Large data

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November 2010

1. The diamonds data
2. Histograms and bar charts
3. Frequency polygons
4. Scatterplots for large data

Diamonds

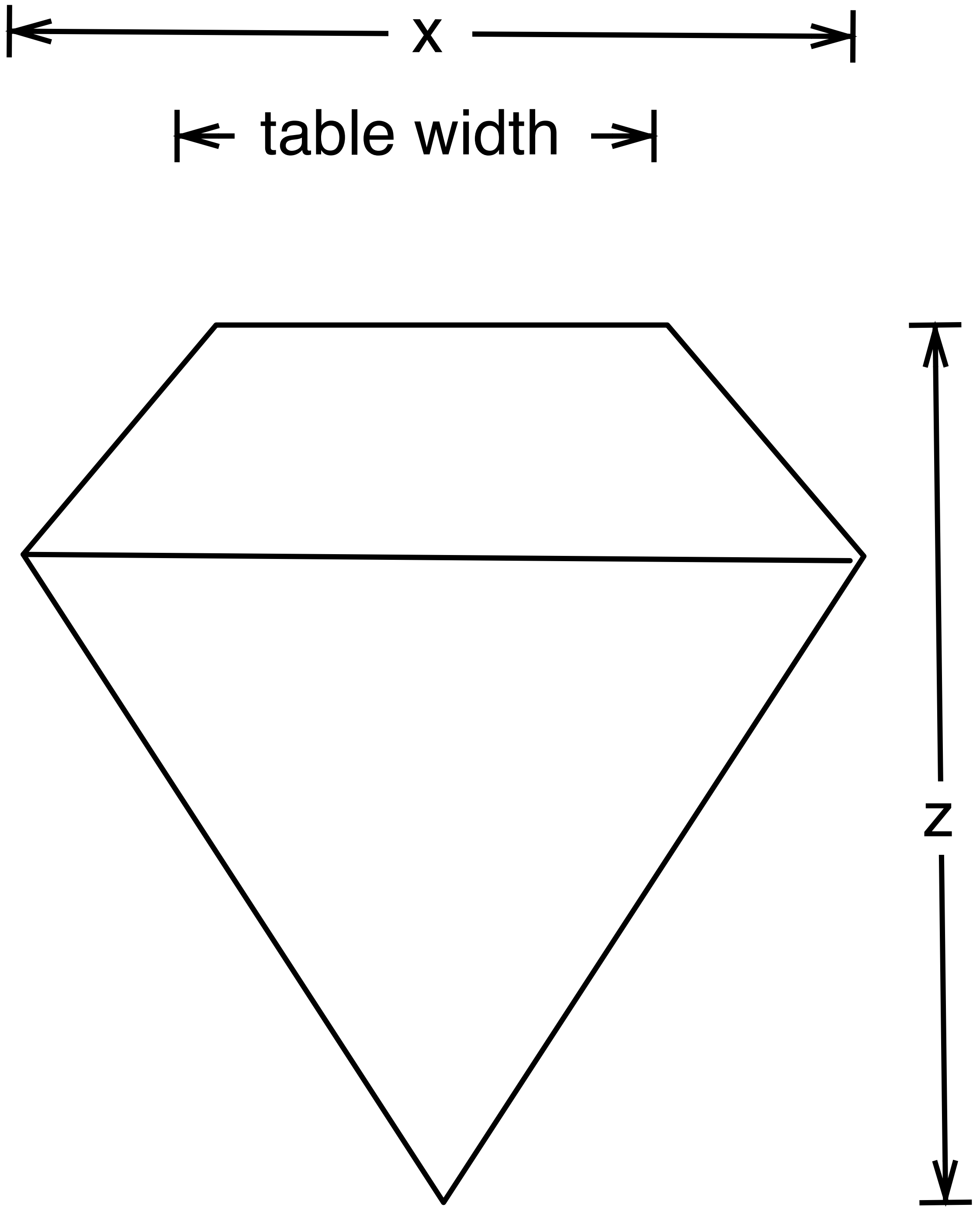
Diamonds data

~**54,000** round diamonds from http://www.diamondse.info/

Carat, colour, clarity, cut

Total depth, table, depth, width, height

Price



depth = z / diameter
table = table width / x * 100

Histogram & bar charts

Histograms and barcharts

Used to display the **distribution** of a variable

Categorical variable → bar chart

Continuous variable → histogram

Examples

```
# With only one variable, qplot guesses that
# you want a bar chart or histogram
qplot(cut, data = diamonds)

qplot(carat, data = diamonds)
qplot(carat, data = diamonds, binwidth = 1)
qplot(carat, data = diamonds, binwidth = 0.1)
qplot(carat, data = diamonds, binwidth = 0.01)
resolution(diamonds$carat)

last_plot() + xlim(0, 3)
```

Examples

```r
# With only one variable, qplot guesses that
# you want a bar chart or histogram
qplot(cut, data = diamonds)

qplot(carat, data = diamonds)
qplot(carat, data = diamonds, binwidth = 1)
qplot(carat, data = diamonds, binwidth = 0.1)
qplot(carat, data = diamonds, binwidth = 0.01)
resolution(diamonds$carat)

last_plot() + xlim(0, 3)
```

Common ggplot2 technique: adding together plot components

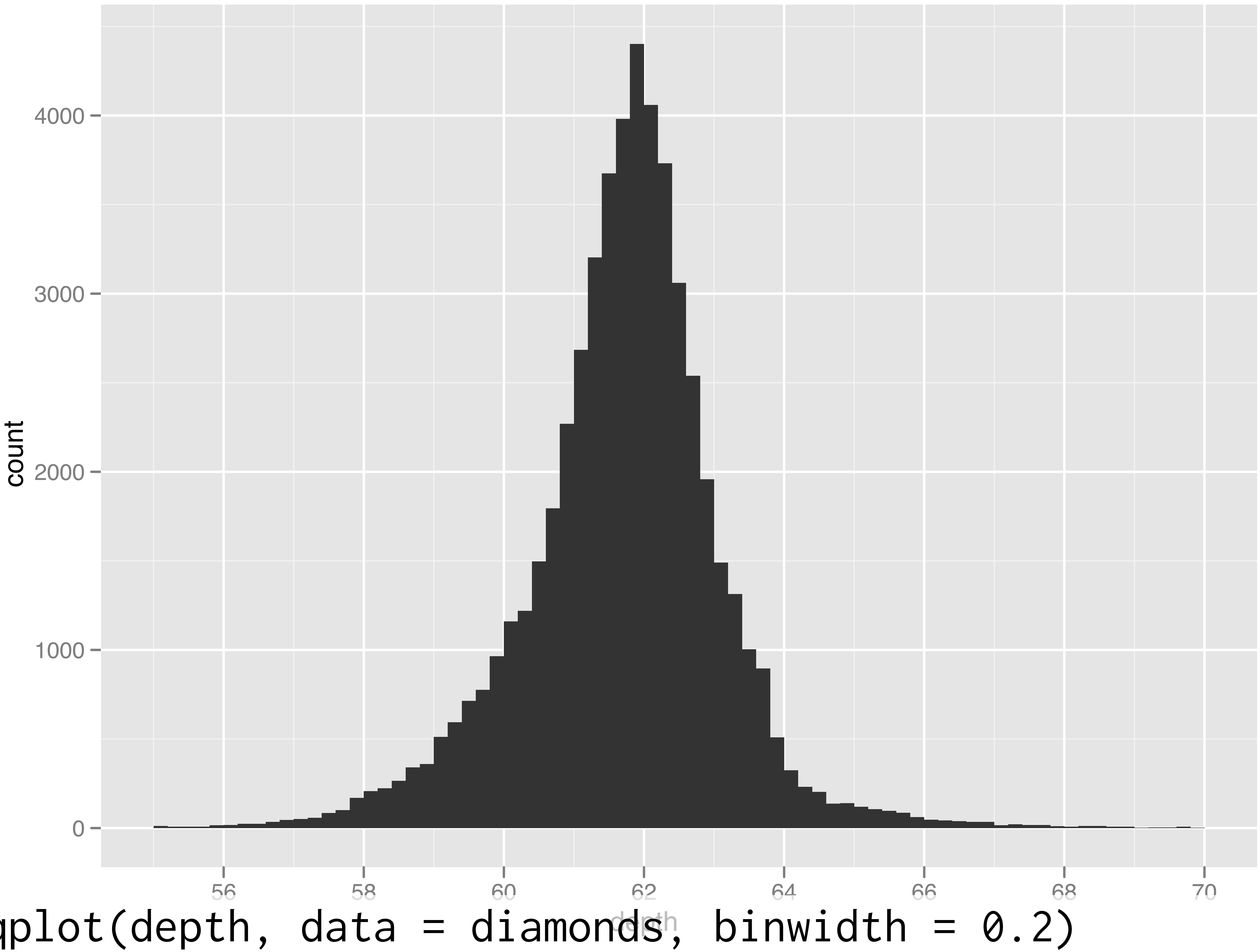
Always experiment with the bin width!

```
qplot(table, data = diamonds, binwidth = 1)

# To zoom in on a plot region use xlim() and ylim()
qplot(table, data = diamonds, binwidth = 1) +
   xlim(50, 70)
qplot(table, data = diamonds, binwidth = 0.1) +
  xlim(50, 70)
qplot(table, data = diamonds, binwidth = 0.1) +
  xlim(50, 70) + ylim(0, 50)

# Note that this type of zooming discards data
outside of the plot regions
# See coord_cartesian() for an alternative
```

