UC Berkeley **Spring Semester 2003**
Economics 241A **Guido Imbens**

Midterm Exam
Monday March 17$^{\text{th}}$, 4.00-5.30pm

All three questions will be weighted equally. Within each question the different parts are weighted equally. Good luck!

1. Suppose you have data on unemployment durations T_i (in weeks) and covariates X_i for N individuals. Assume that the hazard function is

$$h(t|x) = \exp(\beta' x),$$

and that all durations are independent.

   (a) Suppose you observe the complete durations. What is the log likelihood function?

   (b) Suppose you obtain the data in the following way. On March 1st you go to an unemployment registry and record information about the next 100 individuals registring as unemployed, including their covariates and the date they show up (not enough people show up on the first day). You follow these people till they find a job, or till March 31st, whichever comes first. What is the log likelihood function in this case?

   (c) Suppose instead you go to the unemployment registry and randomly sample 100 people currently unemployed. You record their information, including how long they have been unemployed already. Two weeks later you return and record for each of the 100 individuals whether and when they found a job. What is the log likelihood function in this case?

2. Suppose that given covariates X_{i1} (age), X_{i2} (education) and X_{i3} (earnings) the probability of commuting by car ($Y_i = 1$) rather than by public transportation ($Y_i = 0$) is

$$Pr(Y_i = 1|X_{i1}, X_{i2}, X_{i3}) = \frac{\exp(\beta_0 + \beta_1 \cdot X_{i1} + \beta_2 \cdot X_{i2} + \beta_3 \cdot X_{i3}}{1 + \exp(\beta_0 + \beta_1 \cdot X_{i1} + \beta_2 \cdot X_{i2} + \beta_3 \cdot X_{i3}}.$$

   (a) What is the likelihood function given data on commuting behavior and the three covariates from a random sample?

   (b) Suppose we wish to test the null hypothesis that $\beta_3 = 0$. Describe how a likelihood ratio test would work. What is the distribution of the test statistics under the null hypothesis?

   (c) Describe how a Hausman test would work in this case. What is the distribution of the test statistics under the null hypothesis?

3. Consider estimating θ by the Generalized Method of Moments, using the moment restrictions

$$\psi(y, \theta) = \begin{pmatrix} y - \theta \\ y^2 - \theta^2 - \theta \end{pmatrix}.$$

   (a) Describe how you would estimate θ efficiently using GMM methods

(b) Describe how you would estimate θ using Empirical Likelihood methods.

(c) What is the large sample variance of $\hat{\theta}_{gmm}$?

(d) Suppose Y has a Poisson distribution with mean θ. How does the variance of the GMM estimator simplify?