Teaching data analysis

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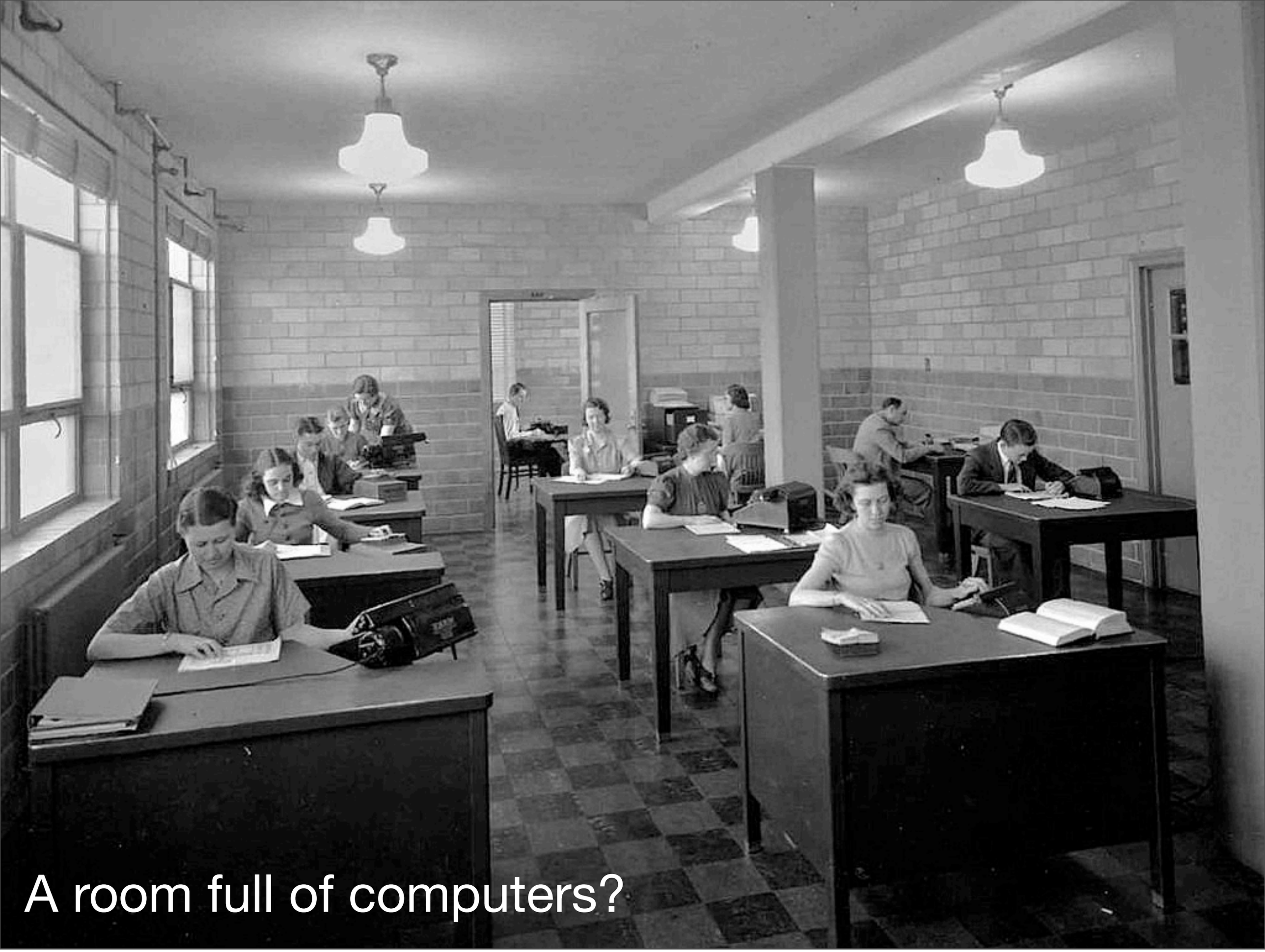
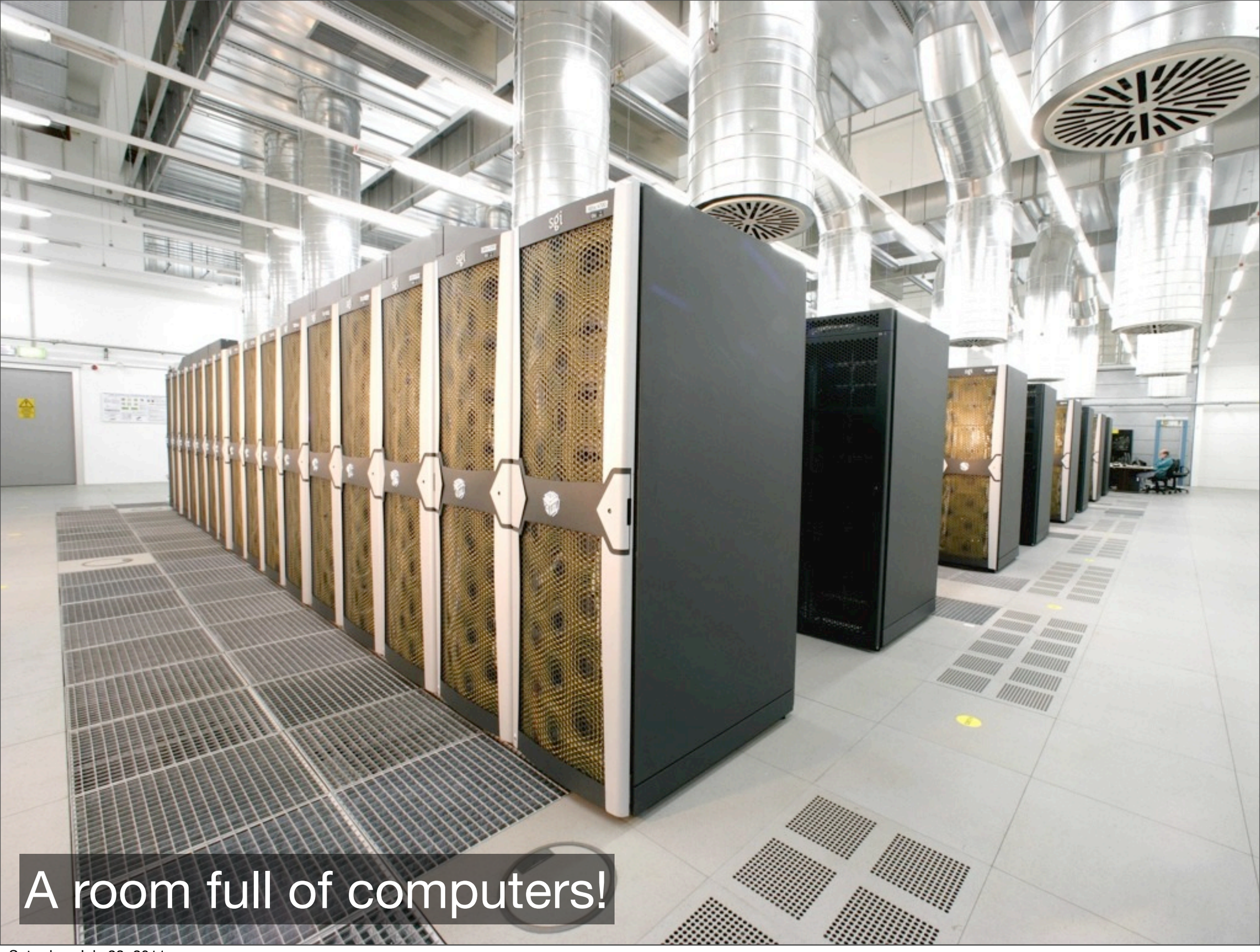
1. Why is programming an important part of data analysis?
2. How can we make programming engaging and accessible?
3. What types of practice and feedback help students learn?