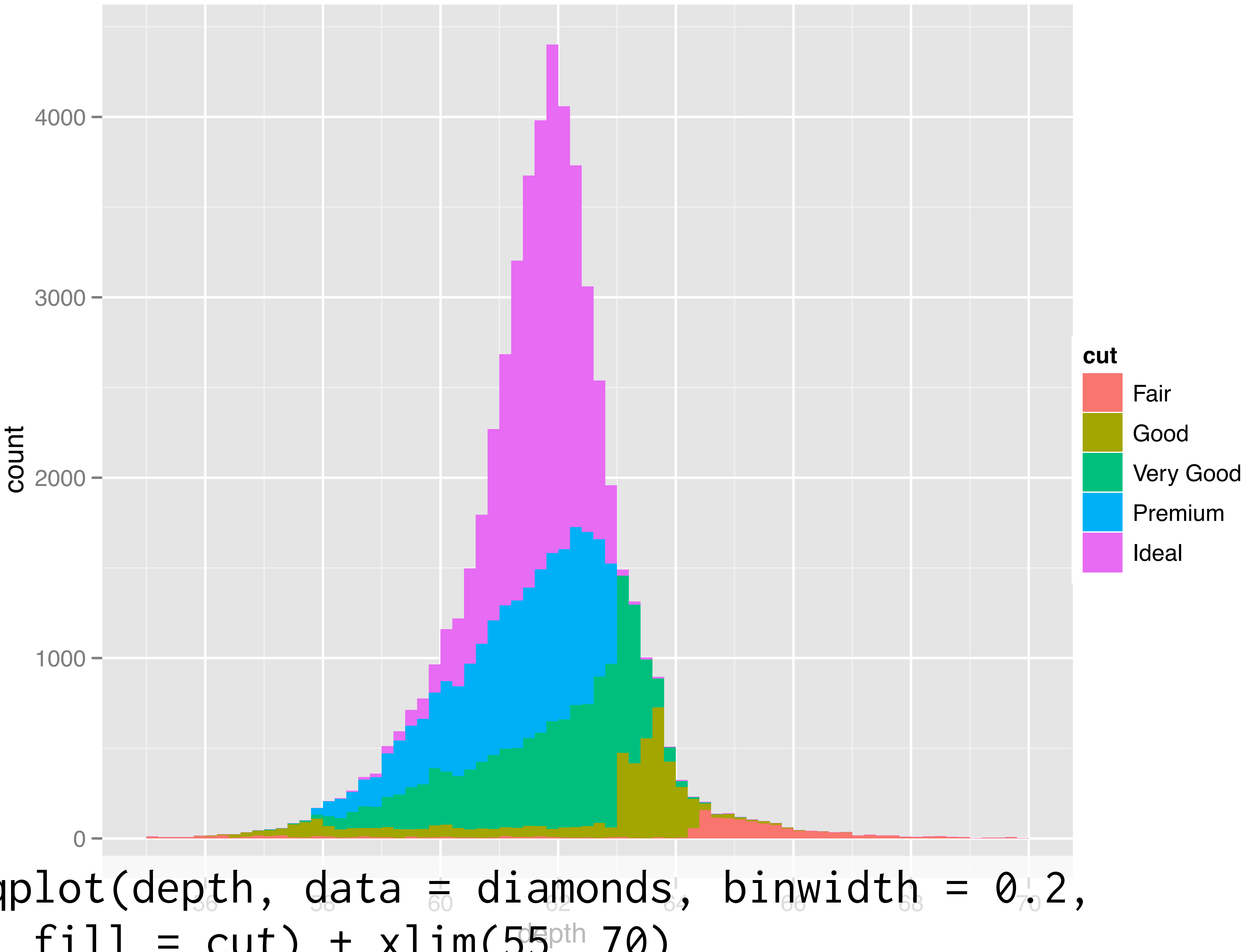
Additional variables

As with scatterplots can use **aesthetics** or **faceting**. Using aesthetics creates pretty, but ineffective, plots.

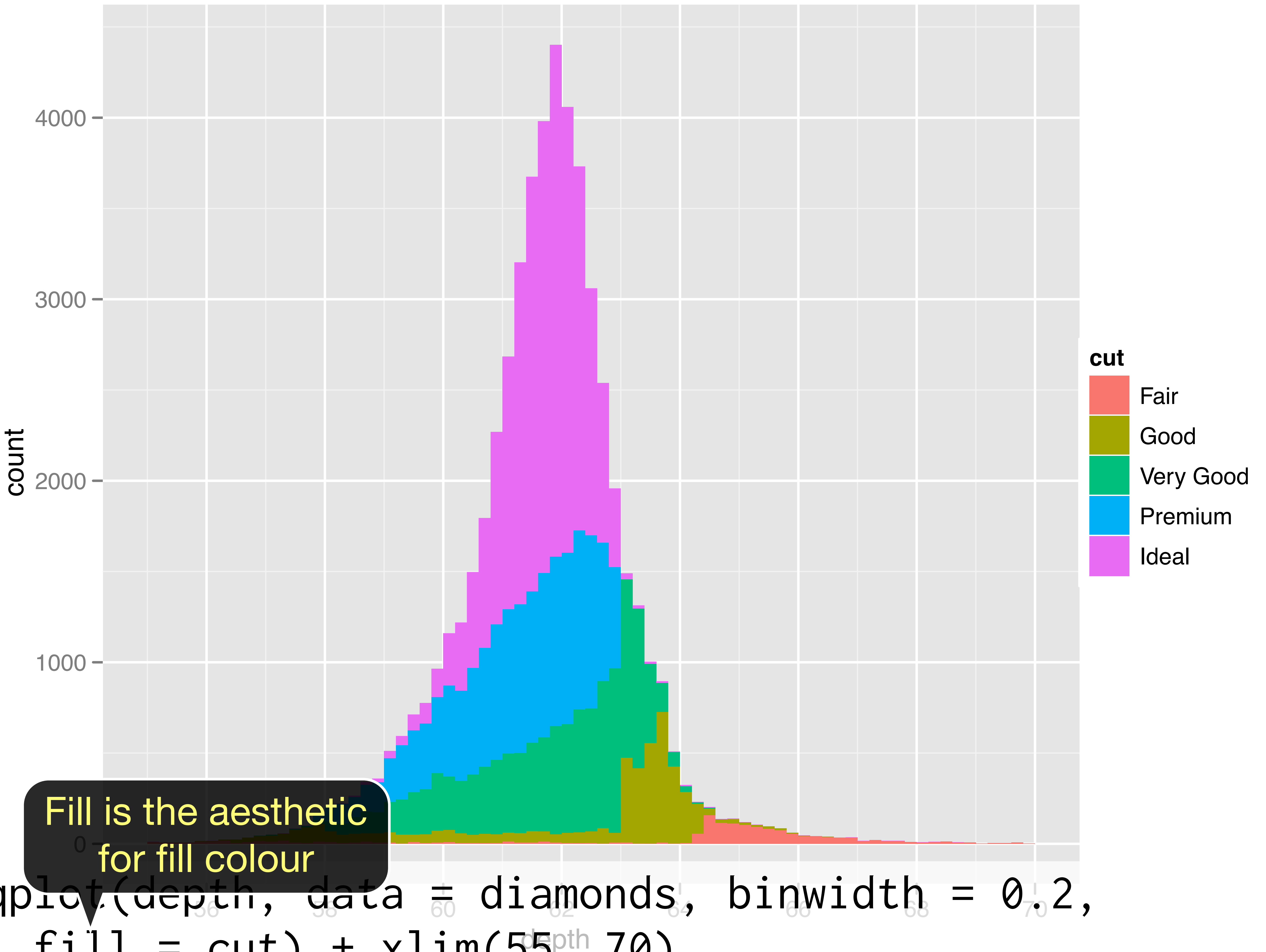
The following examples show the difference, when investigating the relationship between cut and depth.



```
qplot(depth, data = diamonds, binwidth = 0.2)
```

