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THE STATA JOURNAL

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Stata tip 27: Classifying data points on scatter plots

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When you have scatter plots of counted or measured variables, you may often wish to classify data points according to the values of a further categorical variable. There are several ways to do this. Here we focus on the use of `separate`, gray-scale gradation, and text characters as class symbols. If different categories really do plot as distinct clusters, it should not matter too much how you show them, but knowing some Stata tricks should also help.

One starting point is that differing markers may be used on the plot whenever there are several variables plotted on the *y*-axis. With the `auto.dta` dataset, you can imagine

```
. sysuse auto
. gen mpg0 = mpg if foreign == 0
. gen mpg1 = mpg if foreign == 1
. scatter mpg? weight
```

Note the use of the wildcard `mpg?`, which picks up any variable names that have `mpg` followed by just one other character. Once the two variables `mpg0` and `mpg1` have been generated, different markers are automatic. This process still raises two questions. To get an acceptable graph, we need self-explanatory variable labels or at least self-explanatory text in the graph legend. Moreover, two categories are easy enough, but do we have to do this for each of say 5, 7, or 9 categories?

In fact, it would have been better to type

```
. separate mpg, by(foreign) veryshortlabel
. scatter mpg? weight
```

The command `separate` (see [D] `separate`) generates all the variables we need in one command and has a stab at labeling them intelligibly. In this case, we use the (undocumented) `veryshortlabel` option, which was implemented with graphics especially in mind. You may prefer the results of the documented `shortlabel` option. Note that the `by()` option can take true-or-false conditions, such as `price < 6000`, as well as categorical variables.

If your categorical variable consists of qualitatively different categories, you are likely to want to use qualitatively different symbols. Alternatively, if that variable is ordered or graded, the coding you use should also be ordered. One possibility is to use symbols colored in a sequence of gray scales.

Some data on landforms illustrate the point: Ian S. Evans kindly supplied measurements of 260 cirques in Wales, armchair-shaped hollows formerly occupied by small glaciers. Length tends to increase with width, approximately as a power function, but qualitative aspects of form, particularly how closely they approach a classic, well-developed shape, are also coded in a grade variable.

```

. separate length, by(grade) veryshortlabel
. scatter length? width, xsc(log) ysc(log) ms(0 ..)
> mcolor(gs1 gs4 gs7 gs10 gs13) mlcolor(black ..) msize(*1.5 ..)
> yti("': variable label length'") yla(200 500 1000 2000, ang(h))
> xla(200 500 1000 2000) legend(pos(11) ring(0) col(1))

```

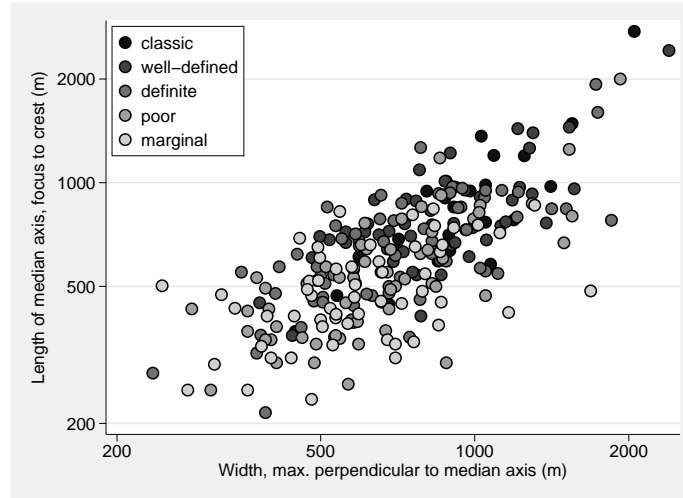


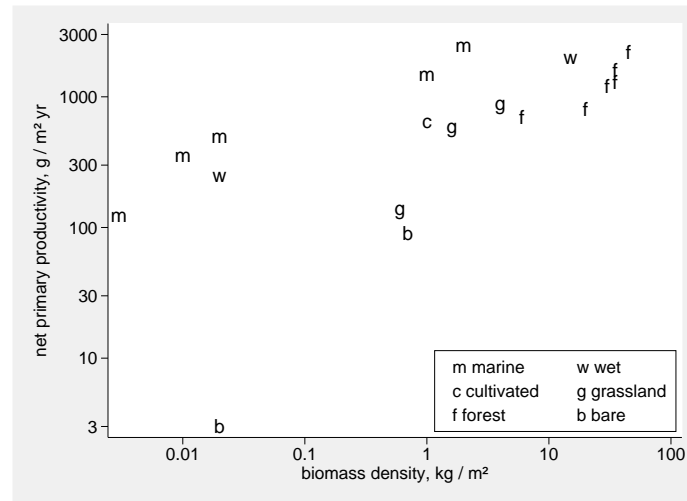
Figure 1 shows length versus width, subdivided by grade. Some practical details deserve emphasis. Gray scales near 16 (white) may be difficult to spot against a light background, including any printed page. Therefore, a dark outline color is recommended. Bigger symbols than the default are needed to do the coloring justice, but as a consequence, this approach is less likely to be useful with thousands of data points. A `by()` option showing different categories separately might work better. With the coding here, it so happens that the darkest category is plotted first and is thus liable to be overplotted by lighter categories wherever data points are dense. Some experimentation with the opposite order of plotting might be a good idea to see which works better.

An alternative that sometimes works nicely is to use ordinary text characters as different markers. One clean style is to suppress the marker symbols completely, using instead the contents of a `str1` variable as marker labels. Whittaker (1975, 224) gave data on net primary productivity and biomass density for various ecosystem types. Figure 2 shows the subdivision.

```

. scatter npp bd, xsc(log) ysc(log) ms(i) mlabpos(0) mlabsize(*1.4)
> mla(c) yla(3000 1000 300 100 30 10 3, nogrid ang(h))
> xla(0.01 "0.01" 0.1 "0.1" 1 10 100)
> legend(on ring(0) pos(5) order( - "m marine" - "w wet" - "c cultivated" -
> "g grassland" - "f forest" - "b bare"))

```



With three or four orders of magnitude variation in each variable, log scales are advisable. On those scales, there is a broad correlation whereby more biomass means higher productivity, but also considerable variation, much of which can be rationalized in terms of very different cover types. For the same biomass density, marine and other wet ecosystems have higher productivity than land ecosystems.

On the Stata side, remember `mlabpos(0)` and note that the **legend** must be set **on** explicitly. For different purposes, or for different tastes, what is here given as the legend might go better as text in a caption in a printed report. Behind the practice here lies general advice that lowercase letters, such as **abc**, work better than uppercase, such as **ABC**, as they are easier to distinguish from each other, and they are less likely to impart an synaesthetic sense in readers that the graph designer is shouting at them.

References

Whittaker, R. H. 1975. *Communities and Ecosystems*. New York: Macmillan.