SCHOOL OF ECONOMICS *Course Outline 2019/20*

Financial Econometrics

Continuous Time Econometrics with Applications in Asset Pricing

Jun YU

Purpose

The aim of this course is to enhance the understanding of some of the time series econometric methods and models used in continuous time. The courses is en extension to the discrete time series methods and analysis covered in Econometrics II (623). Students who wish to take this course must have taken Econ623.

Content Outline

Topic 1: Ordinary differential equations: theory

Topic 2: Ordinary differential equations: numerical issues

Topic 3: Asymptotic theory for IID sequence, ergodic sequence and martingales

Topic 4: Brownian processes and stochastic differential equations

Topic 5: Levy processes

Topic 6: Continous time models in asset pricing

Topic 7: Econometric analysis of continous time models in asset pricing

- Exact maximum likelihood
- Quasi maximum likelihood
- GMM
- Bayesian methods
- Simulation based methods
- Asymptotic theory
- Finite sample theory

Topic 8: Multivariate continuous time models

Topic 9: Unit roots, local-to-unity, and moderate-deviation from unity, structural break in continuous time models

Topic 10: Fractional continuous time models

Instructor:

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Learning Resources: Books

Arnold, V.I., 1973, Ordinary different equations, MIT

Bergstrom, AR, 1984, Continuous time stochastic models and issues of aggregation over time. In Z. Griliches and M.D. Intriligator, editors, Handbook of Econometrics. Vol. II (Elsevier Science, Amsterdam).

Butcher, J. C., 2003, The Numerical Analysis of Ordinary Differential Equations, John Wiley.

Hamilton, J., 1994, Time Series Analysis, Princeton University Press.

Mishura, Y. 2008, Stochastic Calculus for Fractional Brownian Motion and Related Processes. Springer.

Singleton, K., 2006, Empirical Dynamic Asset Pricing, Princeton University Press.

White, H., 2001, Asymptotic Theory for Econometricians, Acadmic Press.

Learning Resources: Research Papers

Aït-Sahalia, Y., 2002, Maximum likelihood estimation of discretely sampled di¤usion: A closed-form approximation approach. Econometrica, 70, 223-262.

Aït-Sahalia, Y., 2008, Closed-Form Likelihood Expansions for Multivariate Di¤usions. Annals of Statistics, 36, 906-937.

Aït-Sahalia, Y. and J. Yu, 2006, Saddlepoint approximation for continuous-time Markov Processes. Journal of Econometrics,134, 507-551

Anderson, T.W., 1959, On asymptotic distribution of estimates of parameters of stochastic difference equations. Annals of Mathematical Statistics 30, 676-687.

Balduzzi, P., S. Das, and S. Foresi, 1998, The Central Tendency: A Second Factor in Bond Yields, Review of Economics and Statistics, 80, 62-72.

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Chen, Y., Yu, J., 2015, Optimal Jackknife for Unit Root Models, Statistics and Probability Letters, 99, 135-142

Chen, Y., Phillips, P.C.B., Yu, J., 2017, Inference in Continuous Systems with Mild Explosive Regressors, Journal of Econometrics, 201, 400-416

Cox, J., Ingersoll, J., and S. Ross, 1985, A Theory of the Term Structure of Interest Rates, Econometrica, 53, 385-407.

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Duffie, D., J. Pan, and K. J. Singleton, 2000, Transform Analysis and Asset Pricing for Affine Jump-diffusions, Econometrica, 68, 1343-1376.

Durham, G., and A. R. Gallant, 2002, Numerical Techniques for Maximum Likelihood Estimation of Continuous-time Diffusion Processes, Journal of Business and Economic Statistics, 20, 297-316.

Gouriéroux, C., A. Monfort, and E. Renault, 1993, Indirect Inference, Journal of Applied Econometrics, 8, S85-S118.

Jiang, L., Wang, X., Yu, J., New Distribution Theory for the Estimation of Structural Break Point in Mean. *Journal of Econometrics*, 2018, 205, 156-176.

Jiang, L., Wang, X., Yu, J., In-fill Asymptotic Theory for Structural Break Point in Autoregression, Working paper, SMU.

Heston, S.L. 1993, A closed-form solution for options with stochastic volatility, with application to bond and currency options, Review of Financial Studies 6, 327-343.

Nowman, K. B., 1997, Gaussian Estimation of Single-factor Continuous Time Models of the Term Structure of Interest Rates, Journal of Finance, 52, 1695-1703.

Piazzesi, M., 2009, Affine Term Structure Models, Handbook of Financial Econometrics.

Phillips, P.C.B., Time Series Regression with a Unit Root, Econometrica, 55, 277--301.

Phillips, P.C.B., Towards a unified asymptotic theory for autoregression, Biometrica, 74, 535—547.

Phillips, P.C.B. and T. Magdalinos, 2009, Unit root and cointegrating limit theory when the initialization is in the infinite past. Econometric Theory 25, 1682-1715.

Phillips, P.C.B., S.P. Shi and J. Yu, 2015a, Testing for multiple bubbles: historical episodes of exuberance and collapse in the S&P500. International Economic Review.

Phillips, P.C.B., S.P. Shi and J. Yu, 2015b, Testing for multiple bubbles: Limit theory of real time detector. International Economic Review.

Phillips, P.C.B., S.P. Shi and J. Yu, 2014, SpeciÖcation sensitivity in right-tailed unit root testing for explosive behavior. Oxford Bulletin of Economics and Statistics 76, 315-333.

Phillips, P.C.B., Y. Wu and J. Yu, 2011, Explosive behavior in the 1990s Nasdaq: When did exuberance escalate asset values? International Economic Review 52, 201-226.

Phillips, P.C.B. and J. Yu, 2005, Jackknifing bond option prices. Review of Financial Studies, 18, 707-742.

Phillips, P.C.B. and J. Yu, 2009a, A Two-Stage Realized Volatility Approach to Estimation of Di¤usion Processes with Discrete Data. Journal of Econometrics, 150, 139-150.

Phillips, P.C.B. and J. Yu, 2009b, Simulation-based Estimation of Contingent-claims Prices. Review of Financial Studies, 22, 3669-3705.

Phillips, P.C.B., and J. Yu., 2009c, Maximum likelihood and Gaussian estimation of continuous time models in finance. Handbook of Financial Time Series, 497-530.

Phillips, P.C.B. and J. Yu, 2011, Dating the timeline of Önancial bubbles during the subprime crisis. Quantitative Economics 2, 455-491.

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Wang, X., 2018, Estimation for Persistency Matrix in Multivariate Diffusions, Working Paper, Chinese University of Hong Kong.

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Wang, X., Yu, J., 2016, Double Asymptotics for an Explosive Continuous Time Models, Journal of Econometrics, 2016, 193, 35-53.

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Yu, J., 2005, On Leverage in a Stochastic Volatility Model, Journal of Econometrics. 127, 165-178.

Yu, J., 2011, Simulation-based Estimation Methods for Financial Time Series Models, Handbook of Computational Finance, 427-465.

Yu, J., 2012, Bias in the Estimation of Mean Reversion Parameter in a Simple Continuous Time Model, Journal of Econometrics. 169, 114-122.

Yu, J., 2014, Econometric Analysis of Continuous Time Models: A Survey of Peter Phillips' Work and Some New Results, Econometric Theory, 30, 737-774.

Zhou, Q. and Yu, J., 2015, Asymptotic Theory for Linear Diffusions under Alternative Sampling Schemes, Economics Letters, 128, 1-5.