UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Introduzione alle Serie Storiche M

2425-1-F8204B012

Learning objectives

The course has two objectives:

1. to introduce students the fundamentals on linear models, regression and econometric methods for economic time series;
2. to introduce students to univariate time series analysis using 'classical' methods. In particular, the course will cover the topics of exploratory analysis for temporal data, component identification (trend, seasonality, cycle, and structural breaks), stochastic processes, SARIMA models, and regression models for time series data.
   The methodologies addressed above will be used on real data for the purpose of forecasting and interpreting economic phenomena and their patterns.
   The course contributes to the achievement of educational objectives in the learning area of the CdS: Economic Statistics and Econometrics.

Contents

The summary contents (macro-themes) of the course are as follows:

1. Insights and key concepts on economic time series
2. Introduction to stochastic processes for temporal data
3. Introduction to linear regression models (assumptions, estimation methods) with emphasis on temporal data
4. Exploratory analysis (EDA) for temporal data
5. Time series components and decomposition
6. SARIMA models

Detailed program

The detailed contents of the course are as follows:

1. Insights and key concepts on economic time series (taxonomy of time series concepts, observable and unobservable components)
2. Recalls on linear models and linear regression (Gauss-Markov Theorem, parameter estimation with OLSE/MLE, diagnostic tests and hypothesis violations)
3. Introduction to stochastic processes (definition, properties and examples) and recall of probability for time series: autocovariance functions and autocorrelation
4. Exploratory analysis (EDA) for time series: graphical analysis, indexes and tests on the characteristics of data, trend analysis (parametric and nonparametric linear models), seasonality analysis (harmonic regression), Box-Cox transformation and heteroschedasticity in time series
5. Stationarity, unit roots, ADF tests, differentiation
6. Classical decomposition of time series: additive and multiplicative models
7. Wold's theorem and genesis of AR, MA and ARMA processes.
8. Stationary processes and ARMA models: identification, parameter estimation, diagnostic tests, prediction theory
9. Integrated processes and ARIMA models.
10. Seasonal processes and SARIMA models.
11. Linear regression models with ARIMA errors (regARIMA).

Prerequisites

There are no formal prerequisites, but it is expected that the student possesses a minimum knowledge of descriptive statistics, probability calculus (random variables) and linear algebra (matrix calculus).

Teaching methods

The course provides 6 ECTS (CFU), corresponding to 42 hours sudvided as follows:

- In-presence frontal teaching (modalità erogativa) for theoretical content: about 30 hours
- In-presence laboratory class with R statistical software for the analysis of real case studies: about 4 hours
- Remote (syncro) laboratory class with R statistical software for the analysis of real case studies: about 8 hours

Assessment methods

Students will be evaluated by:

1. Development of an individual project covering most of the topics covered in the course. The case study on real empirical data should be coordinated (and periodically validated) with the lecturer. Weight: 50% of the final grade.
2. Individual Assignment in which each student must answer 2 theoretical questions drawn from a pool. The questions will be completed unsupervised (at home) and will then be commented on at the oral exam. Weight: 15% of the final grade.

3. Oral examination in which the project, assignment questions, and additional questions on the content covered in the course will be exposed. Weight: 35% of the final grade.

Textbooks and Reading Materials

1. Slides and further materials from the lecturer
2. Essential textbooks

- Theory (with same notation used in the slides) on time series: "Time series analysis - Univariate and Multivariate Methods" (William W.S., 2006), 2nd ed
- Applications with R and recall on theory: "Forecasting: principles and practice" (Hyndman and Athanasopoulos, 2018), 2nd or 3rd ed
- Linear regression and linear models: "Modello Lineare - Teoria e applicazioni con R" (Grigoletto et al., 2017), 1st ed

3. Adavanced textbooks

- "Time series analysis and its applications" (Shumway and Stoffer, 2017), 4th ed.

Semester

I semester, II cycle

Teaching language

Italian

Sustainable Development Goals

QUALITY EDUCATION