Econ 7218 Problem Set 1

Due by Monday, March 22, 2021

For this course, it will be necessary to use a general or scientific programming language such as Matlab, Python, or R. The goal of this problem set is to learn the basics of such tools by simulating and estimating a simple discrete choice model via numerical optimization algorithms.

Consider a simple binary choice model where unobserved error terms U_1 and U_2 are both standard type-I value distributed with cdf

$$F(u) = \exp(-\exp(-u))$$

and where there are two covariates $X_1 \sim N(0,1)$ and $X_2 \sim \chi^2_1$.

$$y_i = \begin{cases} 1 & if\ X_{1i}\beta_1 + U_{1i} > X_{2i}\beta_2 + U_{2i} \\ 0 & otherwise \end{cases}$$

The resulting probability function of y_i is

$$Pr(y_i = 1|X_{1i}, X_{2i}) = \frac{\exp(X_{1i}\beta_1 - X_{2i}\beta_2)}{1 + \exp(X_{1i}\beta_1 - X_{2i}\beta_2)}.$$

Suppose that $\beta = 1.0$ and $\beta_2 = -0.5$.

1. Simulate a dataset of size $N = 400$ from the model for a given set of parameter values (β_1, β_2).
2. Code the log likelihood function as a function of the parameters (β_1, β_2).
3. Code a grid search algorithm over the parameter space $\beta_1 \in [-5, 5]$ and $\beta_2 \in [-5, 5]$.
4. Generate $R = 100$ samples of size $N = 400$ in Step 1. Estimate the model for each sample with a gradient method (BHHH, BFGS, etc.) or Nelder-Mead to maximize the log likelihood function and report the mean and standard deviation of the parameter estimates across the samples.

Turn in your code and a short write-up which includes the results and algorithms on NTU COOL.