Instructor: Mikkel Plagborg-Møller, mikkelpm@princeton.edu

Lectures: Wed 10.00am–12.00pm, room 624, 19 W 4th St
Office hours: Wed 2.00pm–3.00pm, office 826, 19 W 4th St

**Description.** Modern time series methods for applied macroeconomics. The first half of the course covers causal time series identification approaches, including Local Projections, SVARs, instruments/proxies, sign restrictions, and issues related to invertibility. The second half of the course covers a diverse set of topics: estimation of heterogeneous agent models, dynamic factor models, long-run variance estimation, and macroeconomic tail risk. The target audience includes both applied students and econometric theory students.

**Prerequisites.** ECON-GA 2100 and ECON-GA 2101 required. ECON-GA 3002-008 (“Empirical Methods for Dynamic Macroeconomics”) recommended.

**Material.** There is no required textbook for the course. Handouts will be made available on the website. Attached to this syllabus is a list of optional readings that are useful for a deeper understanding of the material.

Some students might find it useful to have a textbook as an additional reference. Good reference books include:


**Homework.** I will post problem sets on the course website approximately every two-three weeks. The due date will typically be two weeks after the assignment is posted. Problem sets should be printed out and handed in at the beginning of class on the due dates. Students are encouraged to collaborate on the problem sets, but answers and computer code must be typed up independently. The problem sets will be graded coarsely, i.e., a full score will be given as long as the work demonstrates dedication and thoughtfulness. I reserve the right to subtract points for sloppy exposition, including unreadable code. If you find a grading error, please resubmit your problem set along with a one-paragraph explanation; I reserve the right to re-grade the entire problem set.

**Class project.** Each student will give a short presentation in class on a recent published paper or working paper that uses advanced time series methods. The paper must be pre-approved by me. The presentation should include a replication exercise and a critical discussion of the paper’s methods. It is also acceptable to present applications or extensions of a purely theoretical paper. Original work is encouraged, as long as it relates to the pre-approved paper. Presentations will be graded based on clarity and effort.

**Grading.** The final course grade will be a monotonic function of the weighted average of (i) the average problem set score (50% weight) and (ii) the presentation score (50% weight).

**Important dates.** These dates are preliminary. Changes will be announced via course email.

- Jan 29 (Wed): First class
- Mar 18 (Wed): No class due to spring break
Mar 25 (Wed): Deadline for pre-approval of presentation topic

Apr 29 (Wed): Student project presentations

May 6 (Wed): Last class

Course outline. The following outline is preliminary and may change without warning.

1. Causal identification in macroeconomics.
   i) SVMA model, SVAR model, invertibility.
   ii) Identification through exclusion restrictions.
   iii) Local Projection versus VAR estimation of impulse responses.
   iv) Identification under potential non-invertibility.
   v) Identification using instruments/proxies.
   vi) Recoverability.
   vii) Partial identification through sign/magnitude restrictions.
   viii) Identification through non-Gaussianity/heteroskedasticity.

2. Challenges for statistical inference on impulse responses.
   i) Shrinkage estimation.
   ii) Simultaneous confidence bands.
   iii) Bootstrap.
   iv) Frequentist inference with persistent data and at long horizons.

3. Estimation of heterogeneous agent models.
   i) Challenges when combining micro and macro data.
   ii) Moment matching.
   iii) Likelihood inference.

4. Dynamic factor models.
   i) State space approach.
   ii) Principal components.
iii) Inference on number of factors.

5. Long-run variance estimation.
   i) Spectral estimators.
   ii) VAR-HAC.
   iii) Kernel estimators.
   iv) Fixed-b asymptotics.

   i) Growth at Risk.
   ii) Forecast evaluation.

Optional reading list

Introductory readings are listed first and marked with a star (*). Other readings are included for your reference. Original contributions are not always cited when good handbook/textbook references are available. The reading list is preliminary and may change without warning.

1 Causal identification in macroeconomics

Exclusion restrictions, instruments/proxies


Kilian and Lütkepohl: chapters 4, 7–12, 15.


**Invertibility, recoverability**


**Sign/magnitude restrictions**


**Identification through non-Gaussianity/heteroskedasticity**

* Kilian and Lütkepohl: chapter 14.


**Applications**


2 Challenges for statistical inference on impulse responses

Shrinkage


Simultaneous confidence bands


Bootstrap

* Kilian and Lütkepohl: chapters 12.1–12.5.


Persistent data, long horizons


3 Estimating heterogeneous agent models


Herbst and Schorfheide: chapters 1–3, 5.


4 **Dynamic factor models**

Estimation and inference


Determining the number of factors


Applications


5 Long-run variance estimation

Theory

* Hayashi: 6.5–6.6.

Brockwell and Davis: chapters 10.1–10.5, 11.6.


**Applications**


**6 Macroeconomic tail risk**
