

STATISTICAL METHODS FOR ORDINAL DATA

1. Introduction

In practice, many multivariate data sets consist of observations of ordinal variables rather than continuous variables. Most statistical methods for structural equation modeling assume that the data are observations of continuous variables. In practice, this problem is overcome by treating the ordinal variables as if they were continuous variables. Unfortunately, this approach may yield misleading results (see e.g. Jöreskog 1994 and Jöreskog & Sörbom 1999).

LISREL 8.7 for Windows (Jöreskog & Sörbom 2004) includes several statistical methods for the analysis of ordinal data. These methods are logistic regression, PROBIT regression as well as Weighted Least Squares (WLS) and Diagonally Weighted Least Squares (DWLS) for polychoric correlation and covariance matrices. More details about these methods are provided in Jöreskog (2002).

In this note, the logistic and PROBIT regression methods of LISREL 8.7 for Windows are illustrated by using a data set of observations on ordinal variables. This data set is described in the next section. The method of logistic regression is illustrated in Section 3. Thereafter, the PROBIT regression method is illustrated. Multivariate logistic and PROBIT regression analyses are performed in Section 5. In Section 6, the methods of multivariate logistic and PROBIT regression are demonstrated.

2. The Data

Barnes & Kaase (1979) conducted a cross-national survey to obtain information on conventional and unconventional forms of political participation in industrial societies. This survey is known as the Political Action Survey. This survey included several attitude and perception statements to which the respondents had to respond to as one of agree strongly, agree, disagree, disagree strongly, don't know or no answer. Amongst others, the following six statements were administered to each respondent.

"People like me have no say in what the government does." (**NOSAY**)

"Voting is the only way that people like me can have any say about how the government runs things." (**VOTING**)

"Sometimes politics and government seem so complicated that a person like me cannot really understand what is going on." (**COMPLEX**)

"I don't think that public officials care much about what people like me think." (**NOCARE**)

"Generally speaking, those we elect to Congress in Washington lose touch with people pretty quickly." (**TOUCH**)

"Parties are only interested in people's votes but not in their opinions." (**INTEREST**)

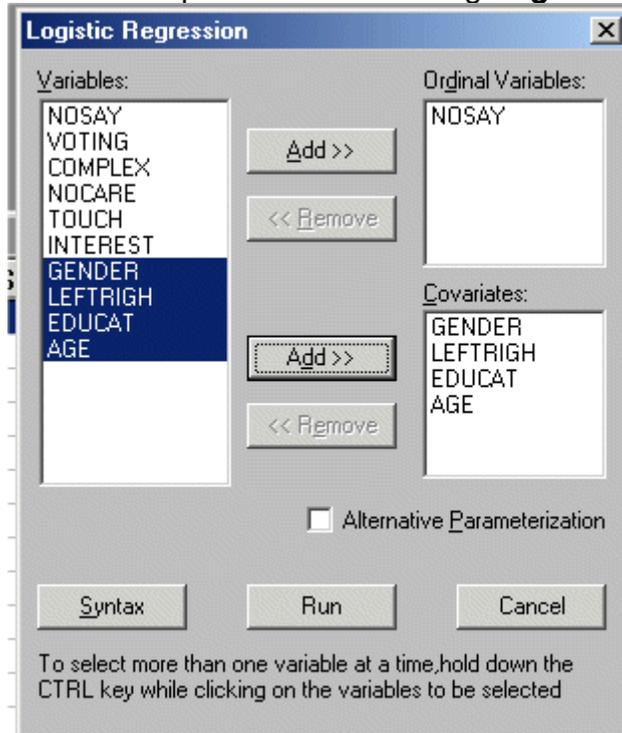
The responses to these statements of a sample of 1076 United States respondents, along with their gender (**GENDER**), education level (**EDUCAT**), age (**AGE**) and left-right score (**LEFTRIGH**), are listed in the PRELIS System File (PSF) **USA.PSF**. This file is located in the **WORKSHOP** folder of the LISREL 8.7 for Windows installation folder. A small portion of this file is shown in the following PSF window.



