ECON 6200 : Section 9 (Review) 3/25/25

Prelim 1 is on March 27th Thursday @ 10:10 AM

Office Hours : Tomorrow Wednesday 9 AM – 11 AM

(Not exhaustive!)

Topics to Review for Prelim

① OLS

a) best linear predictor (projection) vs. causal linear model

b) decomposition of the projection : FWL, OVB

c) finite sample theory of OLS :

- assumptions
- results : unbiasedness, finite-sample variance, Gauss-Markov theorem
- exact distribution and hypothesis testing under normality

d) asymptotic theory :

- assumptions
- results : consistency, asymptotic normality
- inference : joint inference, multiple hypothesis testing

② Instrumental Variables

a) intuition
b) assumptions: relevance + validity
   ↳ whether and when they are testable / not testable
c) results: consistent, but not unbiasedness, asymptotics of simple IV (vs. OLS)
d) IV vs. TSLS → leads to overidentification
e) Weak Instrument (Intuition)

③ GMM

a) definition
b) relationship w/ TSLS
c) assumptions
d) results: consistency, asymptotic normality, asymptotic efficiency
   ↳ optimal weights
   ↳ efficient TSGMM estimator
e) overidentification test
f) multiple equation GMM:
   - Ex: SUR, common coefs., ...
   - pro/cons of joint estimation

④ Panel Data

↳ go over fixed effects derivations

2016 Q1

1. Poisson Regression. A researcher observes the random variables $(y_i, \mathbf{x}_i)$, where (conditionally on $\mathbf{x}_i$) y_i is distributed independently according to a Poisson distribution with parameter

$$\lambda_i = \mathbf{x}_i'\boldsymbol{\beta}.$$

Recall that the Poisson distribution has probability mass function

$$\Pr(y_i = y) = \lambda^y \exp(-\lambda)/y!, y \geq 0,$$

and expectation and variance equal to λ.

1.1 A researcher estimates $\boldsymbol{\beta}$ by running an OLS regression of y_i on $\mathbf{x}_i$. Write down the estimator $\widehat{\boldsymbol{\beta}}$. Is $\widehat{\boldsymbol{\beta}}$ consistent?

1.2 Is $\widehat{\boldsymbol{\beta}}$ unbiased? Is it linear (in the sense required by Gauss-Markov)? Is it best linear unbiased?

1.3 Fitted values from the above regression can be negative. To avoid that, one could model y_i as being Poisson with parameter

$$\lambda_i = \exp\left(\mathbf{x}_i'\boldsymbol{\beta}\right).$$

Asuming this model is true, can $\boldsymbol{\beta}$ be estimated by OLS regression of $\log y_i$ on $\mathbf{x}_i$?

1.4 Can you sketch out a method to estimate $\boldsymbol{\beta}$ in the model from 1.3?

2024 Q1

2 This question is about scalar random variables (Y, X, Z). Researchers observe i.i.d. realizations $(Y_i, X_i, Z_i)_{i=1}^n$ and are interested in the causal effect of X on Y. Assume homoskedasticity throughout.

2.1 Researcher 1 uses the following two-step procedure:

1. Regress X on Z.
2. Regress Y on the fitted values $\hat{X}$ of the first regression.

Name the estimator and state standard assumptions under which this estimator will be appropriate in some asymptotic sense.

2.2 Researcher 2 uses the following two-step procedure:

1. Regress X on Z.
2. Regress Y on the residuals $\hat{\eta} := X - \hat{X}$ of the first regression.

Name the estimator and state standard assumptions under which this estimator will be appropriate in some asymptotic sense.

2.3 Suppose all assumptions that you stated hold. What estimator (of the above or other) would you propose?

2014 Q3