Econometric Analysis of Tick Data
SS 2014

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Course Description

The course covers diverse topics lying at the intersection of high-frequency financial econometrics and empirical market microstructure. While, nowadays, high-frequency financial econometrics is commonly understood as the statistical analysis of intra-day financial time series, empirical market microstructure looks at markets, rules, and traders generating these time series at the highest possible sampling frequency (tick or transactions data), and analyzes policy implications.

PART I first sketches out the trading process which varies with the institutional arrangements of the market under consideration. These organizational structures and the motives and behaviors of market participants lead to different degrees of data availability and quality. Consequently, there are different proxies for market variables of interest to traders and regulators. Since stochastic properties of market variables turned out to be qualitatively similar (in a statistical sense) over all asset classes, they became to be known as “stylized facts of financial markets” (Cont, 2001). Stylized facts are important as they guide the way to realistic econometric models. Yet, stylized facts of tick data (like errors, price discreteness, irregularly spaced observations, seasonality, etc.) are markedly different from those of daily or lower frequency data and, thus, call for a much more elaborate scrutiny of data as well as data-preprocessing before standard econometric techniques can be applied.

PART II presents simple economic models which help to explain some of the above stylized facts. A special role in this part is played by bid and ask prices as they convey information on the efficient price, liquidity, and uncertainty.

PART III applies time series techniques to tackle some of the issues raised in PART I. Specifically, GARCH-type models and vector autoregressions will be used to model randomly clustering observations and to analyze the process of price discovery in financial markets. The resulting insights and implications are relevant for policy makers and regulators of exchanges.

PART IV shows that tick data might also have an edge over lower frequency modeling when it comes to volatility. Tick data allows for the nonparametric estimation of latent volatility, which is known as realized volatility.

Learning Outcomes

By the successful completion of this course, students will have a solid understanding of trading processes on financial markets and the data they are generating, based on a mix of practical and theoretical insights. Likewise, they will be able to implement and check appropriate empirical models, and to discuss their
results in a balanced way.

**Course Requirement/Graded Activities**

Upon successful completion of this course, students will earn six ECTS points. To this end, students will have to write an empirical research paper on an extension of one of the topics covered in this course. The paper should comprise (no more than) fifteen text pages and must be submitted (along with code) within six weeks after final class.

**Tutorial**

The lecture is accompanied by a tutorial which will take place in the institute’s Student PC Lab. This is due to the fact that, after a short recap of fundamental concepts of financial and time series econometrics, students are required to gain a substantial amount of hands-on experience concerning data handling and model implementation. These are time-consuming issues when starting from scratch but inevitable for accomplishing the final empirical research paper. Thus, it is strongly recommended to participate in the computer tutorial on a regular basis in order to reduce the research paper’s workload.

The tutorial will present implementations in MathWorks’ Matlab which is one of the standard software package in the financial industry. For students unfamiliar with Matlab, the tutorial will provide an introduction suitable for mastering all upcoming computational challenges. Recently, MathWorks also started to offer a Trading Toolbox which would be a natural followup on this course.

**Course Readings and Material**

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Course Outline

I. A Glimpse on Financial Markets and Data

   Required readings: Dacorogna et al. (2001, Ch. 2), Harris (2003, Parts I & VII), Hautsch (2012, Ch. 2)
   Recommended readings: Hasbrouck (2007, Ch. 2 & 12), Madhavan (2000), Madhavan (2002), Shiryaev (1999, Ch. I)

2. Data Errors & Cleaning
   Required readings: Barndorff-Nielsen et al. (2009), Brownless and Gallo (2006)
   Recommended readings: Hautsch (2012, Ch. 3)

3. Stylized Facts of Tick Data
   Required readings: Dacorogna et al. (2001, Ch. 5), Hautsch (2012, Ch. 3), Tsay (2005, Ch. 5)
   Recommended readings: Goodhart and O’Hara (1997)

II. Economic Models for Tick Data Peculiarities

1. Asynchronous Trading
   Required readings: Lo and MacKinlay (2002, Ch. 4)
   Recommended readings: Lo and MacKinlay (1990), Tsay (2005, Ch. 5)

2. Bid-Ask Bounce
   Required readings: Hasbrouck (2007, Ch. 3), Tsay (2005, Ch. 5)
   Recommended readings: Roll (1984)

3. Asymmetric-Information Perspectives on Bid-Ask Spreads
   Required readings: O’Hara (1995, Ch. 3–6)

III. Econometric Models

1. The Autoregressive Conditional Duration Model
   Required readings: Tsay (2005, Ch. 5)
   Recommended readings: Engle and Russell (1998), Pacurar (2008), Zhang et al. (2001)

2. Price Formation & Informational Efficiency
   Required readings: Hasbrouck (2007, Ch. 8–10)
   Recommended readings: Dufour and Engle (2000), Hasbrouck (1991a,b)

IV. Realized Volatility
1. Realized Volatility & Market Microstructure Noise

   Required readings: McAleer and Medeiros (2008)

   Recommended readings: Andersen and Bollerslev (1998), Andersen et al. (2001a,b), Zhang et al. (2005)

2. A Heterogeneous Autoregressive Model of Realized Volatility

   Required readings: Corsi (2009)

   Recommended readings: Aït-Sahalia and Mancini (2008), Müller et al. (1997)

3. Market Expectations on Realized Volatility

   Required readings: Giot and Laurent (2007)

   Recommended readings: Busch et al. (2011), Christensen and Prabhala (1998), Shiryaev (1999, Ch. VIII)

References


