IE 48B Special Topics in Time Series Analytics
Fall 2021

Type:	Departmental Elective
Credits/ECTS:	3 Credits / 6 ECTS
Class/Laboratory/PS schedule:	Monday (13:00-14:50) Thursday(09:00-10:50)
Instructor:	Mustafa Gökçe Baydoğan
	Office: M4082 (mustafa.baydogan@boun.edu.tr)
	Office Hours: By appointment
Teaching assistant:	İlayda Çelenk (ilayda.celenk@boun.edu.tr)
Course website:	http://moodle.boun.edu.tr/

Course Description:
Analysis on large time series databases has received considerable interest over the past decade as time series data has increased in applications from different domains such as medicine, finance, multimedia, etc. The significant amount of time series available in different fields requires a systematic and analytical approach to identify relations, detect anomalies, select the most important information and anticipate major events.

Following topics are covered:

1. Theoretical foundations (i.e. type of time series, time domain, frequency domain, univariate and multivariate time series, categorical time series, mixed variable types)
2. Time series representations (i.e, feature extraction for describing time series data, data-adaptive, non-data adaptive and etc.)
3. Time series similarity measures (i.e. dynamic time warping, longest common subsequence)
4. Tasks involving time series
    - Classification
    - Regression: forecasting, survival models
    - Advanced time series decomposition (i.e. empirical mode decomposition, independent component analysis)
    - Change point / Anomaly/ Outlier detection

Reference Books:

- *Time Series Analysis and Its Applications, With R Examples*, Shumway, Robert H., Stoffer, David S,, third edition, Springer
- *Data mining in time series databases*, Last, Mark, Abraham Kandel, and Horst Bunke. Vol. 57. World scientific, 2004.
- *An Introduction to Statistical Learning with Applications in R*, Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, Springer, NY, 2013
  (available online: http://www-bcf.usc.edu/~gareth/ISL/)

About the course:
Time series analytics is a rapidly evolving topic that is at the intersection of several disciplines, including statistics (e.g., time series analysis), temporal pattern recognition, temporal databases, optimization, visualization, high-performance computing, and parallel computing. It is concerned with automatic discovery of interesting regularities or relationships which in turn lead to better understanding of the underlying processes in the case of ordered data streams with temporal interdependencies. The focus will be mainly on modeling time series data for different time series analytics tasks.

Lectures will be held online through live zoom sessions. The sessions will also be recorded so that you can go over relevant material later. Class attendance is very important and strongly encouraged. Office hours will also be held online by appointment.

Software Use: We will be using R as the main statistical tool. You will be submitting your homework and project online as an HTML file) on Github (Markdown, https://www.markdownguide.org/, language will be used).

Topics covered:

Topic	Topic
1 (1 week)	Introduction
2 (2 weeks)	Theoretical foundations
3 (3 weeks)	Time series representations
4 (2 weeks)	Time series similarity measures
5 (4 weeks)	Time series analytics tasks

Grading Criteria:

5 Homework (5% each), Class Project (20%), Midterm (25%), Final Exam (30%).

Exams will be held in-class if possible. Otherwise it will be in the form a take-home exam.

Requirements:

- Knowledge of R or Python
- As part of a group, you will be asked to present homework or examples.
- Class attendance is very important and strongly encouraged.
- Academic integrity is expected. Your work is to be your own.

Prepared by, and date of preparation: Mustafa Gökçe Baydoğan, September 2021