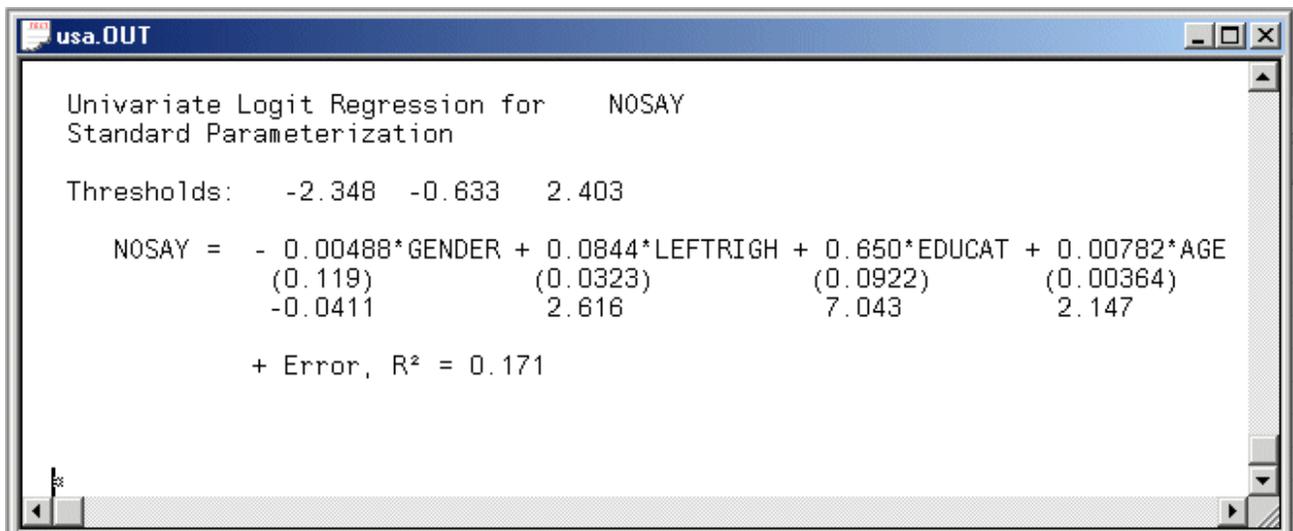
	NOSAY	VOTING	COMPLEX	NOCARE	TOUCH	INTEREST	GENDE
1	2.000	2.000	1.000	1.000	1.000	1.000	2.
2	2.000	3.000	3.000	3.000	2.000	3.000	2.
3	3.000	2.000	2.000	3.000	3.000	3.000	1.
4	2.000	2.000	2.000	2.000	1.000	2.000	2.
5	2.000	1.000	2.000	2.000	1.000	1.000	1.
6	3.000	3.000	2.000	2.000	3.000	3.000	1.
7	2.000	2.000	3.000	1.000	1.000	1.000	1.
8	3.000	2.000	3.000	3.000	2.000	3.000	1.
9	3.000	2.000	1.000	1.000	2.000	2.000	2.
10	1.000	1.000	1.000	1.000	1.000	1.000	2.
11	3.000	3.000	3.000	3.000	3.000	3.000	2.
12	1.000	4.000	4.000	2.000	1.000	1.000	2.
13	3.000	3.000	2.000	2.000	2.000	2.000	1.
14	3.000	3.000	4.000	2.000	1.000	1.000	1.
15	3.000	3.000	3.000	3.000	3.000	3.000	2.

3. Logistic Regression of NOSAY

- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type:** dropdown list box.
- Browse for the file **USA.PSF** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open **USA.PSF** in a PSF window.
- Click on the **Logistic Regressions** option on the **Statistics** menu to load the **Logistic Regression** dialog box.
- Select the label **NOSAY** in the **Variables** list box.
- Click on the **Add** push button to transfer the label **NOSAY** to the **Ordinal Variables** list box.
- Select the labels **GENDER**, **LEFTRIGH**, **EDUCAT** and **AGE** in the **Variables** list box.
- Click on the **Add** push button to produce the following **Logistic Regression** dialog box.