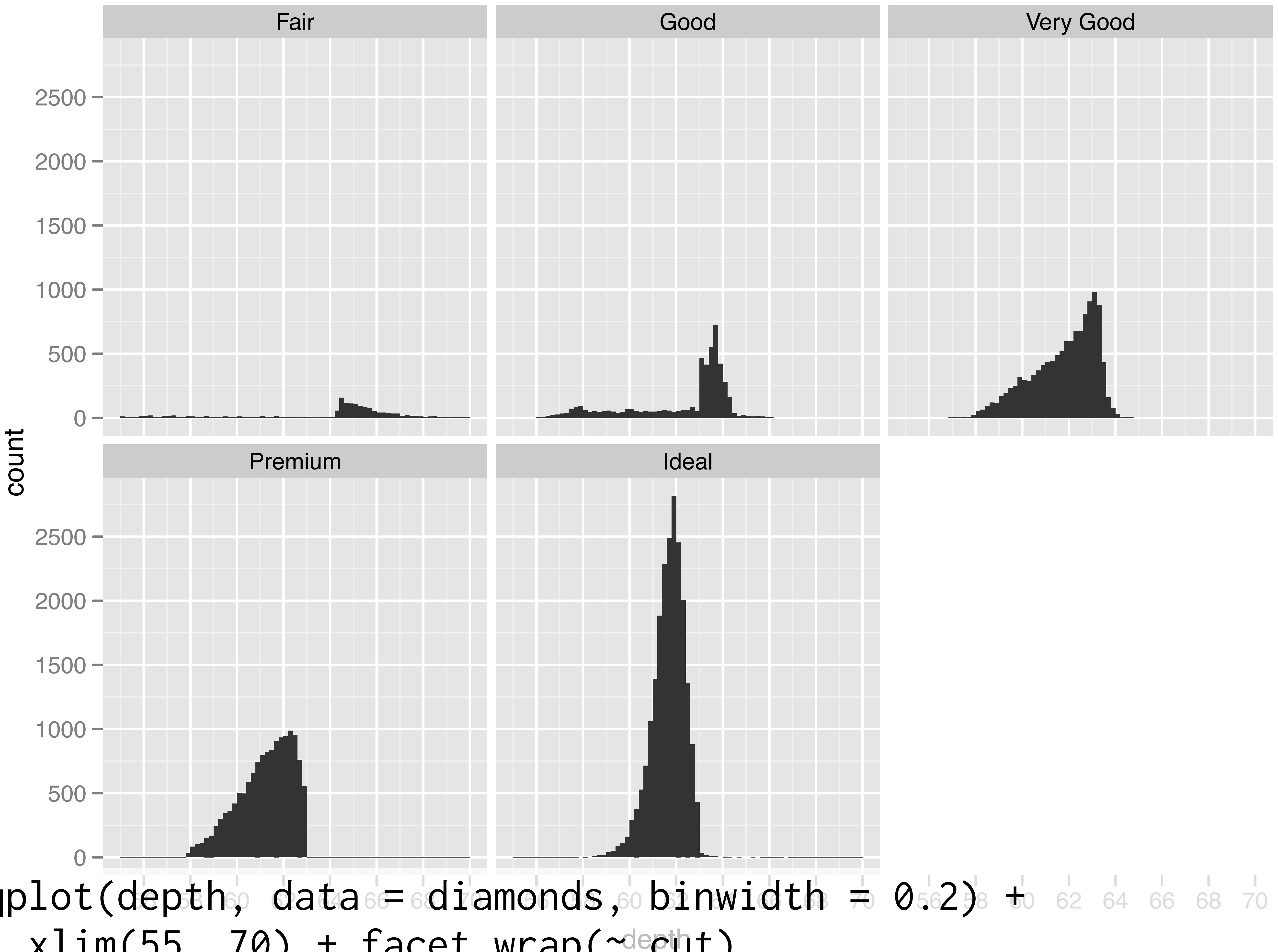


```
qplot(depth, data = diamonds, binwidth = 0.2,
  fill = cut) + xlim(55, 70)
```



Fill is the aesthetic for fill colour

```
qplot(depth, data = diamonds, binwidth = 0.2,
  fill = cut) + xlim(55, 70)
```



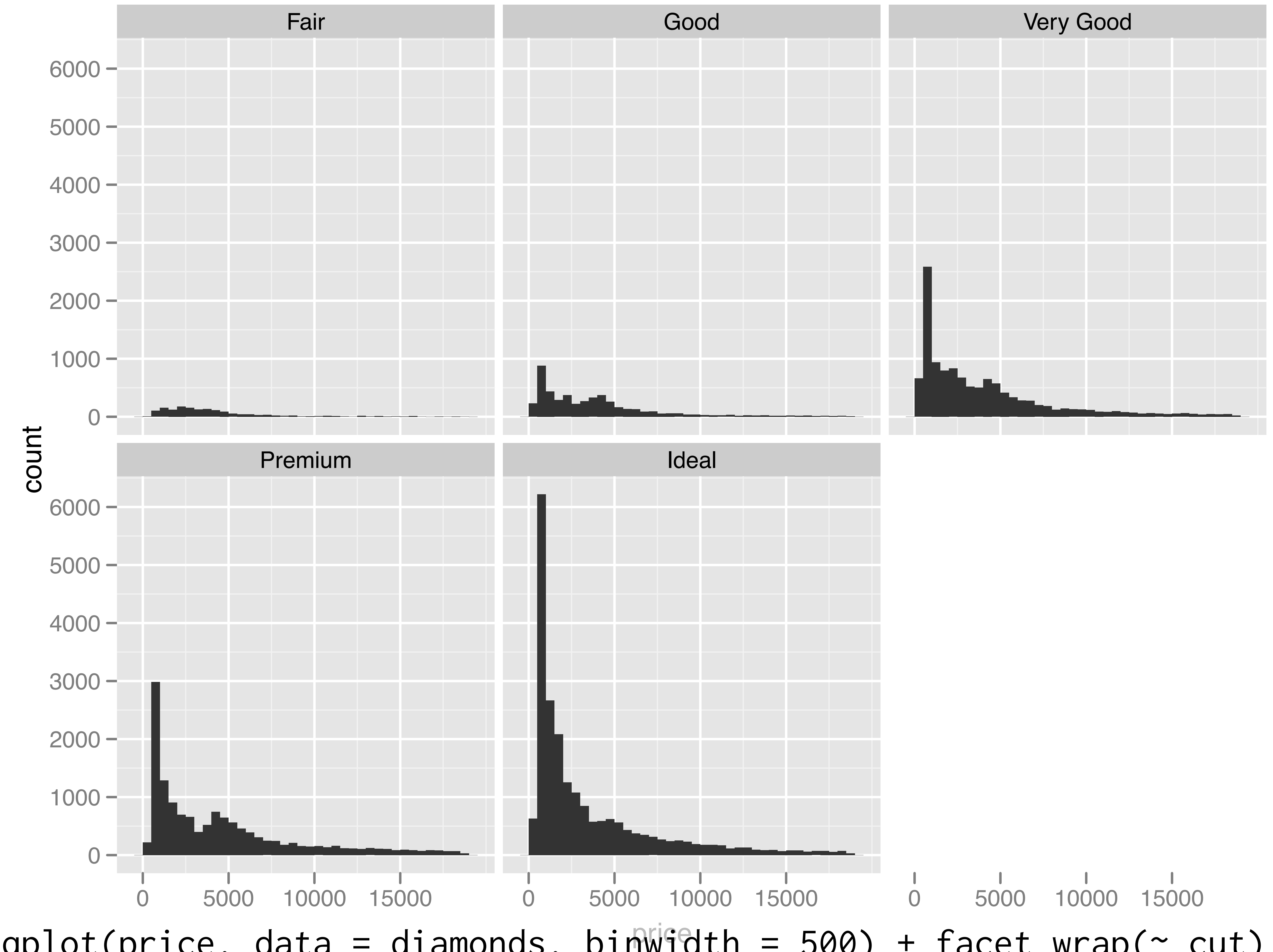
```
qplot(depth, data = diamonds, binwidth = 0.2) +
  xlim(55, 70) + facet_wrap(~ cut)
```

Your turn

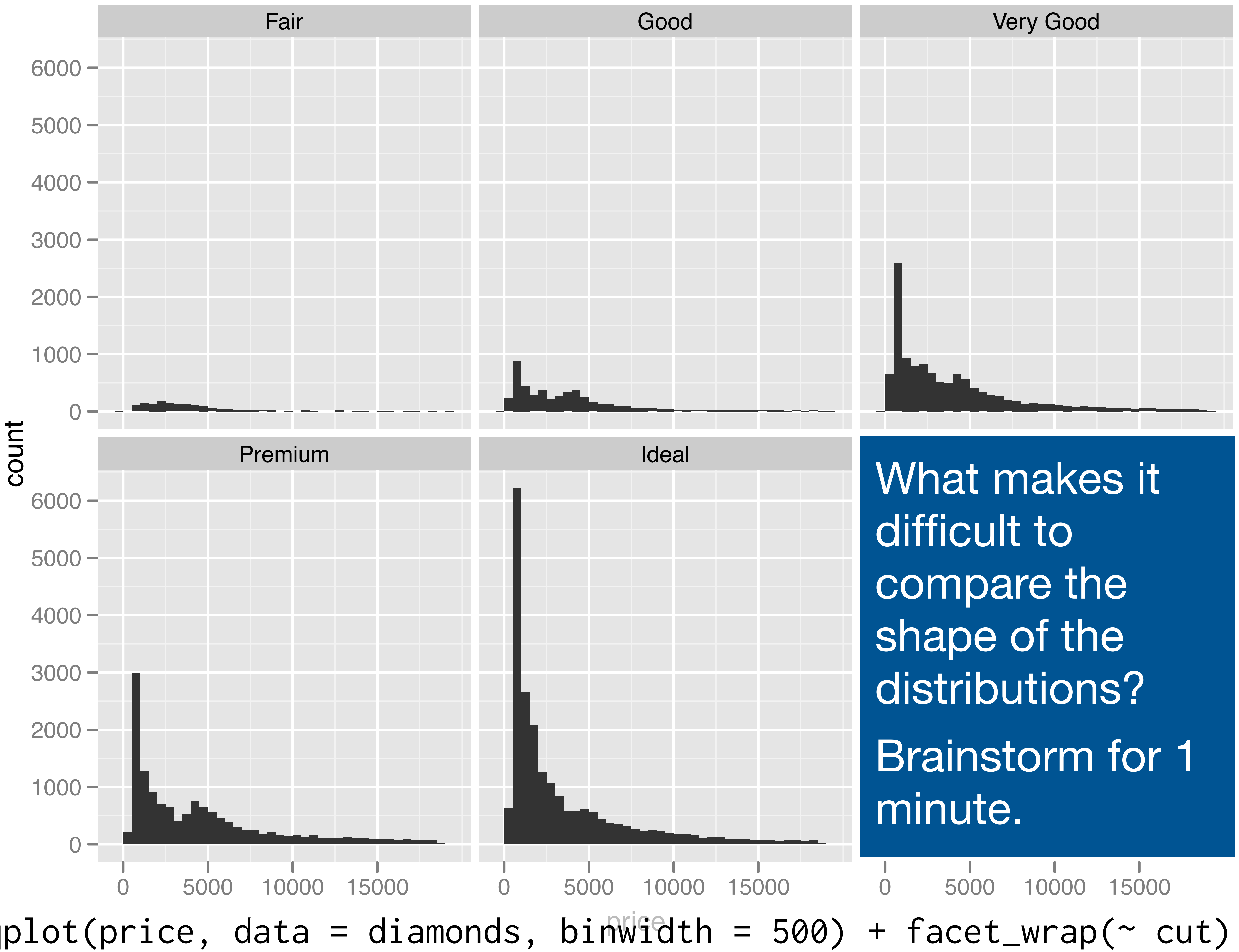
Explore the distribution of price.

