The Lattice Plotting System in R

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The Lattice Plotting System

The lattice plotting system is implemented using the following packages:

- *lattice*: contains code for producing Trellis graphics, which are independent of the “base” graphics system; includes functions like `xyplot`, `bwplot`, `levelplot`
- *grid*: implements a different graphing system independent of the “base” system; the *lattice* package builds on top of *grid*
    - We seldom call functions from the *grid* package directly
- The lattice plotting system does not have a "two-phase" aspect with separate plotting and annotation like in base plotting
- All plotting/annotation is done at once with a single function call

Lattice Functions

- `xyplot`: this is the main function for creating scatterplots
- `bwplot`: box-and-whiskers plots (“boxplots”)
- `histogram`: histograms
- `stripplot`: like a boxplot but with actual points
- `dotplot`: plot dots on "violin strings"
- `splom`: scatterplot matrix; like `pairs` in base plotting system
- `levelplot`, `contourplot`: for plotting "image" data

Lattice Functions

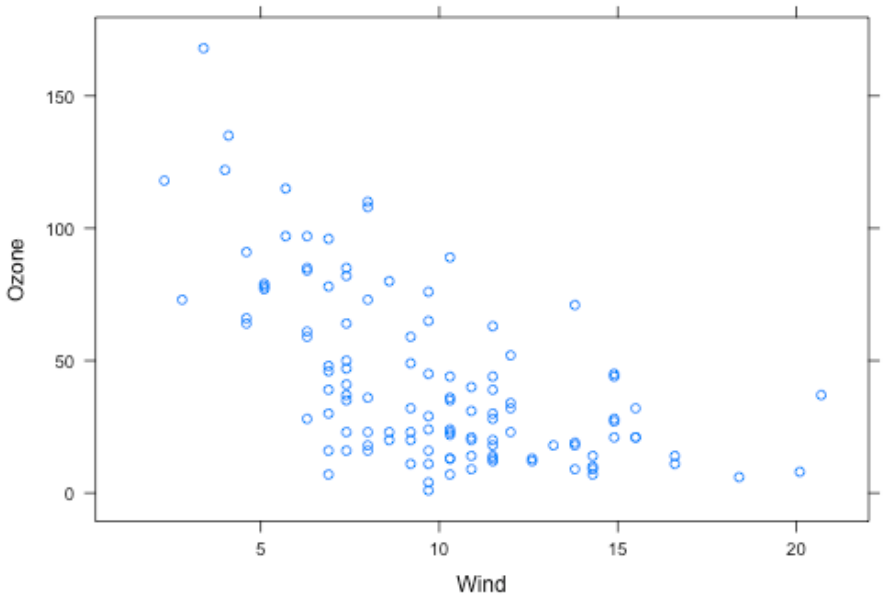
Lattice functions generally take a formula for their first argument, usually of the form

```
xyplot(y ~ x | f * g, data)
```

- We use the *formula notation* here, hence the ~.
- On the left of the ~ is the y-axis variable, on the right is the x-axis variable
- f and g are *conditioning variables* — they are optional
    - the * indicates an interaction between two variables
- The second argument is the data frame or list from which the variables in the formula should be looked up
    - If no data frame or list is passed, then the parent frame is used.
- If no other arguments are passed, there are defaults that can be used.

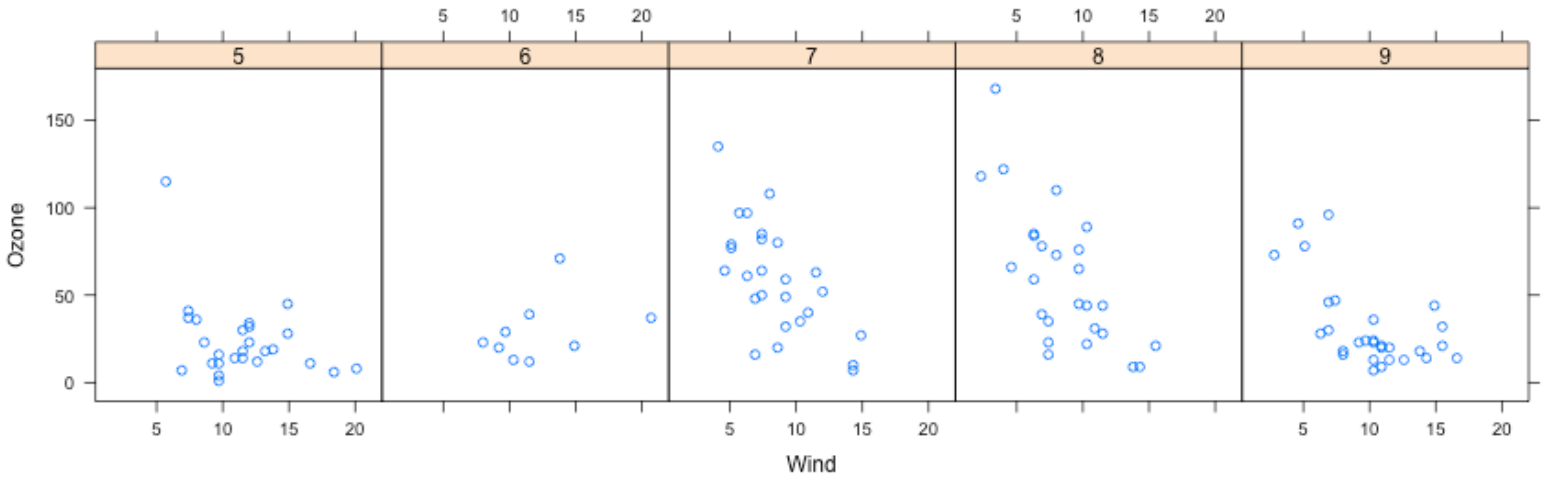
Simple Lattice Plot

```
library(lattice)
library(datasets)
## Simple scatterplot
xyplot(Ozone ~ Wind, data = airquality)
```