Why programming?


A room full of computers?

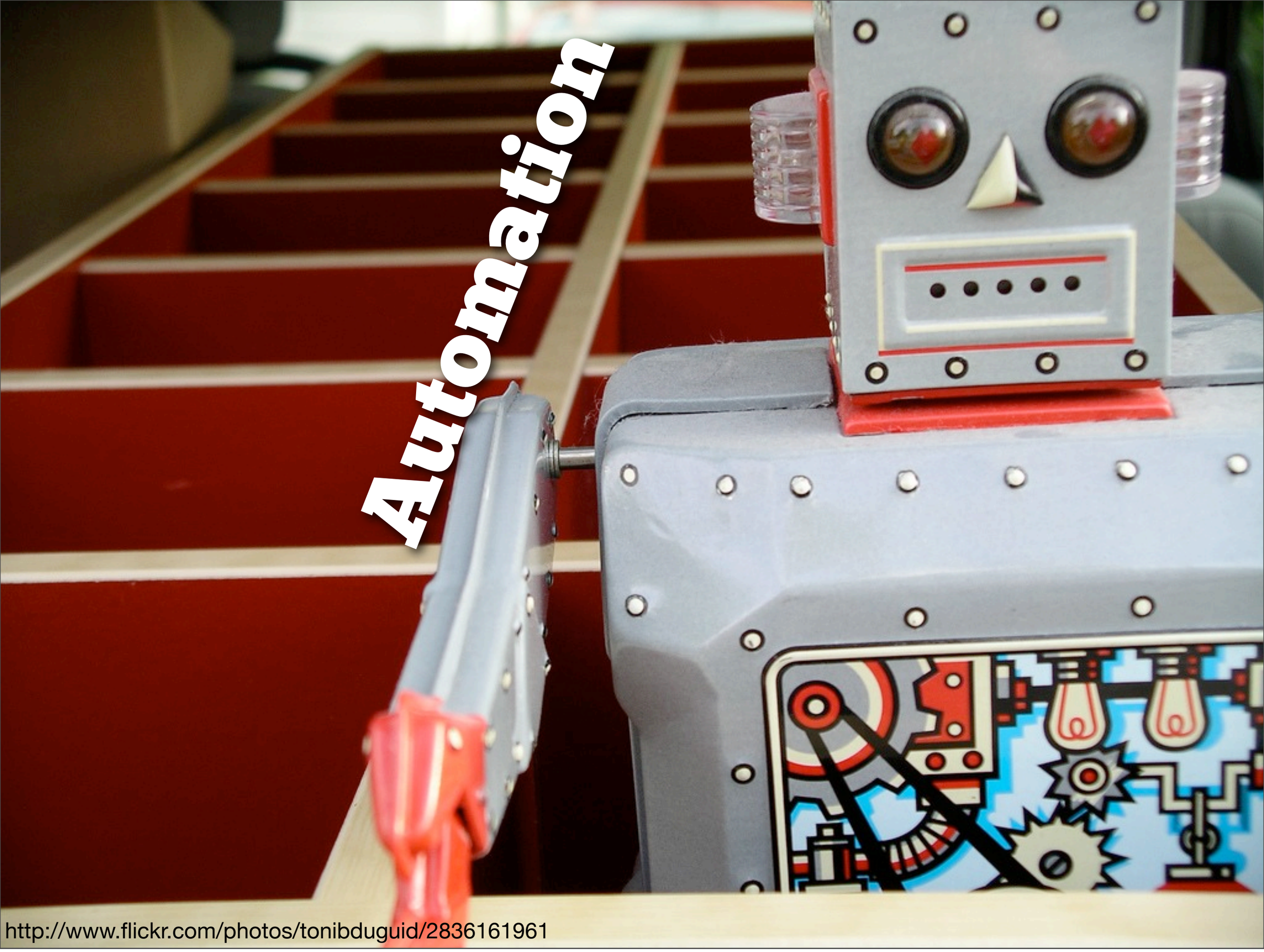

A room full of computers!

