The Stata Journal

Editors
H. Joseph Newton
Department of Statistics
Texas A&M University
College Station, Texas
editors@stata-journal.com

Nicholas J. Cox
Department of Geography
Durham University
Durham, UK
editors@stata-journal.com

Associate Editors
Christopher F. Baum, Boston College
Nathaniel Beck, New York University
Rino Bellocco, Karolinska Institutet, Sweden, and University of Milano-Bicocca, Italy
Maarten L. Buis, WZB, Germany
A. Colin Cameron, University of California–Davis
Mario A. Cleves, University of Arkansas for Medical Sciences
William D. Dupont, Vanderbilt University
Philip Ender, University of California–Los Angeles
David Epstein, Columbia University
Allan Gregory, Queen’s University
James Hardin, University of South Carolina
Ben Jann, University of Bern, Switzerland
Stephen Jenkins, London School of Economics and Political Science
Ulrich Kohler, University of Potsdam, Germany

Frauke Kreuter, Univ. of Maryland–College Park
Peter A. Lachenbruch, Oregon State University
Jens Lauritzen, Odense University Hospital
Stanley Lemeshow, Ohio State University
J. Scott Long, Indiana University
Roger Newson, Imperial College, London
Austin Nichols, Urban Institute, Washington DC
Marcello Pagano, Harvard School of Public Health
Sophia Rabe-Hesketh, Univ. of California–Berkeley
J. Patrick Royston, MRC Clinical Trials Unit, London
Philip Ryan, University of Adelaide
Mark E. Schaffer, Heriot-Watt Univ., Edinburgh
Jeroen Weesie, Utrecht University
Ian White, MRC Biostatistics Unit, Cambridge
Nicholas J. G. Winter, University of Virginia
Jeffrey Wooldridge, Michigan State University

Stata Press Editorial Manager
Lisa Gilmore

Stata Press Copy Editors
David Culwell and Deirdre Skaggs

The Stata Journal publishes reviewed papers together with shorter notes or comments, regular columns, book reviews, and other material of interest to Stata users. Examples of the types of papers include 1) expository papers that link the use of Stata commands or programs to associated principles, such as those that will serve as tutorials for users first encountering a new field of statistics or a major new technique; 2) papers that go “beyond the Stata manual” in explaining key features or uses of Stata that are of interest to intermediate or advanced users of Stata; 3) papers that discuss new commands or Stata programs of interest either to a wide spectrum of users (e.g., in data management or graphics) or to some large segment of Stata users (e.g., in survey statistics, survival analysis, panel analysis, or limited dependent variable modeling); 4) papers analyzing the statistical properties of new or existing estimators and tests in Stata; 5) papers that could be of interest or usefulness to researchers, especially in fields that are of practical importance but are not often included in texts or other journals, such as the use of Stata in managing datasets, with advice from hard-won experience; and 6) papers of interest to those who teach, including Stata with topics such as extended examples of techniques and interpretation of results, simulations of statistical concepts, and overviews of subject areas.

The Stata Journal is indexed and abstracted by CompuMath Citation Index, Current Contents/Social and Behavioral Sciences, RePEc: Research Papers in Economics, Science Citation Index Expanded (also known as SciSearch), Scopus, and Social Sciences Citation Index.

For more information on the Stata Journal, including information for authors, see the webpage

http://www.stata-journal.com
Subscriptions are available from StataCorp, 4905 Lakeway Drive, College Station, Texas 77845, telephone 979-696-4600 or 800-STATA-PC, fax 979-696-4601, or online at http://www.stata.com/bookstore/sj.html

Subscription rates listed below include both a printed and an electronic copy unless otherwise mentioned.

<table>
<thead>
<tr>
<th></th>
<th>U.S. and Canada</th>
<th>Elsewhere</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Printed &amp; electronic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-year subscription</td>
<td>$ 98</td>
<td>$138</td>
</tr>
<tr>
<td>2-year subscription</td>
<td>$165</td>
<td>$245</td>
</tr>
<tr>
<td>3-year subscription</td>
<td>$225</td>
<td>$345</td>
</tr>
<tr>
<td>1-year student subscription</td>
<td>$ 75</td>
<td>$ 99</td>
</tr>
<tr>
<td>1-year institutional subscription</td>
<td>$245</td>
<td>$285</td>
</tr>
<tr>
<td>2-year institutional subscription</td>
<td>$445</td>
<td>$525</td>
</tr>
<tr>
<td>3-year institutional subscription</td>
<td>$645</td>
<td>$765</td>
</tr>
<tr>
<td><strong>Electronic only</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-year subscription</td>
<td>$ 75</td>
<td>$ 75</td>
</tr>
<tr>
<td>2-year subscription</td>
<td>$125</td>
<td>$125</td>
</tr>
<tr>
<td>3-year subscription</td>
<td>$165</td>
<td>$165</td>
</tr>
<tr>
<td>1-year student subscription</td>
<td>$ 45</td>
<td>$ 45</td>
</tr>
</tbody>
</table>

Back issues of the Stata Journal may be ordered online at http://www.stata.com/bookstore/sjj.html

Individual articles three or more years old may be accessed online without charge. More recent articles may be ordered online.

http://www.stata-journal.com/archives.html

The Stata Journal is published quarterly by the Stata Press, College Station, Texas, USA.