Simple Lattice Plot

```
library(datasets)
library(lattice)
## Convert 'Month' to a factor variable
airquality <- transform(airquality, Month = factor(Month))
xyplot(Ozone ~ Wind | Month, data = airquality, layout = c(5, 1))
```



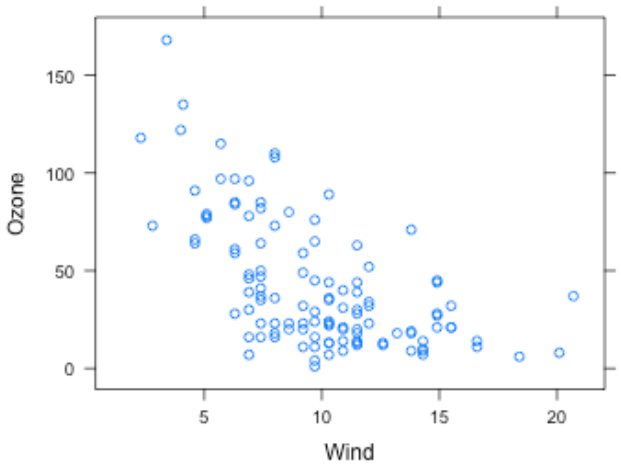
Lattice Behavior

Lattice functions behave differently from base graphics functions in one critical way.

- Base graphics functions plot data directly to the graphics device (screen, PDF file, etc.)
- Lattice graphics functions return an object of class **trellis**
- The print methods for lattice functions actually do the work of plotting the data on the graphics device.
- Lattice functions return "plot objects" that can, in principle, be stored (but it's usually better to just save the code + data).
- On the command line, trellis objects are *auto-printed* so that it appears the function is plotting the data

Lattice Behavior

```
p <- xyplot(Ozone ~ Wind, data = airquality)  ## Nothing happens!
print(p)  ## Plot appears
```



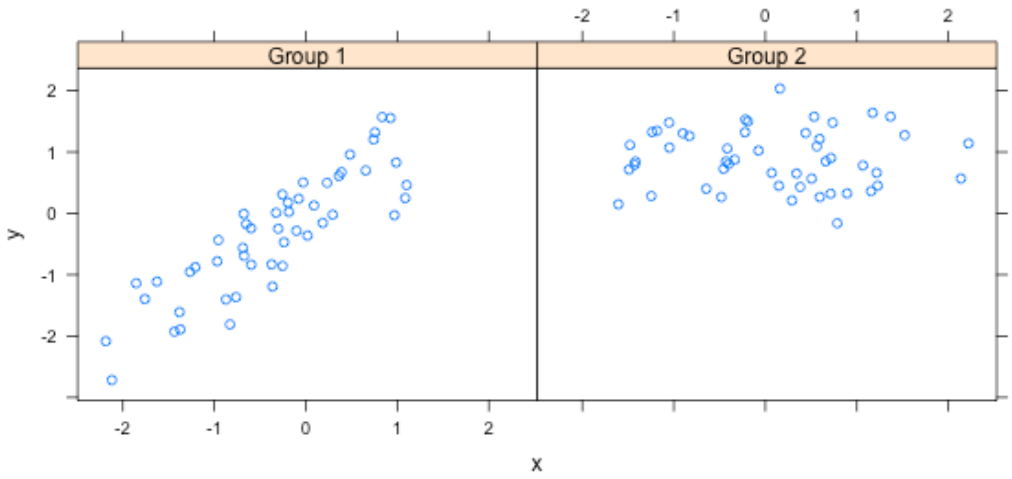

```
xyplot(Ozone ~ Wind, data = airquality)  ## Auto-printing
```

