Syllabus

AUG
2018

Overview

This course is an introduction to high-frequency financial econometrics. Its focus is on understanding the core theory and applying its theorems to observed high-frequency financial data. Students will work with high-frequency data on different financial assets and create weekly project reports. The course is designed for students interested in obtaining a general understanding of high-frequency financial econometrics. See below for a list of topics.

Textbook

- Main Text: High-frequency Financial Econometrics by Ait-Sahalia and Jacod
- Secondary Text (Advanced): Discretization of Processes by Jacod and Protter

Readings

- Lecture Notes
- Papers from the literature (indicated in the lecture notes)

Prerequisites

- This course is intended for Duke MA and PhD students.
- Undergraduate econometrics or advanced statistics is required. Specifically, students should be comfortable with the notions of asymptotic approximations.
- Knowledge of Matlab is required. Students must have the latest version of Matlab installed, which is freely available via Duke OIT services.
- The following software packages can be learned over the semester: Python 3.x, TensorFlow, Bash and Git.

Grades

- Final grade will be based on weekly projects, a midterm and a final examination.
- Exams can be either 48-hour take home or in-class closed book with a note sheet allowed.
- Grade Division:
    - Projects: 35%
    - Midterm: 20%*
    - Final: 45%
- *If a student misses the midterm for any reason, then its weight is placed on the final examination. If

a student attempts the midterm but fails to turn it in, then this student's midterm score is recorded as zero.

Projects

- Projects will be assigned on a weekly basis.
- Problem sets are individual. Each student must do the entire problem set. This includes: writing your own code, making your own plots, interpreting the results, and preparing a pdf report with Latex.
- The best way to learn the contents of the course and obtain an excellent grade is to do the hard work yourself.
- Grading of Projects:
  - Projects are due by midnight of the announced due date. See schedule below for dates.
  - No late projects are accepted.
  - Grading is done on a 0-10 scale.
  - Projects with excessive overlap with other student's answers will receive a zero grade. Students must uphold the Duke Community Standard.

Schedule and Topics

The table below contains our schedule for the semester. Notice that the midterm and the final exam are already scheduled.

Tuesdays	Thursdays	Fridays	Topics of the Week
Aug 28th	**Aug 30th**	**Aug 31st**	
Lecture 1	Lecture 2	Project 1 Posted	Jump Diffusion Process Simulation LaTeX, Git
Sep 4th	**Sep 6th**	**Sep 7th**	
Lecture 3 In class lab 1	Lecture 4 Project 1 Due	Project 2 Posted	Implied Volatility Volatility Signature Matlab
Sep 11th	**Sep 13th**	**Sep 14th**	
Lecture 5 In class lab 2	Lecture 6 Project 2 Due	Project 3 Posted	Separating Jump Returns Truncated Variance Inference for IV

Sep 18th	**Sep 20th**	**Sep 21st**	
Lecture 7	Lecture 8 Project 3 Due	Project 4 Posted	Realized Beta Bootstrapping Local Variance Jump Regression
Sep 25th	**Sep 27th**		
Lecture 9 In class lab 3	Lecture 10 Project 4 Due		Variance Forecasting AR, HAR and RQ Models
Oct 2nd	**Oct 4th**		
Review Lecture Midterm Posted	Midterm Due Solution Discussion		
Oct 9th	**Oct 11th**		
Fall Break	Lecture 11		Neural Networks
Oct 16th	**Oct 18th**	**Oct 19th**	
Lecture 12	Lecture 13	Project 5 Posted	Stochastic Gradient Descent Python, Numpy, TensorFlow
Oct 23rd	**Oct 25th**	**Oct 26th**	
Lecture 14 In class lab 4	Lecture 15 Project 5 Due	Project 6 Posted	Value at Risk Expected Shortfall
Oct 30th	**Nov 1st**	**Nov 2nd**	
Lecture 16	Lecture 17 Project 6 Due	Project 7 Posted	Options, Black-Scholes Heston Model, AFT Model

Nov 6th	**Nov 8th**	**Nov 9th**	
Lecture 18	Lecture 19 Project 7 Due	Project 8 Posted	Risk-Neutral Distribution Replicating Portfolios with Options
Nov 13th	**Nov 15th**	**Nov 16th**	
Lecture 20 In class lab 5	Lecture 21 Project 8 Due	Project 9 Posted	Minimal Variance Portfolios Portfolio Risk
Nov 20th	**Nov 22nd**		
Thanksgiving	Thanksgiving		
Nov 27th	**Nov 29th**		
Lecture 22	Review Project 9 Due		Microstructure Noise Two-Scale RV
Dec 4th	**Dec 6th**		
Reading Period	Reading Period		
Dec 11th	**Dec 12th**		
Reading Period	Final Exam 7 PM to 10 PM Same room as lectures		