3 reasons

Reproducibility

http://www.flickr.com/photos/tonibduguid/2836161961

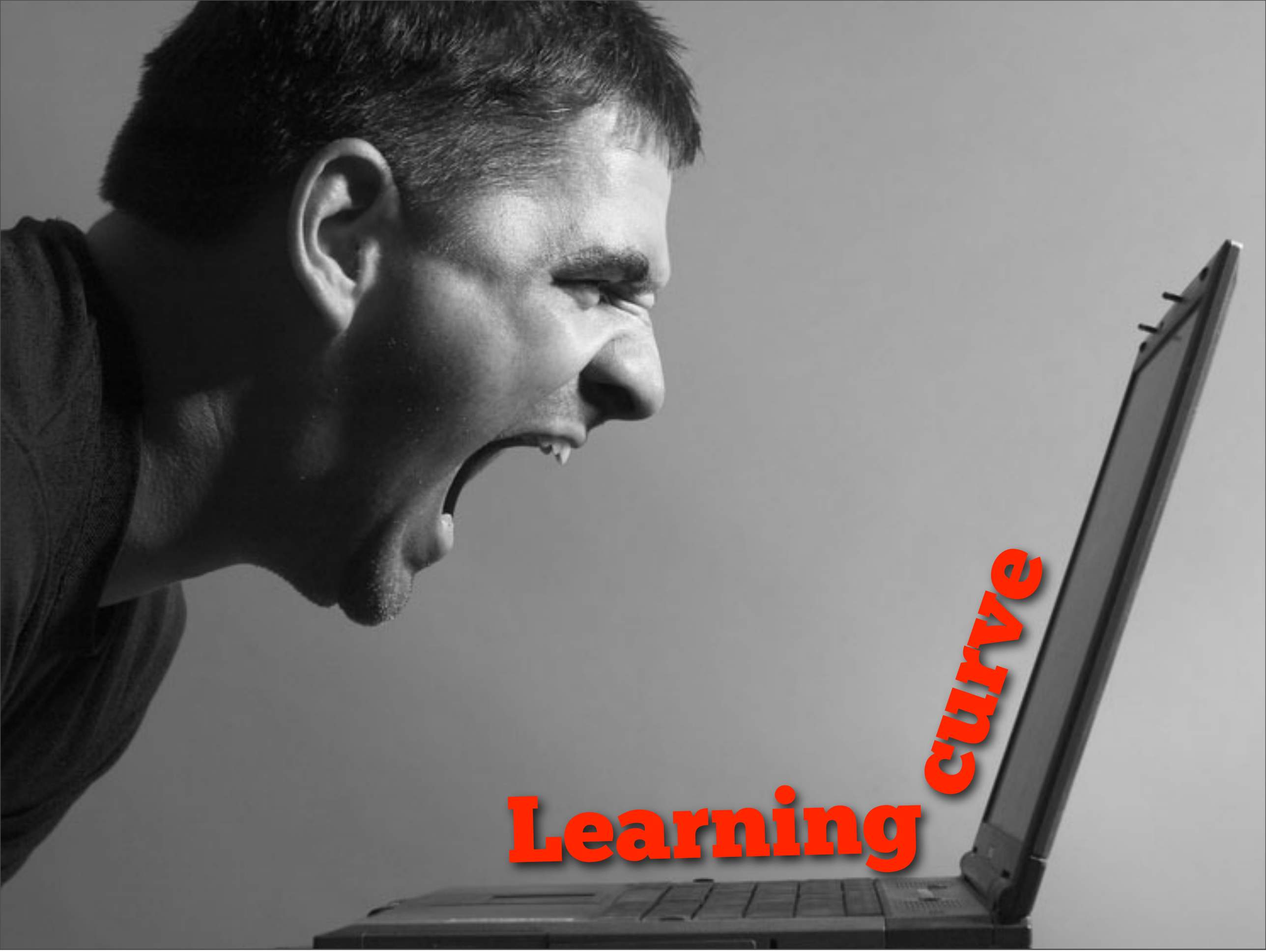
Automation



http://www.flickr.com/photos/tonibduguid/2836161961

Communication

http://www.flickr.com/photos/altemark/337248947


Learning curve

Teaching techniques

1. Start with visualisation

A grammar of graphics means:

