Dynamic Predictive Modeling in Econometric Big-Data Environments

With Applications to

Financial Markets and Macroeconomic Fundamentals

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Thursdays, 5:30-8:30, McNeil 410, October 18 - December 8

We will focus on tools and applications of dynamic predictive modeling in econometric "Big-Data" environments. We will provide both a selective survey and new results.

Topics potentially include but are not limited to: the two modeling cultures; wide and dense data; selection (all-subset, partial-subset, one-shot, ...); shrinkage (Bayesian and otherwise); distillation (factor structure, PCA, ...); hybrids (e.g., shrinkage toward factor structure, lasso and its variants, ...); regularization for $T < K$; realized volatility (i.e., empirical quadratic variation and covariation) including microstructure noise, jumps, "realized X" for various X, ...); assembling and constraining "vast" realized covariance matrices; tick data and inter-trade durations; long memory, self-similarity, and multi-fractals; network connectivity measurement; network visualization; all-pairs Granger causality in high dimensions; VAR's in ultra-high dimensions (estimation, identification, visualization, time-varying parameters, ...); "honest" predictive model comparisons; real-time monitoring.

Areas of application potentially include but are not limited to financial economics and macroeconomics.

Open questions and conjectures will be discussed wherever possible.

Course materials (syllabus, slides, papers, ...) are at `www.ssc.upenn.edu/~fdiebold/Teaching712/Students712.zip`. The vintage may be updated often, so check back often.

Diebold site: `http://www.ssc.upenn.edu/~fdiebold`

Open texts: `http://www.ssc.upenn.edu/~fdiebold/Textbooks.html`

1 Aspects of Big Data Through the Lens of Time Series (Or: Aspects of Time Series Through the Lens of Big Data)

1.1 Diebold, F.X., *Lecture slides*

1.2 Presentation: Minsu and Paul on high-dimensional filtering

Background readings:

* Fan et al. (2016), "An Overview of the Estimation of Large Covariance and Precision Matrices", *Econometrics Journal*.

* Pati et al. (2016), "Posterior Contraction in Sparse Bayesian Factor Models for Sparse Covariance Matrices", *Annals of Statistics*.

* Doucet et al. (2013), "Rao-blackwellised Particle Filtering for Dynamic Bayesian Networks", *Proceedings of the Sixteenth Conference on Uncertainty in Artificial Intelligence*.

Furrer and Bengtsson (2007), "Estimation of High-Dimensional Prior and Posterior Covariance Matrices in Kalman Filter Variants", *Journal of Multivariate Analysis*.

Shen and Ghosal (2016), "Adaptive Bayesian Density Regression for High-Dimensional Data", *Bernoulli*.

2 Aspects and Applications of Dynamic Factor Structure

2.1 Diebold, F.X., *Lecture slides*

* Diebold, F.X. and Rudebusch, G,D. (2013), *Yield Curve Modeling and Forecasting,* Princeton University Press.

Sites:

Federal Reserve Board Nelson-Siegel, `http://www.federalreserve.gov/econresdata/feds/2006/index.htm`

Krippner book, `http://www.palgrave.com/page/detail/zero-lower-bound-term-structure-m?K=9781137408327`

FRB Atlanta shadow rate, `https://www.frbatlanta.org/cqer/research/shadow_rate.aspx`

2.2 Presentation: Ross on term-structure models and the zero lower bound

Background readings:

* Christensen, J.H.E. and Rudebusch, G.D. (2016), "Modeling Yields at the Zero Lower Bound: Are Shadow Rates the Solution?", in Eric Hillebrand , Siem Jan Koopman (ed.) *Dynamic Factor Models* (Advances in Econometrics, Volume 35) Emerald Group Publishing Limited, 75 - 125.

* Diebold, F.X., Rudebusch, G.D., and Aruoba, S.B. (2006), "The Macroeconomy and the Yield Curve: a Dynamic Latent Factor Approach," *Journal of Econometrics*, 131, 309-338.

* Joslin, S., Priebsch, M., and Singleton, K.J. (2014), "Risk Premiums in Dynamic Term Structure Models with Unspanned Macro Risks", *Journal of Finance*, 69, 11971233. doi:10.1111/jofi.12131

* Christensen, J.H.E. (2013), "A Regime-Switching Model of the Yield Curve at the Zero Bound", Working Paper Series 2013-34, Federal Reserve Bank of San Francisco.

