Applied Econometrics

Machine Learning in Health Economics

Course instructor

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Lecture: September 19-23, 2022

Prerequisites: A solid introductory course 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.

Course description: The course covers a selection of state-of-the-art methods in econometrics and machine learning. 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 likely cover the following topics:

- Regression Shrinkage Methods (Ridge, Lasso, Elastic Net)
- Decision Trees, Random/Causal Forests
- Advanced Identification Strategies (e.g., Double Machine Learning)
- Introduction to Neural Networks

In the morning sessions, we will discuss the econometric methods and/or machine learning techniques (including some applications to illustrate them). Students will then apply these methods and will replicate recent research papers in the afternoon sessions. There will be an organizational meeting one week before the lectures start (via Zoom). At this meeting, I will assign a (replication) project to each student, which (s)he will present at the end of the course week. The presentation (roughly 15 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. The report will be due four weeks after the presentations.

Grading: Successful participation (no explicit grading)

Recommended textbooks:

Hansen Bruce. *Econometrics*, online textbook
available at `http://www.ssc.wisc.edu/~bhansen/econometrics`

Hastie Trevor, Tibshirani Robert and Friedman Jerome. *The Elements of Statistical Learning*, Springer,
available at `https://web.stanford.edu/~hastie/Papers/ESLII.pdf`

Goodfellow Ian, Bengio Yoshua and Courville Aaron. *Deep Learning*, MIT Press,
available at `https://www.deeplearningbook.org`

Reading materials:

- 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.
- Borgschulte and Vogler (2020): Did the ACA Medicaid Expansion Save Lives?, *Journal of Health Economics*, 72, 102333.
- Brot-Goldberg *et al.* (2017): What does a Deductible Do? The Impact of Cost-Sharing on Health Care Prices, Quantities, and Spending Dynamics, *Quarterly Journal of Economics*, 132(3), 1261–1318.
- Buchner, Wasem and Schillo (2017): Regression Trees Identify Relevant Interactions: Can this Improve the Predictive Performance of Risk Adjustment?, *Health Economics*, 26, 74–85.
- Chernozhukov *et al.* (2018): Double/debiased Machine Learning for Treatment and Structural Parameters, *Econometrics Journal*, 21, C1–C68.
- Everding and Marcus (2020): The Effect of Unemployment on the Smoking Behavior of Couples, *Health Economics*, 154–170.
- Farbmacher, Guber, Klaassen (2021): Instrument Validity Tests with Causal Forests, *Journal of Business and Economic Statistics*, forthcoming.
- Farbmacher, Löw, Spindler (2021): An Explainable Attention Network for Fraud Detection in Claims Management, *Journal of Econometrics*, forthcoming.
- McGuire, Zink and Rose (2021): Improving the Performance of Risk Adjustment Systems, *American Journal of Health Economics*, 7(4).
- Mullainathan and Spiess (2017): Machine Learning: An Applied Econometric Approach, *Journal of Economic Perspectives*, 31(2), 87–106.
- Rose (2016): A Machine Learning Framework for Plan Payment Risk Adjustment, *Health Services Research*, 51(6), 2358–2374.
- Rose, Bergquist and Layton (2017): Computational Health Economics for Identification of Unprofitable Health Care Enrollees, *Biostatistics*, 18(4), 682–694.
- Varian (2014): Big Data: New Tricks for Econometrics, *Journal of Economic Perspectives*, 28(2), 3–28.
- Windmeijer, Farbmacher, Davies, Davey Smith (2019): On the Use of the Lasso for Instrumental Variables Estimation with Some Invalid Instruments, *Journal of the American Statistical Association*, 114(527), 1339–1350.
- Wüthrich and Zhu (2021): Omitted Variable Bias of Lasso-based Inference Methods: A Finite Sample Analysis, *Review of Economics and Statistics*, forthcoming.