Lattice Panel Functions

- Lattice functions have a **panel function** which controls what happens inside each panel of the plot.
- The *lattice* package comes with default panel functions, but you can supply your own if you want to customize what happens in each panel
- Panel functions receive the x/y coordinates of the data points in their panel (along with any optional arguments)

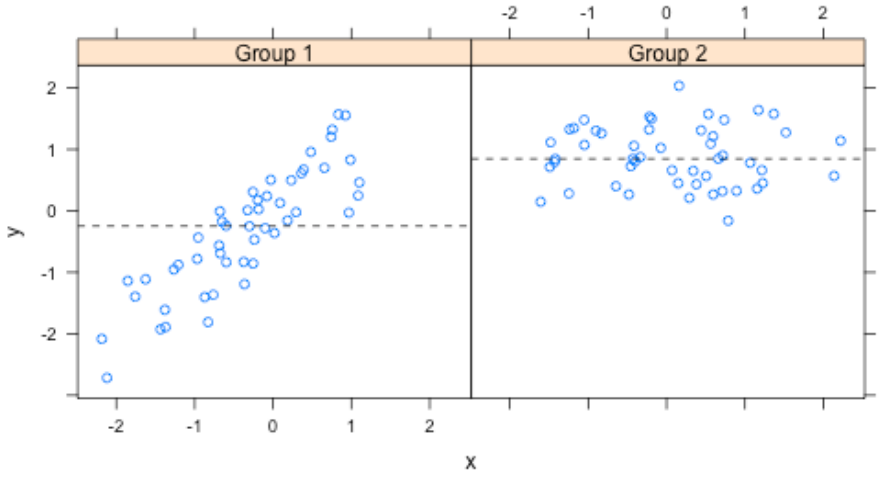
Lattice Panel Functions

```
set.seed(10)
x <- rnorm(100)
f <- rep(0:1, each = 50)
y <- x + f - f * x + rnorm(100, sd = 0.5)
f <- factor(f, labels = c("Group 1", "Group 2"))
xyplot(y ~ x | f, layout = c(2, 1))  ## Plot with 2 panels
```



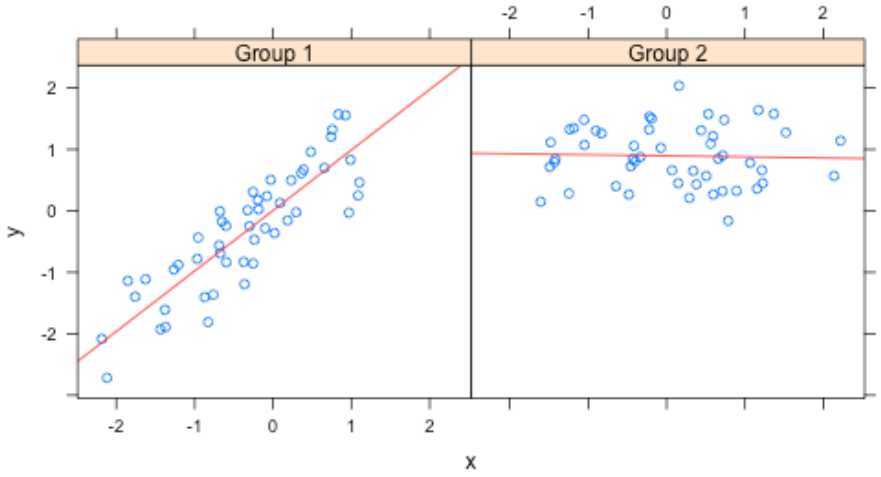
Lattice Panel Functions

```
## Custom panel function
xyplot(y ~ x | f, panel = function(x, y, ...) {
    panel.xyplot(x, y, ...)  ## First call the default panel function for 'xyplot'
    panel.abline(h = median(y), lty = 2)  ## Add a horizontal line at the median
})
```



Lattice Panel Functions: Regression line

```
## Custom panel function
xyplot(y ~ x | f, panel = function(x, y, ...) {
    panel.xyplot(x, y, ...)  ## First call default panel function
    panel.lmline(x, y, col = 2)  ## Overlay a simple linear regression line
})
```

