

Explaining Professor Mittelhammer: Lecture VIIIB

Charles B. Moss ¹

¹University of Florida

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Introduction to Limited Dependent Variables

- As I said in Professor Mittelhammer's Lecture I need to explain a couple of things.
- Professor Mittelhammer's model involves one of dichotomous choice.
 - The economic agent decides to participate in a program ($y_i = 1$),
 - The economic agent decides not to participate in a program ($y_i = 0$).
- The structure of the variable does not conform with our assumption that the dependent variable is normally distributed (the regression equation yielding an estimate of the mean of that distribution).

Probability Specification

- To model this dichotomous model we hypothesize that some factors of interest affect the probability that a decision maker chooses an alternative.
- Using the Logit framework

$$f(x_i|\beta) = \frac{\exp[x_i\beta]}{1 + \exp[x_i\beta]} \quad (1)$$

where this logit function ($f(x_i|\beta)$) is bounded between zero and 1.

- Alternatively, we model this probability with a probit function ($\Phi(x_i\beta)$) which is the integral of standard normal distribution function.

Estimation

- Either specification can be estimated within a maximum likelihood framework

$$L(\beta) = \prod_{i=1}^N [f(x_i|\beta)]^{y_i} [1 - f(x_i|\beta)]^{1-y_i}. \quad (2)$$

- Taking the logarithm of the likelihood function

$$\ln[L(\beta)] = \sum_{i \ni y_i=1} \ln[f(x_i|\beta)] + \sum_{i \ni y_i=0} \ln[1 - f(x_i|\beta)] \quad (3)$$

Application

- As an example, consider whether LEADS/SPREAD improved the condition of coffee producers in Rwanda by reducing the poverty rate.
- As depicted in the following table
 - Rwanda Poverty - is 1 if the household is in poverty (as defined by the Rwandan poverty level - not the U.S. poverty level).
 - Control - is 1 if the individual grows a significant level of coffee and benefitted from LEADS/SPREAD.
 - Total in household - number of individuals in each household.
 - Sex of head of household - 1 if the head of household is male and zero if the head of household is female.

Data

Rwanda Poverty	Control	Total in Household	Sex of Head of Household
0	1	2	1
0	1	9	1
1	1	6	1
1	1	4	1
1	0	6	1
1	0	6	1
1	0	6	0
1	0	4	0
1	0	2	1
1	0	5	1
0	1	7	1
1	1	4	1
0	1	5	1
1	0	4	1

Results

Variable	Estimate
Intercept	1.2081 (0.4166)
treatm	-0.5429 (0.2405)
nhouse	-0.0416 (0.0606)
sexhhd	-0.0167 0.3394

Modification - Selection Problem

- Another wrinkle is the selection problem. Being in the treatment group is a random variable.
- Thus, selection could be correlated with other variables. In this model, let's assume that selecting into the treatment group is affected by the sex of head of household.
- The complete specification would be

$$\begin{bmatrix} f_1(z_{1i}|\alpha) \\ f_2(z_{2i}|\beta) \end{bmatrix} = \begin{bmatrix} \frac{\alpha_0 + \alpha_1 f_2(z_{2i}|\beta) + \alpha_2 x_{3i} + \alpha_{4i}}{1 - (\alpha_0 + \alpha_1 f_2(z_{2i}|\beta) + \alpha_2 x_{3i} + \alpha_{4i})} \\ \frac{\beta_0 + \beta_1 x_{4i}}{1 - (\beta_0 + \beta_1 x_{4i})} \end{bmatrix} \quad (4)$$