

Problem Set 5

Due: 04/03

Reminder: Please upload hand-written part on NTU COOL

Part One: Hand-Written Exercise

1. Verify the statement on slide 40, Lecture 4. That is, write down the 3×3 matrix $\mathbf{R}\tilde{\mathbf{D}}\mathbf{R}'$ using the notation d_{ij} , where $\mathbf{R} = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & \cdots & 0 \\ 0 & 0 & 1 & 0 & 0 & \cdots & 0 \\ 0 & 0 & 0 & 1 & 0 & \cdots & 0 \end{bmatrix}$ and

$$\tilde{\mathbf{D}} = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1(k+1)} \\ d_{21} & d_{22} & \cdots & d_{2(k+1)} \\ \vdots & \vdots & \ddots & \vdots \\ d_{(k+1)1} & d_{(k+1)2} & \cdots & d_{(k+1)(k+1)} \end{bmatrix}.$$
2. Verify the statement on slide 10, Lecture 5. That is, $\hat{\beta}_{1,IV} = \frac{\sum_{i=1}^n (z_i - \bar{z})(y_i - \bar{y})}{\sum_{i=1}^n (z_i - \bar{z})(x_i - \bar{x})}$.
3. Verify the statement on slide 28, Lecture 5. That is, $\sqrt{n}(\hat{\beta}_{\text{GMM}} - \mathbf{b}_o) \xrightarrow{D} \mathcal{N}(\mathbf{0}, \mathbf{D}_o)$.

Part Two: Part Two: Computer Exercise

1. Please load the dataset `SchoolingReturns` in R, which is a cross-section data from the U.S. National Longitudinal Survey of Young Men (NLSYM) in 1976, containing 3,010 observations on 22 variables. The variable we are interested in modelling is “`wage`”. However, using the variable “`education`”, the years of education, to explain “`wage`” is problematic because it can be argued that schooling is endogenous (and thus “`experience`” is also endogenous since it equals to `age - education - 6`). Thus, we conduct 2SLS estimations with the outcome `log(wage)`, endogenous regressors “`education`”, “`experience`” and the square of “`experience`” with their IV “`nearcollege`”, “`age`” and the square of “`age`”. Other exogenous regressors are “`ethnicity`”, “`smsa`” and “`south`”.
 - (a) Perform the first stage of 2SLS.
 - (b) Perform the second stage of 2SLS. Show the estimated coefficient for “`education`”.
 - (c) Perform 2SLS with the function “`ivreg`” and show the estimated coefficient for “`education`”. Verify that it’s identical to (b).