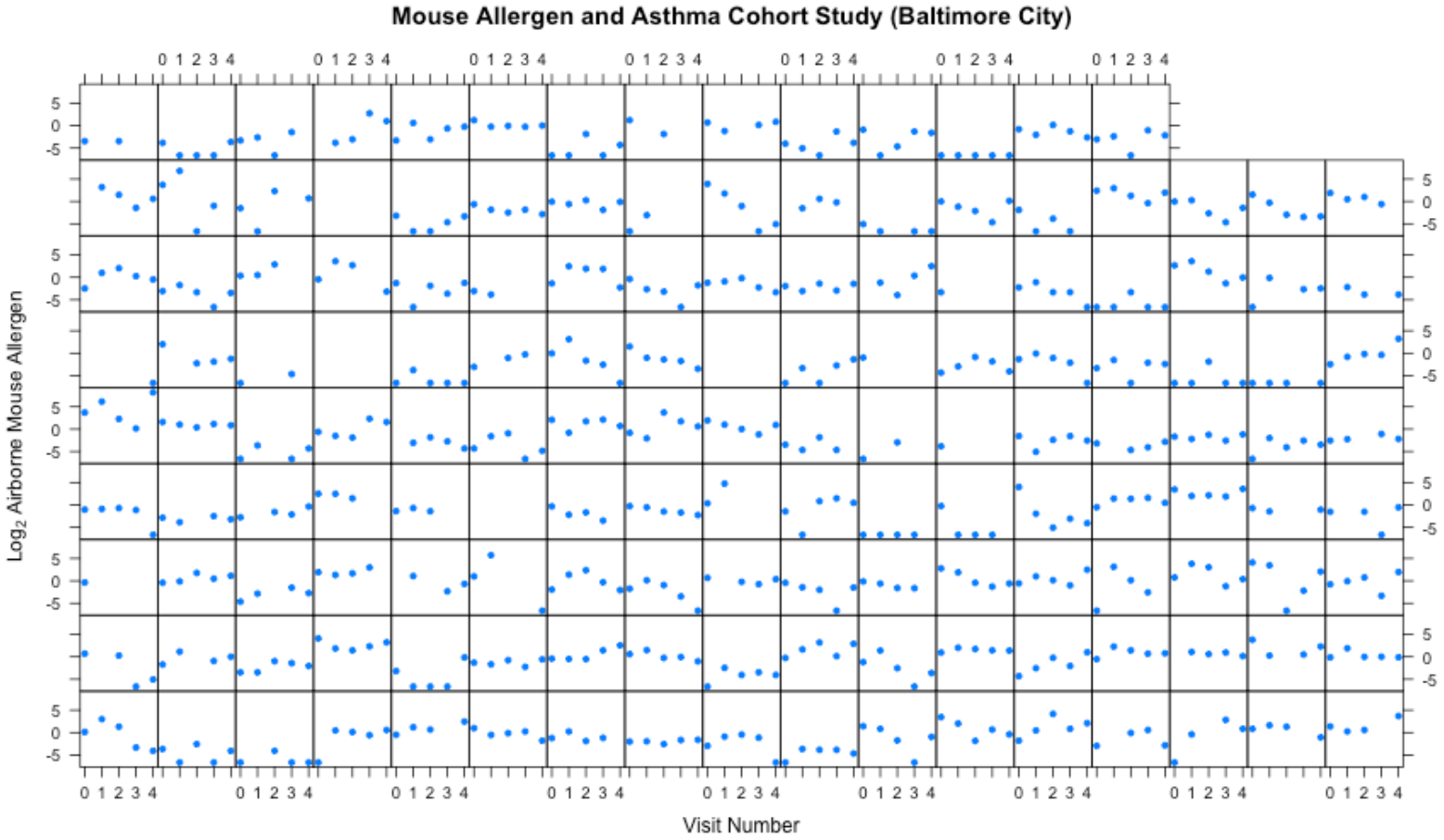


Many Panel Lattice Plot: Example from MAACS

- Study: Mouse Allergen and Asthma Cohort Study (MAACS)
- Study subjects: Children with asthma living in Baltimore City, many allergic to mouse allergen
- Design: Observational study, baseline home visit + every 3 months for a year.
- Question: How does indoor airborne mouse allergen vary over time and across subjects?

Ahluwalia et al., *Journal of Allergy and Clinical Immunology*, 2013

Many Panel Lattice Plot



Summary

- Lattice plots are constructed with a single function call to a core lattice function (e.g. `xyplot`)
- Aspects like margins and spacing are automatically handled and defaults are usually sufficient
- The lattice system is ideal for creating conditioning plots where you examine the same kind of plot under many different conditions
- Panel functions can be specified/customized to modify what is plotted in each of the plot panels