Spring 2020 University of Akron
3470: 577 Time Series Analysis

Time and Place: TTh 4:15 - 5:30pm CAS108
Instructor: Dr. Nao Mimoto
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Email: nmimoto@uakron.edu
Office Hours: TTh 1:00-3:00 and by appointment
Course Web Page: https://nmimoto.github.io/477/
Prerequisite: 3470:450 or 451 or 461 or equivalent or permission of instructor

Main Textbook: Cryer (2008) Time Series Analysis. 2nd Ed. Springer. (Available from UA library web. Link on the course web page.)

Other Textbooks:
Links to textbooks are listed in the course web page.

Shumway (2011) Time Series Analysis and its Applications with R examples. Springer.
Cowpertwait (2009) Introductory time series with R. Springer.
Brockwell (2002) Introduction to Time Series and Forecasting. 2nd ed. Springer.
Hyndman (2009) Forecasting: Principles and Practice. Otexts.com

Course Description: Stationarity. ARIMA modeling with seasonality. Parameter estimation, model diagnostics and forecasting. Regression with autocorrelated errors. Cointegration and Multivariate ARMA models. Heteroscedasticity and Long-memory models.

Learning Objectives: Student completing this course will be able to understand fundamental concept of Time Series Analysis such as autocorrelation, and weak stationarity assumption. Students also learns how to apply those concepts in analyzing time series data, such as determination of the presence of autocorrelation, extraction of trend, fit ARMA models, and perform stationarity transformation.

R software: This class uses statistical software R. It is a free software that can be downloaded from http://www.r-project.org/ and installed on your PC/Mac/Linux. Each lecture, theoretical findings and statistical properties discussed will be demonstrated using R.

Class Web Page: Lecture slides, sample R code, Homework assignments and other class materials/announcements will be posted on the course web page listed above.

Attendance: You are expected to attend all meetings of the class. If you miss a class for whatever reason, you are responsible for all covering materials, assignments and deadlines.

Homework: Four homework sets will be assigned throughout the semester and will be collected in class. Some homework may be online (Brightspace). Emphasis will be on the conceptual and theoretical aspects of various time series models.

In-class modeling assignments: There will be two ``Lab'' days around the middle of the semester, in which students will model and forecast given time series using the software R. Instructor's help will be available on site. This is intended to bring all students up to pace with R coding necessary for time series analysis.

Modeling assignments: Student will be given real-life datasets and asked to demonstrate various model fitting and forecasting techniques, as well as to show understanding of their theoretical implications and limitations within a practical context. Students will submit a written report with R code and figures.

Final Project: As group of three or less, students are expected to complete final project, which analyzes the real time series dataset taken from online data repository using what they have learned in this course. Dataset may be Financial/Economic, Hydrological/Climate, or other type. Students will submit written report of the analysis of their findings and give 10min presentation in the last week of the semester.

Grading Scale: Grading is based on homework and exam scores according to the below grading scheme. Student must complete the final exam in order to receive a grade. If a student scores better than 10/15 on the final Exam (without partial credits), the student will receive automatic 1/2 grade bonus. (B to B+, B+ to A-, etc.)

- Homework (4) 25%
- In-class Assignments (2) 25%
- Modeling Assignments (2) 30%
- Final Project 20%

A (100 - 90%), B (89 - 80%), C (79 - 70%), D (69 - 60%)

A plus/minus grade may be assigned if a student's total fall just below one of the cut-offs.

Tentative Course Outline:

Week

1. Autocorrelation and Stationarity
    - Concept of week and strong stationarity. ACF and sample ACF.
2. Trends
    - Deterministic Trends vs Random Trends. Random walk with and without drift.
3. Autoregressive Models (Assignment 1 due)
    - Parameter estimation. Stationarity condition. Causal representation.
4. Moving Average Models (Assignment 2 due)
    - Parameter estimation. Stationarity condition. Inverted representation.
5. ARMA model (Assignment 3 due)
    - Stationarity condition.
6. Integrated ARMA model (Assignment 4 due)
    - Box-Jenkins methodology. Indication for over-/under-differencing.
7. Review (In-Class project 1)

8. Seasonal Model
    - SARIMA model, Test for presence of seasonal component.
9. Regression With Correlated Errors (In-Class project 2)
    - Deterministic trend with covariates. ARIMAX model.
10. Heteroscedasticity
    - Identification, Generalized autoregressive heteroscedastic model.
11. Structural Stability (Modeling Project 1 due)
    - Parameter consistency. Identification and hypothesis test.
12. Cointegration
    - Concept of cointegration. Granger method.
13. Vector AR Models and Long-Memory Time Series. (Modeling Project 2 due)
    - Long-range dependence and fractal integrated models.
14. Spectral Analysis
    - Spectral representation of autocovariances. Fourier Transformation.
15. Final Project Presentation

Important Dates:

- Jan 19 - Last day to add without signatures
- Jan 26 - Last day to add
- Jan 26 - Last day to drop without “WD”
- Mar 01 - Last day to drop

Academic Honesty: The Department of Statistics and Probability adheres to the policies of academic honesty as specifies in the General Student Regulations 1.0, Protection of Scholarships and Grades, and in the All-University of Integrity of Scholarship and Grades which are included in Spartan Life: Student Handbook and Resource Guide. Student who plagiarize will receive a grade 0.0 on the assignment.

ADA: Any student who feels he/she may need an accommodation based on the impact of a disability should contact the Office of Accessibility at (330) 972-7928.
The office is located in Simmons Hall room 105. Their web page can be viewed at http://www.uakron.edu/access/.

Disclaimer: The instructor reserves the right to make any changes he considers academically advisable. Changes will be announced in class and on the course web site. It is your responsibility to keep up with any changed policies and assignments.