14.384. Time Series Analysis  
Fall, 2014  
Anna Mikusheva  

Meeting time and location: Tuesdays and Thursdays, 9-10.30a.m., E51-372  
Recitations: Fri., 4-5.30pm, E51-361  
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Course Description  
The course provides a survey of the theory and application of time series methods in econometrics. Topics covered will include univariate stationary and non-stationary models, vector autoregressions, frequency domain methods, models for estimation and inference in persistent time series, structural breaks. We will cover different methods of estimation and inferences of modern dynamic stochastic general equilibrium models (DSGE): simulated method of moments, Maximum likelihood and Bayesian approach. The empirical applications in the course will be drawn primarily from macroeconomics.  

Goals:  
The main objective of this course is to develop the skills needed to do empirical research in fields operating with time series data sets. The course aims to provide students with techniques and receipts for estimation and assessment of quality of economic models with time series data. Special attention will be placed on limitations and pitfalls of different methods and their potential fixes. The course will also emphasize recent developments in Time Series Analysis and will present some open questions and areas of ongoing research.  

Grading  
Final grades will be based on 5 problem sets (60% weight), and a take home final exam (40% weight). The problem sets will emphasize different aspects of the course, including theory and estimation procedures we discuss in class. I strongly believe that the best way to learn the techniques is by doing. Every problem set will include an applied task that may include computer programming. I do not restrict you in your choice of computer language. I also do not require you to write all programs by yourself from scratch. You may use user-written parts of codes you find on the Internet, but I do require that you understand the program you use and properly document it with all needed citations of original sources. Collaboration with other students on problem sets is encouraged, however, the problem sets should be written independently.  

If you are Economics PhD student, your econometrics paper requirement could be fulfilled by turning in a research paper on a topic related to material covered in the class. The paper is due at the end of IAP. The paper should be empirical.
Textbooks and Readings
The primary text is Hamilton (1994), which is somewhat out-dated. A fantastic reference on current state of the field is the method lectures “What New in Econometrics-Time Series” delivered by James H. Stock and Mark W. Watson during NBER Summer Institute 2008. The slides and videos of the lectures are available on the web http://www.nber.org/minicourse_2008.html. Most of the readings for the later parts of the course are journal articles. The course overviews a large literature, so not all topics are treated in the same depth, and only a few references listed under a topic will be covered. The other papers are additional references for those who wish to study specific topics in greater detail. The lectures will be self-contained. The previous years lecture notes are available through MIT OpenCourseWare.

Books:

Required:

Recommended:

Acknowledgement:
I am extremely grateful to Jim Stock (Harvard), Rustam Ibragimov (Harvard), Frank Schorfheide (UPenn) and Barbara Rossi (Duke) for their advice and permission to use their course materials.

The last but not the least:
Your feedback is highly valuable. Please, speak up if you have suggestions on how the course can be improved.
Course Outline

Asterisked references are more important to the course. The following is a tentative list of topics that will be covered in this course. I reserve the right to add (hardly possible) or delete (very likely) topics as the course progresses.

I. Introduction. Stationary time series.

- **Introduction to stationary time series:** ARMA, limit theory for stationary time series, causal relationships, HAC. Lectures 1-3.
  *Hamilton, Chs. 1-5, 7, 8.
  *Hall and Heyde, Ch 3.
  Brockwell and Davis, Chs. 1, 3, Sect. 5.7.

- **Frequency Domain Analysis:** spectra; filters; transforms; nonparametric estimation. Lectures 3-5.
  *Hamilton, Ch. 6.
  Brockwell and Davis, Chaps. 4 and 10.

- **Model selection and information criteria:** consistent estimation of number of lags, discussion of non-uniformity and post-selection inferences. Lecture 5.

II. Mutivariate stationary analysis
- **VAR**: definition, estimation: OLS, ML, Granger causality, Impulse response functions and variance decompositions. Lectures 6,7
  *Hamilton, Chaps. 10, 11
  *Lütkepohl, H. (2005), Chaps. 2, 3

- **Structural VARs**: Identification, short term restrictions, long-term restrictions. Lecture 9.
  Wright, J.H. (2011) “What does Monetary Policy do to Long-Term Interest Rates at the Zero Lower Bound?” working paper

- **VAR and DSGE models**: World decomposition, fundamentality of shocks, do long-run restrictions identify anything? Lecture 9.

- **Factor model and FAVAR**: Motivation, Principal components, choosing number of static and dynamic factors, structural FAVAR, IV regression with factors. Lectures 10-11.


III. Univariate non-stationary processes

- Asymptotic theory of empirical processes: Lecture 12
  *Hamilton, Sections 17.1-17.3
  Hall and Heyde, Chaps. 3, 4, and 5 and the Appendix.

- Univariate unit roots and near unit root problem: unit root testing, confidence sets for persistence, tests for stationarity. Lectures 13-14
  *Hamilton, Ch. 17

- Structural breaks and non-linearity: testing for breaks with known and unknown dates, multiple breaks, estimating number of breaks. Lecture 15.
  *Hamilton (1994), Ch. 22.


**IV. Multivariate non-stationary**

- **Multivariate unit roots and co-integration:** estimating cointegration relations, canonical form.
  Lectures 16-17


- **Persistent regressors (prediction regression)** limit theory, Stambaugh correction, nuisance parameter problem, conservative procedures, conditional procedures. Lecture 17.


**V. GMM and related issues**

- **GMM and Simulated GMM:** GMM estimation and asymptotic theory, testing in GMM setting, simulated method of moments and time series specifics: estimation of covariance structure, initial condition problem, indirect inference.

  *Hamilton, Chap. 14
  *DeJong and Dave, Ch. 7
  *Canova, Ch. 5


- **Weak IV:** what is weak IV, alternative asymptotic theory, how to detect weak IV, procedures robust to weak IV, unsolved problems.


VI. Likelihood methods

- **Kalman filter and its applications:** *State-Space models, time varying coefficients. Lectures 20-21.*
  
  *Hamilton (1994), Ch. 13
  *Canova (2007), Ch. 6

- **ML estimation of DSGE:** *stochastic singularities problem, misspecification and quasi-ML, identification. Lecture 22.*
  
  DeJong and Dave, Ch. 8
  Canova, Ch. 6

- **Identification and weak identification of DSGE:**


VII. Bayesian methods. *Lectures 23-26.*

- **Bayesian concepts:**
  
  *Hamilton, 1994, section 12.3

- **Markov Chain Monte Carlo (MCMC): Metropolis-Hastings, Gibbs sampler, data augmentation**
  


- **Estimation of DSGE models using Bayesian methods.**


