ezaccess.libraries.psu.edu.

Statistical Software: R: Go to http://cran.r-project.org/bin/windows/base/ to download R for free. There are also a few R GUI's available that may be of interest if you are new to R, R Studio for example. If you are unfamiliar with R (or need to brush up), please take some time to follow through the introduction: https://onlinecourses.science.psu.edu/statprogram/node/50. If you wish, you can use other programs such as Minitab or SAS, but the main support given in the class notes and assignments will be for R.

Prerequisite: Stat 462 or Stat 501 or Stat 511

Course Webpage: Canvas: https://psu.instructure.com

Course Outline

- Lessons 1-5 (*Note*: No Classes January 16.):
  - Modeling univariate time series data with Autoregressive and Moving Average Models (denoted as ARIMA models, sometimes called Box Jenkins models).
  - Tools for model identification, model estimation, and assessment of the suitability of the model.
  - Using a model for forecasting and determining prediction intervals for forecasts.
  - Smoothing methods and trend/seasonal decomposition methods. Smoothing methods include moving averages, exponential smoothing, and Lowess smoothers.
- Exam 1 (February 13 - 19)
- Lessons 7 -13 (*Note*: Spring Break March 5 - 11.):
  - Analyzing the frequency domain - Periodograms, Spectral Density, Identifying the important periodic components of a series.
  - Relationships between time series variables, cross correlation, lagged regression models
  - Intervention Analysis (before/after analysis of a time series to assess effect of a new policy, treatment, etc.)
  - Longitudinal Analysis and Repeated Measures Models for comparing treatments when the response is a time series.
  - Vector Autoregressive Models for Multivariate Time Series
  - ARCH Models for changing variation and periods of volatility in a series
  - Fractional Differencing (ARFIMA)
  - Threshold Models
- Exam 2 (April 24 - May 1)

Homework
There will be 13 weekly homework assignments. Each Monday, the following week's module will be posted within the Canvas Modules, giving you the option to stay a little ahead of schedule. The lesson module will provide a link to the online notes and the week's homework assignment. The course notes are publicly available online and contain your reading assignment, an overview of the week's lesson, the week's learning objectives, and course notes.

Answers to the homework assignment for a week will be due 6 days later, on the following Sunday by midnight EDT/EST as appropriate. You will upload answers (in a Word or pdf document) to the designated Canvas Drop box in the Lesson Module. This procedure will also hold for the two midterms. (Late homework will not be accepted without a proper University approved excuse and your lowest homework grade will be dropped.)

My teaching assistant will grade the assignments within 48 hours after the due date. In order to receive credit for homework, all assignments must include *how* an answer is obtained, not just the numerical solution. You will receive an e-mail when your score and comments are available for review in Canvas. You may view grades and comments by returning to the appropriate drop box and clicking on your submission.

Weekly Quizzes
There will be a short lesson quiz each week over the current material. The questions are similar to homework questions without data analysis. The quizzes are limited to 3 hours and are only available during the lesson week. You must take the quiz within the lesson week by the due date of the homework. (Late quizzes are not accepted and your lowest quiz grade will be dropped (11/12 quizzes count).)

Exams
There will be two exams. The exams will not require a proctor - they will essentially be homework for which you cannot get help. You will be given 6 or so days to complete the work on an exam. For the most part, the exams will be data analysis projects. Late exams will not be accepted without a proper University approved excuse.

Grades
The weekly assignments will count 35% of the course grade, the quizzes 20%, and the exams 45% (22.5% each). The final letter grading will follow the standard University guideline and is as follows:

F	D	C	C+	B-	B	B+	A-	A
0	60	70	77	80	83	87	90	93

All grades will be available in the Canvas grade book.

Code of Mutual Respect and Admiration
The Eberly College of Science Code of Mutual Respect and Cooperation (http://www.science.psu.edu/climate/code-of-mutual-respect-and-cooperation-1) embodies the values that we hope our faculty, staff, and students possess and will endorse to make The Eberly College of Science a place where every individual feels respected and valued, as well as challenged and rewarded.

Academic Integrity
All Penn State and Eberly College of Science policies regarding academic integrity apply to this course. Please consult the Penn State Academic Integrity Policy at http://www.science.psu.edu/academic/Integrity/index.html for details. Collaboration: You are expected to complete all assignments on your own. Academic dishonesty can lead to a failing grade or referral to the Office of Judicial Affairs Academic dishonesty includes, but is not limited to:

- cheating
- plagiarism
- fabrication of information or citations
- facilitating acts of academic dishonesty by others
- unauthorized prior possession of examinations

- submitting the work of another person or work previously used without informing the instructor and securing written approval
- tampering with the academic work of other students

The Eberly College of Science is committed to the academic success of students enrolled in the College's courses and undergraduate programs. When in need of help, students can utilize various College- and University- wide resources for learning assistance. /http://www.science.psu.edu/advising/success/
Examples: Any sharing of assignment solutions or answer keys via personal communication or websites other than those communications or web-based applications used as part of the course is not allowed. Copying from other students, copying from answer keys or solution sets or having tutors complete assignments for students is unacceptable. All of these are examples of academic dishonesty. The instructor will monitor the web for inappropriate posting of instructional materials.

Disability Services
Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at http://equity.psu.edu/ods/.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at http://equity.psu.edu/ods/guidelines). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

Attendance
This course will be conducted entirely online. There will be no set class meeting times, but you will be required to complete weekly assignments with specific due dates. Many of the assignments are open for multiple days, so it is your responsibility to complete the work early if you plan to travel or participate in national holidays, religious observances or University approved activities.

If you need to request an exception due to a personal or medical emergency, contact the instructor directly as soon as you are able. Such requests will be considered on a case by case basis.

This course abides by the Penn State Class Attendance Policy 42-27: http://senate.psu.edu/policies/42-00.html#42-27,
Attendance Policy E-11: http://www.psu.edu/oue/aappm/E-11.html,
and Conflict Exam Policy 44-35: http://www.psu.edu/ufs/policies/44-00.html#44-35.
Please also see Illness Verification Policy: http://studentaffairs.psu.edu/health/welcome/illnessVerification/,
and Religious Observance Policy: http://www.psu.edu/oue/aappm/R-4.html.
Students who miss class for legitimate reasons will be given a reasonable opportunity to make up missed work, including exams and quizzes. Students are not required to secure the signature of medical personnel in the case of illness or injury and should use their best judgment on whether they are well enough to participate in class or not; the University Health Center will not provide medical verification for minor illnesses or injuries. Other legitimate reasons for missing class include religious observance, family emergencies, and regularly scheduled university-approved curricular or extracurricular activities. Students who encounter serious family, health, or personal situations that result in extended absences should contact the Office of Student and Family Services for help: http://studentaffairs.psu.edu/familyservices/. Whenever possible, students participating in University-approved activities should submit to the instructor a Class Absence Form available from the Registrar's Office: http://www.registrar.psu.edu/student_forms/, at least one week prior to the activity. (Note: This form is currently only available online as a PDF).

In case of weather-related delays at the University, this online course will proceed as planned. I will inform you if there are any extenuating circumstances regarding content or activity due dates in the course due to weather delays. If you are affected by a weather-related emergency, then please contact the instructor at the earliest possible time to make special arrangements.