Course Outline – Ac.F851 – Advanced Quantitative Methods

This course aims to provide doctoral students with the necessary econometric and financial econometric techniques to conduct research in finance and accounting. It also serves as a basis for the more applied course Ac.F875 taught in term 2.

This course will cover econometric techniques on an advanced level that form the basis for quantitative and empirical research in finance and accounting. It will also cover the related necessary programming skills in advanced econometrics and statistical software packages such as MatLab and GAUSS.

The course will start with covering two key areas:

i) Generalized Methods of Moments and
ii) Maximum Likelihood Techniques

in a) time series models, b) multiple equations models and c) panel frameworks.

Depending on the composition of the students' cohort additional advanced methods that will be covered in the course may include: Simulated Maximum Likelihood, Efficient Important Sampling, Indirect Inference, Bayesian Methods, High-Frequency Financial Econometrics, Point Processes, Count Data Models, Limited Dependent Variable models.

Aims of the Course:

- Deep understanding of Maximum Likelihood and Generalised Methods of Moments Theory, and their applications
- The ability to implement these models/methods in advanced software packages such as (Matlab, GAUSS, Ox, Stata)

Structure of the Course:

- 9 weeks, every week (two hours sessions)
- Assessment: 50% Empirical Component (two Take Home exams), 50% Final Exam

Indicative Syllabus:

Session 1:
Review Linear Regression Model with stochastic regressors, Estimation Theory, Inference, Instruments, Misspecification

Session 2 – Computer Lab Session:
Introduction to GAUSS and MatLab and related software packages

Session 3:
Asymptotic Theory in linear models under different assumptions for the data generating process. Laws of Large Numbers, Central Limit Theorems

Session 4:
Concept of Endogeneity, Instrumental Variables, GMM, some relationships to Maximum Likelihood

Session 5 – Computer Lab Session:
Properties of Financial Data, Descriptive Analysis, OLS and ML in GAUSS and MatLab

Session 6:
Multiple Equations GMM, Application to Asset Pricing Models

Session 7 – Computer Lab Session:
Time Series Model, Implementation of ML for dynamic models, Specification Tests, Some Forecasting

Session 8 – tbc:
Theory of Point Processes, Random Time Change Theorem, Properties of HF Data

Session 9 – tbc:
Dynamic duration, count data and intensity Models; Estimation and Specification Tests.

Detailed Course Outline:

Week	Label	Details	Take Home Exams 50% all together
1	Introduction & Theory I	Review Linear Regression Model, Assumptions, Estimation OLS, ML, MM, Testing, Relaxing Assumptions, Misspecification	
2	Lab Session I	Introduction to computer lab & software packages (Matlab & GAUSS)	
3	Theory II	Asymptotic Theory, Law of Large Numbers, Central Limit Theorems	
4	Theory III	IV, GMM, ML & Misspecification;	
5	Lab Session II	Descriptive Statistics, Graphics, OLS	Take Home I: Reproduction of EViews OLS Output (including Newey-West)
6	Theory IV	GMM - CAPM and extensions	
7	Lab Session III	Time Series Models, Model Selection & Specification Tests, Forecasting Procedures, Criteria & Tests & ML estimation	
8	Theory V	Point Process Theory & Properties of High Frequency Data	Take Home II: ARMA-GARCH - ML exercise (incl. model specification & forecasting)
9	Theory VI	Duration, Count data and Intensity Models	
10		EXAM	

Reading List (incomplete):

- Andersen, T. G., T. Bollerslev, F. X. Diebold, & H. Ebens (2001): The Distribution of Stock Return Volatility, Journal of Financial Economics, 61, 43-76.
- Bandi, F. M. & J. R. Russell (2007): Microstructure Noise, Realized Volatility, and Optimal Sampling, Review of Economic Studies, 75, 339 - 369.
- **Bauwens, L. & N. Hautsch (2006): Modelling Financial High Frequency Data Using Point**

Processes, in: Handbook of Financial Time Series, T. G. Andersen, R. A. Davis, J.-P. Kreiss and T. Mikosch (eds.), Springer.

