1. Answer two questions out of the three.

14.382 Econometrics I
Final Examination
Spring, May 2004
(Professor Jerry Hausman)

INSTRUCTIONS: (2 hour final exam)

2. Let $y = \beta_1 x_1 + \epsilon$ where $x_1 = x_1^* + v$
   where $Ev = 0, E(x_{1i}v_i) = 0, E(E_i v_i) = 0, E(\epsilon_i x_{1i}^*) = 0.$
   (i) Suppose you do least squares. Derive the plim of $\hat{\beta}$ and demonstrate "attenuation bias." ("iron law" of econometrics)
   (ii) Suppose you have an instrument z. What properties must z have to be a valid instrument? Give a proof that the IV estimation is consistent.
   (iii) Suppose the specification is $y_1 = \beta_1 x_1 + \beta_2 x_2 + \epsilon$, where $Cov\ (x_1, x_2) \neq 0$ and $E(x_{2i}v_i) = 0, E(x_{2i}\epsilon_i) = 0$. Determine the large sample bias in $\hat{\beta}_1$ and $\hat{\beta}_2$. (Hint: partial out x_2).
   (iv) Does the "iron law" of econometrics hold for $\hat{\beta}_1$ (downward bias in magnitude). Does the presence of x_2 lead to less or more large sample bias in $\hat{\beta}_1$?
3. You have a panel data model:

$$y_{it} = X_{it}\beta + Z_i\gamma_i + \alpha_i + \eta_{it}$$

$$i = 1,\ldots,N; t = 1,\ldots,T$$

   Where N is large and T is small.
   (i) How should you test Ho: $E\left(\alpha_i | X_{it}, Z_i\right) = 0$?
   (ii) You run fixed effects estimation and do an F test that Ho:

$$\alpha_1 = \alpha_2 = \ldots = \alpha_N = 0$$

   Specify the test. What should you conclude about your estimates of β and γ if you reject Ho?
   (iii) Suppose you think you may have errors in variables (EIV) in one of the X_{it}'s: $X_{1it} = X_{1it}^* + v_{it}$, where $Ev_{it} = 0$, $Ev_{it}v_{i\tau} = 0$ for $t \neq \tau$ and $E(X_{1it}^* v_{it}) = 0$. What effect could EIV have on your fixed effects estimates and your test of $E(\alpha_i | X_{it}, Z_i) = 0$?
   (iv) How could you test if you do have an EIV problem? Can you give a consistent estimator if you do have an EIV problem?
4. You have a Tobit Model:
   $y_i^* = X_i\beta + \epsilon_i, \quad \epsilon_i \sim N(0, \sigma^2), \quad i = 1,\ldots,N.$
   and
   $y_i = y_i^* \quad if\ y_i^* < S_i$
   $y_i = S_i \quad if\ y_i^* \geq S_i$
   (i) Write down the likelihood function (LF) where $S_i = S_j$ for all i,j. Then generalize the LF where $S_i \neq S_j$.
   (ii) Demonstrate "Fisher Consistency" for the situations where $S_i \neq S_j$.
   (iii) Suppose you observe the S_i's with error: $S_i = S_i^* + v_i$, where the S_i^* are not observed and $E(S_i^* v_i) = 0$, $E(\epsilon v_i) = 0$, and $E(v_i) = 0$. What is the effect on the ML estimates?
   (iv) Suppose you decide to test the model specification. You do a probit model for $y_i < S_i$ or $y_i = S_i$. You compare these results to the ML Tobit Model estimate. Give a test and

determine its properties.