UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Economic Time Series Analysis

**2425-3-E4101B016**

## Learning objectives

The main aims of the course are two. The first one is to provide the students with a solid theoretical background in time series analysis. The second aim is to enable students to apply time series analysis to real economic datasets, using econometrics software packages. The most used software are R and Gretl.

## Contents

1. Overview

2. Stochastic processes

3. Linear projection and Wold’s decomposition

4. Stationary Time Series Models

5. Unit root test

6. Nonstationary Time Series Models

7. Box-Jenkins approach to model identification

8. Seasonal Time Series Models

9. Maximum likelihood estimation

10. Diagnostic Checking and Model Selection

11. Forecasting ARMA models

12. Traditional approach and deterministic components

13. Forecasting using the traditional approach

14. Time series decomposition methods

15. Advanced methods for seasonal adjustments using the traditional approach

## Detailed program

1. Overview

2. Stochastic processes: time series and Stochastic Processe, stationarity, the Autocovariance and Autocorrelation Functions, the Partial Autocorrelation Function , white Noise Processes , sample Mean, Autocovariances, and Autocorrelation, ergodicity

3. Linear projection and Wold’s decomposition

4. Stationary Time Series Models: autoregressive Processes, moving Average Processes, the Dual Relationship Between AR(p) and MA(q) Processe, autoregressive Moving Average ARMA(p, q) Processes

5. Nonstationary Time Series Models: nonstationarity in the Mean, deterministic Trend Models , stochastic Trend Models, ARIMA Models, Nonstationarity in the Variance and the Autocovariance, variance Stabilizing Transformations

6. Box-Jenkins approach to model identification

7. Seasonal Time Series Models : Traditional Methods and seasonal ARIMA Models

8. Conditional and unconditional Maximum likelihood estimation

9. Diagnostic Checking and Model Selection: residual analysis, Ljung-Box test, Akaike and Schwartz information criteria

10. Forecasting ARMA models : linear projection and optimal forecas, forecasting based on an infinite number of observations (Wiener-Kolmogorov filter, forecasting based on an finite number of observations

11. Time series regression

12. Unit root tests

13. Traditional approach for time series analysis: deterministic components, trend, cycle, seasonality and error

14. Brown, Holt and Holt-Winters prediction methods

15. X11 and similar methods for seasonality adjustments

## Prerequisites

Knowledge of the topics of Statistics I and II, Probability, Multivariate Statistical Analysis and Calculus II is recommended.

## Teaching methods

Traditional lectures will be accompanied by laboratory sessions to simulate and re-descover the main theoretical results. The students will practice both on time series simulated from different stochastic processes and on real economic time series.

## Assessment methods

The exam is written and oral, divided in two parts:

1. a written and oral test on the main theoretical topics of the course to assess the students' ability to formulate and demonstrate the theoretical foundations of ARIMA processes;

2. an applied part consisting in the analysis of a time series, the identification of the generating process and forecasting for a given period

## Textbooks and Reading Materials

WEI, William W. S. *Time series analysis, Univariate and Multivariate Methods*. Pearson Addison Wesley, Boston, last edition.

Zavanella, B. Analisi Classica Delle Serie Storiche, 2. ed.; CUESP: Milano, 1997.

Zavanella, B. Analisi Moderna Delle Serie Storiche, 2. ed.; CUESP: Milano, 1997.

## Semester

Second semester (third quarter)

## Teaching language

Italian

## Sustainable Development Goals

DECENT WORK AND ECONOMIC GROWTH