How does it vary with colour, or cut?

Practice zooming in on regions of interest.



```
qplot(price, data = diamonds, binwidth = 500) + facet_wrap(~ cut)
```



What makes it difficult to compare the shape of the distributions?

Brainstorm for 1 minute.

```
qplot(price, data = diamonds, binwidth = 500) + facet_wrap(~ cut)
```

Problems

Each histogram far away from the others, but we know stacking is hard to read → *use another way of displaying densities*

Varying relative abundance makes comparisons difficult → *rescale to ensure constant area*

```
# Large distances make comparisons hard
qplot(price, data = diamonds, binwidth = 500) +
  facet_wrap(~ cut)

# Stacked heights hard to compare
qplot(price, data = diamonds, binwidth = 500, fill = cut)

# Much better - but still have differing relative abundance
qplot(price, data = diamonds, binwidth = 500,
  geom = "freqpoly", colour = cut)

# Instead of displaying count on y-axis, display density
# .. indicates that variable isn't in original data
qplot(price, ..density.., data = diamonds, binwidth = 500,
  geom = "freqpoly", colour = cut)

# To use with histogram, you need to be explicit
qplot(price, ..density.., data = diamonds, binwidth = 500,
  geom = "histogram") + facet_wrap(~ cut)
```

Your turn

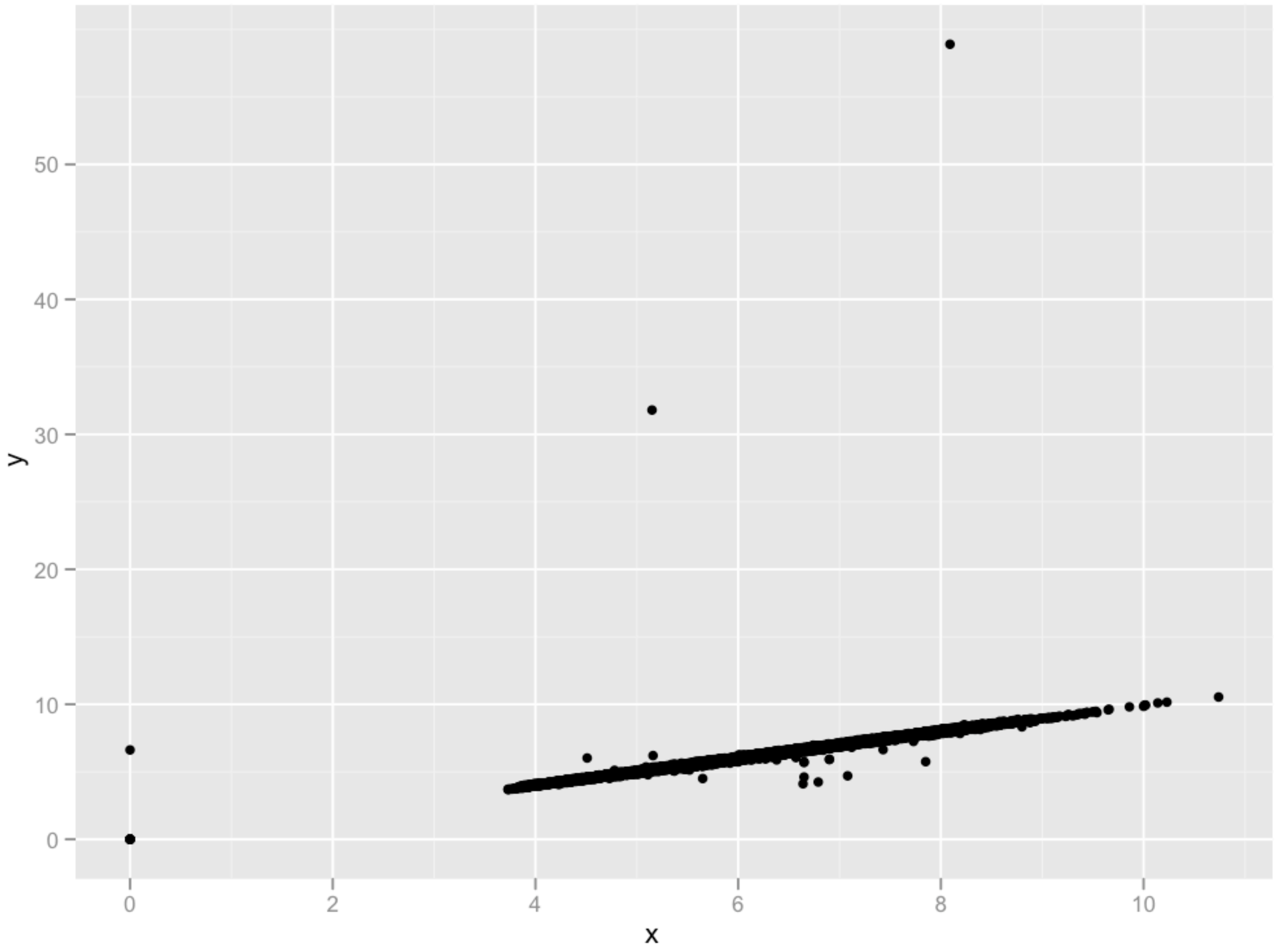
Practice using this technique to explore the relationship between price and cut, and carat and cut.

Do you see what you expect?

