Computer Homework 5

The Octave data file spector.mat contains 32 observations on 4 variables. These variables are: a student’s grade point average (GPA), a student’s grade on a pre-test instrument (TUCE), a binary variable that indicates whether a student was exposed to a new teaching method (PSI), and a binary variable that indicates improvement in a student’s exam grade (GRADE). Spector and Mazzeo, “Probit Analysis and Economic Education,” Journal of Economic Education 11, 1980, use this data to estimate a Probit model that attempts to predict GRADE based upon knowledge of GPA, TUCE, and PSI. The Octave function file probit_marg.m provides estimates of the marginal effects of each regressor in a Probit model. It also provides asymptotic t-statistics for these estimates and a classification table that summarizes the relationship between actual and predicted values of the dependent variable.

Model A: \[ P(\text{GRADE}=1) = \Phi(\alpha + \beta \text{ GPA} ) \]

1. Use the program files probit.m and probit_marg.m to estimate the coefficients and marginal effects of Model A.

2. Estimate the coefficients and marginal effects of Model A after imposing the restriction \( \beta=0 \). (Simply specify \texttt{ind='\textendash'} and proceed normally.)
   a. Show that \( \hat{\alpha} = \Phi^{-1}(\hat{p}) \), where \( \hat{p} \) denotes the sample mean of GRADE.
   b. Show that \[ \ln L(\hat{\alpha}) = n \hat{p} \ln(\hat{p}) + n(1 - \hat{p}) \ln(1 - \hat{p}) \]

3. Estimate the coefficients and marginal effects of Model A after imposing the restriction \( \alpha=0 \). (Simply “comment-out” the following lines in both probit.m and probit_marg.m.)

\[
x = [ \text{ones(nobs,1)} \; x ];
\]
\[
\text{ind} = [ '\text{Con} ' \; \text{ind} ];
\]

4. a. Why does the model in part (2) predict \( \text{GRADE}=0 \) for all observations?
   b. Why does the estimate of \( \beta \) change signs when the restriction \( \alpha=0 \) is imposed?
   c. Why does the model in part (3) predict \( \text{GRADE}=0 \) for all observations?
   d. What does this suggest about the practical role of \( \alpha \) in a binary choice model?

Model B: \[ P(\text{GRADE}=1) = \Phi(\alpha + \beta \text{ GPA} + \gamma \text{ TUCE} + 0 \text{ PSI} ) \]

5. Estimate the coefficients and marginal effects of model B.

6. How is the structure of the model affected by the use of the binary regressor, PSI?

7. Is the coefficient of GPA significantly different than zero?

8. Is the marginal effect of GPA significantly different than zero?

9. Test the joint significance of the regressors.

The next page illustrates use of probit.m and probit_marg.m for part (1) above.
```matlab
>> data='spector'; dep='grade'; ind='gpa';

>> beta=zeros(2,1);

>> beta=probit(data,dep,ind,beta);
Probit Model - The dependent variable is: grade
The data set is: spector

Grad: 4.4081 LogL: -16.5701 Size: 1.00
Grad: 0.8271 LogL: -16.4116 Size: 1.00
Grad: 0.1185 LogL: -16.4053 Size: 1.00
Grad: 0.0484 LogL: -16.4046 Size: 1.00
Grad: 0.0136 LogL: -16.4045 Size: 1.00
Grad: 0.0057 LogL: -16.4045 Size: 1.00
Grad: 0.0018 LogL: -16.4045 Size: 1.00
Grad: 0.0007 LogL: -16.4045 Size: 1.00
Grad: 0.0002 LogL: -16.4045 Size: 1.00
Grad: 0.0001 LogL: -16.4045 Size: 1.00

Regressor  Coefficient  Std. Error  t-stat       Prob>|t|  
----------------------------------------------
Con       -5.42418       1.65343      -3.28056       0.00263
Gpa       1.58896       0.54119       2.93604       0.00633

>> probit_marg(data,dep,ind,beta);
Probit Marginal Effects - The dependent variable is: grade
The data set is: spector

Regressor  Marginal  Std. Error  t-stat       Prob>|t|  
----------------------------------------------
Con       -1.93666       0.64675      -2.99443       0.00547
Gpa       0.56733       0.21787       2.60393       0.01419

Predicted 0 Predicted 1
Actual 0    18       3
Actual 1    5        6
```