scatterplot
histogram

x

aesthetics
facetting

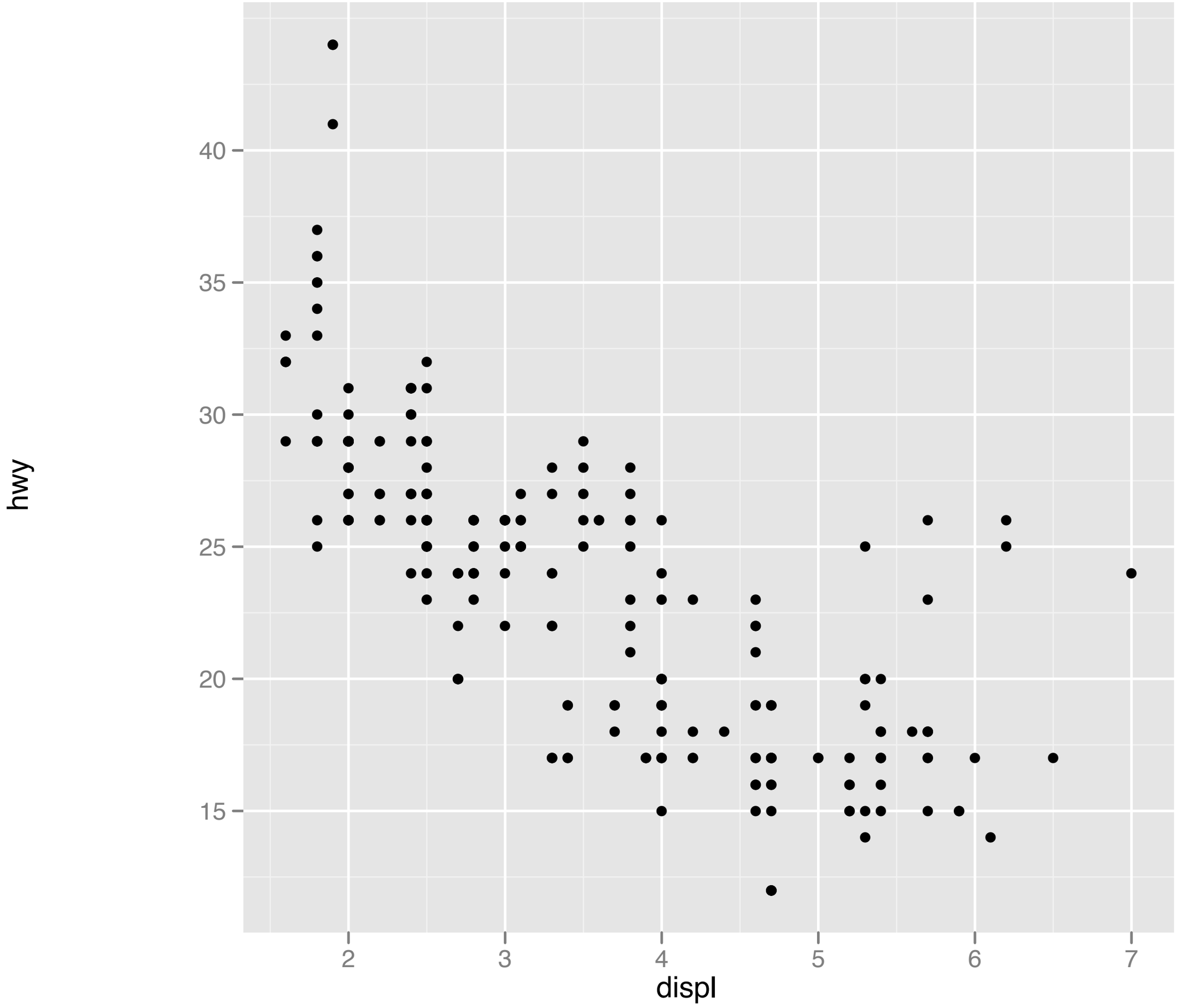
=

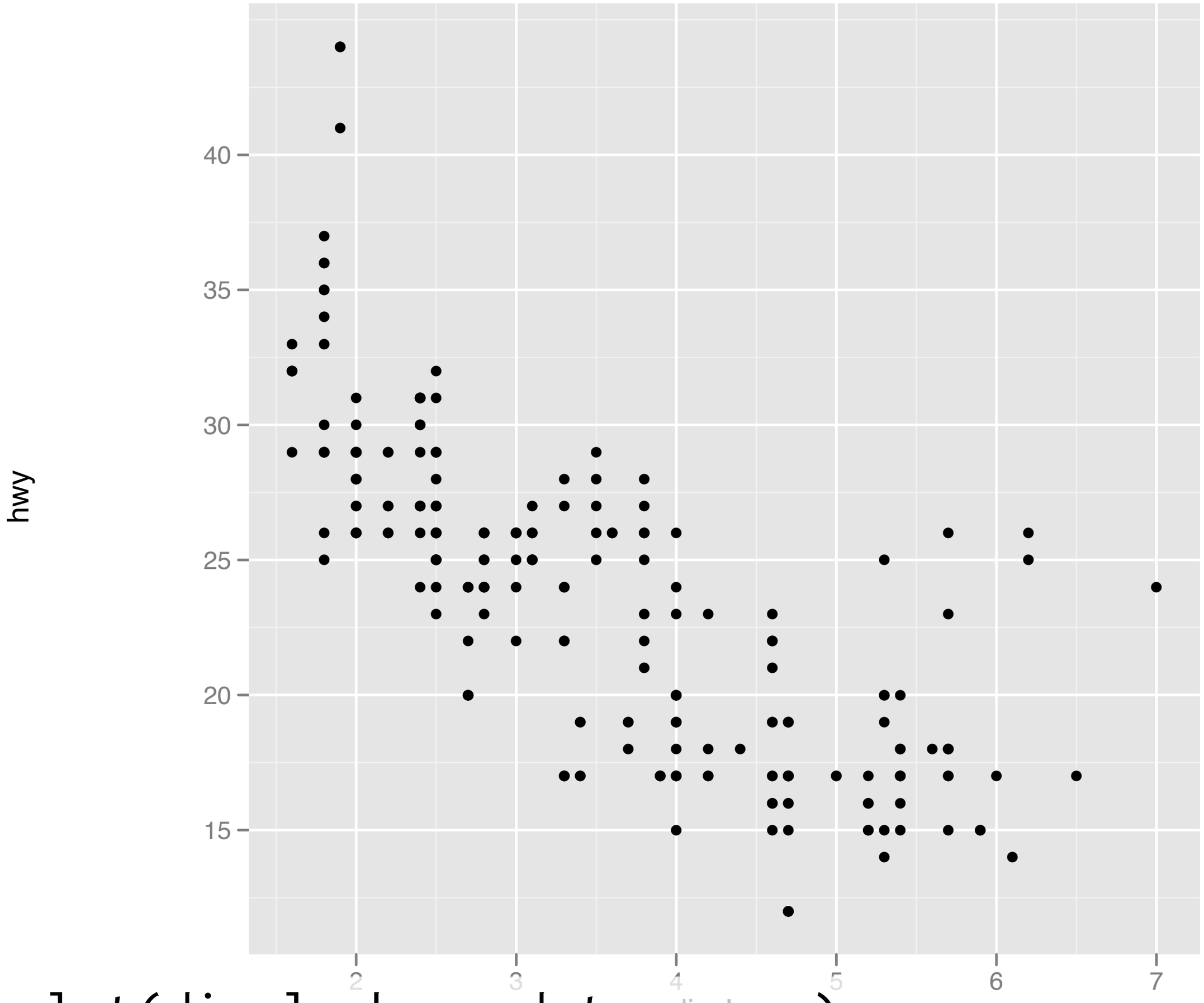
1000's of
possible
graphics

Can later teach other geometric elements:

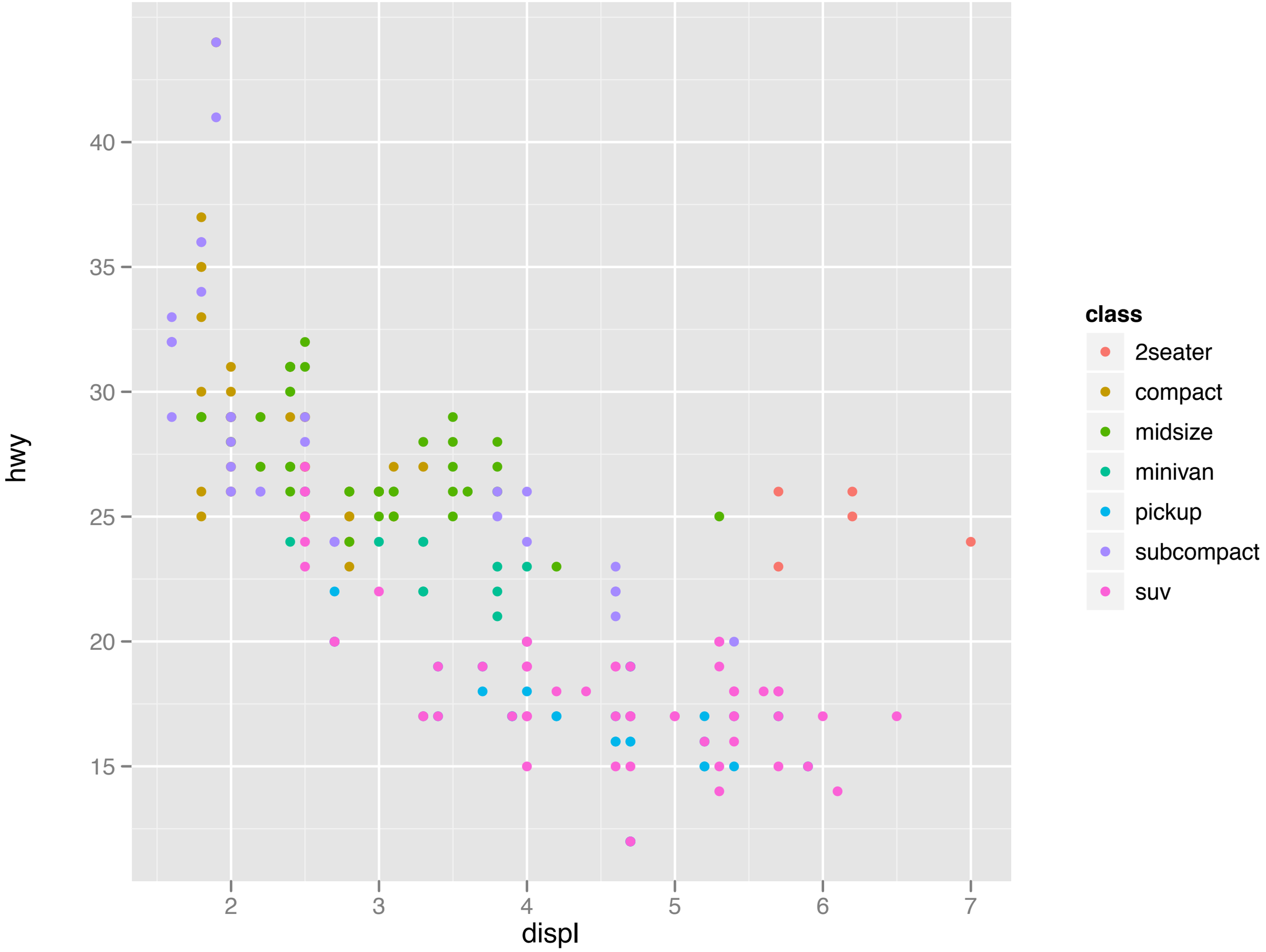
line
path
polygon

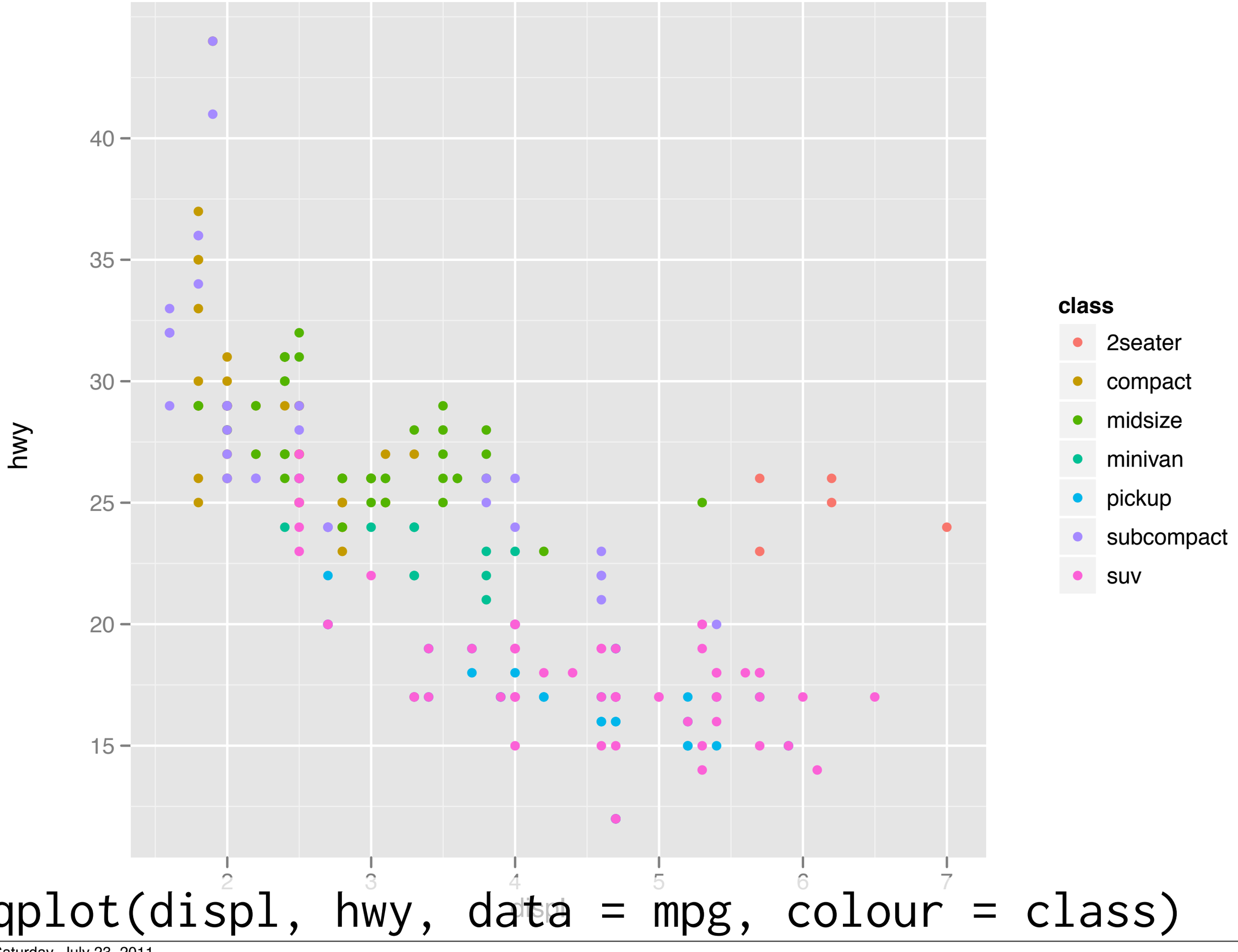
boxplot
smoother
hexagon binning


hwy
40
35
30
25
20
15
2
3
4
5
6
7
displ

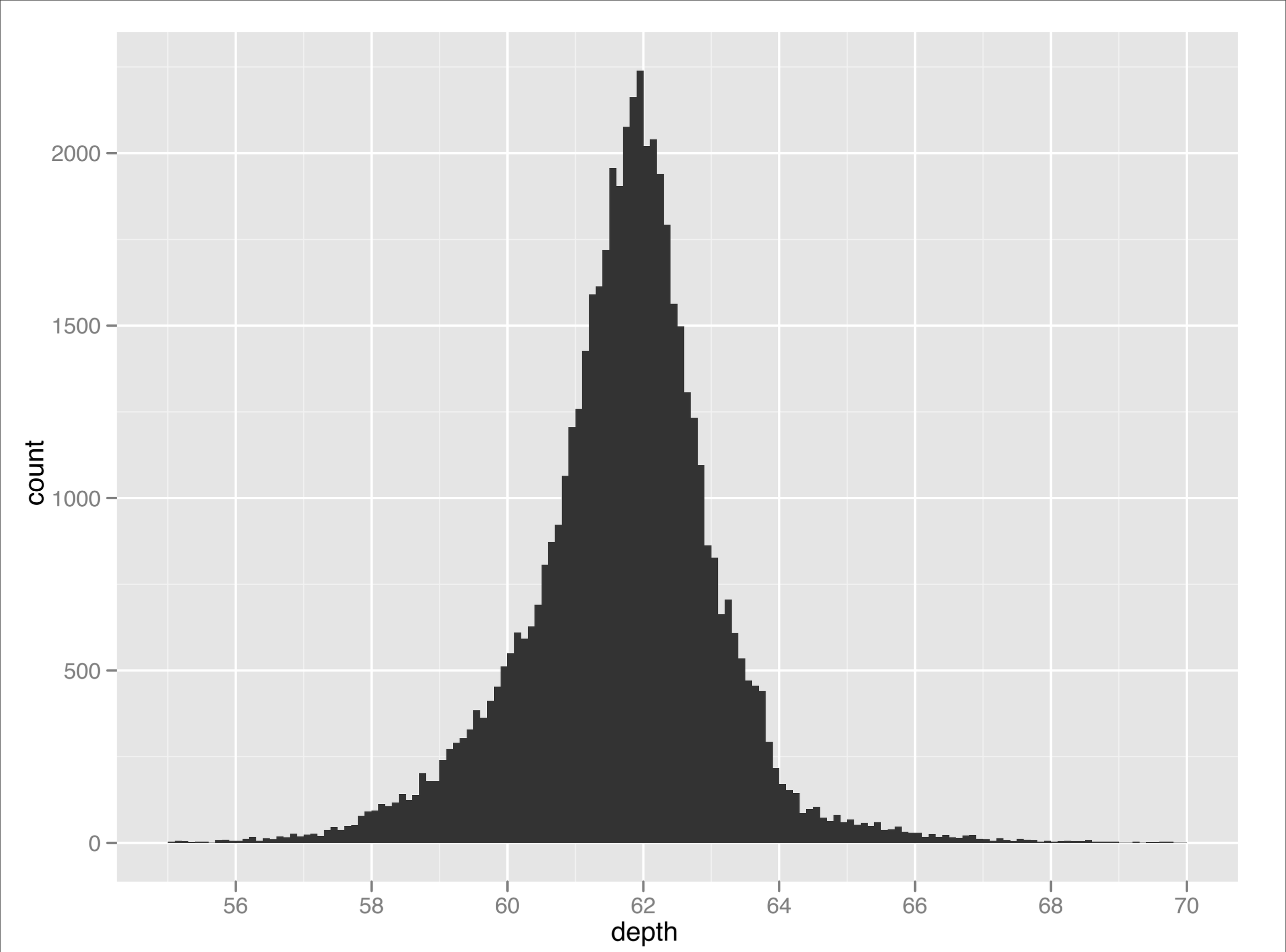


