# Multivariate time series

| Course title - Intitulé du cours | Multivariate time series |
|---|---|
| Level / Semester - Niveau /semestre | M2 / S1 |
| School - Composante | Ecole d'Economie de Toulouse |
| Teacher - Enseignant responsable | STEPHANE GREGOIR |
| Other teacher(s) - Autre(s) enseignant(s) | |
| Other teacher(s) - Autre(s) enseignant(s) | |
| Other teacher(s) - Autre(s) enseignant(s) | |
| Other teacher(s) - Autre(s) enseignant(s) | |
| Other teacher(s) - Autre(s) enseignant(s) | |
| Lecture Hours - Volume Horaire CM | 15 |
| TA Hours - Volume horaire TD | |
| TP Hours - Volume horaire TP | 0 |
| Course Language - Langue du cours | Anglais |
| TA and/or TP Language - Langue des TD et/ou TP | Anglais |

**Teaching staff contacts - Coordonnées de l'équipe pédagogique :**

stephane.gregoir@tse-fr.eu

Office: T509
Office hours: Monday 5.30-6.30 PM and by appointment

**Course's Objectives - Objectifs du cours :**

The objective of this course is to introduce the simultaneous modeling of a small set of time series mainly in a linear framework. Some non-linear models will be discussed. This type of modeling makes it possible to describe the dynamic relationships that exist between variables, to produce better forecasts by modeling them simultaneously and to construct structural analyses. To implement this approach, it is necessary to analyze the stationarity or integration and cointegration properties of data. The concepts and tools will be introduced in class and illustrated by practical exercises and implementations with different software.

At the end of the course, the student should be able to perform multivariate modelling (VAR, VECM, VARX,...) to describe the relationships between a small set of variables, to predict these variables and to test for some structural relationships they satisfy.

**Prerequisites - Pré requis :**

Univariate time series (Stationarity, ARMA modeling)

Intermediate econometrics (Least square estimators, maximum likelihood estimator, method of moments, test theory and practice)

**Practical information about the sessions - Modalités pratiques de gestion du cours :**

Laptops or tablets are accepted in class.

**Grading system - Modalités d'évaluation :**

Grading policy: 50% project; 50% final exam

**Bibliography/references - Bibliographie/références :**

H. Lütkepohl "New Introduction to Multiple Time Series Analysis" Springer

J. D. Hamilton "Time series analysis ", Princeton university

S. Johansen "Likelihood-Based Inference in Cointegrated Vector Autoregressive Models"

P.J. Brockwell and R.A. Davis "Introduction to Time Series and Forecasting"

E. J. Hannan "Multiple Times Series"

**Session planning - Planification des séances :**

1. Introduction : examples and motivation
2. Refresher on univariate time series and direct extension to multivariate time series
3. Unit Root tests
4. Spurious regressions; From Wold representation to the autoregressive representation
5. VAR estimation without constraints and under constraints
6. VAR models and their uses
7. VECM representation and estimation (one-step and two-step methods, cointegration tests, tests for linear constraints on the cointegration space)
8. Causality
9. Identification issues in VAR and VECM models