ECON 509900 Causal inference in econometrics
National Tsing Hua University
1st semester, 2022-2023

Time: 3:30pm -6:20pm, every Tuesday (T7T8T9)
Venue: TSMC 203

Office hours: By appointment
Instructor: CY (Chor-yiu) SIN
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Course description: Economics (or management in general) always concerns the cause-effects such as the price causes the quantity demanded/supplied, or a training program causes the productivity of the unemployed.   In a nutshell, a casual equation specifies how a treatment affects an outcome.   In this course, we start with some critiques on the conventional econometric tools such as ordinary least squares (OLS) or instrumental variable (IV) estimation which fails to mimic a randomized experiment nor a natural experiment.   To mimic the former, we go through the literature on "selecting the observables" such as sub-classification and matching.   To mimic the latter, we go through the literature on "selecting the un-observables" such as difference-in-differences (DID), synthetic controls and regression discontinuity (RD).   Casual inference with machine learning methods will also be discussed.

This course discusses the basic principles with examples in economics and management.   Hands-on exercises with the software "R" will also be provided.

Course topics:

1. A traditional approach of ordinary least squares (OLS) or instrumental variable (IV) estimation: its deficiencies
2. Treatment and outcome, counterfactuals, randomized experiments, natural experiments
3. A modern approach of IV: the local average treatment effect (LATE), IV in random trials, internal and external validity
4. Sub-classification, matching, propensity score
5. Difference-in-differences (DID), synthetic controls, panel estimation
6. Regression discontinuity (RD): basic theory, sharp RD, RD diagnostics, global and local RD estimation, fuzzy RD, regression kink design
7. Selection model: control function (CF) estimation, connections to IV, marginal treatment effect
8. Bayes, empirical Bayes and machine learning methods

Textbooks recommended:

(1) Angrist, J.D., Pischke, J.-S., 2009. Mostly Harmless Econometrics: An Empiricist's Companion. New Jersey, U.S.A.: Princeton University Press.

(2) Angrist, J.D., Pischke, J.-S., 2015. Mastering Metrics: The Path from Cause to Effect. New Jersey, U.S.A.: Princeton University Press.

(3) Berzuini, C., Dawid, P., Bernardinelli, L., 2012. Causality - Statistical Perspectives and Applications. West Sussex, U.K.: John Wiley & Sons.

(4) Huynh, V.-N., Kreinovich, V., Sriboonchitta, S., 2016. Causal Inference in Econometrics. Switzerland: Springer.

(5) Imbens, G.W., Rubin, D.B., 2015. Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction. New York, U.S.A.: Cambridge University Press.

(6) Marinovic, I., 2016. Causal Inferences in Capital Markets Research. Delft, The Netherlands: Now Publishers Inc.

Other references:

(1) Angrist, J.D., Pischke, J.-S., 2017. Undergraduate econometrics instruction: through our classes, darkly. Journal of Economic Perspectives 31, 125-144.

(2) Athey, S., 2019. The impact of machine learning on economics (with comments), pp.507-551 in A.K. Agrawal, J. Gans and A. Goldfarb (eds.): The Economics of Artificial Intelligence: An Agenda. Chicago, U.S.A.: University of Chicago Press.

(3) Blackwell, M., Glynn, A.N., 2018. How to make causal inferences with time-series cross-sectional data under selection on observables. American Political Science Review 112, 1067-1082.

(4) Hartford, J., Lewis, G., Leyton-Brown, K., Taddy, M., 2017. Deep IV: a flexible approach for counterfactual prediction. Proceedings of the 34th International Conference on Machine Learning, Sydney, Australia, PMLR 70, 1414-1423.

(5) Ho, T.H., Lim, N., Reza, S., Xia, X., 2017. Causal inference models in operations management. Manufacturing and Service Operations Management 19, 509-525.

(6) Hsiao, C., Ching, H.S., Wan, S.K., 2012. A panel data approach for program evaluation: measuring the benefits of political and economic integration of Hong Kong with Mainland China. Journal of Applied Econometrics 27, 705-740.

(7) Varian, H.R., 2016. Causal inference in economics and marketing. Proceedings of the National Academy of Sciences of the United States of America 113, 7310-7315.

Software: While the software R will be extensively used in class, students are also welcomed to use other software such as C++, Fortran, Gauss, Matlab, Python, SAS or STATA.

Assessment: Attendance and participation in discussions 40%, mid-term examination (oral presentation) 30%, final examination (oral presentation and written report): 30%.

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