

FIN-407

**Financial econometrics**

Gourier Elise Marie

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**

This course aims to give an introduction to the application of machine learning to finance. These techniques gained popularity due to the limitations of traditional financial econometrics methods tackling big data<sup>##</sup>. We will review and compare traditional methods and machine learning algorithms.

**Content**

## 1- Introduction to financial markets and financial time series

- Introduction to financial markets
- Some probabilistic tools to analyze financial time series
- Stylized facts of asset returns
- Introduction to option pricing

## 2- Introduction to machine learning in finance

- Goals of machine learning
- Applications of machine learning
- Timeline of machine learning
- Main types of algorithms
- Natural Language Processing

## 3- Supervised learning

- Regression
- Classification
- Feedforward neural networks

## 4- Time series models

- ARMA processes
- Vector AutoRegressive processes
- Heteroskedastic volatility models

## 5- State space models

- Kalman filter
- Extended and unscented filter
- Particle filter

#### 6- Unsupervised learning

- Clustering
- Factor analysis

#### 7- Advanced Neural Networks

- Recurrent Neural Networks
- Convolutional Neural Networks

#### 8- Project presentations

### Keywords

Econometrics, Machine Learning, 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 optimal methods for problems seen
- Optimize techniques / algorithms used
- Construct econometric models
- Implement financial econometrics traditional and machine learning algorithms
- Exploit information contained in data

### 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

Projects

### Expected student activities

- Participate in lectures
- Participate in exercises sessions
- Solve the problem sets
- Work on a project and present outcomes
- Write a final exam

### Assessment methods

(Project report+Project presentation+Exam)/3

### 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

Dixon M. F, Halperin I. and Bilokon P. (2020): "Machine Learning in Finance", Springer

#### Ressources en bibliothèque

- [Times Series Analysis / Hamilton](#)
- [Time Series and Dynamic Models / Gourieroux](#)
- [Machine Learning in Finance / Dixon](#)
- [GARCH Models / Frank](#)
- [Statistics and Econometric Model / Gourieroux](#)
- [Econometric Asset Pricing Modelling / Bertholon](#)

### Prerequisite for

- Courses using statistical dynamic models