

Preface

The LISREL methodology development started in 1970, when Karl Jöreskog presented a first LISREL model at a conference. The first generally available LISREL program (version 3) was published in 1975. The name LISREL is an acronym for “linear structural relations.” The qualifier “linear” is too restrictive for the current version of the LISREL program, but the name LISREL has become synonymous with “structural equation modeling” or SEM.

In 1986, the first version of PRELIS was published. Its main function is the computation of the appropriate summary statistics for analysis with the LISREL program. Over time, its functionality has expanded to include a variety of exploratory tools to give users a better understanding of their data before they attempt a LISREL model. Its name stands for “preprocessor for LISREL.”

SIMPLIS was publicly introduced in 1993 as an alternative syntax for the LISREL model specification. As the name implied, it meant a tremendous simplification over the original LISREL syntax, which required some understanding of matrix algebra as well as the memorization of several Greek characters. Another added capability was the drawing of path diagrams, with some first attempts to allow the user to interact with the program. Up to that point, the user communicated with the program in so-called batch mode. Some kind of script, also called “syntax file” or “command file,” had to be written with a text editor, containing instructions for the program. Instructions about where the data file was to be found, how many variables it contained, the names of the variables, etc. This command file was then submitted to the actual program for execution.

In 1998, the first truly interactive version of LISREL (version 8.20, for MS Windows) introduced a dialog-box interface to facilitate the writing of those command files. As much as possible, typing of syntax was replaced with point-and-click actions in a series of dialog boxes. From these actions, the program then produced the equivalent command file, in PRELIS syntax for processing of raw data, or in SIMPLIS or LISREL syntax for the actual SEM analysis.

The path diagram feature became much more flexible, giving maximum control to the user, not only to specify or change a model, but also to produce a graphic representation of the model with publication quality that could be exported as a separate file for subsequent import in a document. Parallel with these developments regarding the way that the user interacts with the program, numerous statistical features were added, including a multilevel analysis module, exploratory factor analysis and principal component analysis, imputation for missing values, bootstrap and Monte Carlo procedures, etc.

The LISREL program makes all these additions available to the user through a choice of menus and submenus, toolbars, and command buttons. As a result, the LISREL user

interface has grown to the point that a separate manual became necessary. This manual is specifically written to guide the user through the *interactive* part of the LISREL program. It does so mostly by example.

There are four other user's guides available with the LISREL program. These user's guides are platform independent by concentrating exclusively on the "batch mode" way of operation in the illustrations: the user writes a syntax (or command) file using a text editor and submits this file to the program for execution.

The four user's guides introduce the user to the methodology of structural equation modeling, both theoretically and through a variety of applications. Specifically, the *PRELIS 2: User's Reference Guide* focuses on the intricacies of multivariate data screening and preparing the data for subsequent model fitting. The *LISREL 8: User's Reference Guide* deals with the fitting and testing of structural equation models with the use of the LISREL syntax, while *LISREL 8: Structural Equation Modeling with the SIMPLIS Command Language* does the same, but using the SIMPLIS syntax. *LISREL 8: New Statistical Features* introduces multilevel modeling and various powerful statistical additions to LISREL 8, namely, two-stage least-squares estimation, exploratory factor analysis, principal components, normal scores, and latent variable scores.

In an undertaking of this nature, various people usually play an indispensable role. First, we would like to thank Professor Doug Hawkins from the University of Minnesota for allowing us to add his Formal Inference-Based Recursive Modeling (FIRM) program to the options available to a LISREL user. Professor Hawkins kindly provided us, not only with the program, but also the documentation on which the FIRM-related sections of this guide are based. We however accept full responsibility for the final versions of these sections. We would also like to thank Gerhard Mels and Bola King for their suggestions and unflagging enthusiasm for proofreading. Their contributions led to many improvements in the final form of this guide. Finally, we would like to thank Professors Karl Jöreskog and Dag Sörbom for allowing us to base numerous examples on material in the remaining four LISREL guides.

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1 Introduction

This User's Guide is designed for use with the Windows version of LISREL 8 for Windows 95, 98, NT, 2000 and Millenium. It focuses on the fully interactive mode of working with LISREL that is only available on the Windows platform. This Guide details how the graphical user interface results in a highly improved work environment.

All features from LISREL 7 are still there and the user can run existing syntax files without change. Important differences from the previous version are the new SIMPLIS syntax, path diagrams, and the list output.

Not only is the quality of the path diagram now of publication-ready standard, all characteristics of the display are under the user's control, namely, the position, size, and shape of the variable objects, the paths among them, and the colors, fonts, and patterns. Regardless of changes made to the characteristics of the display, the program maintains the underlying model specification and a changed model can be re-estimated at any time. New with LISREL 8 is the option to start with the path diagram and draw a model specification from scratch. Conceptual path diagrams, *i.e.*, path diagrams without parameter estimates, may also be requested. Each path diagram may be exported as a Windows metafile (WMF format) or as a Graphics Interchange file (GIF format).

A series of dialog boxes guides the user through the different stages of the problem and model specification. When done, the program builds a multilevel modeling, SIMPLIS, or LISREL input file from the user's responses. This is the mode that Windows users have come to expect.

One of the new features of LISREL 8 is that one may switch from one mode to another: from dialog box mode to SIMPLIS syntax, from SIMPLIS syntax to LISREL syntax, from LISREL syntax to path diagram mode. Users who have become familiar with the program via the SIMPLIS command language can now type in existing LISREL command files (as found in the literature, for example) and let the program translate them in the more user-friendly SIMPLIS syntax or display them as path diagrams. The dialog box mode may also be used selectively to set up the problem specification, after which model specification may be continued in the path-diagram mode. This flexibility not only allows users to develop their own specific ways of working with the program, but it also greatly increases the applicability of the program in teaching situations.

PRELIS, the part of the program used to screen and summarize data before specifying the actual model using LISREL, is now much more integrated from the user's perspective. The program can read a variety of data formats, including data from all the major statistical packages, and present the data in spreadsheet format. Graphing capabilities allow the user to view the distributions of variables separately or to inspect univariate,

bivariate or multivariate plots. The characteristics of the graphics can be modified by the user and exported as Windows metafiles (WMF format).

Pull-down menus and dialog boxes as an alternative to constructing a syntax file is a much easier way of running PRELIS. However, the batch mode is still available for those who prefer to write a syntax file or who wish to use an existing syntax file.

It is this wealth of features in LISREL and the need to walk the first-time user through it step-by-step, using a variety of applications, that gave rise to this User's Guide.

The remainder of this guide is organized in four major sections. Chapter 2 provides an overview of the graphical user interface while Chapters 3 to 6 contain examples. Chapter 7 describes the new statistical features which are as yet undocumented elsewhere. Finally, Chapter 8 gives a summary of the syntax which has been added to LISREL since the release of LISREL 8.30.