Rudebusch, G.D. and Wu, T. (2008), "A Macro-Finance Model of the Term Structure, Monetary Policy and the Economy", *Economic Journal*, 118, 906926. doi:10.1111/j.1468-0297.2008.02155.

Rudebusch, G.D. and Wu, T. (2007), "Accounting for a Shift in Term Structure Behavior with No-Arbitrage and Macro-Finance Models", *Journal of Money, Credit and Banking*, 39, 395422. doi:10.1111/j.0022-2879.2007.00030.

3 High-Dimensional VAR's and Networks

3.1 Diebold, F.X., *Lecture slides*

3.2 Presentation: Frank on commodity connectedness

Background readings:

* Diebold, F.X., Liu, L. and Yilmaz, K. (2016), "Commodity Connectedness," Manuscript.

4 Aspects of Univariate Volatility Modeling

4.1 Diebold, F.X., *Lecture slides*

* Andersen, T.G., Bollerslev, T., Christoffersen, P.F. and Diebold, F.X. (2013), "Financial Risk Measurement for Financial Risk Management," in G. Constantinedes, M. Harris and Rene Stulz (eds.), *Handbook of the Economics of Finance, Volume 2, Part B*, Elsevier,1127-1220.

Sites:

V-Lab, `http://vlab.stern.nyu.edu/en/`

4.2 Presentation: Paul on dynamic density estimation

Background readings:

* Andersen, Bollerslev, Frederiksen, Nielsen, "Continuous-Time Models, Realized Volatilities, and Testable Distributional Assumptions for Daily Stock Returns"

Bollerslev, Patton, Quadvlieg, "Exploiting the Errors: A Simple Approach for Improved Volatility Forecasting"

Pati, Dunson and Tokdar, "Posterior Consistency in Conditional Distribution Estimation"

Mykland, Zhang, "Inference for Continuous Semimartingales Observed at High Frequency"

Tang, Ghosal, "A Consistent Nonparametric Bayesian Procedure for Estimating Autoregressive Conditional Densities"

Zhang, Mykland, Ait-Sahalia "A Tale of Two Time Scales Determining Integrated Volatility With Noisy High-Frequency Data"

5 Aspects of Multivariate Volatility Modeling

5.1 Diebold, F.X., *Lecture slides*

* Andersen, T.G., Bollerslev, T., Christoffersen, P.F. and Diebold, F.X. (2013), "Financial Risk Measurement for Financial Risk Management," in G. Constantinedes, M. Harris and Rene Stulz (eds.), *Handbook of the Economics of Finance, Volume 2, Part B*, Elsevier,1127-1220.

Sites:

V-Lab, `http://vlab.stern.nyu.edu/en/`

5.2 Presentation: Jake and Ross on factor structure in idiosyncratic volatility

Background readings:

* Barigozzi, M. and Hallin, M. (2016), "Generalized Dynamic Factor Models and Volatilities: Recovering the Market Volatility Shocks", *Econometrics Journal*, 19, C33C60. doi:10.1111/ectj.12047

* Herskovic, B., Kelly, B.T., Lustig, H., and Van Nieuwerburgh, S. (2014), "The Common Factor in Idiosyncratic Volatility: Quantitative Asset Pricing Implications", Working Paper 20076, National Bureau of Economic Research. URL http://www.nber.org/papers/w20076.

* Kalnina, I. and Tewou, K. (2015), "Cross-Sectional Dependence in Idiosyncratic Volatility", Cahiers de recherche 08-2015, Centre interuniversitaire de recherche en conomie quantitative, CIREQ.

6 Presentations by "younger" students

Younger students (potentially in teams) will in some sense re-create the very recent cutting-edge University of Chicago conference, "Machine Learning: What's in it for Economics?" (`http://bfi.uchicago.edu/events/machine-learning-what%E2%80%99s-it-economics`), presenting and discussing selected papers. Original papers, presenter's slides, and discussant's slides are in the course zip file at `www.ssc.upenn.edu/~fdiebold/Teaching712/Students712.zip`. You should examine all slides carefully, but ultimately your presentations and discussions should reflect *your own* views / opinions / emphasis, which may well differ from those of the author and original discussant.