EC 421

Final Review Questions from "New" Lectures

13 March 2019

Note: These questions should help you review—along with our four problem sets. This review is not necessarily comprehensive. I still suggest reviewing the problem sets, notes, and other course material.

Note$_2$: We will not provide an answer key to these review questions.

0. If $y_i = \beta_0 + \beta_1 x_i + u_i$, does $\text{Cov}(x_i, u_i) \neq 0$ violate any of our assumptions? If so: which assumptions are violated and how does this affect OLS?

1. What is the difference between a **static** time-series model and a **dynamic** time-series model?

2. How would we estimate the *total effect* of **income** on **births** using the following estimated model?

$$\text{Births}_t = \hat{\beta}_0 + \hat{\beta}_1 \text{Income}_t + \hat{\beta}_2 \text{Income}_{t-1} + \hat{\beta}_3 \text{Income}_{t-2} + e_t$$

3. We are interested in the effect of income on births. Write down an ADL(2,2) model.

4. **T/F** By including a lagged dependent variable, we implicitly include many lags of the explanatory variable.

5. **T/F** In the model $\text{Births}_t = \beta_0 + \beta_1 \text{Income}_t + u_t$, the parameter β_1 gives the effect of income in the previous time period on births in the current period.

6. **T/F** OLS is consistent for dynamic time-series models with lagged dependent variables as long as the model maintains the contemporaenous exogeneity assumption.

7. How do lagged explanatory variables affect OLS? Is this effect different from lagged dynamic variables?

8. Define autocorrelation. Give an example of a variable that you believe is autocorrelated and, using your definition, explain why you believe it is autocorrelated.

9. Write down the formula/equation for an AR(3) process.

10. How does autocorrelation impact OLS's estimates for static models? What about dynamic models with lagged explanatory variables?

11. Explain why OLS is biased for dyanmic models with lagged dependent variables and autocorrelated disturbances. It may be helpful to (a) write out a model with a lagged dependent variable and (b) write out an AR(1) disturbance.

12. What are the null and alternative hypotheses for a Breusch-Godfrey test?

13. If a Breusch-Godfrey test rejects H_0, what do we conclude? What if it fails to reject H_0?

14. Explain how misspecification can lead to autoregressive disturbances.

15. What does it mean for the variance of a random variable to be stationary?

16. If the covariance between u_t and u_{t-1} increases as t gets larger, then is u_t stationary? Briefly explain.

17. Write down the function for a random walk. Is it stationary?

18. We discussed random walks and autocorrelated variables. How are these concepts similar? How are they different?

19. **T/F** Nonstationary processes can cause OLS to find significant and spurious relationships.

20. How do randomized experiments help us causally estimate treatment effects?

21. What is the fundamental problem of causal inferenece? How do we "deal" with it?

22. Define selection bias and give an example.

23. What problem does instrumental variables attempt to solve?

24. What are the two requirements for a valid instrument?

25. **T/F** An instrument is *exogenous* if it directly affects y (the outcome) and also affects y through the endogenous variable x.

26. Explain why *physical fitness* is probably an invalid instrument for military service, while *military draft* is likely a valid instrument.

27. The probability limit of the instrumental variables estimator is

$$\operatorname{plim}\left(\hat{\beta}_1^{\mathrm{IV}}\right) = \beta_1 + \frac{\operatorname{Cov}(z,\, u)}{\operatorname{Cov}(z,\, x)}$$

where z is our instrument, u is the disturbance, and x is our endogenous variable.

Use this equation to show how the two requirements of a valid instrument give us consistency.

28. Define unbiasedness, consistency, and efficiency.

29. Under which circumstances can we trust OLS to be unbiased and/or consistent? When is it efficient?

30. Under which circumstances is OLS to be biased and/or inconsistent?

"Suggestions"

A. Review the Venn diagrams in the instrumental variables lecture. Using the diagram explain omitted-variable bias, how *valid* instrumental variables can avoid omitted-variable bias, and how instruments can "break" (be in valid).

B. Review the "ideal dataset/experiment" in the causality lecture and instrumental variables lecture. Explain why the "ideal" is not possible? Using the provided example data, calculate (**1**) individual treatment effects, (**2**) average treatment effects, (**3**) difference in means between the treatment and control groups, and (**4**) selection bias.