

ECON 5360 Final Exam – Spring 2013

1. **Systems of Equations (50 pts)**. Consider the following structural simultaneous equation model:

$$\begin{aligned}y_{1,t} &= \beta_x x_t + \gamma_1 y_{2,t} + \epsilon_{1,t} \\ y_{2,t} &= \beta_w w_t + \beta_z z_t + \gamma_2 y_{1,t} + \epsilon_{2,t}\end{aligned}$$

where all variables are in deviation-from-mean form, the vector $\{x, w, z\}$ is exogenous, and $t = 1, \dots, T$.

- Find the reduced-form equations.
 - Propose an estimation strategy for the reduced-form parameters. How does your estimation strategy compare to estimation of an SUR model? Explain.
 - Are the structural parameters identified? Explain.
 - Formally show that OLS estimates of γ_1 are biased.
 - Describe how to perform GMM estimation of β_x and γ_1 .
2. **Panel Data (50 pts)**. Consider a simple panel model with one exogenous variable, $x_{i,t}$.

- Write down a two-way fixed effects (FE) model, clearly defining all variables and the notation.
 - Write down the standard random effects (RE) model and the associated variance-covariance matrix of the errors, Ω .
 - Form the matrix equivalent of your model in part (a).
 - What is the variance-covariance matrix for the OLS estimator, b , of the RE model? What are the tradeoffs between b and $\hat{\beta}_{RE}$?
 - Develop a Hausman test for FE vs. RE. Write a short paragraph that includes some intuition for how the test works.
3. **Probit Model (50 pts)**. Consider a probit model for passing this class (i.e., receiving an 80% or better):

$$y_i^* = \beta_0 + x_i \beta_1 + \epsilon_i,$$

where y_i^* is your latent cumulative score and x is the number of hours devoted to studying per week.

- How would you estimate β_0 and β_1 if you had data on cumulative scores? Could you identify the parameters separately from σ ?
- Now assume you only have data on whether the student passes ($y_i = 1$) or fails ($y_i = 0$). Carefully form the likelihood function.
- Find the first-order conditions (FOCs) for the probit model.
- Propose a strategy to solve the FOCs and complete the estimation.
- Find an expression for the marginal effect, δ_x , of one more hour studying on the probability of passing this class. Show how to find the associated standard error of $\hat{\delta}_x$.