Dr. Arne Jonas Warnke
(BASF SE)

Heidelberg University
Summer Term 2020

Topics in Machine Learning and Applied Econometrics

Comments

The seminar takes place on June 19-20, 2020, in room 01.030. A maximum of 15 students can participate in the seminar.

Description

Econometrics on the one hand is often hypothesis-driven, for example based on economic theory, with the aim to estimate parameters and establish causal relationships. Machine learning on the other hand is data-driven, often interested in accurate predictions, at best without being explicitly coded. In this seminar, we will illuminate similarities and differences between these two “cultures” of statistical learning. We will discuss typical approaches on how to gain insights from data, the role of theory and what each discipline can learn from the other.

We will consider, among others, an introduction to the following topics

- Parameter estimation, causality and prediction
- Generalizability
- Average and heterogeneous (causal) effects
- Internal and external validity
- Quantifying uncertainty
- Black box modelling vs interpretability
- From linear models to regression trees to deep learning
- Supervised and unsupervised learning
- Hyperparameter tuning
- Fairness and statistical discrimination
- Reinforcement learning
- Artificial Intelligence and productivity growth

Instead of presenting a seminar paper, participants may also opt for an empirical programming challenge (in Python or R).

The first meeting will take place on April 24, 2019, from 14.00 to 16.00 in room 02.036. To register for the seminar, please indicate a topic you are interested in (you may also suggest new topics) via email to arne.warnke@gmail.com . Additional Q&A sessions will be announced in the first meeting.
The deadline for registration is April 22, 2019.

Certificates

Your grade will be based on the following: seminar paper (60%), seminar presentation (30%) and active participation (10%) in the seminar discussion. For the students who participate in the programming challenge, the grading looks as follows: coding (30%), documentation (30%), seminar presentation (30%) and active participation (10%).

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Content (among others)

Athey, Susan. "The impact of machine learning on economics." In *The Economics of Artificial Intelligence: An Agenda*. University of Chicago Press, 2018.
https://www.gsb.stanford.edu/sites/gsb/files/publication-pdf/atheyimpactmlecon.pdf

Athey, Susan, and Guido Imbens. *Lectures on Machine Learning*. NBER Summer Institute Econometric Lectures, 2015. https://www.nber.org/econometrics_minicourse_2015/

Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. *Deep Learning*. MIT Press (2016). Available at https://www.deeplearningbook.org/

Breiman, Leo. "Statistical modeling: The two cultures." *Statistical science* 16, no. 3 (2001): 199-231. Available via http://www2.math.uu.se/~thulin/mm/breiman.pdf

Brynjolfsson, Erik, Daniel Rock, and Chad Syverson. "Artificial Intelligence and the Modern Productivity Paradox." *The Economics of Artificial Intelligence: An Agenda* (2019): 23.
https://www.nber.org/papers/w24001.pdf

Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. *The elements of statistical learning*. Vol. 1, no. 10. New York, NY, USA:: Springer series in statistics, 2001. Available at
https://web.stanford.edu/~hastie/ElemStatLearn/download.html

Gentzkow, Matthew, Bryan Kelly, and Matt Taddy. "Text as data." *Journal of Economic Literature* 57, no. 3 (2019): 535-74. https://web.stanford.edu/~gentzkow/research/text-as-data.pdf

Koopmans, Tjalling C. "Measurement without theory." *The Review of Economics and Statistics* 29, no. 3 (1947): 161-172.

James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. *An introduction to statistical learning*. Vol. 112. New York: Springer, 2013.
http://www-bcf.usc.edu/~gareth/ISL/ISLR%20Seventh%20Printing.pdf

Mullainathan, Sendhil, and Jann Spiess. "Machine learning: an applied econometric approach." *Journal of Economic Perspectives* 31, no. 2 (2017): 87-106.
https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.31.2.87