Econometrics III: Advanced Econometrics (only PhD)

Course instructor:
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Office hours: by arrangement

Timetable: 1st part in person: March 13-14, 2023 (9.30am to 4pm, room 2544)
2nd part via Zoom: March 20, 2023 (individual sessions)
3rd part in person: March 23-24, 2023 (9.30am to 4pm, room 2544)

Prerequisites: Ideally, Econometrics I and II (TUM) or equivalently solid introductory courses in econometrics. Preferably some basic knowledge of R and Python. Participants should bring their own laptop with R and/or Python installed. The target audience are PhD students.

Grading: Successful participation (6 ECTS); details below

Registration: Until March 13, 2023, via email.

Course description:
The course is part of a series of econometrics courses at TUM School of Management that also comprises "Econometrics I: Research Design and Estimation Methods" by Prof. Dr. Hanna Hottenrott, "Econometrics II: Causal Inference" by Prof. Dr. Joachim Henkel and "Econometrics IV: Machine Learning" by me. Econometrics III will be a block lecture but conceptualized as a seminar based on student presentations. The course covers a selection of state-of-the-art methods in econometrics. It aims to provide students with a sound understanding of the methods discussed, such that they are able to do research using modern econometric techniques, as well as critically assess existing studies.

In particular, the course will cover the following topics:

- Generalized Methods of Moments (GMM) Estimation
- Potential Outcomes and Treatment Effects
- Panel Data Estimation
- Regression Shrinkage Methods (Ridge, Lasso, Elastic Net)
- Double Machine Learning

1^{st} part of the course (in person):

In the first meeting, we will discuss the econometric methods (including some applications to illustrate them). Students will then apply these methods and will replicate recent research papers in economics. In this meeting I will also assign a (replication) project to each student, which (s)he will present at the second part of the course. You can also come up with an application and/or dataset you are interested in.

2^{nd} part of the course (via Zoom):

Individual Zoom sessions to discuss your (replication) project.
https://tum-conf.zoom.us/j/6610117956 (access code in a separate mail)

3^{rd} part of the course (in person):

The third part of the course will be similar to a reading course in which we will discuss your (replication) projects. All participants are expected to read the papers before the meetings. The presentation (roughly 30 minutes) together with a short report that summarizes the assigned paper (roughly 5 pages w/o figures, tables and references) will be relevant for the grading.

Recommended textbooks:

- Hansen Bruce. *Econometrics*, available here
- Angrist Joshua and Pischke Jörn-Steffen *Mostly Harmless Econometrics* available here
- Hastie Trevor, Tibshirani Robert and Friedman Jerome. *The Elements of Statistical Learning*, Springer, available here
- James Gareth, Witten Daniela, Hastie Trevor and Tibshirani Robert. *An Introduction to Statistical Learning with Applications in R*, Springer, available here

Papers you definitely should read:

- Bach *et al.* (2022): DoubleML - An Object-Oriented Implementation of Double Machine Learning in Python, *Journal of Machine Learning Research* 23(53), 1-6.
- Tibshirani (1996): Regression Shrinkage and Selection via the Lasso. *Journal of the Royal Statistical Society: Series B (Methodological)* 58(1), 267–288.
- Zou (2006): The Adaptive Lasso and Its Oracle Properties, *Journal of the American Statistical Association* 101(476), 1418-1429.

Papers you could read if you have plenty of time:

- Angrist and Frandsen (2020): Machine Labor, NBER Working Paper 26584.
- Athey and Imbens (2019): Machine Learning Methods Economists Should Know About, *Annual Review of Economics*, 11, 685–725.
- Mullainathan and Spiess (2017): Machine Learning: An Applied Econometric Approach, *Journal of Economic Perspectives*, 31(2), 87–106.
- Varian (2014): Big Data: New Tricks for Econometrics, *Journal of Economic Perspectives*, 28(2), 3–28.