UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Spatial and Temporal Data Analysis

2223-2-E4102B086

Learning objectives

To introduce the students to the main statistical methodologies for the treatment of temporal and spatial data structures, from both theoretical and applicative points of view.

Contents

PART A - Temporal data analysis

- Forecasting univariate time-series through model in the ARIMA class
- Decomposition and forecasting through structural models with unobserved components (ETS, BATS/TBATS, UCM).
- Models with external regressors.
- Models for multivariate time-series (hints).
- Spectral analysis.
- Time-series cluster analysis.

PARTE B - Spatial data analysis

- Descriptive analysis of spatial data.
- Generating models for spatial data.
- Prediction of spatial data.

Detailed program

PART A. Temporal data analysis

- Time series: types, strucutre and examples
- Time-series components: Trend, Cycle, Seasonality and Innovation
- Finite variance and stationary stochastic processes: mathematical structure, autocovariance, autocorrelation and partial autocorrelation functions. Wold's theorem and ARMA representations.
- ARMA, ARIMA and SARIMA models for univariate time series: identification, estimation and validation.
- Forecasting through ARMA/ARIMA/SARIMA models.
- Decomposition and forecasting through structural models with unobserved components (ETS, BATS/TBATS and UCM). State-space form and the Kalman filter.
- Time-series models with external regressors
- Models for multivariate time series (hints)
- Time-series spectral analysis: spectrum estimation and linear filtering.
- Time-series clustering.

PART B - Spatial data

- Spatial data types.
- Spatial data visualization.
- Random fields and point processes.
- Spatial correlation.
- Spatial prediction and kriging.
- Spatial regression.

Prerequisites

There are no formal prerequisites, but basic knowledge of Mathematical Analysis, Linear Algebra and Statistical Inference is needed.

Teaching methods

Frontal lectures and practical/discussion sessions, supported by the use of social forums/channels.

Assessment methods

Oral exam.
There are no intermediate assessments.

Evaluation criteria:

1. Comprehension of the fundamental concepts.
2. Mastering basic techniques in time-series and spatial data modeling.
3. Topic coverage.
4. Capability to link the different parts of the program and to critically discuss and compare them.

Textbooks and Reading Materials

Lecture notes provided by the teacher

Semester

II semester, I cycle.

Teaching language

Italian

Sustainable Development Goals