FIN-407

Financial econometrics

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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
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly
Number of positions	

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##. 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 probalilistic 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 predicition 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 Univertsity 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