Address changes should be sent to the Stata Journal, StataCorp, 4905 Lakeway Drive, College Station, TX 77845, USA, or emailed to sj@stata.com.

Copyright © 2014 by StataCorp LP

Copyright Statement: The Stata Journal and the contents of the supporting files (programs, datasets, and help files) are copyright © by StataCorp LP. The contents of the supporting files (programs, datasets, and help files) may be copied or reproduced by any means whatsoever, in whole or in part, as long as any copy or reproduction includes attribution to both (1) the author and (2) the Stata Journal.

The articles appearing in the Stata Journal may be copied or reproduced as printed copies, in whole or in part, as long as any copy or reproduction includes attribution to both (1) the author and (2) the Stata Journal.

Written permission must be obtained from StataCorp if you wish to make electronic copies of the insertions. This precludes placing electronic copies of the Stata Journal, in whole or in part, on publicly accessible websites, file servers, or other locations where the copy may be accessed by anyone other than the subscriber.

Users of any of the software, ideas, data, or other materials published in the Stata Journal or the supporting files understand that such use is made without warranty of any kind, by either the Stata Journal, the author, or StataCorp. In particular, there is no warranty of fitness of purpose or merchantability, nor for special, incidental, or consequential damages such as loss of profits. The purpose of the Stata Journal is to promote free communication among Stata users.

The Stata Journal (ISSN 1536-867X) is a publication of Stata Press. Stata, Stata, Stata Press, Mata, and NetCourse are registered trademarks of StataCorp LP.
Introduction

There are many different reasons for wanting to create multipanel graphs, presented in \( r \geq 1 \) rows and \( c \geq 1 \) columns: these reasons include making efficient use of restricted display space and enhancing the presentation of results. In basic Stata, the flexible approach to confidently handle these tasks is given by using the `graph combine` functionality (see `help graph combine`). For related discussions and examples, see the stimulating books *An Introduction to Stata for Health Researchers* (Juul and Frydenberg 2010) and *A Visual Guide to Stata Graphics* (Mitchell 2012).

Basic usage

First, we start with setting up seven simple, but quite artificial, linear relations disturbed by normally distributed noise based on simulated \( x \) and \( y \) variables (interpreted in the standard sense).

```stata
set obs 100
generate xvar=10*runiform()
forvalues i=1/7 {
    generate y`i´=xvar*`i´+runiform()*(`i´*3)
    label variable y`i´ "Outcome variable `i´"
}
```

Second, we simply fit linear regressions that correspond to these relations and then save the seven corresponding graphs in memory.

```stata
foreach yvar of varlist y* {
    local lbl: variable label `yvar`
sort xvar
    reg `yvar` xvar
    local b : display %3.2f _b[xvar]
predict p, xb
twoway (scatter `yvar` xvar) (line p xvar), ///
ytitle("`lbl`") xtitle("Explanatory covariate") ///
yscale(range(0 80)) ///
legend(off) note("{\(\beta\)} = `b´", position(4) ring(0)) ///
name("graph_`yvar´", replace)
drop p
}
```

© 2014 StataCorp LP
Finally, we intend to combine the graphs into a multipanel setup. Assuming that the graphs belong to two distinct groups—graphs 1–3 and 4–7, respectively—they are mirrored in the construction. This is achieved by the following:

1. Combine graphs 1–3 into panel 1.
2. Combine graphs 4–7 into panel 2.
3. Combine the resulting 1-row panels, panel 1 \((r \times c = 1 \times 3)\) and panel 2 \((r \times c = 1 \times 4)\), into a final 2-row panel \((r = 2)\; \text{see figure}\; \text{I}\).

