Assignment #9

Referee report for Athey (2018, forthcoming)

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Research Question

This paper mainly discusses the influence machine learning has on economic research. To be more specific, the research question behind is: how does machine learning shape the development of economic research and what are the prospects of applying machine learning skills into economic study?

Overall, the author compellingly answers these two main research questions, because there are separately adequate discussions about the linkage between machine learning techniques and economics in terms of both ongoing research and future predictions. The development of this paper is as follows: Firstly, the author narrows the discussion of machine learning to "a field which creates algorithms for the application in data manipulation" (Athey, 2018, p3). Building on this definition, the applications could be mainly split into two parts, "supervised and unsupervised machine learning" (Athey, 2018, p3). In this part, the author broadly summarizes how ML could serve as a way to develop "data-driven" researches and the other influences ML has on empirical analysis. Besides, the difficulties of ML to deal with "causal effect estimation" (Athey, 2018, p5) are also brought up. Secondly, the author focuses on the applications of prediction method on policy analysis. The special field of research is listed separately because prediction is quite demanding in this area and ML has the advantages of prediction accuracy. Thirdly, as causal inference is the main interests of the economists, the author outlines the swiftly growing literature of the combination between ML and causality analysis. More emphasis is put on the estimation of "average treatment effects" (Athly, 2018, p12), "heterogeneous treatment effects and optimal policies" (Athey, 2018, p13), the problem of "contextual bandits" (Athey, 2018, p16), "robustness and supplementary analysis"

(Athey, 2018, p17), "panel data and difference-in-difference models" (Athey, 2018, p18) and "factor models and structural models" (Athey, 2018, p19). The last part of the paper shows the authors' prediction for the future "impact of ML on economics" (Athey, 2018, p21).

Literature

As this paper is a review article, there is no specific method utilized to address specific research questions. The paper could be seen as a reference for the computational economists who are considering starting a new project or any social science researchers who are struggling with data collecting and data analysis. Based on her familiarity with the development of ML techniques and empirical analysis, Athey mentions a number of representative papers revolving around different perspectives of applying ML in different stages of economic researches.

However, the author also misses some citations which are worth mentioning in my perspective. Firstly, the author mentions in the paper that "there are many interesting methodological issues involved in finding models that have stable performance and are robust to changing circumstances" (Athey, 2018, p9). However, she did not list any papers related to this special characteristics of ML. Both Argyriou, et al. (2007) and Nie et al. (2010) are great papers about the robustness of machine learning models and should be added into Athey's paper for reference. Secondly, in the last part, the author makes a prediction that the field of "societal impacts of machine learning" and especially "regulatory problems" will become hot research topics. In fact, there are already some published papers concerning the societal effects of ML. One recently published paper on Nature, Awad et al.(2018), gives us an example about how machines could help make moral decisions.

There are also a few unnecessary citations in the paper. For example, the author mentions White (1992) when discussing "ML methods for supervised learning"

(Athey, 2018, p4). Nevertheless, White's paper are not highly correlated with the information Athey tries to convey in that paragraph.

Grammatical and Spelling Errors

There are several grammatical and spelling errors in the body of the text. In the introduction part, paragraph two, the phrase "designed an optimized for" should be corrected as "designed and optimized for". In page 5, the paragraph starting with "To build some...", line 7, "becaues the" might be changed into "because they". In page 7, line 8, "probabiity" should be "probability". In page 11, the sentence "Techniques like instrumental variables seek to use only some of the information that is in the data the clean or exogenous or experiment-like variation in pricesacrificing predictive accuracy in the current environment to learn about a more fundamental relationship that will help make decisions about changing price." has really made me confused. Maybe the better way is to add a bracket between "the clean..." and "... in price".

Extension

Though the author mentions a lot of research that applies ML methods to economic study, this paper is still not a "comprehensive survey". Athey gives us a great example of how to write a review article outlining an interdisciplinary field of study. The broader prediction part could be utilized as a framework for future studies.

Personally, the application of ML in economics does not only entail empirical and data analysis. When it comes the macroeconomics, ML could also serve as a method to better deal with high-dimensional dynamic models. Some of macroeconomic indicators forecasting methods have also emerged in recent years. For example, neural networks has been proved to be useful in finding DSGE model solutions. The hot topic for now is how to improve the precision of the solutions and the algorithms behind. Besides, the method mentioned in this paper could also be adopted in the other fields of study, such as sociology and psychology.

Reference

1. **Athey, Susan**, "The Impact of Machine Learning on Economics," in Joshua Gans Ajay K. Agrawal and Avi Goldfarb, eds., *The Economics of Artificial Intelligence: An Agenda*, National Bureau of Economic Research

2. **Argyriou, Andreas, Theodoros Evgeniou, and Massimiliano Pontil**, "Multi-task feature learning," *Advances in neural information processing systems*, 2007.

3. **E. Awad, S. Dsouza, R. Kim, J. Schulz, J. Henrich, A. Shari, J.F. Bonnefon, and I. Rahwan**, "The Moral Machine Experiment," *Nature*, 2018.

4. **White, Halbert**, "Artificial neural networks: approximation and learning theory," *Blackwell Publishers, Inc.*, 1992.

5. **Nie, Feiping, et al**, "Efficient and robust feature selection via joint ℓ2, 1-norms minimization," *Advances in neural information processing systems*, 2010.