Time Series Models

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The objective of the tutorial is to present discrete-time linear time series models for both univariate and multivariate dynamics. It will be devoted to the main model specifications, the derivation of their probabilistic properties and the analysis of the relevant inference methods regarding such modelings.

Tutorial 1: Definitions, concepts and some linear models

Stationarity is the basis of a general asymptotic theory for dependent processes. It ensures that an increasing sample goes with a same order increase of information. We propose to remind the definition of stationarity and introduce classic linear models. We will provide some examples of stationary and non-stationary univariate models. We will specify the concept of ergodicity through the estimates of the first and second order moment.

1. Stationary processes.
2. Standard time series models.
3. Moment estimation.

Tutorial 2: The ARMA model

The ARMA dynamic is a mix between an autoregressive and a moving average model and provides a parsimonious description of a stationary process. We propose to analyse causal and invertible ARMA models. Then the characterisation of the order ARMA order will be studied. We finally provide the estimation procedure of such model.

1. ARMA process: causality and invertibility.
2. ARMA p and q order.
3. Statistical inference.

Tutorial 3: Vector Autoregression model

We first analyse the autocorrelation of the Vector Autoregression (VAR) model and then focus on the prediction and estimation. Furthermore, we study the notion of cointegration and the long-term relationship between variables. The Granger causality will finally be of interest to characterize the forecasting ability of the variables.

1. Vector Autoregression.
2. Cointegration.
3. Granger causality.

References

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- Hamilton, J. D. (1994). *Time Series Analysis.* Princeton University Press.