sunflower — Density-distribution sunflower plots

Syntax

`sunflower` *yvar xvar* [*if*] [*in*] [*weight*] [, *options*]

options	Description
Main	
`nograph`	do not show graph
`notable`	do not show summary table; implied when `by()` is specified
marker_options	affect rendition of markers drawn at the plotted points
Bins/Petals	
`binwidth(#)`	width of the hexagonal bins
`binar(#)`	aspect ratio of the hexagonal bins
bin_options	affect rendition of hexagonal bins
`light(#)`	minimum observations for a light sunflower; default is `light(3)`
`dark(#)`	minimum observations for a dark sunflower; default is `dark(13)`
`xcenter(#)`	x-coordinate of the reference bin
`ycenter(#)`	y-coordinate of the reference bin
`petalweight(#)`	observations in a dark sunflower petal
`petallength(#)`	length of sunflower petal as a percentage
petal_options	affect rendition of sunflower petals
`flowersonly`	show petals only; do not render bins
`nosinglepetal`	suppress single petals
Add plots	
`addplot(`*plot*`)`	add other plots to generated graph
Y axis, X axis, Titles, Legend, Overall, By	
twoway_options	any options documented in [G-3] ***twoway_options***

bin_options	Description
[l|d]bstyle(*areastyle*)	overall look of hexagonal bins
[l|d]bcolor(*colorstyle*)	outline and fill color
[l|d]bfcolor(*colorstyle*)	fill color
[l|d]blstyle(*linestyle*)	overall look of outline
[l|d]blcolor(*colorstyle*)	outline color
[l|d]blwidth(*linewidthstyle*)	thickness of outline

petal_options	Description
[l|d]flstyle(*linestyle*)	overall style of sunflower petals
[l|d]flcolor(*colorstyle*)	color of sunflower petals
[l|d]flwidth(*linewidthstyle*)	thickness of sunflower petals

All options are *rightmost*; see [G-4] **concept: repeated options**.
fweights are allowed; see [U] **11.1.6 weight**.

Menu

Graphics > Smoothing and densities > Density-distribution sunflower plot

Description

sunflower draws density-distribution sunflower plots (Plummer and Dupont 2003). These plots are useful for displaying bivariate data whose density is too great for conventional scatterplots to be effective.

A sunflower is several line segments of equal length, called petals, that radiate from a central point. There are two varieties of sunflowers: light and dark. Each petal of a light sunflower represents 1 observation. Each petal of a dark sunflower represents several observations. Dark and light sunflowers represent high- and medium-density regions of the data, and marker symbols represent individual observations in low-density regions.

The plane defined by the variables *yvar* and *xvar* is divided into contiguous hexagonal bins. The number of observations contained within a bin determines how the bin will be represented.

- When there are fewer than light(#) observations in a bin, each point is plotted using the usual marker symbols in a scatterplot.
- Bins with at least light(#) but fewer than dark(#) observations are represented by a light sunflower.
- Bins with at least dark(#) observations are represented by a dark sunflower.

Options

Main

nograph prevents the graph from being generated.

`notable` prevents the summary table from being displayed. This option is implied when the `by()` option is specified.

marker_options affect the rendition of markers drawn at the plotted points, including their shape, size, color, and outline; see [G-3] ***marker_options***.

Bins/Petals

`binwidth(#)` specifies the horizontal width of the hexagonal bins in the same units as *xvar*. By default,

$$binwidth = \texttt{max}(\text{rbw, nbw})$$

where

$$\text{rbw} = \text{range of } xvar/40$$

$$\text{nbw} = \text{range of } xvar/\texttt{max(1,}\text{nb}\texttt{)}$$

and

$$\text{nb} = \texttt{int(min(sqrt(}n\texttt{),10 * log10(}n\texttt{)))}$$

where

$$n = \text{the number of observations in the dataset}$$

`binar(#)` specifies the aspect ratio for the hexagonal bins. The height of the bins is given by

$$binheight = binwidth \times \# \times 2/\sqrt{3}$$

where *binheight* and *binwidth* are specified in the units of *yvar* and *xvar*, respectively. The default is `binar(`*r*`)`, where *r* results in the rendering of regular hexagons.

bin_options affect how the hexagonal bins are rendered.

