

FIN-407

**Financial econometrics**

Monfort Alain

Cursus	Sem.	Type
Financial engineering minor	E	Opt.
Financial engineering	MA2, MA4	Obl.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
<b>Hours</b>	<b>5 weekly</b>
Courses	3 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**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 AUTOREGRSSIVE (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-STYLISTED 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**

100% Final exam

**Supervision**

Office hours	Yes
Assistants	Yes
Forum	No

## Resources

### Bibliography

Hamilton, J.D.(1994):"Time Series Analysis" , Princeton University Press

Gourieroux C. and Monfort A.(1996):"Time Series and Dynamic Models" ,Cambridge University Press

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

Gourieroux C. and Monfort A,(1996): "Statistics and Econometric Models" ,(2 vol.),Cambridge University Press

Bertholon H.,Monfort A. and Pegoraro F. (2008): "Econometric Asset Pricing Modelling",Journal of Financial Econometrics ,4,407-458

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