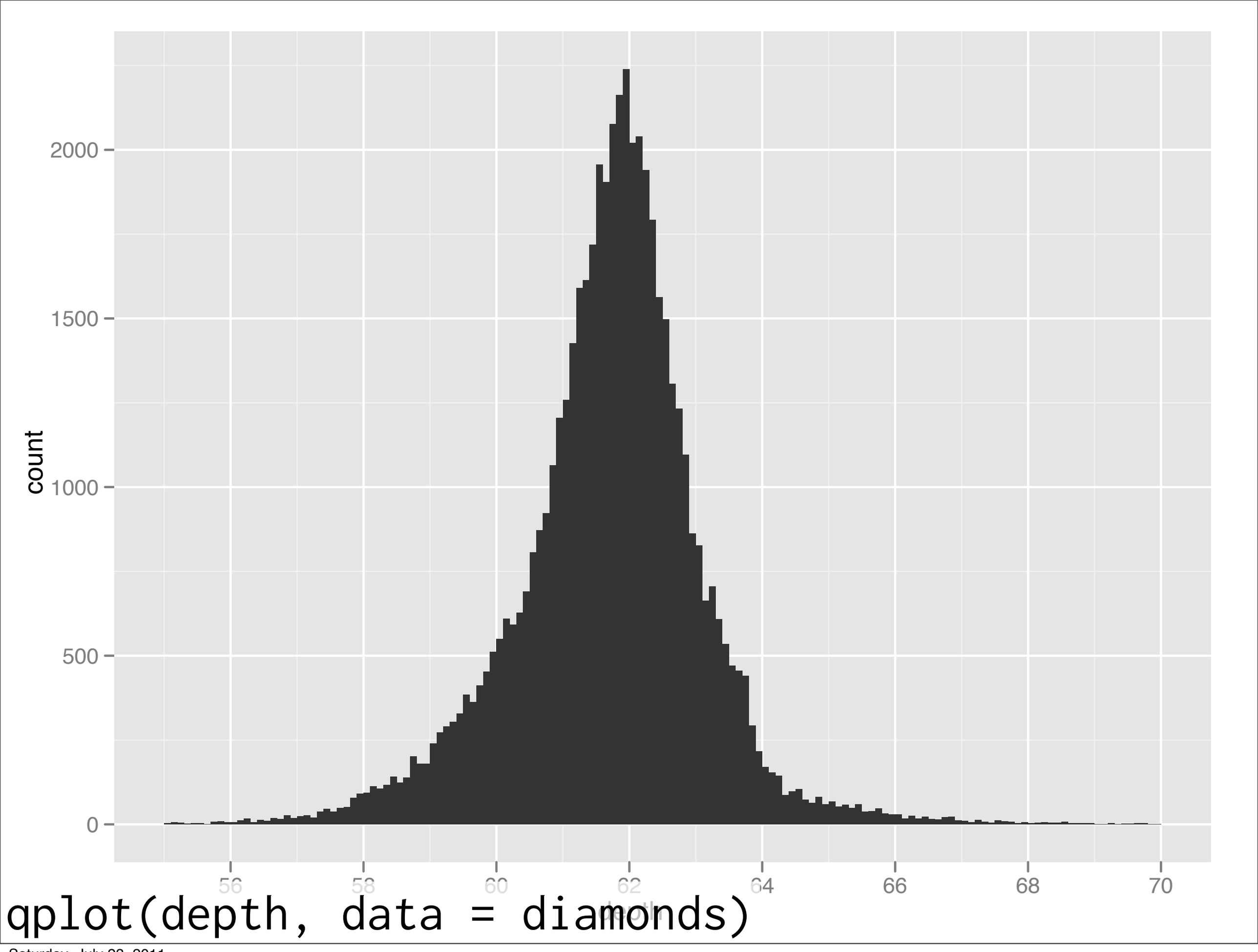

```
qplot(displ, hwy, data = mpg)
```


hwy
40
35
30
25
20
15
2
3
4
5
6
7
displ
class
2seater
compact
midsize
minivan
pickup
subcompact
suv

