Pretesting, Selective Inference

Master's Thesis Workshop 1

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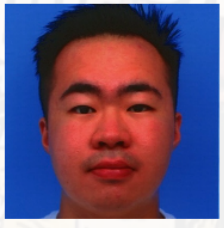
About Me



I am a second-year master's student in Graduate School of Economics, Kyoto University.

Under the guidance of Yoshihiko Nishiyama and Takahide Yanagi, my research focuses on Econometric Theory and Statistics.

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Introduction

Pretesting

- In empirical studies, researchers often implement hypothesis tests before going through with their main analyses, which are used to show certain plausibility of identification conditions.
  - The Hausman test (OLS vs 2SLS)
  - The Durbin-Wu-Hausman test (RE vs FE)
  - The Sargan-Hansen J-test (GMM)
  - Balance test (RCT)
  - Pre-trend test (DiD)
  - Manipulation test (RD)
- These tests are classified as falsification tests, namely, pretests, whose null hypothesis is preferred to be accepted (i.e., failed to reject).

Problems Arising with Pretest

- Recent literatures argue that researchers should not implement such pretests.
- Orthogonality: Specification tests provide no information about the existence of asymptotic bias.
- Low statistical power: Pretests have low statistical power.
- Inconsistent estimates: Conditional on the result of pretesting, the estimator might lose its consistency.
- Low coverage rate: Conditional on the result of pretesting, the coverage probability of $1-\alpha$ confidence interval might be smaller than $1-\alpha$.

Manipulation Test

- In (sharp) RD designs, researchers implement pretests to examine whether the identification condition

$$\text{For each } t = 0, 1,$$
$$\mathbb{E}[Y_i(t)|X_i = x] \text{ is continuous at } x = c$$

  is actually fulfilled.

- The fundamental problem: Note that only one out of $\mathbb{E}[Y_i(0)|X_i = x]$ and $\mathbb{E}[Y_i(1)|X_i = x]$ can be observed. That is, the above condition cannot be directly examined.
- Instead, researchers often examine certain necessary conditions (manipulation test).

Literature: Manipulation Tests

- Testing the continuity of the density of the assignment variable:
  - McCrary (2008) [24]
  - Otsu, Xu and Matsushita (2013) [25]
  - Cattaneo, Jansson and Ma (2020) [6]
- Testing the continuity of the conditional distribution of covariates:
  - Lee (2008) [19]
  - Canay and Kamat (2018) [5]
  - Fusejima, Ishihara and Sawada (2024) [10]
- Testing other necessary conditions of the identification conditions:
  - Arai, Hsu, Kitagawa, Mourifie and Wan (2022) [3] [1]

[1] Quoting lecture slides by T. Yanagi.

Recent Research Interest (1)

- (Master thesis?) Point out that, in RD designs, the estimator of LATE may have asymptotic bias conditional on the result of manipulation test.
- Roth (2022) [27]
  - The event-study estimators have asymptotic bias conditional on the result of pre-trend test.
- Sueishi (2023) [28]
  - The Hausman test and the J test provide no information about the existence of asymptotic bias in the efficient estimator (i.e., **correct specification and valid estimation are different issues**). Note that its framework originates from Chen and Santos (2018) [7].

Recent Research Interest (2)

- Construct a robust estimation/inference procedure in RD designs, which overcomes the problems of pretesting mentioned above.
- Guggenberger (2010a, 2010b) [11],[12]
  - On the impact of the Hausman test on subsequent inference.
- Berk, Brown, Buja, Zhang and Zhao (2013) [4]
  - On valid post-selection inference, which is robust even if wrong models are selected by AIC, BIC or Lasso etc.
- Lee, Sun, Sun and Taylor (2016) [20]
  - On post-selection inference with application to the Lasso.
- Dzemski, Okui and Wang (2025) [9]
  - On location characteristics of conditional confidence intervals concerning publication bias issues.
- Keywords: **Selective Inference**, Post-Model-Selection, $\cdots$

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[2]Kyoto University (Supervisor)
[3]Kyoto University (Supervisor)
[4]Kobe University
[5]University of Tokyo
[6]Waseda University

Survey

Empirical Papers Implementing the Manipulation Test

- メモ：
- Roth (2022) みたいなサーベイをやる.
- とりあえず直近の課題：Sharp RD の実証ペーパー集めてくる．Fusejima et al (2024) でめちゃくちゃ集めてたから参考になりそう.

