Exam 3: Chapters 8, 9, 10, 12 Coverage

Question: What are the things we need to prove/know/memorize/etc?

Remember, you can create and bring a one-page double sided formula sheet!

Calculations and derivations

You should be able to calculate or derive the following. Also, interpret what they mean and do not mean!

General notes (across all our chapters)

- Interpret coefficients correctly and precisely with units
- Use subscripts appropriately and properly write population models and estimated equations

Nonlinear regression (Ch 8)

- Compute the marginal effect of X in a quadratic model, find the turning point of a quadratic
- Apply the log interpretation table to correctly interpret β_1 in level-level, log-level, level-log, and log-log specifications
- Compute the marginal effect of X_1 in a model with an interaction term:
  - Binary $\times$ binary
  - Binary $\times$ continuous
  - Continuous $\times$ continuous

Difference-in-differences (Ch 10)

- Calculate a DiD estimate from a 2x2 table (treatment/control $\times$ before/after) by hand
- Set up and interpret a basic DiD regression
  - Identify which coefficient is the DiD estimate and interpret it
  - Calculate group means from the coefficients (for example, the treatment group in the after period)

Fixed effects / First differencing (Ch 10)

- Show how first-differencing eliminates the entity fixed effect α_i

Instrumental variables (Ch 12)

- Set up and interpret the two stages of 2SLS:
- Evaluate the first-stage F-statistic against the $F > 10$ rule of thumb
- Know the reduced-form / Wald relationship with a binary instrument

Empirical interpretation

You could see any of the following and be asked to interpret key elements:

- Regression output with nonlinear terms (polynomial, log transformations, interaction terms)
- A regression with entity and/or time fixed effects
- 2SLS/IV output (first stage and second stage)
- A DiD setup (2x2 table or regression output)

You could be asked to:

- Interpret coefficients correctly — compute marginal effects at specific values for polynomials and interactions; apply the log table for log specifications
- Given a research scenario…
  - Identify which threat(s) to internal validity apply (and do not apply!) and propose solutions
  - Identify and evaluate threats to external validity
- Discuss the direction of bias from omitted variables or from measurement error (attenuation bias — toward zero)
- Evaluate whether a proposed instrument satisfies the two conditions (relevance, exogeneity) — and distinguish which conditions are testable vs. which require argumentation (*Note that you may think of them as three conditions: relevance, exogeneity, and exclusion, if you prefer*)
- Interpret what the IV estimate actually measures (LATE for compliers, not the ATE for the full population)
- Discuss internal vs. external validity of a study
- Reflect on economic vs. statistical significance

Theoretical interpretation

Five threats to internal validity (Ch 9)

- You should be able to name, define, and identify in context each of the five threats to internal validity
- Know at least one solution for each threat:
- Know the direction of bias for measurement error when applicable (classical) and when you can't know the direction
- Be able to identify which threat applies to a given research scenario

Causal diagrams / DAGs (Ch 9b)

- Draw and interpet (relatively simple) DAGs
- Distinguish causal (front-door) paths from backdoor paths and their implications
- Confounding = OVB = open backdoor path
- Understand what "controlling for" a variable does — and what not to control for (mediators, colliders)
- Explain in theory and through examples

Panel data and fixed effects (Ch 10)

- Distinguish panel data from cross-sectional, time-series, and pooled cross-sections
- Explain what entity fixed effects control for (all time-invariant unobserved characteristics) and what they *cannot* control for (time-varying omitted variables)
- State and interpret the parallel trends assumption and explain why it matters for DiD
  - Know what happens if parallel trends is violated
  - Know how to assess it
- Understand how to adjust standard errors when working with panel data

Instrumental variables (Ch 12)

- The two conditions for a valid instrument (in words and equations), which are testable (and how) and which are not testable
- The weak instruments problem

Cross-chapter connections

- When faced with different sorts of internal validity problems, which methods help (and why) and which do not