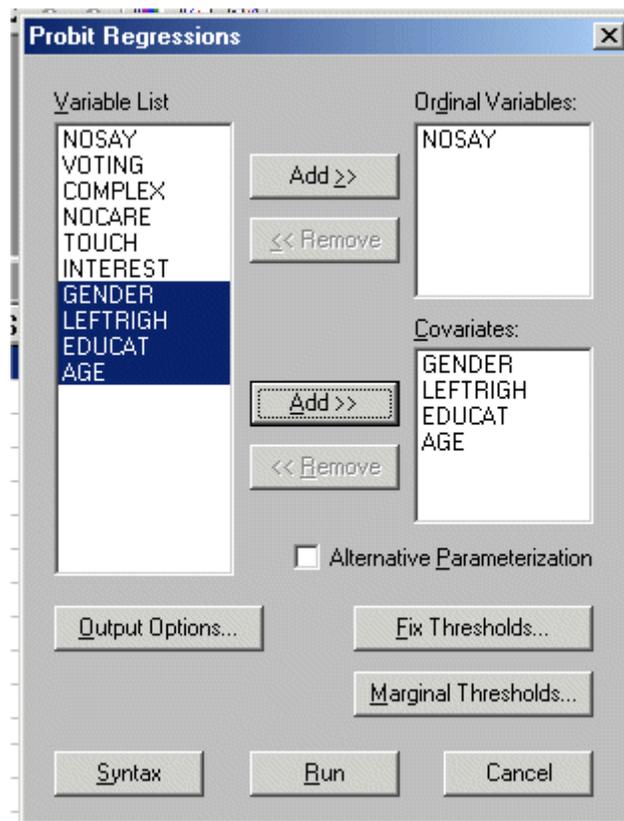


- Click on the **Run** push button to produce the following text editor window for **USA.OUT**.



4. PROBIT Regression of NOSAY

- Select the **Close all** option on the **Window** menu to close all open windows.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type:** dropdown list box.
- Browse for the file **USA.PSF** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open **USA.PSF** in a PSF window.
- Click on the **Probit Regressions** option on the **Statistics** menu to load the **Probit Regressions** dialog box.
- Select the label **NOSAY** in the **Variables** list box.
- Click on the **Add** push button to transfer the label **NOSAY** to the **Ordinal Variables** list box.
- Select the labels **GENDER**, **LEFTRIGH**, **EDUCAT** and **AGE** in the **Variables** list box.
- Click on the **Add** push button to produce the following **Probit Regressions** dialog box.



- Click on the **Run** push button to produce the following text editor window for **USA.OUT**.

```

usa.OUT

Total Sample Size = 1076

Univariate Probit Regression for NOSAY
Standard Parameterization

Thresholds: -1.361 -0.391 1.379

NOSAY = 0.00899*GENDER + 0.0424*LEFTRIGH + 0.360*EDUCAT + 0.00453*AGE
          (0.0675)          (0.0184)          (0.0519)          (0.00207)
          0.133            2.308            6.946            2.187

+ Error, R2 = 0.0586

```

5. Stepwise Logistic and PROBIT Regression of NOSAY

Stepwise Logistic Regression

- Select the **Close all** option on the **Window** menu to close all open windows.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Browse for the file **SLOGIT.PR2** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open the following text editor window.

```

SLOGIT.PR2

Logit Regression of NOSAY
SY=USA.PSF
LR NOSAY on EDUCAT
LR NOSAY on EDUCAT LEFTRIGH
LR NOSAY on EDUCAT LEFTRIGH AGE
LR NOSAY on EDUCAT LEFTRIGH AGE GENDER
OU

```

Line 1 specifies a title for the analysis.

Line 2 specifies the raw data source.

Lines 3 to 6 specify the stepwise logistic regression analysis of **NOSAY**.

Line 7 specifies that the standard PRELIS results should be produced.

- Click on the **Run PRELIS** icon on the main toolbar to produce the text editor window for **SLOGIT.OUT**.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **Output (*.out; *.fit)** option from the **Files of type:** dropdown list box.
- Browse for the file **SLOGIT.FIT** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open the following text editor window.

