

SYLLABUS

QM412E_0101_25

Time Series Analysis

ACADEMIC AREA	: SUPPLY CHAIN MANAGEMENT AND INFORMATION SYSTEMS
PROGRAMME	: MASTER DAIS
PERIOD	: SPRING
COORDINATOR	: Mr. Amine LAHIANI
INSTRUCTOR(S)	: Mr. Amine LAHIANI
CONTACT HOURS	: 15 hours
STUDY TIME	: null hours (Class preparation, homework and assessments)
CREDITS	: 2.0 ECTS

PRE-REQUISITE MODULES :

Basic Statistics: Understanding of core statistical concepts such as mean, variance, correlation, and probability distributions, essential for analyzing temporal data variations.

Probability: Knowledge of probability to comprehend stochastic models and the variability in time-dependent data.

Linear Algebra: Familiarity with matrix and vector manipulation, which is fundamental for multivariate time series models.

Programming Skills: Proficiency in a programming language, usually Python or R, for data manipulation, model application, and visualization of time series results.

These foundational skills prepare students for engaging with models like ARIMA, exponential smoothing, and advanced machine learning approaches for time series forecasting.

MODULE DESCRIPTION :

Time series refer to any variable collected/measured at different points in time. The objective of this course is to present the mathematical and statistical tools to analyze such data. Students are expected to have basic knowledge of R and Python.

These techniques are essential to many fields including financial data, supply chain, retail etc.

CONTRIBUTION TO PROGRAMME LEARNING OBJECTIVES :

- Leverage the economic, ecological, social performance of the firm and its operations to Change Business models #ChangeBusiness

MODULE INTENDED LEARNING OUTCOMES (ILOs) :

1. Know the different techniques used in Business and Management to analyze time series.
2. Know how to use time series techniques to make forecasts using R./ Python
3. Know how to evaluate the performance of forecasting techniques.

TOPICS COVERED :

1. Introduction to Time Series Visualization and Analysis using R /Python
2. Time Series Components and Decomposition
3. Stationarity and Autocorrelation
4. ARIMA Models for Time Series Analysis

5. Time Series Regression Models and Advanced Topics / Machine

RESEARCH-LED TEACHING :

I have published more than 70 papers in the field of Time Series Analysis including analyzing the complex relationships between time series data, modeling the dynamics of time series data, decomposition of time series data, Box-Jenkins modelling procedure, Forecasting of time series data. These papers were published in top Journals according to the CNRS and ABS rankings of journals.

CSR AND SUSTAINABLE DEVELOPMENT GOALS :

My research covered several SDG goals. In particular, I have worked on green and clean energy, renewable energy use and its impact on the air quality, the challenging relationship between economic growth and CO2 emissions, electricity consumption and pollution, energy use and climate change

CSR NB HOURS :

3

SUSTAINABLE DEVELOPMENT GOALS COVERED :

- 03 - Good health and well-being
- 07 - Affordable and clean energy

TEACHING METHODS :

Concept Presentation:

Lectures will introduce foundational concepts, supported by real-world examples to help students understand the significance of Time series Analysis.

Application through Real-World Projects: Students will work on practical projects in different business areas, applying techniques learned in class to solve real business problems in finance, marketing, and operations.

E-learning Platform: Use of an online platform for continuous assessment, self-paced exercises, and supplementary learning modules to reinforce concepts.

METHODS OF ASSESSMENT :

Continuous/Final	Group/Individual	Assessment	Weight	Duration	ILOs assessed
Continuous	Individual	Written assessment at home	60%		2. Know how to use time series techniques to make
Final	Group	Participation or task completion	40%		2. Know how to use time series techniques to make

Assessment 1 details:

The student will be asked to implement a time series method in R or Python in the form of an article. She/he will be provided with a starting paper and code to build upon.

Description:

Comprehensive final exam covering theoretical and practical applications of data science in business.

Content:

Includes problem-solving, case analysis, and questions on data ethics and CSR considerations.