Scatterplots

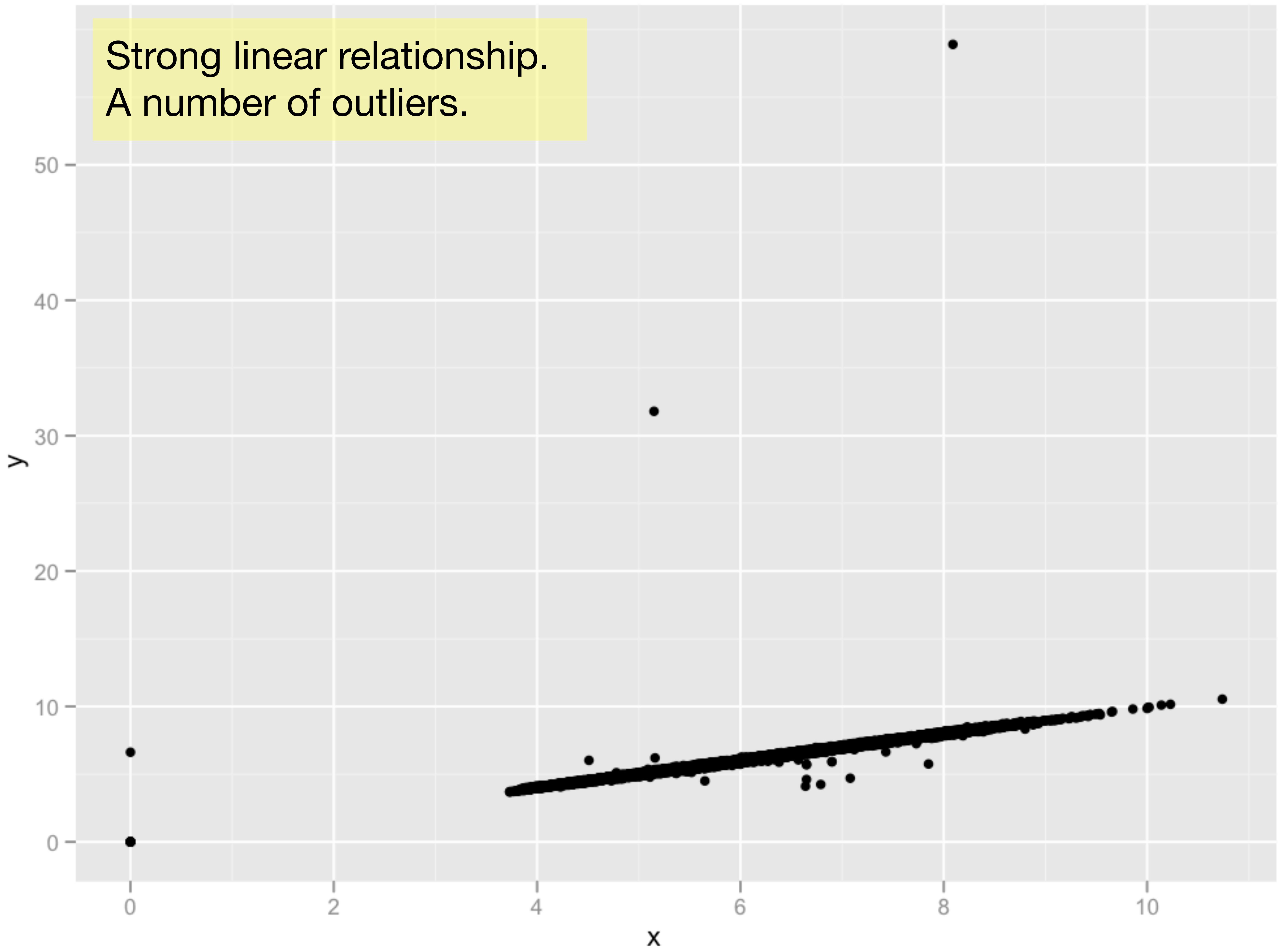
Revision: interpretation

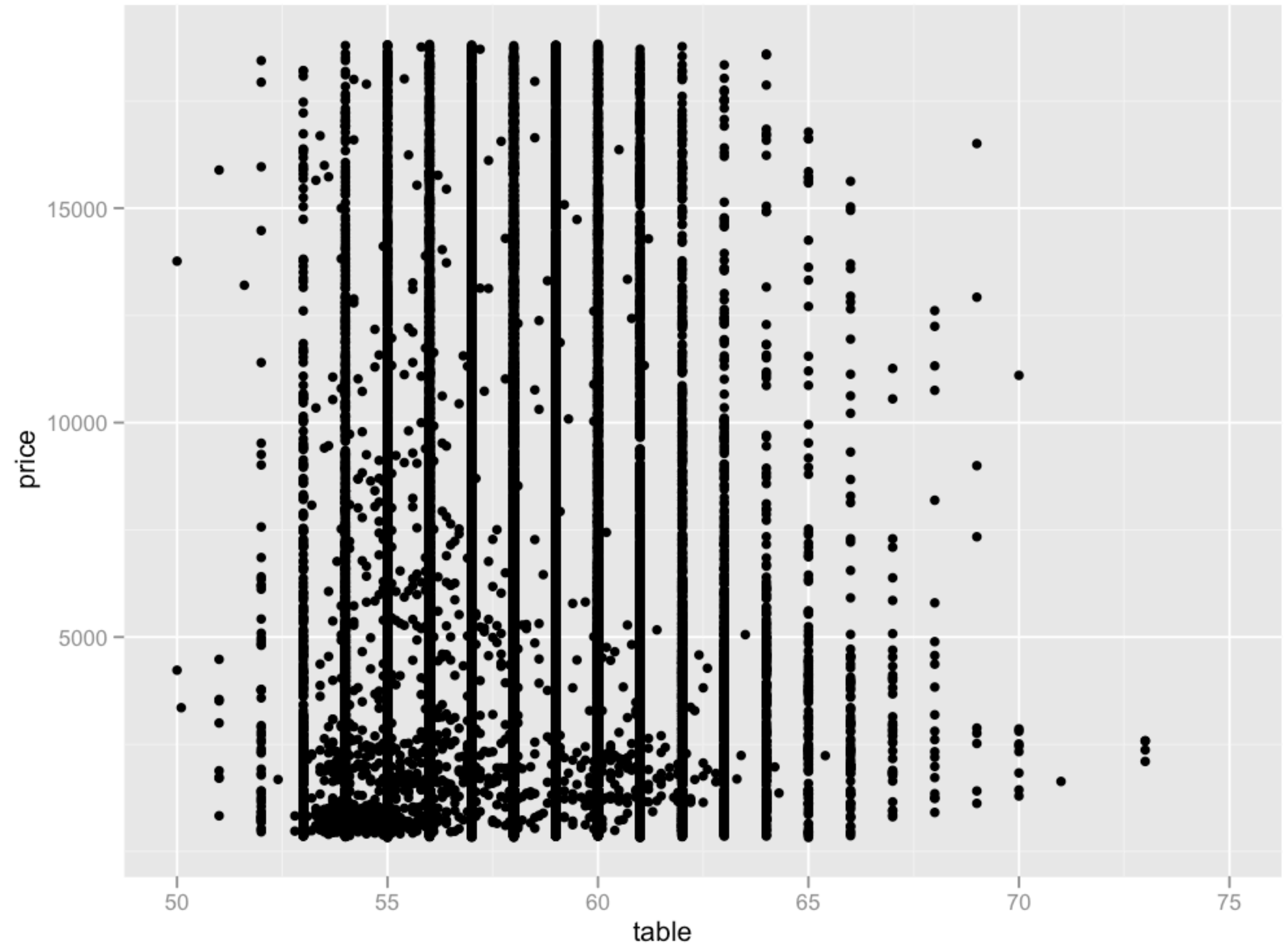
- Global patterns
- Local patterns
- Deviations



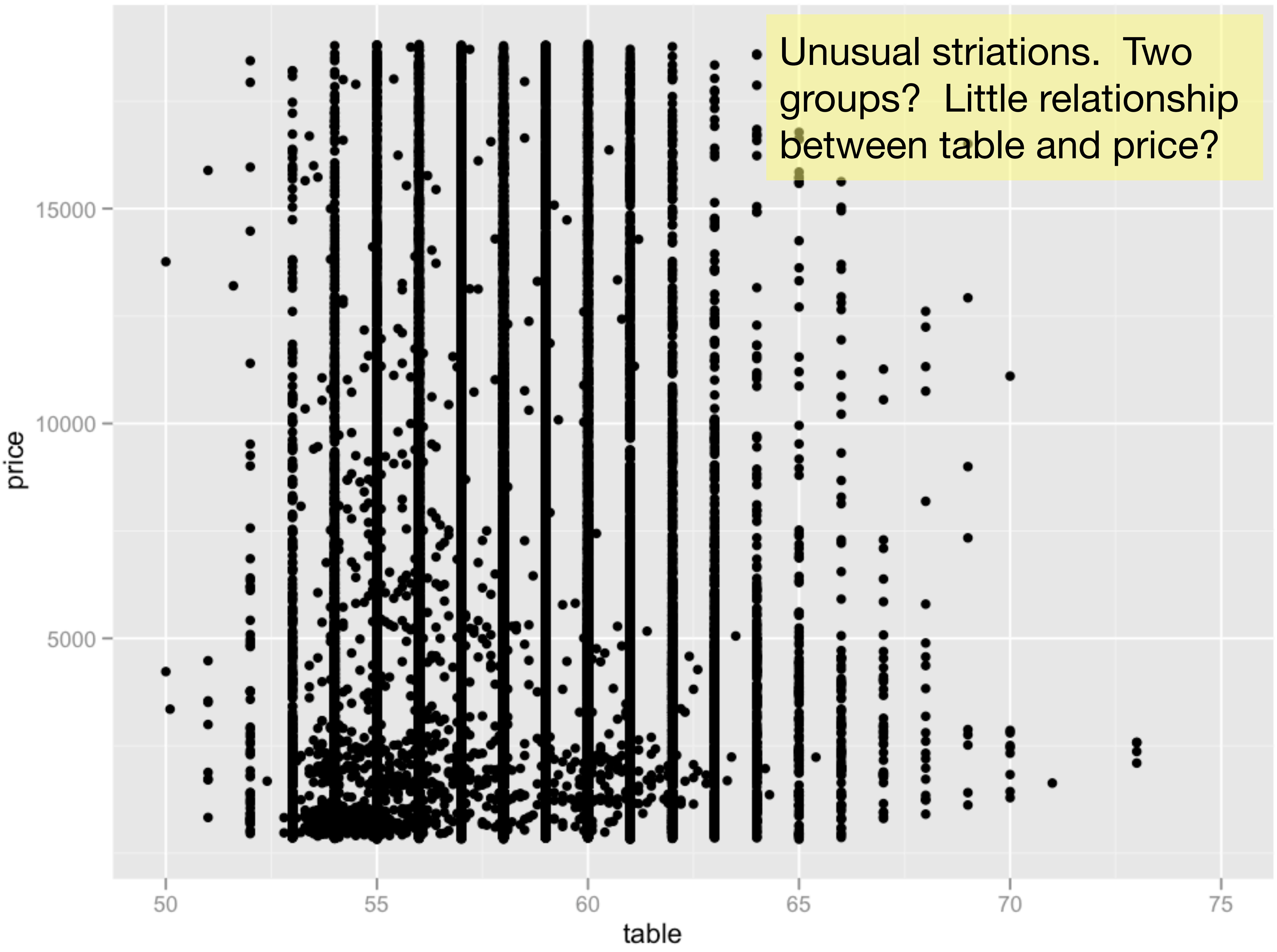
50
40
30
20
10
0
y
0
2
4
6
8
10
x

Strong linear relationship.
A number of outliers.

