Econ 673
Problem Set #3
Due October 10, 2008

1. On the class website, you will find data (Elec.asc) on the decision of 1000 households regarding their choice of home heating fuel (i.e., electric versus non-electric) and their decision regarding participation in a voluntary Time-of-Use (TOU) rate program. The TOU rate program involves paying a lower rate for electricity during the evening and overnight hours and a higher rate during daytime hours. The dataset consists of five variables:

   E_i a dummy variable that denotes the home heating fuel choice, with $E_i = 1$ if the household chose to install electric central heating; $= 0$ otherwise;

   T_i a dummy variable that denotes the electric rate choice, with $T_i = 1$ if the household chose to participate in the voluntary TOU rate program; $= 0$ otherwise;

   W_i denotes the average winter temperature where household i lives;

   C_i denotes the number of household members under the age of 5; and

   R_i denotes the price of electricity relative to the price of natural gas in the region where household i lives;

   A_i a dummy variable denotes whether the head of the household is over 60 years of age, with $A_i = 1$ if the head of the household is over 60 years of age; $= 0$ otherwise.

   You assume that the two choices made by the household are driven by latent variables

   $$E_i^* = \beta_{10} + \beta_{11} W_i + \beta_{12} C_i + \beta_{13} R_i - \epsilon_{1i} \quad (1)$$
   $$T_i^* = \beta_{20} + \beta_{21} W_i + \beta_{22} C_i + \beta_{23} A_i - \epsilon_{2i} \quad (2)$$

   where $\epsilon_{\cdot i} = (\epsilon_{1i}, \epsilon_{2i})' \sim N(0, \Omega)$ and

   $$\Omega = \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}. \quad (3)$$

   (a) Using the available data and GAUSS's MAXLIK routine, estimate the parameters of your model. You will probably want to use the GAUSS command for computing the bivariate normal cdf. The data can be loaded into GAUSS using the command:
   load x[1000,6]= elec.asc;

   (b) Compute the fitted probability that the following types of individuals will participate in the TOU rate program (and the standard error for your estimate):
   - Type I: $W_i = 56$,$C_i = 2$,$R_i = .8$,and $A_i = 0$
   - Type II: $W_i = 20$,$C_i = 0$,$R_i = 1.2$,and $A_i = 1$

   (c) Predict the differences between the proportion of the population over 60 who will participate in a TOU rate program versus the proportion under 60 who will participate. Construct a standard error for this difference as well.

2. Repeat the estimation in part 1 of the problem set, but this time do not employ the cdfbvn command. Instead, rewrite the system of latent equations as:

   $$E_i^* = \beta_{10} + \beta_{11} W_i + \beta_{12} C_i + \beta_{13} R_i + \tau_i - \eta_{1i} \quad (4)$$
   $$T_i^* = \beta_{20} + \beta_{21} W_i + \beta_{22} C_i + \beta_{23} A_i + \tau_i - \eta_{2i} \quad (5)$$

   where $\eta_{\cdot i} = (\eta_{1i}, \eta_{2i})' \sim N(0, I)$ and $\tau_i \sim N(0, \sigma_\tau^2)$, with $\eta_{\cdot i}$ and τ_i being independent of each other.

   (a) Write the conditional log-likelihood for the model, conditioning on τ_i and show that its evaluation requires only the univariate normal cdf function (cdfn).

   (b) Write the unconditional log-likelihood for the model, integrating out the uncertainty regarding τ_i and write an approximation for this integral using a crude Monte Carlo estimator.

   (c) Use the above steps as the bases for a simulated log-likelihood procedure in GAUSS and re-estimate the model using the available data.

   (d) Compare your new findings to those obtained in part 1 of the homework set. Why are they different or the same? Explain.