Objective:

Evaluate the students' ability to apply learned concepts independently, demonstrate critical understanding, and solve complex business problems using data science.

Assessment 2 details:

Group Project Evaluation (40%)

Description:

Collaborative project where students analyze business data, build models, and derive insights for a business case, culminating in a presentation.

Objective:

Develop teamwork skills, apply data science methods in a practical context, and demonstrate understanding of business implications.

ACADEMIC INTEGRITY :

Academic misconduct encompasses various behaviors or actions that violate the principles of academic integrity, fairness, and honesty, thereby undermining the credibility of academic work, assessments, or research. Examples of academic misconduct include:

- Cheating
- Plagiarism
- Fabrication
- Gaining an unfair advantage
- Assisting others in committing academic misconduct, such as by utilizing generative AI
- Falsification of records or official documents
- Unauthorized access to restricted information or data
- Unauthorized or unethical use of generative AIS

Academic misconduct is a serious offense and can result in consequences such as module failure, research project failure, or even expulsion from the school. To prevent unintentional academic misconduct, it is essential to consult with your instructor to understand the specific rules and instructions pertaining to the use of AI in learning and assessment.

For more comprehensive information on academic integrity rules, principles, and disciplinary procedures, please refer to the Academic Integrity section of the Student Handbook.

BIBLIOGRAPHY :

1. Cryer J. D., Chan K-S (2010). Time Series Analysis: With Applications in R (Springer Texts in Statistics) 2nd Edition
2. Shmueli G., Lichtendahl Jr. K.C. (2024). Practical Time Series Forecasting with R. (3rd edn). Axelrod Schnall Publishers.
3. humway R. H. and Stoffer D. S. (2017). Time Series Analysis and its Applications: With R Examples. (4th edn). Springer. (<http://www.stat.pitt.edu/stoffer/tsa4/>) [eBook <https://bit.ly/3mAyt8u>]

Additional Reading

1. Hyndman, R. J. & Athanasopoulos, G. (2018). Forecasting: Principles and Practice. (2nd edn). Otexts. (Free online version at <https://www.otexts.org/fpp>).
2. Hamilton, J.D. (1994). Time Series Analysis. Princeton University Press. (Advanced Reference)
3. Hayashi, F. (2000). Econometrics. Princeton University Press. (Advanced)
4. Brillinger, D.R. (2001). Time Series: Data Analysis and Theory (2nd edn). Society for Industrial and Applied

MODULE PLAN SESSIONS :

Plan Session 01 :

1 / Introduction and Overview :

Introduction to Time Series Analysis

- Overview of time series analysis and its applications
- Introduction to R for time series analysis
- Importing, manipulating, and visualizing time series data in R / Python

Plan Session 02 :

2 / Time Series Data : Data Collection, Time Series Components, Visualizing Time Series, Interactive Visualization, Data Pre-Processing / Smoothing Methods : Moving Average, Differencing, Simple Exponential Smoothing, Advanced Exponential Smoothing, Extensions of Exponential Smoothing / Read relevant chapters from course textbook. Holts and Winters modelling

Plan Session 03 :

3 / Regression Models: Trend & Seasonality : Model with Trend, Model with Seasonality, Model with Trend and Seasonality / Read relevant chapters from course textbook.
Stationarity and statistical tests for stationarity.

Plan Session 04 :

4 / Time Series Data and Serial Correlation: Lags, First Differences, Logarithms and Growth Rates, Autoregression, Partial Autocorrelation
ARIMA models : Identification, Estimation, Validation and Forecasting.
Performance Evaluation : Data Partitioning, Naive Forecasts, Measuring Predictive Accuracy and Evaluating Forecast Uncertainty,
Advanced Data Partitioning: Roll-Forward Validation / Read relevant chapters from course textbook.

Plan Session 05 :

5 / Group Project Presentation:

Final presentation of group projects, showcasing data analysis, insights, and recommendations for business impact.