Variable	-2lnL	Chi-square	df	Covariates
NOSAY	2355.408	42.695	1	EDUCAT
NOSAY	2345.402	52.701	2	EDUCAT LEFTRIGH
NOSAY	2340.792	57.312	3	EDUCAT LEFTRIGH AGE
NOSAY	2340.790	57.313	4	EDUCAT LEFTRIGH AGE GENDER

Stepwise PROBIT Regression

- Select the **Close all** option on the **Window** menu to close all open windows.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Browse for the file **SPROBIT.PR2** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open the following text editor window.

```

Probit Regression of NOSAY
SY=USA.PSF
PR NOSAY on EDUCAT
PR NOSAY on EDUCAT LEFTRIGH
PR NOSAY on EDUCAT LEFTRIGH AGE
PR NOSAY on EDUCAT LEFTRIGH AGE GENDER
OU

```

Line 1 specifies a title for the analysis.

Line 2 specifies the raw data source.

Lines 3 to 6 specify the stepwise PROBIT regression analysis of **NOSAY**.

Line 7 specifies that the standard PRELIS results should be produced.

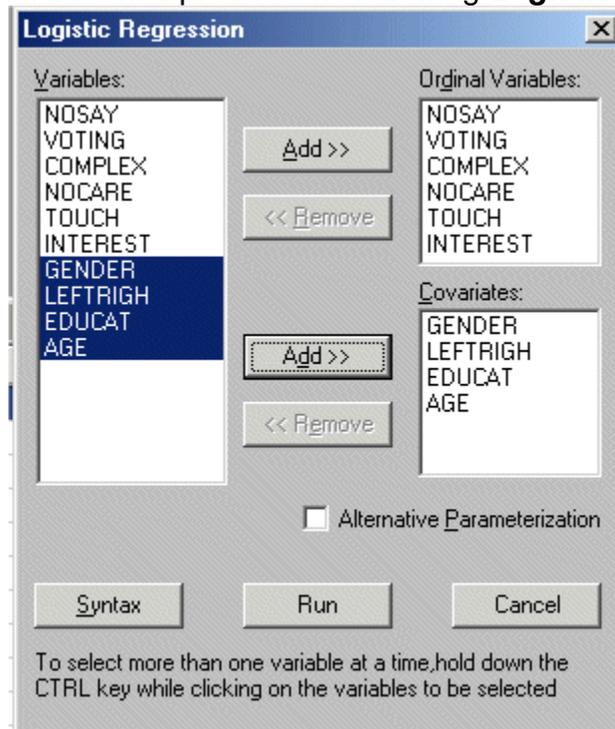
- Click on the **Run PRELIS** icon on the main toolbar to produce the text editor window for **SPROBIT.OUT**.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **Output (*.out; *.fit)** option from the **Files of type:** dropdown list box.
- Browse for the file **SPROBIT.FIT** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open the following text editor window.

Variable	-2lnL	Chi-square	df	Covariates
NOSAY	2357.968	40.136	1	EDUCAT
NOSAY	2349.465	48.638	2	EDUCAT LEFTRIGH
NOSAY	2344.609	53.494	3	EDUCAT LEFTRIGH AGE
NOSAY	2344.591	53.512	4	EDUCAT LEFTRIGH AGE GENDER

6. Multivariate Logistic and PROBIT Regression

Multivariate Logistic Regression

- Select the **Close all** option on the **Window** menu to close all open windows.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type:** dropdown list box.
- Browse for the file **USA.PSF** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open **USA.PSF** in a PSF window.
- Click on the **Logistic Regressions** option on the **Statistics** menu to load the **Logistic Regression** dialog box.
- Select the labels **NOSAY**, **VOTING**, **COMPLEX**, **NOCARE**, **TOUCH** and **INTEREST** in the **Variables** list box.
- Click on the **Add** push button to transfer the labels **NOSAY**, **VOTING**, **COMPLEX**, **NOCARE**, **TOUCH** and **INTEREST** to the **Ordinal Variables** list box.
- Select the labels **GENDER**, **LEFTRIGH**, **EDUCAT** and **AGE** in the **Variables** list box.
- Click on the **Add** push button to produce the following **Logistic Regression** dialog box.