\[
\begin{align*}
\text{graph combine} & \text{ graph}_y1 \text{ graph}_y2 \text{ graph}_y3, & \text{///} \\
& \text{name("firstset", replace) ycommon cols(3) title("First set of graphs")} \\
\text{graph combine} & \text{ graph}_y4 \text{ graph}_y5 \text{ graph}_y6 \text{ graph}_y7, & \text{///} \\
& \text{name("secondset", replace) ycommon cols(4) title("Second set of graphs")} \\
\text{graph combine} & \text{ firstset secondset,} & \text{///} \\
& \text{saving("sevenpanelgraph.gph", replace) ycommon cols(1)} \\
\text{graph export} & \text{ sevenpanelgraph.eps, replace} \\
\end{align*}
\]

Figure 1. Multipanel graph—a combination of combined graphs

3 Some notes on options

The basic functionality facilitates an easy-to-use combination of graphs. A well-suited set of selected options might improve the display.
3.1 Axes

In many cases, keeping scales constant over panels might enhance the interpretability of the jointly graphed relations. Generally, this might prove to be a valid argument; however, it is imperative for the $x$ axis and $y$ axis when comparing vertically (the $x_{\text{common}}$ option) and horizontally (the $y_{\text{common}}$ option), respectively.

3.2 Margins

To keep the panels as tightly linked as possible—to increase overall comparability—it might be suitable to reduce margins through `imargin(zero)`; for other margin choices, see `help marginstyle`.

3.3 Panel pattern

The final number of panels to use is implicitly given by the stated list of panels in the actual program call. (Remember that each panel might in itself be a previously constructed multipanel. In the above example, a single column, $c = 1$, was used at the combination stage.) To define which $r \times c$ panel-matrix shape will be used, one may choose any of the following options (one is enough): `rows(integer)` or `cols(integer)`. To make the graph (distribution of panels) unique, select the `colfirst` option (or not).

If the required number of panels is less than the available number $r \cdot c$, it may be useful to explicitly—given the unique order—tell Stata which panels should be left empty (instead of the default) by using `holes(numlist)`.

3.4 Scaling

Each panel is downscaled when using multipanels, text and markers, etc. It is possible to rescale the downsizing through the `iscale(scale)` option, where `scale` is either an absolute (positive) or a relative value. For example, the absolute value 1 means the original size, and the relative value $\ast 1$ implies the same size as the default selection; 0.75 and $\ast 0.75$ will adjust the size to the three-quarter size counterparts.

4 A second example

For our second example, we will play around with the individual panel sizes. For this, we will use one of the seven graphs (the sixth) from figure 1, which is inspired by the informative help file (see the end of the `help graph combine` post), to complement it with the two corresponding underlying histograms (see result in figure 2).
In the next step, these three panels are combined (note that we use some of the options just discussed). The main point here is that the options `fxsize(number)` and `fysize(number)` govern the widths and heights of the panels; that is, in the example above, the thin sides are left at 25% of the original sizes.

```stata
graph combine hist_y6 graph_y6 hist_xvar, ///
holes(3) rows(2) ///
imargin(0 2 0 0) ///
title(" Twoway graph with histograms", ring(0)) ///
saving(graphwithhistograms.gh, replace)
graph export graphwithhistograms.eps, replace
```

Figure 2. Multipanel graph—a scatterplot with a prediction line and two complementary histograms
5 Discussion and alternatives

In many situations where the subgraphs combine corresponding true data subsets of the present loaded data, a similarly performing alternative would be to use the by() option (see help by). Here the syntax by(varlist[ , options]) allows combined graphing of the corresponding defined graph with respect to all present categories specified by the categorical variables given in varlist. In this setting, the options total and missing add panels based on the total dataset (over nonmissing groups) and missing data for individuals, respectively.

5.1 by() options

As noted above, the option by() allows for suboptions. Some suboptions are similar to the ones available for graph combine—for example, colfirst, cols(), rows(), holes(), iscale(), and imargin(). Similar functionality, but with different names and adapted settings, is given by compact (reduces margins between panels), norescale (uses the same scales over panels), and noedgelabel (restricts the number of displayed labels). Note that an option with no, such as norescale, generally has a counterpart, such as rescale, with a quite obvious implication.

Usually, this type of solution might be convenient in different cases; however, in most situations, this solution is less flexible and more restrictive by nature. Furthermore, graphing several subgroups within a single panel (together but separately marked) is an alternative solution that allows the smaller number of subgroups to be totally displayed while applying distinct colors and markers. For other cases, the multipanel design may be the best choice because one (or several) background groups can be added to each panel to enhance overall comparability. For example, see the discussion of overlaid graphs in Cox (2010), where subgroups are plotted against completely complementary data while using discrete gray-scaled backdrop markers for the background group. This is referred to as adopting a substrate, or subset, graphing design.

References


Juul, S., and M. Frydenberg. 2010. An Introduction to Stata for Health Researchers. 3rd ed. College Station, TX: Stata Press.