



## Econometrics III: Advanced Econometrics & Statistical Learning (only PhD)

### Course instructor:

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Office hours: by arrangement

**Timetable:** March 11-15, 2024 (10am to 5pm, room 2544)

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

**Grading:** Successful participation (6 ECTS); details follow

**Registration:** Until end of February, 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 and “Econometrics II: Causal Inference” by Prof. Dr. Joachim Henkel.

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)
- Advanced Identification Strategies (e.g. Double Machine Learning and Causal Forests)

In the morning, we will briefly discuss the econometric methods (including some applications to illustrate them). Students will then apply these methods and will replicate recent research papers in economics. I will also assign a (replication) project to each student. You can also come up with an own application and/or dataset you are interested in.

### Recommended textbooks:

- Angrist Joshua and Pischke Jörn-Steffen. *Mostly Harmless Econometrics*, [available here](#)
- Bruce Hansen. *Econometrics*, [more here](#)
- Gareth James, Witten Daniela, Hastie Trevor and Tibshirani Robert. *An Introduction to Statistical Learning with Applications in R*, [available here](#)
- Hastie Trevor, Tibshirani Robert and Friedman Jerome. *The Elements of Statistical Learning*, [available here](#)
- Huber Martin. *Causal Analysis*, [more here](#)



**Papers you definitely should read:**

- Athey and Imbens (2019): Machine Learning Methods Economists Should Know About, *Annual Review of Economics*, 11, 685–725.
- Bach *et al.* (2021): DoubleML - An Object-Oriented Implementation of Double Machine Learning in R, *arXiv: 2103.09603*.
- Bach *et al.* (2022): DoubleML - An Object-Oriented Implementation of Double Machine Learning in Python, *Journal of Machine Learning Research* 23(53), 1-6.
- 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.

**Papers you could read if you have plenty of time:**

- 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.