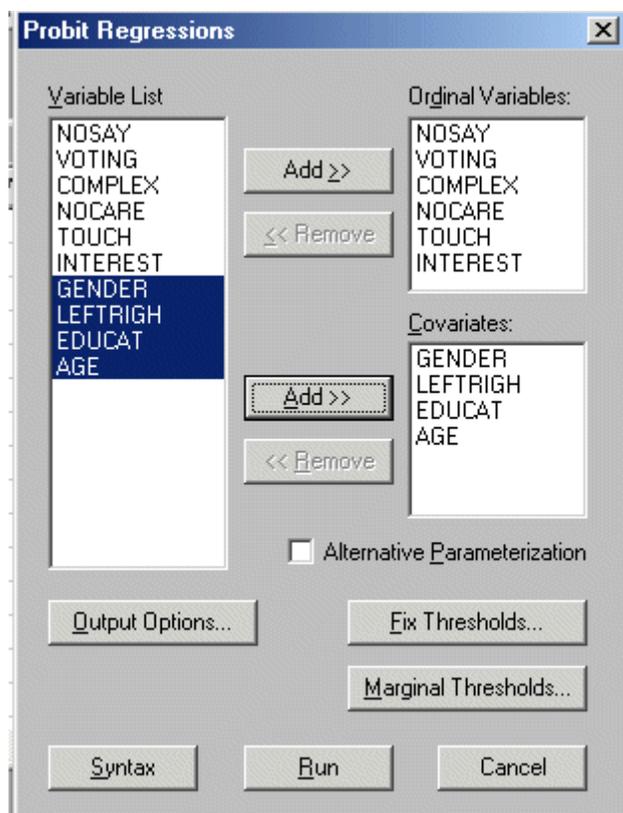
- Click on the **Run** push button to produce the text editor window for **USA.OUT**.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **Output (*.out; *.fit)** option from the **Files of type:** dropdown list box.
- Browse for the file **USA.FIT** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open the following text editor window.

Variable	-2lnL	Chi-square	df	Covariates
NOSAY	2340.790	57.313	4	GENDER LEFTRIGH EDUCAT AGE
VOTING	2467.314	110.152	4	GENDER LEFTRIGH EDUCAT AGE
COMPLEX	2279.764	113.637	4	GENDER LEFTRIGH EDUCAT AGE
NOCARE	2392.594	63.081	4	GENDER LEFTRIGH EDUCAT AGE
TOUCH	2244.766	39.653	4	GENDER LEFTRIGH EDUCAT AGE
INTEREST	2334.276	30.538	4	GENDER LEFTRIGH EDUCAT AGE

Multivariate PROBIT Regression

- Select the **Close all** option on the **Window** menu to close all open windows.

- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **PRELIS data (*.psf)** option from the **Files of type:** dropdown list box.
- Browse for the file **USA.PSF** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open **USA.PSF** in a PSF window.
- Click on the **Probit Regressions** option on the **Statistics** menu to load the **Probit Regressions** dialog box.
- Select the labels **NOSAY**, **VOTING**, **COMPLEX**, **NOCARE**, **TOUCH** and **INTEREST** in the **Variables** list box.
- Click on the **Add** push button to transfer the labels **NOSAY**, **VOTING**, **COMPLEX**, **NOCARE**, **TOUCH** and **INTEREST** to the **Ordinal Variables** list box.
- Select the labels **GENDER**, **LEFTRIGH**, **EDUCAT** and **AGE** in the **Variables** list box.
- Click on the **Add** push button to produce the following **Probit Regressions** dialog box.



- Click on the **Run** push button to produce the text editor window for **USA.OUT**.
- Use the **Open** option on the **File** menu to load the **Open** dialog box.
- Select the **Output (*.out; *.fit)** option from the **Files of type:** dropdown list box.
- Browse for the file **USA.FIT** in the **WORKSHOP** folder of LISREL 8.7 for Windows.
- Click on the **Open** push button to open the following text editor window.

Variable	-2lnL	Chi-square	df	Covariates
NOSAY	2344.591	53.512	4	GENDER LEFTRIGH EDUCAT AGE
VOTING	2470.648	106.818	4	GENDER LEFTRIGH EDUCAT AGE
COMPLEX	2284.676	108.725	4	GENDER LEFTRIGH EDUCAT AGE
NOCARE	2401.907	53.767	4	GENDER LEFTRIGH EDUCAT AGE
TOUCH	2249.115	35.305	4	GENDER LEFTRIGH EDUCAT AGE
INTEREST	2338.651	26.163	4	GENDER LEFTRIGH EDUCAT AGE

References

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