GraphPad Prism, Data Analysis, and Scientific Graphing

Mary L. Swift

Department of Biochemistry and Molecular Biology, College of Medicine, Howard University, Washington, DC 20059-0001

Received November 14, 1996

My first experience with Prism[1] occurred when I was in a panic. Late one evening I was trying to prepare a set of graphs for an enzyme kinetics lecture at 8:00 a.m. the next morning. Being dissatisfied with the output from my spreadsheet program, I imported the data into another scientific graphing application that I had used, only to have that program crash repeatedly. The hour was growing later and later, and my frustration level was reaching the breaking point. I grabbed Prism and loaded it. Within 45 min I had generated eight graphs without reading one word of the documentation! Obviously I began my formal review of Prism with a highly favorable predisposition.

GraphPad Prism is the Windows[2]/Windows95[2] successor to GraphPad's InPlot,[3] a DOS based scientific graphing application. The version reviewed here is 2.01. This software will run on Macintosh's[4] under SoftWindows[5] (version 2) as well as on PCs. System requirements for PCs are a fast 386 processor, 4 MB of RAM, a mouse, and 3 MB of hard disk space. A math coprocessor is not required. I tested Prism on a Gateway2000[6] 486DX2/50, with 8 MB RAM running Windows 3.11 over MS-DOS[2] 6.22.

In addition to creating a highly flexible environment for the production of publication quality graphs, Prism allows for statistical analyses of data. All of the statistical analyses commonly used by most scientists are included. For example, routines for paired or unpaired t-tests, Wilcoxon or nonparametric Mann−Whitney tests, ANOVA, χ^2 test, and linear and nonlinear regression analysis are available with just a few mouse clicks. The resultant output is presented in tabular form which is linked directly to the appropriate help topics. These are accessed by clicking on the Interpret button in the Results section.

This program establishes a working environment organized as a project with several sections: Data (entry), Results (of transforms and statistical analyses), Graphs, Layout (of pages), and Notes. Each of the five sections can hold up to 100 sheets. At program launch the Create Data Table dialog box offers the user choices for the data entry segment—for *x* values the choices include no *x*, text, numbers, and regular sequence and for *y* one may specify single/replicate values, mean ± standard deviation, mean ± standard error, text, and so forth. A default can be set such that data entered are automatically graphed. A hint is included on this and all dialog boxes. These are particularly useful as the authors have correctly anticipated user needs, wants, and uncertainties. I found them to be huge time and emotion savers. Data entry will be straightforward to those familiar with spreadsheets. A nice feature is that columns automatically widen to accommodate the data; unfortunately if the user wishes to change the number format, i.e., the number of decimal places shown in one column, she/he cannot as such formatting applies to the whole sheet. This is unlike modern spreadsheets wherein each column may be assigned different formats. Another dissimilarity with spreadsheets is the sort data feature. Prism will sort data based on numerical *x* values only. The user will not be able to sort facilely "group" data.

After the data have been entered they may be transformed using any of 26 predefined functions or by inputting a user defined relationship. Calculated values are placed into the Results section. Other options include normalization, pruning rows, subtracting/dividing by a baseline value, and transposing rows and columns and the statistical treatments referred to above. These operations may be chained.

A full range of scientific graph types can be created with titles, legends, text boxes, etc. Lines or curves may be fitted to data as smooth curves or using regression, spline, or LOWESS analysis. True Type fonts are supported and special symbols are easily inserted. The usual flexibility in selection of graph symbols, line types, and line thickness is present. To be noted is a feature that allows embedding all or a part of a calculation's result into the graph as a table.

The layout section of a project allows the user to choose from eight page layouts and place graphs into these templates.

Especially nice features are the dynamic linkages among the data, result, and graphing sections, the ability to create template files so that data from repeated experiments can be analyzed without laboriously replicating each keystroke and mouse click, the ability to save files in either a large or small format, and the inclusion of an uninstall routine.

One problem that surfaced was that upon invoking Help, the error message "Routine Not Found" appeared three times. However, upon clearing this message Help ran fine. GraphPad suggested a couple of ways to overcome this glitch, but none worked. Eventually they made a new copy of the prism.hlp file available via ftp. Placing this file in the prism2 directory solved the problem.

The manual is written clearly and is easy to read with very good illustrations. Again the authors have anticipated reader misinterpretations and taken steps to avoid this. Several comprehensive examples, i.e., radioligand binding studies, survival curves, standard curves, have been presented. The section on statistics includes how to use the program, when to use a particular statistical treatment, and how to interpret results. Throughout the program and the manual the authors have shown the ability to present difficult procedures and concepts in clear, uncomplicated language. I believe a beginner could grasp the essentials of the statistics presented.

Free support for Prism may be obtained via telephone, e-mail, or the World Wide Web. At the GraphPad web site (http://www.graphpad.com) one may obtain a demo version of Prism, minor program upgrades, and technical statistical

articles. Other resources available at the site include a FAQ page, known bug with fixes page, customer service page (containing templates for analysis of certain data, i.e., Michaelis−Menten kinetics), and purchasing information.

REFERENCES AND NOTES

(1) GraphPad Software, Inc., 10855 Sorrento Valley Road, #203, San Diego, CA 92121. List Price is $495.00, minor upgrades are free, version upgrades are $99.00. Academic and student discounts are available.

(2) Windows, Windows95, and MS-DOS are registered trademarks of Microsoft Corporation, One Microsoft Way, Redmond, WA 98052-6399.

(3) Swift, M. L., GraphPad InPlot. *J. Chem. Inf. Comput. Sci.* **1994**, *34*, 1024.

(4) Apple Computer, Inc., 1 Infinite Loop, Cupertino, CA 95014-6299.

(5) SoftWindows is a registered trademark of Insignia Solutions, Inc., 2200 Lawson Lane, Santa Clara, CA 95054.

(6) Gateway2000, Inc., 610 Gateway Drive, P.O. Box 2000, N. Sioux City, SD 57049-2000.

CI960402J