`lbstyle(`*areastyle*`)` and `dbstyle(`*areastyle*`)` specify the look of the light and dark hexagonal bins, respectively. The options listed below allow you to change each attribute, but `lbstyle()` and `dbstyle()` provide the starting points. See [G-4] ***areastyle*** for a list of available area styles.

`lbcolor(`*colorstyle*`)` and `dbcolor(`*colorstyle*`)` specify one color to be used both to outline the shape and to fill the interior of the light and dark hexagonal bins, respectively. See [G-4] ***colorstyle*** for a list of color choices.

`lbfcolor(`*colorstyle*`)` and `dbfcolor(`*colorstyle*`)` specify the color to be used to fill the interior of the light and dark hexagonal bins, respectively. See [G-4] ***colorstyle*** for a list of color choices.

`lblstyle(`*linestyle*`)` and `dblstyle(`*linestyle*`)` specify the overall style of the line used to outline the area, which includes its pattern (solid, dashed, etc.), thickness, and color. The other options listed below allow you to change the line's attributes, but `lblstyle()` and `dblstyle()` are the starting points. See [G-4] ***linestyle*** for a list of choices.

`lblcolor(`*colorstyle*`)` and `dblcolor(`*colorstyle*`)` specify the color to be used to outline the light and dark hexagonal bins, respectively. See [G-4] ***colorstyle*** for a list of color choices.

`lblwidth(`*linewidthstyle*`)` and `dblwidth(`*linewidthstyle*`)` specify the thickness of the line to be used to outline the light and dark hexagonal bins, respectively. See [G-4] ***linewidthstyle*** for a list of choices.

`light(#)` specifies the minimum number of observations needed for a bin to be represented by a light sunflower. The default is `light(3)`.

`dark(#)` specifies the minimum number of observations needed for a bin to be represented by a dark sunflower. The default is `dark(13)`.

`xcenter(#)` and `ycenter(#)` specify the center of the reference bin. The default values are the median values of *xvar* and *yvar*, respectively. The centers of the other bins are implicitly defined by the location of the reference bin together with the common bin width and height.

`petalweight(#)` specifies the number of observations represented by each petal of a dark sunflower. The default value is chosen so that the maximum number of petals on a dark sunflower is 14.

`petallength(#)` specifies the length of petals in the sunflowers. The value specified is interpreted as a percentage of half the bin width. The default is 100%.

petal_options affect how the sunflower petals are rendered.

`lflstyle(`*linestyle*`)` and `dflstyle(`*linestyle*`)` specify the overall style of the light and dark sunflower petals, respectively.

`lflcolor(`*colorstyle*`)` and `dflcolor(`*colorstyle*`)` specify the color of the light and dark sunflower petals, respectively.

`lflwidth(`*linewidthstyle*`)` and `dflwidth(`*linewidthstyle*`)` specify the width of the light and dark sunflower petals, respectively.

`flowersonly` suppresses rendering of the bins. This option is equivalent to specifying `lbcolor(none)` and `dbcolor(none)`.

`nosinglepetal` suppresses flowers from being drawn in light bins that contain only 1 observation and dark bins that contain as many observations as the petal weight (see the `petalweight()` option).

Add plots

`addplot(`*plot*`)` provides a way to add other plots to the generated graph; see [G-3] ***addplot_option***.

Y axis, X axis, Titles, Legend, Overall, By

twoway_options are any of the options documented in [G-3] ***twoway_options***. These include options for titling the graph (see [G-3] ***title_options***), options for saving the graph to disk (see [G-3] ***saving_option***), and the `by()` option (see [G-3] ***by_option***).