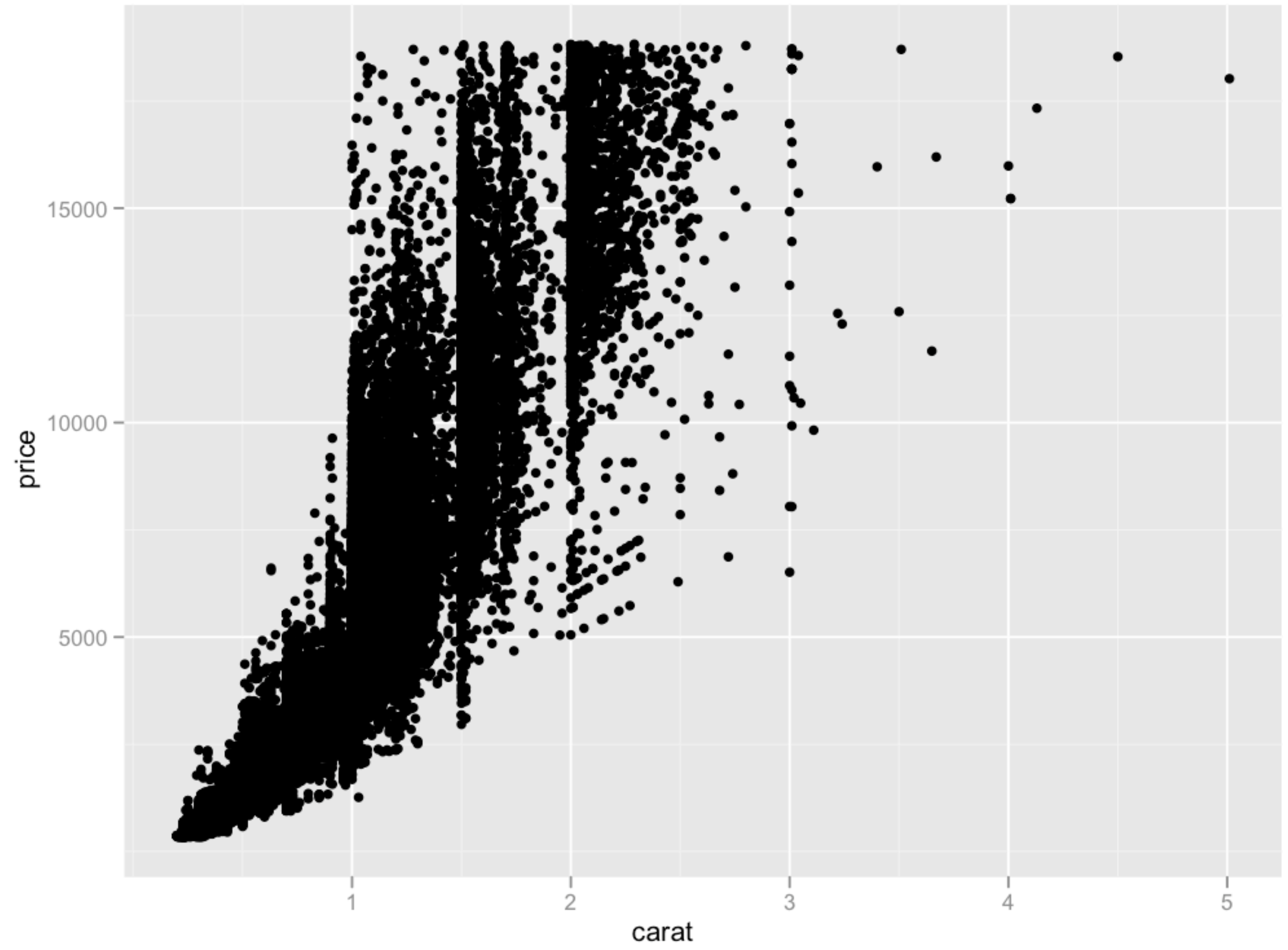




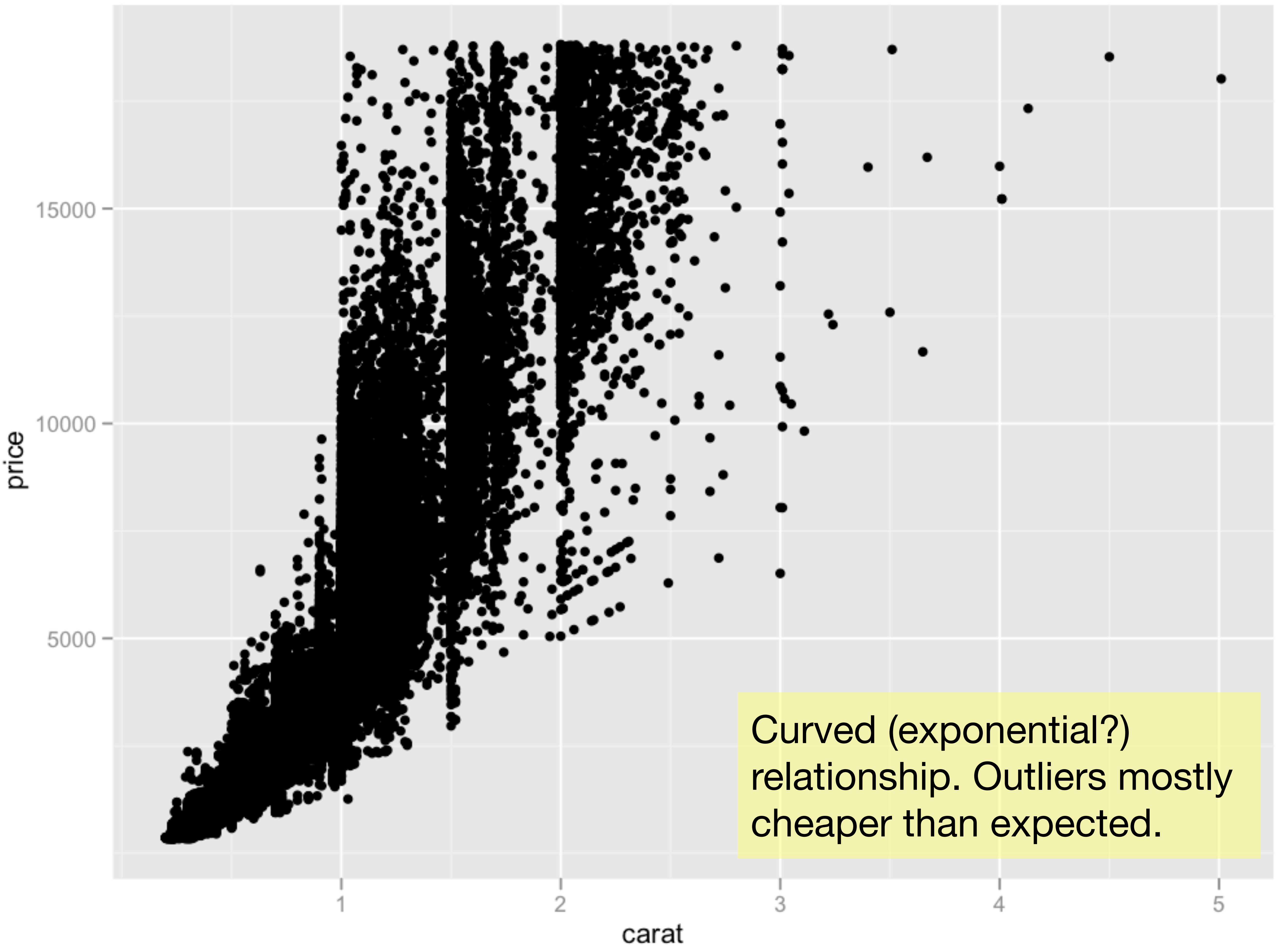
price
15000
10000
5000
50
55
60
65
70
75
table



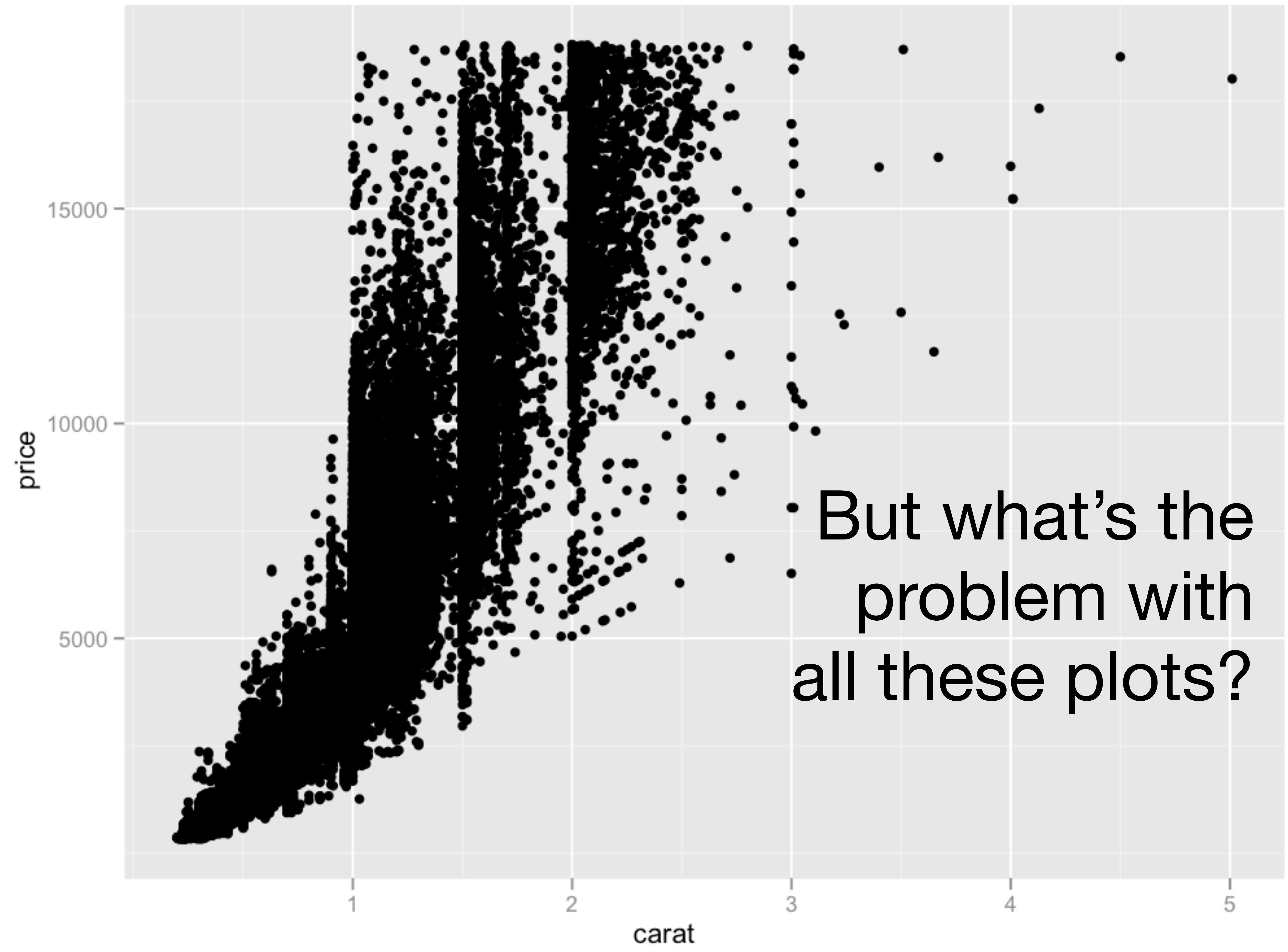
Unusual striations. Two groups? Little relationship between table and price?