Theoretical Analysis

Practical Recommendations

References

References i

- Andrews, D. W. and P. Guggenberger (2009a). Hybrid and size-corrected subsampling methods. *Econometrica 77*(3), 721-762.
- Andrews, D. W. and P. Guggenberger (2009b). Incorrect asymptotic size of subsampling procedures based on post-consistent model selection estimators. *Journal of Econometrics 152*(1), 19-27.
- Arai, Y., Y. C. Hsu, T. Kitagawa, I. Mourifie and Y. Wan (2022). Testing identifying assumptions in fuzzy regression discontinuity designs. *Quantitative Economics 13*, 1-28.

References ii

- Berk, R., L. Brown, A. Buja, K. Zhang, and L. Zhao (2013). Valid post-selection inference. *Annals of Statistics 41*(2), 802-837.
- Canay, I. A. and V. Kamat (2018). Approximate permutation tests and induced order statistics in the regression discontinuity design. *Review of Economic Studies 85*, 1577-1608.
- Cattaneo, M. D., M. Jansson and X. Ma (2020). Simple local polynomial density estimators. *Journal of the American Statistical Association 115*(531), 1449-1455.
- Chen, X. and A. Santos (2018). Overidentification in regular models. *Econometrica 86*(5), 1771-1817.

References iii

- Doko Tchatoka, F. and W. Wang (2021). Size-corrected bootstrap test after pretesting for exogeneity with heteroskedastic or clustered data. SSRN Working Paper.
- Dzemski, A., R. Okui and W. Wang (2025). Location characteristics of conditional selective confidence intervals via polyhedral methods. arXiv:2502.20917v1.
- Fusejima, K., T. Ishihara and M. Sawada (2024). A unified diagnostic test for regression discontinuity designs. arXiv:2205.04345v4.
- Guggenberger, P. (2010a). The impact of a hausman pretest on the asymptotic size of a hypothesis test. *Econometric Theory 26*(2), 369-382.

References iv

- Guggenberger, P. (2010b). The impact of a hausman pretest on the size of a hypothesis test: The panel data case. *Journal of Econometrics 156*(2), 337-343.
- Guggenberger, P. and G. Kumar (2012). On the size distortion of tests after an overidentifying restrictions pretest. *Journal of Applied Econometrics 27*(7), 1138-1160.
- Judge, G. G. and M. E. Bock (1978). *The Statistical Implications of Pre-test and Stein-Rule Estimators in Econometrics.* North-Holland
- Kabaila, P. (1995). The effect of model selection on confidence regions and prediction regions. *Econometric Theory 11*(3), 537-549.

References v

- Kitamura, Y., T. Otsu and K. Evdokimov (2013). Robustness, infinitesimal neighborhoods, and moment restrictions. *Econometrica 81*(3), 1185-1201.
- Kivaranovic, D. and H. Leeb (2021). On the length of post-model-selection confidence intervals conditional on polyhedral constraints. *Journal of the American Statistical Association 116*(534), 845-857.
- Kivaranovic, D. and H. Leeb (2024). A (tight) upper bound for the length of confidence intervals with conditional coverage. *Electronic Journal of Statistics 18*, 1677-1701.

References vi

- Lee, D. S. (2008). Randomized experiments from non-random selection in US House elections. *Journal of Econometrics 142*(2), 675-697.
- Lee, J. D., D. L. Sun, Y. Sun and J. E. Taylor (2016). Exact post-selection inference, with application to the lasso. *Annals of Statistics 44*(3), 907-927.
- Leeb, H., and B. M. Potscher (2005). Model selection and inference: Facts and fiction. *Econometric Theory 21*(1), 21-59.
- Leeb, H., and B. M. Potscher (2006). Can one estimate the conditional distribution of post-model-selection estimators? *Annals of Statistics 34*(5), 2554-2591.

References vii

- Leeb, H., B. M. Potscher and K. Ewald (2015). On various confidence intervals post-model-selection. *Statistical Science 30*(2), 216-227.
- McCrary (2008). Manipulation of the running variable in the regression discontinuity design: A density test. *Journal of Econometrics 142*(2), 698-714.
- Otsu, T., K. L. Xu, and Y. Matsushita (2013). Estimation and inference of discontinuity in density. *Journal of Business and Economic Statistics 31*(4), 507-524.
- Potscher, B. M. (1991). Effects of model selection on inference. *Econometric Theory 7*(2), 163-185.

References viii

- Roth, J. (2022). Pretest with caution: Event-study estimates after testing for parallel trends. *American Economic Review: Insights 4*(3), 305-322.
- Sueishi, N. (2023). A misuse of specification tests. arXiv:2211.11915v1.
- Tibshirani, R. J., J. Taylor, R. Lockhart and R. Tibshirani (2016). Exact post-selection inference for sequential regression procedures. *Journal of the American Statistical Association 111*(514), 600-620.