Remarks and examples

stata.com

See Dupont (2009, 87–92) for a discussion of sunflower plots and how to create them using Stata.

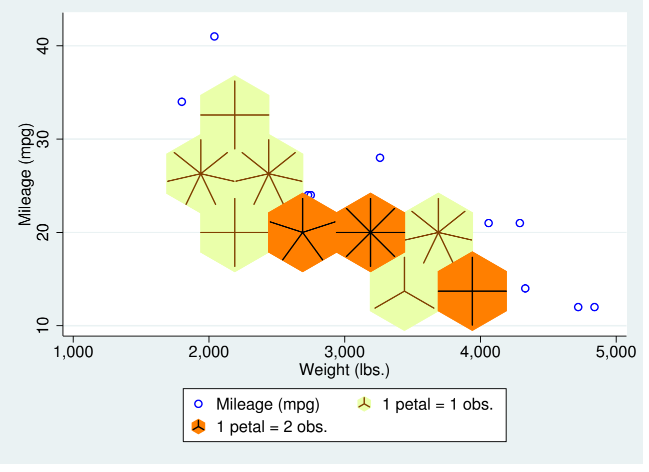
▷ Example 1

Using the auto dataset, we want to examine the relationship between `weight` and `mpg`. To do that, we type

```
. use http://www.stata-press.com/data/r13/auto
(1978 Automobile Data)

. sunflower mpg weight, binwid(500) petalw(2) dark(8) scheme(s2color)
Bin width           =       500
Bin height          =   8.38703
Bin aspect ratio    =  .0145268
Max obs in a bin    =        15
Light               =         3
Dark                =         8
X-center            =      3190
Y-center            =        20
Petal weight        =         2

──────────────────────────────────────────────────────────────────
      flower       petal      No. of      No. of  estimated     actual
        type      weight      petals     flowers       obs.       obs.
──────────────────────────────────────────────────────────────────
        none                                            10         10
       light           1           3           1         3          3
       light           1           4           2         8          8
       light           1           7           3        21         21
        dark           2           4           1         8          8
        dark           2           5           1        10          9
        dark           2           8           1        16         15
──────────────────────────────────────────────────────────────────
                                                        76         74
```



The three darkly shaded sunflowers immediately catch our eyes, indicating a group of eight cars that are heavy (nearly 4,000 pounds) and fuel inefficient and two groups of cars that get about 20 miles per gallon and weight in the neighborhood of 3,000 pounds, one with 10 cars and one with 8 cars. The lighter sunflowers with seven petals each indicate groups of seven cars that share similar weight and fuel economy characteristics. To obtain the number of cars in each group, we counted the number of petals in each flower and consulted the graph legend to see how many observations each petal represents.

◁

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References

Cleveland, W. S., and R. McGill. 1984. The many faces of a scatterplot. *Journal of the American Statistical Association* 79: 807–822.

Dupont, W. D. 2009. *Statistical Modeling for Biomedical Researchers: A Simple Introduction to the Analysis of Complex Data*. 2nd ed. Cambridge: Cambridge University Press.

Dupont, W. D., and W. D. Plummer, Jr. 2005. Using density-distribution sunflower plots to explore bivariate relationships in dense data. *Stata Journal* 5: 371–384.

Huang, C., J. A. McDonald, and W. Stuetzle. 1997. Variable resolution bivariate plots. *Journal of Computational and Graphical Statistics* 6: 383–396.

Levy, D. E. 1999. *50 Years of Discovery: Medical Milestones from the National Heart, Lung, and Blood Institute's Framingham Heart Study*. Hoboken, NJ: Center for Bio-Medical Communication.

Plummer, W. D., Jr., and W. D. Dupont. 2003. Density distribution sunflower plots. *Journal of Statistical Software* 8: 1–11.

Steichen, T. J., and N. J. Cox. 1999. flower: Stata module to draw sunflower plots. Boston College Department of Economics, Statistical Software Components S393001. http://ideas.repec.org/c/boc/bocode/s393001.html.