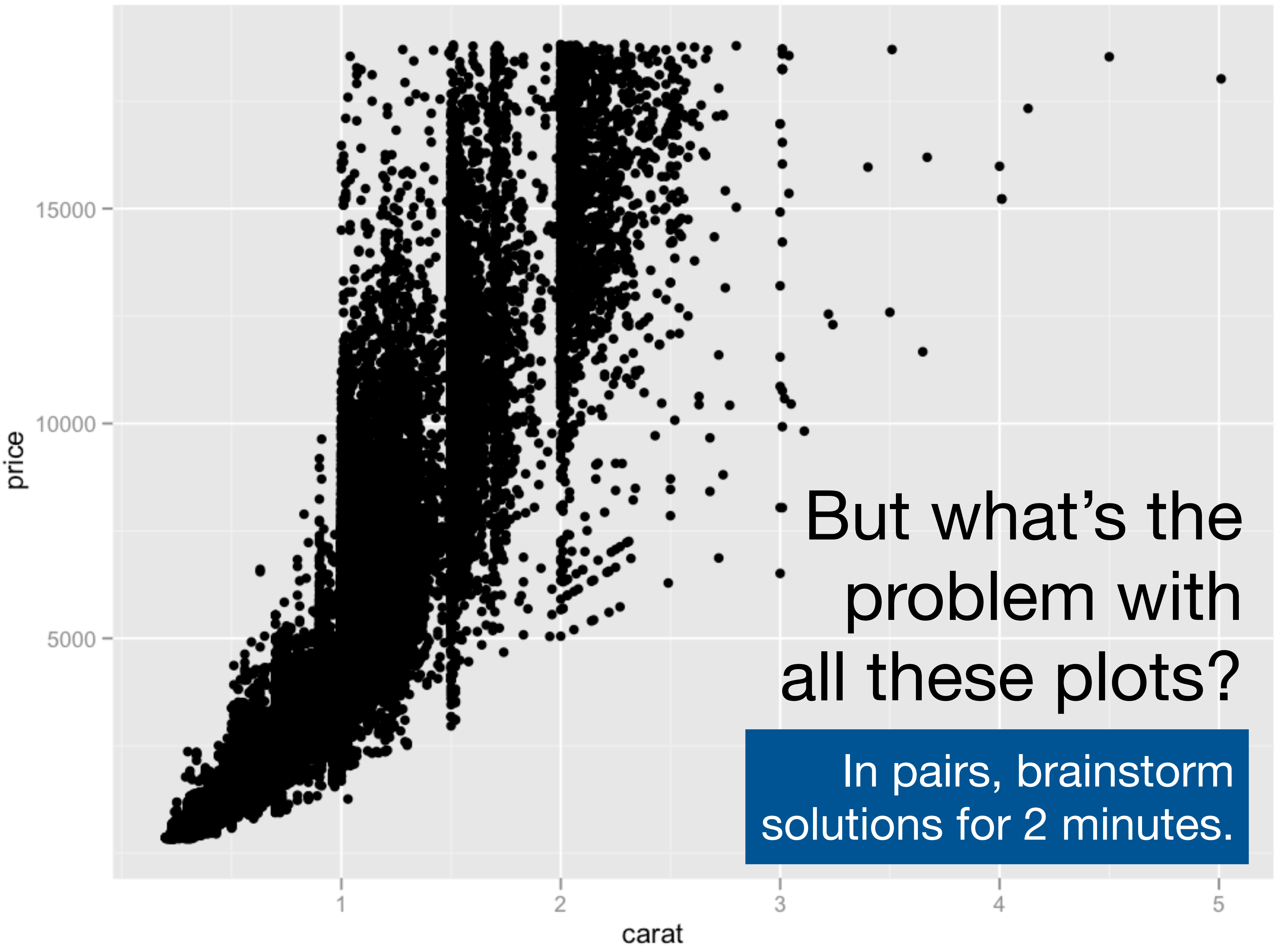
price
15000
10000
5000
1
2
3
4
5
carat



Curved (exponential?) relationship. Outliers mostly cheaper than expected.



But what's the problem with all these plots?



But what's the problem with all these plots?

In pairs, brainstorm solutions for 2 minutes.

Idea	ggplot
Small points	`shape = I(".")`
Transparency	`alpha = I(1/50)`
Jittering	`geom = "jitter"`
Smooth curve	`geom = "smooth"`
2d bins	`geom = "bin2d"` or `geom = "hex"`
Density contours	`geom = "density2d"`

```
# There are two ways to add additional geoms
# 1) A vector of geom names:
qplot(price, carat, data = diamonds,
  geom = c("point", "smooth"))

# 2) Add on extra geoms
qplot(price, carat, data = diamonds) + geom_smooth()

# This how you get help about a specific geom:
?geom_smooth
# or go to http://had.co.nz/ggplot2/geom_smooth.html
# To set aesthetics to a particular value, you need
# to wrap that value in I()

qplot(price, carat, data = diamonds, colour = "blue")
qplot(price, carat, data = diamonds, colour = I("blue"))

# Practical application: varying alpha
qplot(price, carat, data = diamonds, alpha = I(1/10))
qplot(price, carat, data = diamonds, alpha = I(1/50))
qplot(price, carat, data = diamonds, alpha = I(1/100))
qplot(price, carat, data = diamonds, alpha = I(1/250))
```

Your turn

Explore the relationship between carat, price and clarity, using these techniques.

(i.e. make this plot more informative:

`qplot(carat, price, data = diamonds, colour = cut)`)

Which did you find most useful?

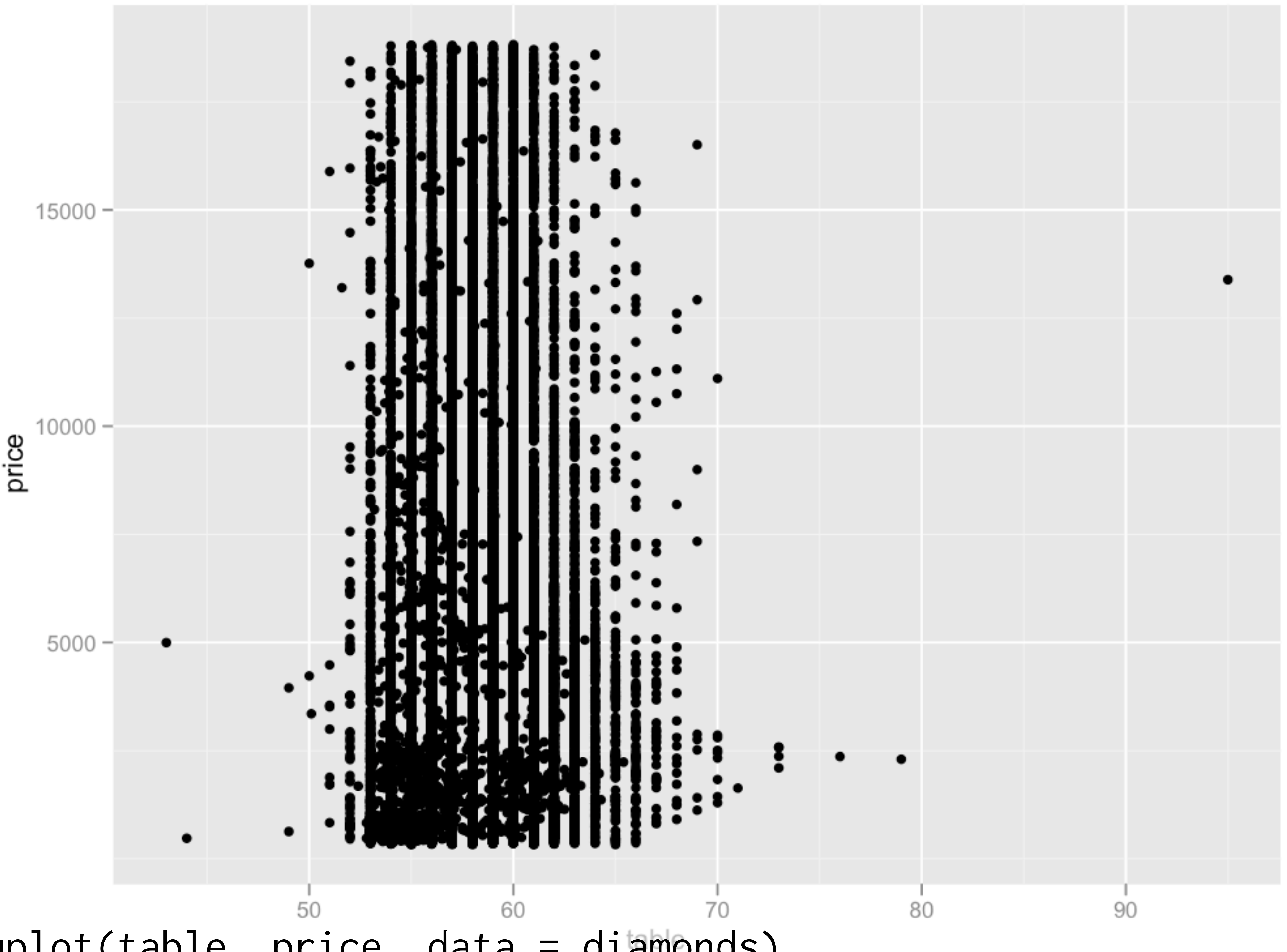
```
qplot(carat, price, data = diamonds,
  colour = clarity)
qplot(log10(carat), log10(price),
  data = diamonds, colour = clarity)
qplot(log10(carat), log10(carat / price),
  data = diamonds, colour = clarity)


qplot(log10(carat), log10(price), data = diamonds,
  geom = "hex", bins = 10) + facet_wrap(~ cut)
qplot(log10(carat), log10(price), data = diamonds,
  colour = cut, geom = "blank") + geom_smooth(method
= "lm")
```

```
mod <- lm(log10(price) ~ log10(carat),
  data = diamonds)

qplot(log10(carat), log10(price), data = diamonds,
  geom = "bin2d") +
  facet_wrap( ~ cut) +
  geom_abline(intercept = coef(mod)[1],
    slope = coef(mod)[2], size = 2)
```

