UNIVERSITY OF ALBERTA

Finance Speaker Series

Alberta School of Business
Department of Finance

Presents:

Max Farrell

University of Chicago

Topic:

Deep Learning for Individual Heterogeneity: An Automatic Inference Framework & Deep Neural Networks for Estimation and Inference

Friday, October 1, 2021
1:30pm – 3:00pm

Zoom details located in the calendar invite.
If you are not a member of the Finance department and would like to attend, please contact Beth Boison
(boison@ualberta.ca)
for the Zoom meeting details.

ABSTRACT

We develop methodology for estimation and inference using machine learning to enrich economic models. Our framework takes a standard economic model and recasts the parameters as fully flexible nonparametric functions, to capture the rich heterogeneity based on potentially high dimensional or complex observable characteristics. These "parameter functions" retain the interpretability, economic meaning, and discipline of

classical parameters. Deep learning is particularly well-suited to structured modeling of heterogeneity in economics. We show how to design the network architecture to match the structure of the economic model, delivering novel methodology that moves deep learning beyond prediction. We prove convergence rates for the estimated parameter functions. These functions are the key inputs into the finite-dimensional parameter of inferential interest. We obtain inference based on a novel influence function calculation that covers any second-stage parameter and any machine-learning-enriched model that uses a smooth per-observation loss function. No additional derivations are required. The score can be taken directly to data, using automatic differentiation if needed. The researcher need only define the original model and define the parameter of interest. A key insight is that we need not write down the influence function in order to evaluate it on the data. Our framework gives new results for a host of contexts, covering such diverse examples as price elasticities, willingness-to-pay, and surplus measures in binary or multinomial choice models, effects of continuous treatment variables, fractional outcome models, count data, heterogeneous production functions, and more. We apply our methodology to a large scale advertising experiment for short-term loans. We show how economically meaningful estimates and inferences can be made that would be unavailable without our results.

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