Ph.D. Econometrics II
Heinz School, Carnegie Mellon University
90-907, Fall 1999

Final

Instructions You may use any books, notes, calculators, and other aids you like. You may not converse, nor may you cooperate.

Please complete all questions.

Each question is worth 25 points.

Please show all relevant work.

Please interpret your results in plain English.

Please refer to the relevant page in the output to tell us where you are getting your numbers and other results. (use the "SAS" page numbers — the small ones — so that the first regression appears on page 2).

Special When doing any matrix algebra involving matrices larger than 2 by 2, you do not have to do the algebra. Just set up the equation with all numbers "ready to go" and then explain what you would do.

1. Suppose that we have a Tobit model:

$$\begin{aligned} Y^* &= X\beta + \epsilon \\ Y &= 0 Y^* \leq 0 \\ Y &= Y^* Y^* > 0 \\ & \epsilon \sim N(0, \sigma^2) \end{aligned}$$

However, we only observe a dummy variable Z which is equal to 1 if $Y^* > 0$ and 0 otherwise.

(a) Of the $K+1$ parameters β, σ, what can we estimate using Z and the Xx?

(b) Which of the following things can we estimate consistently and how?

i. $P\{Y > 0\}$

ii. $E(Y|Y > 0, X)$

iii. "Standardized" $E(Y|Y > 0)$. What I mean by standardized is, instead of the level of Y, the number of standard deviations(of the error) of Y above zero (that is Y/σ).

2. Consider the following selection model, for which we have panel data:

$$\begin{aligned} Y_{1it} &= X_{it}\beta_1 + \epsilon_{1it} \\ Y_{2it} &= X_{it}\beta_2 + \epsilon_{2it} \\ W_{it} &= Y_{2it}Y_{1it} > 0 \end{aligned}$$

W is a wage and Y_1 controls selection into employment.

Two methods are proposed to estimate this model. First, a conventional selection model by maximum likelihood. Second, a fixed effects model in which W is regressed on X for all those observations where W is observed.

(a) For the selection model to yield consistent estimates of β_2, which of the following assumptions are important (and why):

i. Y_1 equation properly specified

ii. Y_2 equation properly specified

iii. $\epsilon_i t \sim N(0, \Sigma)$

iv. No fixed or random individual or time effects in either equation, Y_1 or Y_2

v. ϵ_1 and ϵ_2 independent

(b) How about for the fixed effects model?

3. Please consider the fragment of the output from homework 3 attached. I have heavily edited the .lst file to make it more readable. Also, recall the model of hospital costs:

$$\ln Cost_{it} = \beta_1 + \beta_2 \ln visits_{it} + \beta_3 \ln days_{it} + \epsilon_{it}$$

Please calculate the what the *expected* marginal costs of an extra day for the hospital ID 10735 would have been in 1995 if it had the average levels of days and visits. That is, calculate $E\left\{\frac{\partial C}{\partial days}\right\}$. Notice, I am not asking about the expected value of the *natural log* of costs for this hospital!

You may assume that error terms are normal if that helps you. Also, recall that $Eexp(x) = exp(V(x)/2)$ if x is normal with zero mean.

4. Consider the output marked final-orderedprobit. Here, an ordered probit model is estimated which has number of hospitals in a city as the LHS variable and population as the RHS variable.

   Let's define the population threshold for one hospital as the minimum population necessary to support one hospital (assuming the error term is zero). The population threshold for two hospitals is the minimum pop to support two hosps (assuming the error term is zero).

   The pattern of these thresholds reveals something about the nature of competition in hospital markets (ask your colleague Jean Abraham for a copy of her job market paper if you are curious about what).

   Please construct an estimate and 95% confidence interval for:

   (a) the first threshold

   (b) the ratio of the first to the second thresholds

   Hint: It would be wise to begin by writing down the ordered probit model and thinking about how it works when you are assuming that the error is equal to zero.

   If you need help reading the SAS output, please ask for it.