Summary

The objective of this course is to present the main tools of financial econometrics and to show their relevance for prediction, causality, shock propagation, signal extraction, risk measure and asset pricing.

Content

1- STOCHASTIC PROCESSES: Moments, Stationarity, Autocorrelation and Partial autocorrelation functions, Estimation of autocorrelation and partial autocorrelation functions
2- ARMA, ARIMA MODELS: Lag operator, Autoregressive processes, Moving average processes, ARMA processes, ARIMA processes
3- PREDICTION WITH ARIMA MODELS: General principles of prediction, Prediction in ARIMA models, Prediction function and pivotal values, Prediction intervals
4- INFERENCE IN ARMA MODELS: Estimation, Tests and confidence regions, Validation, Model selection
5- EXOGENEITY AND CAUSALITY: Definition based on probability distributions, Causality measures, Causality tests, Examples
6- VECTOR AUTOREGRESSIVE (VAR) MODELS AND RESPONSE FUNCTIONS; Multivariate processes, Definition of a VAR, Estimation and tests in a VAR, Causality, Shock propagation, Impulse response function, Variance decomposition, Structural shocks, Examples
7- STYLISED FACTS IN FINANCIAL TIME SERIES: Fat tails, Volatility clustering, Asymmetric response to shocks, Correlation of powers, Persistence, Co-volatility
8- UNIVARIATE ARCH-GARCH MODELS: Motivations, Different kinds of white noises, Definitions of ARCH and GARCH models, Stationarity, Coherence with stylized facts
9- GENERALIZATIONS OF UNIVARIATE GARCH MODELS: Regression models with GARCH errors, ARMA-GARCH models, GARCH-M models, Asymmetric response models
10- INFERENCE IN GARCH TYPE MODELS: Inference under conditional normality, Inference under conditional Student assumption, Semi-parametric approach, Examples
11- MULTIVARIATE GARCH MODELS: Constant Conditional Correlation (CCC) models, Dynamic Conditional Correlation (DCC) models, Asymmetric Volatility, Examples
12- KALMAN FILTER AND EXTENSIONS: Definition of a linear factor model, Kalman filter, Kalman smoother, Estimation and tests, Extended Kalman Filter of order 1, Extended Kalman Filter of order 2, Quadratic Kalman Filter
13- APPLICATIONS OF THE KALMAN FILTER: Value at Risk modeling, Multivariate Factor GARCH models, Stochastic volatility models
14- HIDDEN MARKOV CHAINS: Markov chains, Switching regime models, Kitagawa-Hamilton algorithm, EM algorithm, Coding, Parameterization of the transition matrix, Application to stochastic volatility models
15- DISCRETE TIME AFFINE PROCESSES: Laplace Transform, Affine processes, Examples, Multi-Horizon Laplace Transform, Application to asset pricing

Keywords

Econometrics, Finance
Learning Prerequisites

Required courses

Econometrics

Recommended courses

Introduction to finance

Important concepts to start the course

Basic linear algebra.
Basic probabilistic and statistical concepts.

Learning Outcomes

By the end of the course, the student must be able to:

• Elaborate a prediction program
• Assess / Evaluate existing estimation and prediction methods
• Formulate new estimation and prediction methods
• Propose risk measures
• Optimize signal extraction techniques
• Construct econometric pricing models
• Implement ARMA, GARCH, Stochastic Volatility models
• Exploit signal extraction algorithms (Kalman and Kitagawa-Hamilton filters)

Transversal skills

• Give feedback (critique) in an appropriate fashion.
• Demonstrate the capacity for critical thinking
• Use a work methodology appropriate to the task.

Teaching methods

Lectures and exercise sessions

Expected student activities

• Participate in lectures
• Participate in exercises sessions
• Solve the problem sets
• Write a midterm exam
• Write a final exam

Assessment methods

(M+2F)/3, F final exam, M midterm exam

Supervision
Office hours: Yes
Assistants: Yes
Forum: No

Resources

Bibliography
Frank C. and Zakoian J.M.(2010) :"Garch Model's , Wiley
Gourieroux C.

Ressources en bibliothèque
• Times Series Analysis / Hamilton
• Time Series and Dynamic Models / Gourieroux
• Econometric Asset Pricing Modelling / Bertholon
• GARCH Models / Francq
• Statistics and Econometric Model / Gourieroux

Prerequisite for
• Courses using statistical dynamic models