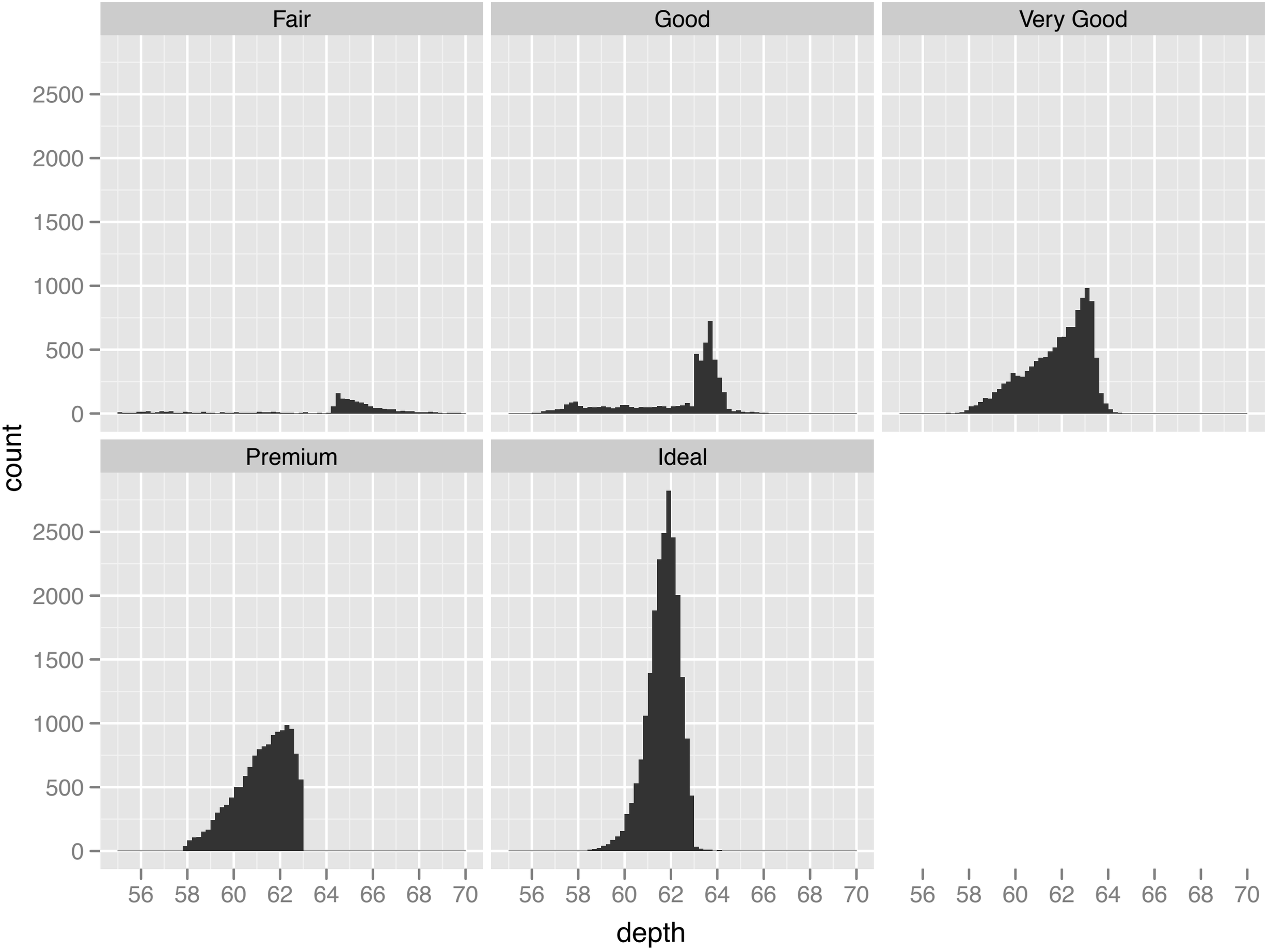


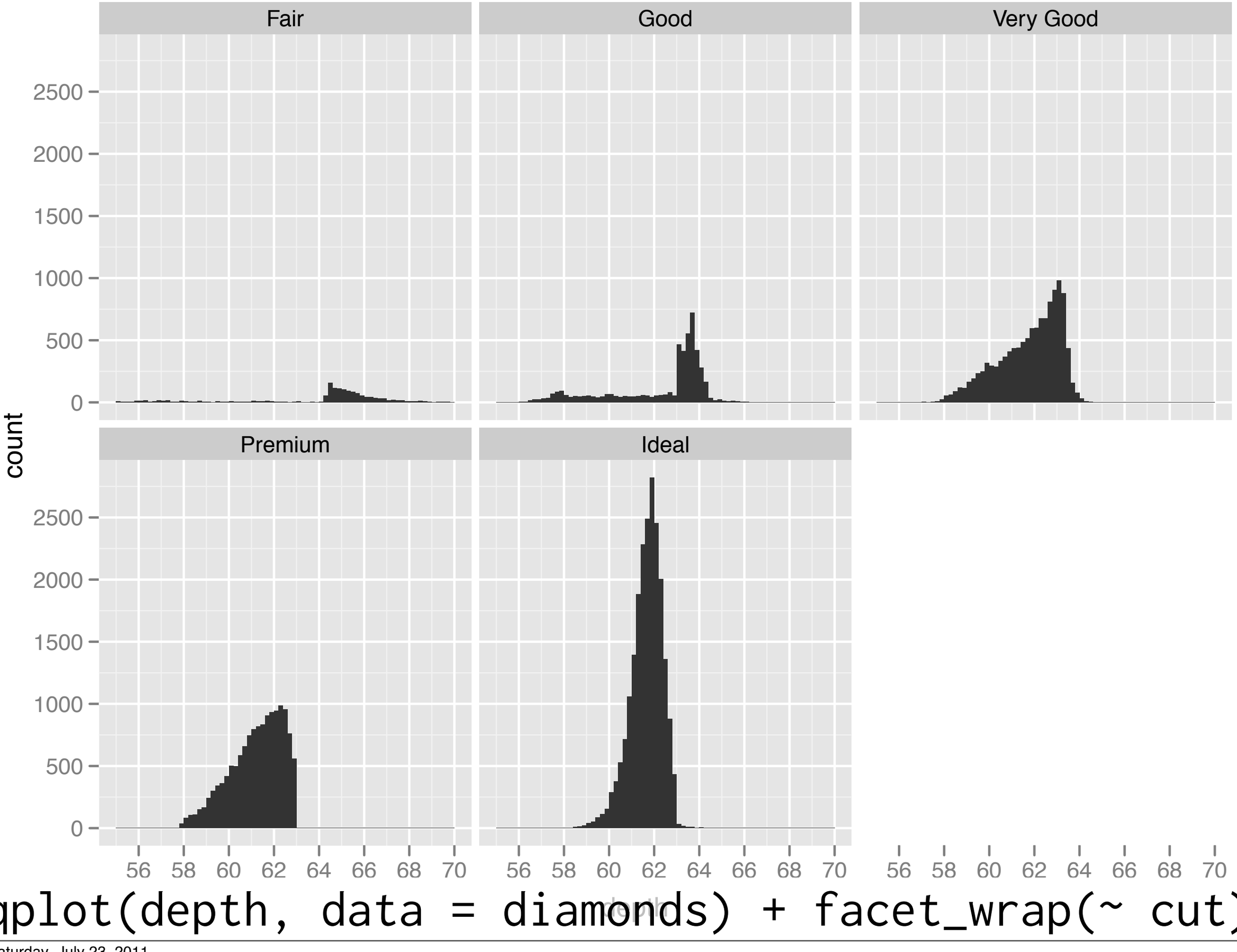

```
qplot(displ, hwy, data = mpg, colour = class)
```


count
2000
1500
1000
500
0
56
58
60
62
64
66
68
70
depth




```
qplot(depth, data = diamonds)
```


Fair
Good
Very Good
Premium
Ideal
count
depth
0
500
1000
1500
2000
2500
56
58
60
62
64
66
68
70




```
qplot(depth, data = diamonds) + facet_wrap(~ cut)
```

