ECON6300/7320/8300
Advanced Microeconometrics
Bootstrap

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Practical 7
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Introduction

- This class will review:
  - Bootstrap without asymptotic refinement
  - Bootstrap with asymptotic refinement
  - Clustered bootstrap
  - Residual bootstrap
- We begin with a demonstration using the data from Microeconometrics using STATA chapter 3 (Health and insurance data)
- We move on to a Monte-Carlo based practical.

Practical

- In this practical you will conduct a Monte-Carlo experiment to assess the distribution of the OLS estimator under endogeneity.
- The data generating process is:

$$y_i = \beta x_i + u_i \quad i = 1, ..., N$$
$$x_i = \frac{\alpha_1 z_i + \alpha_2 u_i + v_i}{\sqrt{\alpha_1^2 + \alpha_2^2 + 1}}$$
$$u_i \sim \mathcal{N}(0,1), z_i \sim \mathcal{N}(0,1), v_i \sim \mathcal{N}(0,1)$$

- **Note:** We scale x_i by $\sqrt{\alpha_1^2 + \alpha_2^2 + 1}$ so that $x_i \sim \mathcal{N}(0,1)$. Consequently, we can vary α_1, α_2 without changing the marginal distribution of x_i, though clearly we change it's joint distribution with z_i, u_i, v_i.

Practical

1. For which value(s) of α_1, α_2 does $\mathrm{E}[u_i|x_i] = 0$? For which value(s) does $\mathrm{E}[u_i|z_i] = 0$?
2. Write a program to generate the data, compute the OLS and 2SLS estimators of β, and store them as scalars.
   - To generate the data, use $N = 500$, $\beta = 1$ and $\alpha_1 = \alpha_2 = 0.5$.
   - For the 2SLS estimator, use z_i as the instrument.
3. Conduct a Monte-Carlo experiment with 1000 replications in order to obtain the distributions of $\widehat{\beta}_{OLS}$ and $\widehat{\beta}_{2SLS}$.
4. Summarize $\widehat{\beta}_{OLS}$ and $\widehat{\beta}_{2SLS}$ and produce a histogram of their distributions. What do you conclude about the estimators?
5. Repeat 2-4 setting $\alpha_1 = 0.5, \alpha_2 = 0$. Explain why your results change.
6. Repeat 2-4 setting $\alpha_1 = 0, \alpha_2 = 0.5$. Explain why your results change.
7. Repeat 2-4 using $N = 10,000$. Explain why your results change.