Predictive Models for Time Series Analysis

A Hands-On Course

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IN SUPREMÆ DIGNITATIS 1343
UNIVERSITÀ DI PISA

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Classes

- Introduction & Preprocessing - 01/04/2025 - 09-13
- Distances, Approximation & Global Features - 03/04/2025 - 9-13
- Classification & Regression Part 1 - 07/04/2025 - 14-18
- Classification & Regression Part 2 - 10/04/2025 - 09-13
- Forecasting - 15/04/2025 - 09-13
- In-class Project - 17/04/2025 - 09-13

Syllabus

- **Time Series Preprocessing**
  - Time Series, Datasets and Problems
  - Missing Values and Anomalies
  - Normalizations
  - Time Series Components
  - Stationarity

- **Distances, Approximations & Global Features**
  - Euclidean Distance
  - Dynamic Time Warping
  - Piecewise Aggregate Approximation
  - Symbolic Aggregate approXimation
  - Discrete Fourier Transformation
  - Symbolic Fourier Approximation
  - Singular Value Decomposition
  - Principal Component Analysis
  - Global Structural Features

- **Classification & Regression**
  - Instance-based Models
  - Linear Models
  - Tree-based Models
  - Shapelet-based Models
  - Dictionary-based Models
  - Deep Learning-based Models
  - Kernel-based Models
  - Ensemble-based Models

- **Forecasting**
  - Simple Forecasting Methods
  - Exponential Smoothing
  - Autoregressive Methods
  - Forecasting via Reduced Regression
  - Deep Learning-based Models
  - Probabilistic Forecasting

Exam - TSA Project

- The project starts the last lecture.
- Objective: accomplish a TSA task in the best possible way showing different approaches the problem and justifying every choices.
- A PDF report with images and tables of maximum 10 pages (min font 11pt) summarizing the analytical workflow designed and followed.
- The code/notebooks to realize the project.
- The project must be submitted within 7 days from the last lecture.
- **Deadline 24/04/2025**

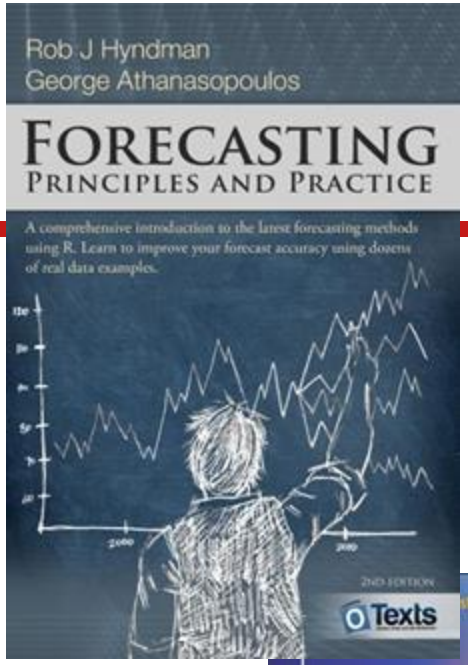
Laboratory

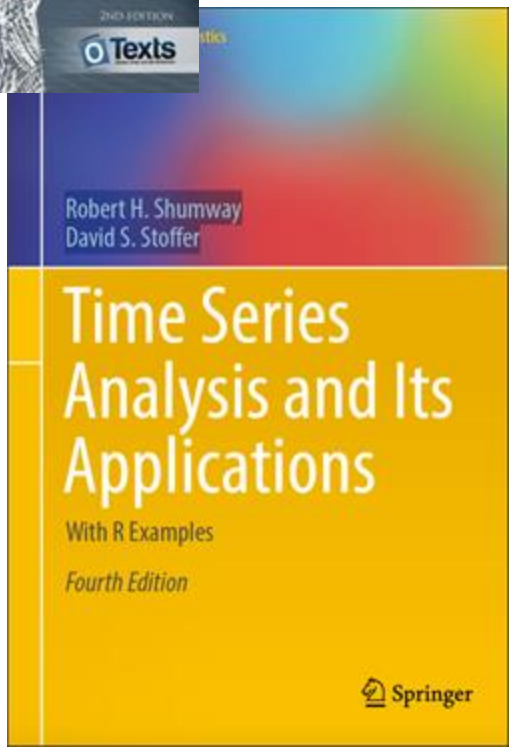
ANACONDA®

SKTIME

tslearn

Material & Resources





- Forecasting: Principles and Practic. Rob J Hyndman and George Athanasaopoulus. (https://otexts.com/fpp2/)
- Time Series Analysis and Its Applications. Robert H. Shumway and David S. Stoffer. 4th edition.(http://www.stat.ucla.edu/~frederic/415/S23/tsa4.pdf)
- Time Series Analysis in R (https://s-ai-f.github.io/Time-Series/)
- Introductory Time Series with R. Michaela A. Kratofil (https://michaela-kratofil.com/files/2009_Book_IntroductoryTimeSeriesWithR.pdf)
- Mining Time Series Data. Chotirat Ann Ratanamahatana et al. 2010. (https://www.researchgate.net/publication/227001229_Mining_Time_Series_Data)
- Dynamic Programming Algorithm Optimization for Spoken Word Recognition. Hiroaki Sakode et al. 1978.
- Experiencing SAX: a Novel Symbolic Representation of Time Series. Jessica Line et al. 2009
- catch22: CAnonical Time-series CHaracteristics selected through highly comparative time-series analysis Carl H Lubba et al. 2019.

Questions?

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Let’s start!