TIME SERIES ANALYSIS

Bachelor in Data and Business Analytics BDBA SEP-2023
TSA-DBA.2.M.A

Area Others

Number of sessions: 20

Academic year: 23-24

Degree course: SECOND

Number of credits: 3.0

Semester: 1º

Category: COMPULSORY

Language: English

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Dr Ibáñez has a PhD in Applied Computational Statistics from Lancaster University (UK); MSc in Mathematical Engineering from Universidad Carlos III (Spain), and Ingeniero Superior en Geodesia by Universidad Politécnica de Madrid (Spain)

Currently he is Chief Data and Analytics Officer at Wecity, CDO and founder of Real Estate AI; and lecturer in Data Science for several institutions in Madrid: IE, AFI y UCJC. Recent roles are CDO for Atresmedia , CDO for Urban Data Analytics, Academic Director at AFI, and previously head in analytics for multinational companies like Orange, SAS or Accenture.

The office hours will be carried on online and under demand (email) of the student.

SUBJECT DESCRIPTION

Time series analysis comprise methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data.

Time series analysis and forecasting are one of the most applied data science techniques in business, finance, engineering, logistic, etc.

Examples of time series include the continuous monitoring of a person's heart rate, hourly readings of air temperature, daily closing price of a company stock, monthly rainfall data, and yearly sales figures. It has a well-established theoretical grounding in statistics and dynamic systems theory.

This course introduces the most important methods to model time series data: Decomposition, Exponential Smoothing and ARIMA models

LEARNING OBJECTIVES

The main objective of this course is to provide students with a working methodology and a solid knowledge on the use of times series analysis in business. At the end of the course; students should be able to:

- Be able to differentiate statistical models for independent observations and for observations with temporal correlation.
- Identify patterns in correlated data—trends and seasonal variation.
- Understand and model time-series data; with Exponential Smoothing and ARIMA models.
- Understand and use the most important algorithms.
- Design the best methodology for each tipe of time series data (e.g.: financial, hierarchical sets of time series, seasonal, etc.)
- Use tools as: ACF, PACR, CCF, Stationarity test, etc.

The emphasis will be on methods that are replicable and testable, and practical examples.

TEACHING METHODOLOGY

Learning Activity	Weighting	Estimated time a student should dedicate to prepare for and participate in
Lectures	40.0 %	30.0 hours
Discussions	0.0 %	0.0 hours
Exercises in class, Asynchronous sessions, Field Work	26.67 %	20.0 hours
Group work	6.67 %	5.0 hours
Individual studying	26.67 %	20.0 hours
TOTAL	100.0 %	75.0 hours

PROGRAM

SESSION 1 (LIVE IN-PERSON)

TS Compared to other domains of statistics

- Example case with automatic forecasting of multiple time series, with different
- models, and evaluating errors of each model
- Install R packages and ensure everyone has a proper installation
- Homework:
    - Time Series in R - tibbles and tsibbles
    - Solved exercises

SESSION 2 (LIVE IN-PERSON)

Time Series Graphs

- Create a proper timeplot with good grid resolution
- Learn about seasonal plots, seasonal subseries plots…

- Scatterplots and non-linearities…
- Homework exercises

SESSION 3 (LIVE IN-PERSON)

Time Series Graphs

- Autocorrelation
- Why are lagged variables important, what is a lagged variable
- Relationship with scatterplots
- Identify trend, seasonal patterns
- Formula
- Partial Autocorrelation
- Homework exercises

SESSION 4 (LIVE IN-PERSON)

Time Series Decomposition

- Additive vs Multiplicative schemes
- Moving average
- Transformations to even out variance (multiplicative to additive)
- Logarithmic and Box-cox transformation
- STL Decomposition. Adjustment of windows
- Exercises as homework

SESSION 5 (LIVE IN-PERSON)

Benchmark Methods and general syntax of fitting models

- Naive, Seasonal Naive, ETS, Forecasting with decomposition.

SESSION 6 (LIVE IN-PERSON)

Practical Exercises with R

Simple Exponential Smoothing Models

SESSION 7 (LIVE IN-PERSON)

Double Exponential Smoothing Models.

Triple Exponential Smoothing Models

SESSION 8 (LIVE IN-PERSON)

Double Exponential Smoothing Models.

Triple Exponential Smoothing Models

SESSION 9 (LIVE IN-PERSON)

AR and MA Models.

Practical Exercises with R

SESSION 10 (LIVE IN-PERSON)

AR and MA Models.
Practical Exercises with R

SESSION 11 (LIVE IN-PERSON)

ARMA Moldes
Stationary time Series, transformations and Integrarion

SESSION 12 (LIVE IN-PERSON)

ARMA Moldes
Stationary time Series, transformations and Integrarion

SESSION 13 (LIVE IN-PERSON)

ARIMA Models.
Seasonal SARIMA Models

SESSION 14 (LIVE IN-PERSON)

ARIMA Models.
Seasonal SARIMA Models

SESSION 15 (LIVE IN-PERSON)

Automatic selection of ARIMA models

SESSION 16 (LIVE IN-PERSON)

Modelling time series with complex seasonality

SESSION 17 (LIVE IN-PERSON)

Practical Exercises with R

SESSION 18 (LIVE IN-PERSON)

Practical Exercises with R

SESSION 19 (LIVE IN-PERSON)

Practical exercises with R

SESSION 20 (LIVE IN-PERSON)

GROUP PROJECT PRESENTATION

EVALUATION CRITERIA

criteria	percentage	Learning Objectives	Comments
Final Exam	60 %		Practical R
Intermediate Tests	20 %		Multiple Choice test
Group Presentation	20 %		Group project

RE-SIT / RE-TAKE POLICY

BIBLIOGRAPHY

Compulsory

- Hyndman, R J & Athanasopoilos, G. (2021). *Forecasting Principles and Practice.* 3. oText. ISBN 0987507133 (Digital)

Recommended

- Peter J. Brockwell, Richard A. Davis. *Introduction to Time Series and Forecasting.* Springer Texts in Statistics. ISBN 9783319298528 (Printed)

BEHAVIOR RULES

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