2. Motivate everything with a real problem

Baseball

NBA play-by-play

Diamond prices

Baby names

Airline delays

Card counting

Fuel economy

Movie rankings

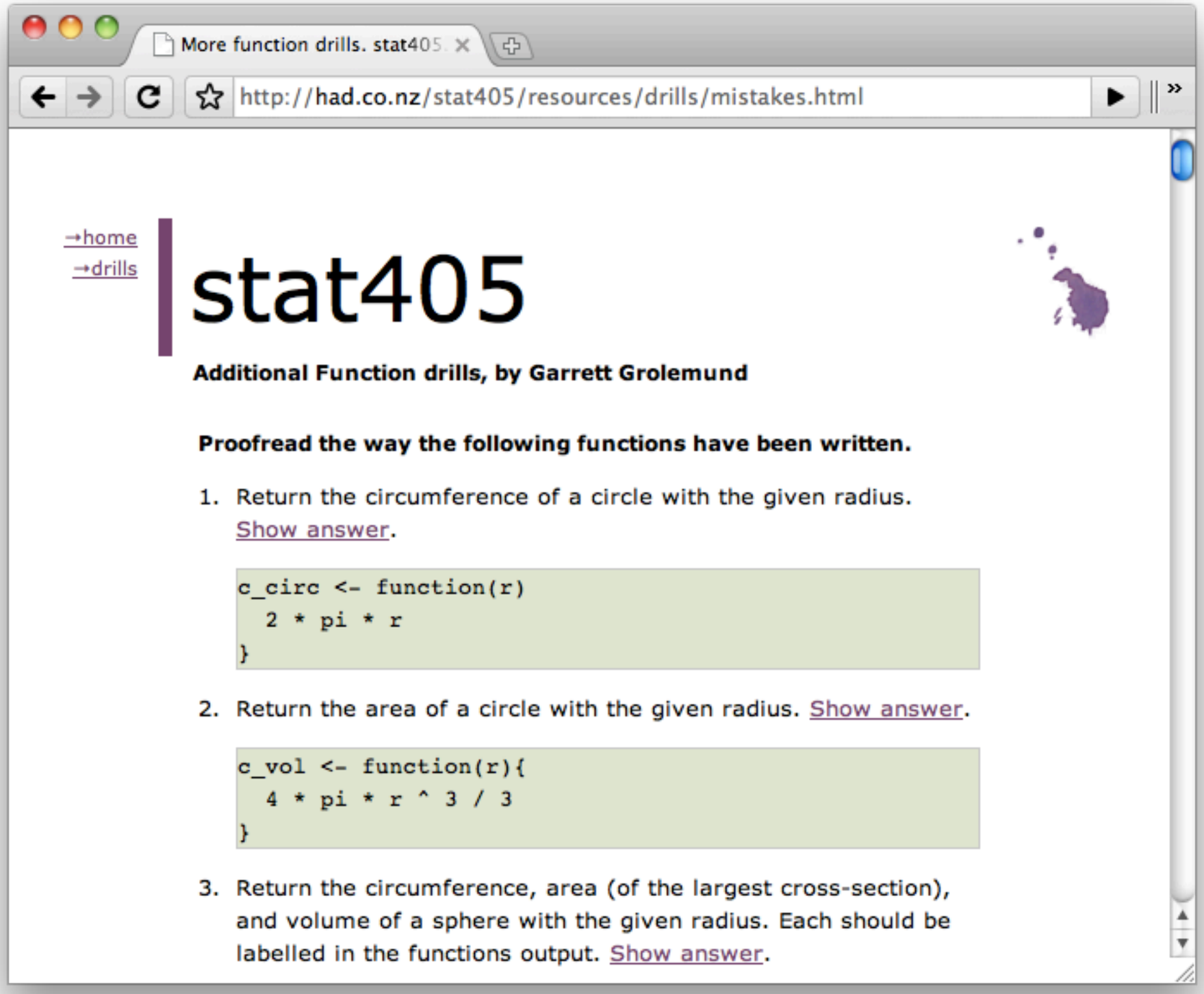
http://github.com/hadley

The problem motivates the tools.

Practice & Feedback

	Technique
Muscle memory	Drills
Dispositions	Open-ended data analyses

C. Wild and M. Pfannkuch. *Statistical thinking in empirical enquiry*. International Statistical Review, 67(3): 223–248, 1999.


More function drills. stat405
http://had.co.nz/stat405/resources/drills/mistakes.html
→home
→drills
stat405
Additional Function drills, by Garrett Grolemund
Proofread the way the following functions have been written.
1. Return the circumference of a circle with the given radius. Show answer.
c_circ <- function(r)
2 * pi * r
}
2. Return the area of a circle with the given radius. Show answer.
c_vol <- function(r){
4 * pi * r ^ 3 / 3
}
3. Return the circumference, area (of the largest cross-section), and volume of a sphere with the given radius. Each should be labelled in the functions output. Show answer.

More function drills. stat405

http://had.co.nz/stat405/resources/drills/mistakes.html

→home
→drills

stat405

Additional Function drills, by Garrett Grolemund

Proofread the way the following functions have been written.

1. Return the circumference of a circle with the given radius. Hide answer.

```
c_circ <- function(r)
  2 * pi * r
}
```

```
c_circ <- function(r){
  2 * pi * r
}
```

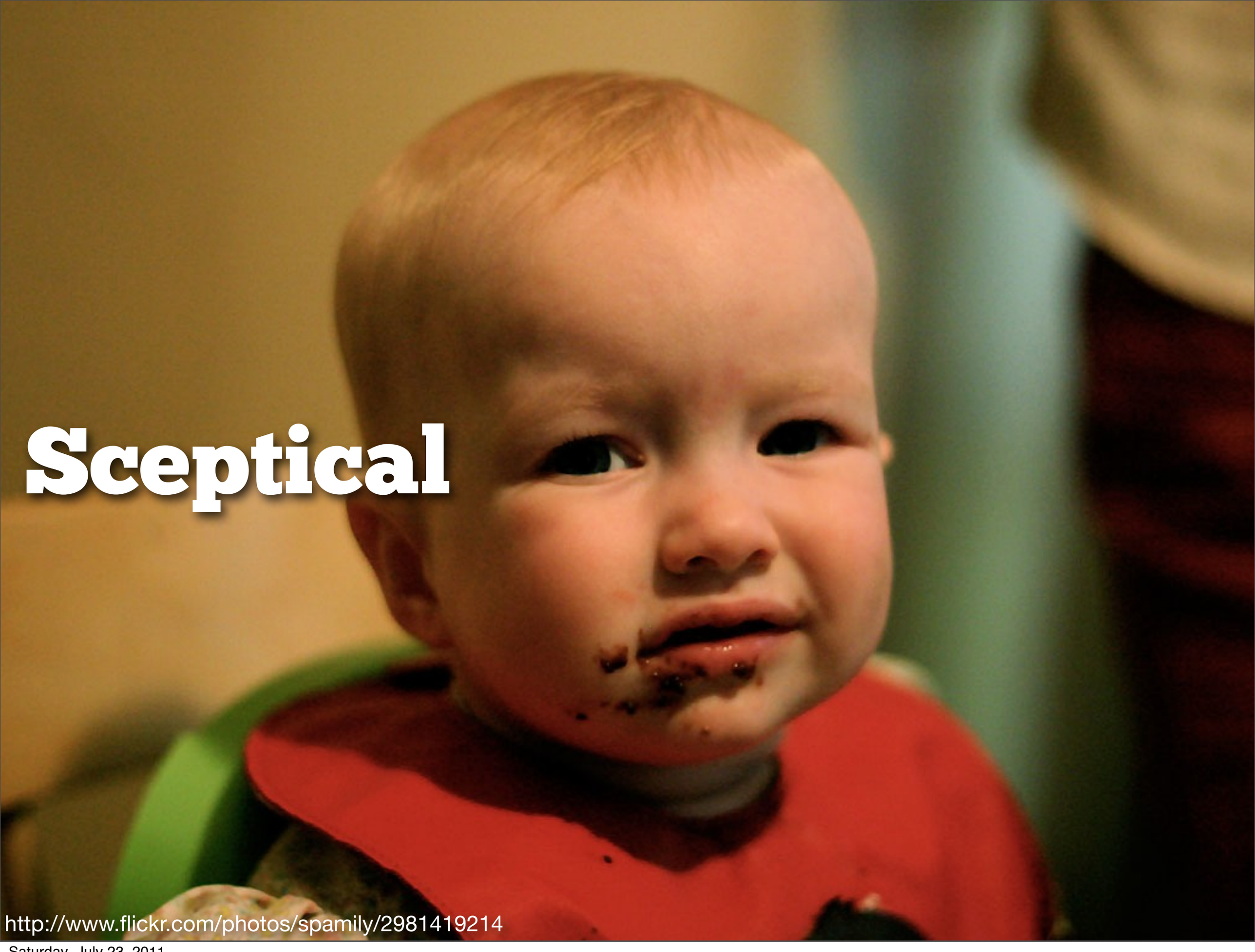
2. Return the area of a circle with the given radius. Show answer.

```
c_vol <- function(r){
  4 * pi * r ^ 3 / 3
}
```

Curious

http://www.flickr.com/photos/tommyhj/145269819

Sceptical



http://www.flickr.com/photos/spamily/2981419214

http://www.flickr.com/photos/kristinroach/3995676135

Conclusions

1. Statistics students need to learn how to program
2. Teach programming by starting with visualisation
3. Motivate every new technique with a real problem
4. Practice low-level skills with drills
5. Give feedback on dispositions