- Barndorff-Nielsen, O. E. & N. Shephard (2002): Estimating Quadratic Variation Using Realised Variance, Journal of Applied Econometrics, 17, 457-477.
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- Barndorff-Nielsen, O., P. Hansen, A. Lunde, & N. Shephard (2008): Designing realised kernels to measure the ex-post variation of equity prices in the presence of noise, Econometrica.
- **Bien K., I. Nolte & W. Pohlmeier (2011): An Inflated Multivariate Integer Count Hurdle Model: An Application to Bid and Ask Quote Dynamics, *Journal of Applied Econometrics,* 26, 669-707*;***
- Bollerslev T, R. Engle R & M Wooldridge (1998): A Capital Asset Pricing Model with Time-Varying Covariances, The Journal of Political Economy, Vol. 96, No. 1, pp. 116-131
- **Cochrane, J (2000): Asset Pricing, Princeton University Press, Princeton.**
- Engle, R. F. & J. R. Russell (1998): Autoregressive Conditional Duration: A New Model for Irregularly Spaced Transaction Data, Econometrica, 66, 1127-1162.
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- Hall A, (2005): Generalized Method of Moments, Oxford University Press, New York.
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- Hansen L, (1982): Large Sample Properties of Generalized Method of Moments Estimators, Econometrica, Vol. 50, No. 4, pp. 1029-1054.
- Hansen L & K Singelton (1982): Generalized Instrumental Variables Estimation of Nonlinear Rational Expectations Models, Econometrica, Vol. 50, No. 5, pp. 1269-1286
- **Hautsch (2004): Modelling Irregularly Spaced Financial Data – Theory and Practice of Dynamic Duration Models, Lecture Notes in Economics and Mathematical Systems, Vol. 539, Springer-Verlag, Berlin.**
- Hawkes, A. G. (1971): Spectra of some self-exciting and mutually exciting point processes, Biometrika, 58, 83-90.
- Hayashi, T. & N. Yoshida (2005): On Covariance Estimation of Non-Synchronously Observed Diffusion Processes, Bernoulli, 11, 359-379.
- **Hayashi, F (2000): Econometrics, Princeton University Press, Princeton.**
- Jasiak, J. (1999): Persistence in Intertrade Durations, Tech. rep., York University.
- Karr, A. F. (1991): Point Processes and their Statistical Inference, Dekker, New York.
- Leland S, (1946): The Government, the Banks and the National Debt, The Journal of Finance, Vol. 1, No. 1, pp. 5-26.
- **Liesenfeld, R,. I. Nolte & W. Pohlmeier (2006): Modelling Financial Transaction Price Movements: A Dynamic Integer Count Data Model*, Empirical Economics*, 30(4), 795-825;**
- **Nolte, I. & V. Voev (2012): Least Squares Inference on Integrated Volatility and the Relationship between Efficient Prices and Noise, *Journal of Business & Economic Statistics, 30 (1), 94-108***
- Russell, J. R. (1999): Econometric Modelling of Multivariate Irregularly-Spaced High Frequency Data, Working Paper, University of Chicago.
- Schumpeter J, (1933): The Common Sense of Econometrics, Econometrica, Vol. 1, No. 1, pp. 5-12.
- Voev, V. & A. Lunde (2007): Integrated Covariance Estimation Using High-Frequency Data in the Presence of Noise, Journal of Financial Econometrics, 5, 68-104.
- **White, H (2001): Asymptotic Theory for Econometricians, Academic Press, Elsevier, Chapter 1-6.**
- Zhang, L., P. A. Mykland, & Y. Ait-Sahalia (2005): A Tale of Two Time Scales: Determining Integrated Volatility with Noisy High Frequency Data, Journal of the American Statistical Association, 100, 1394-1411.