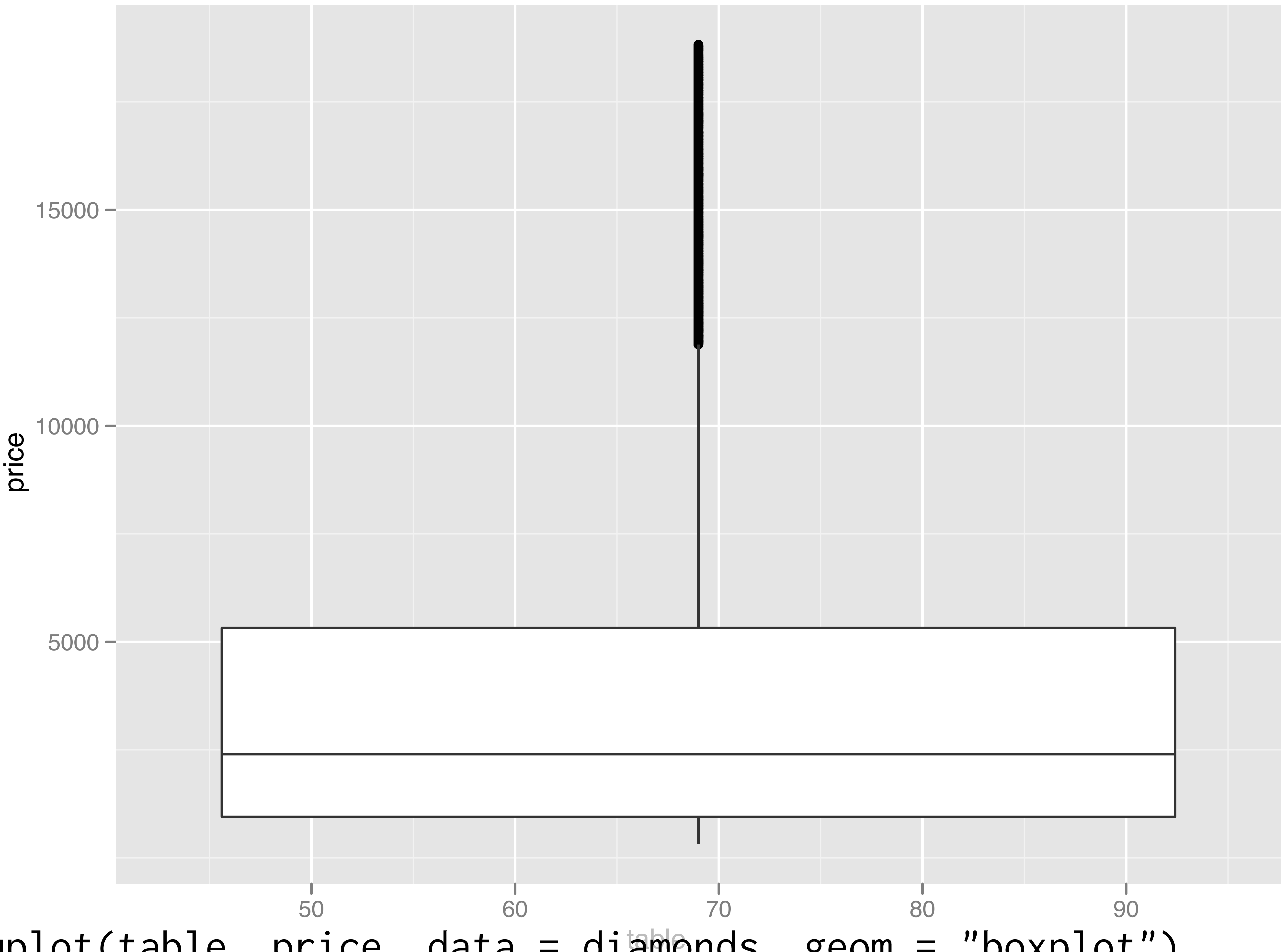
Boxplots

Less information than a histogram, but take up much less space.

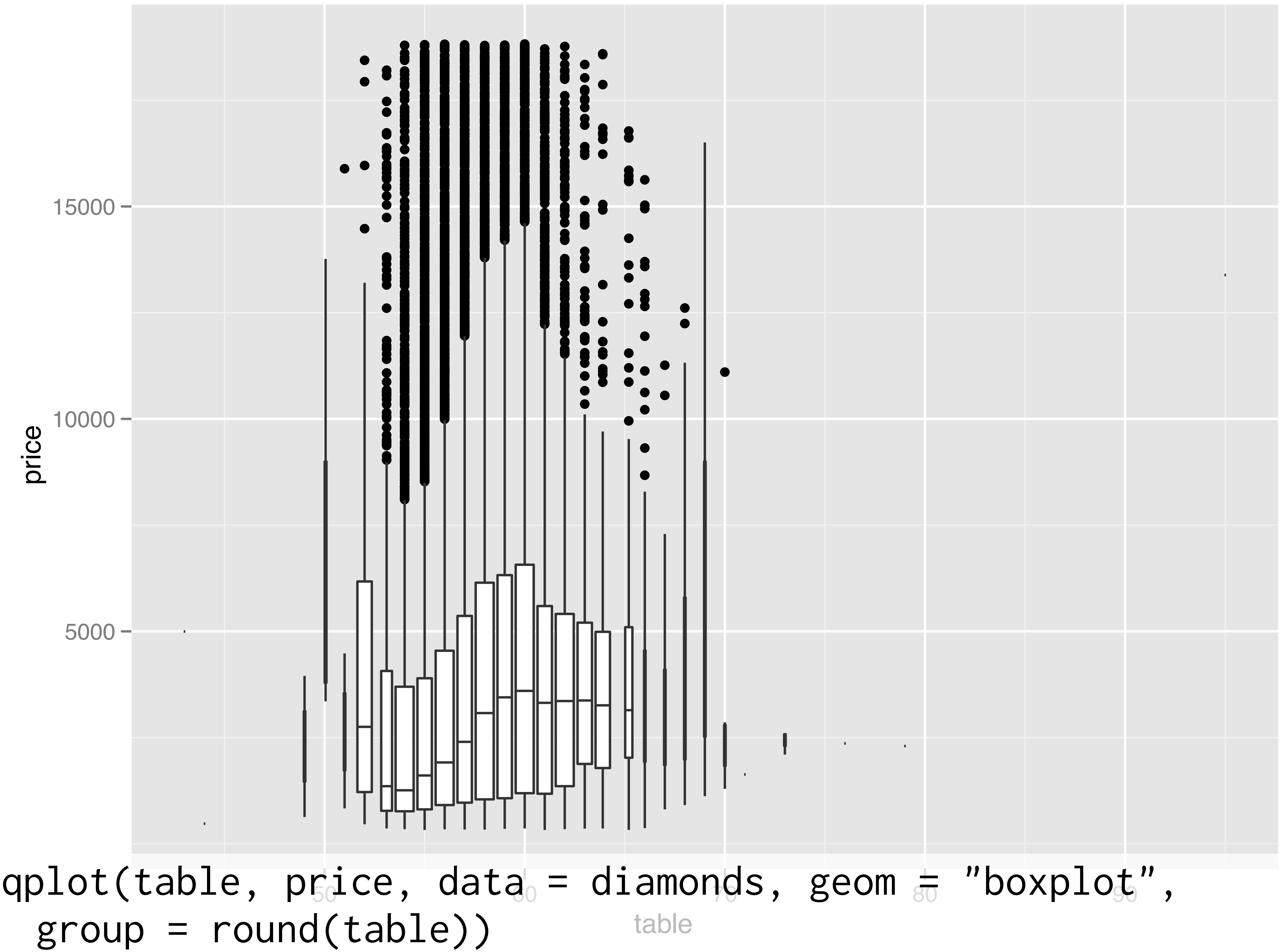
Already seen them used with discrete x values. Can also use with continuous x values, by specifying how we want the data **group**ed.



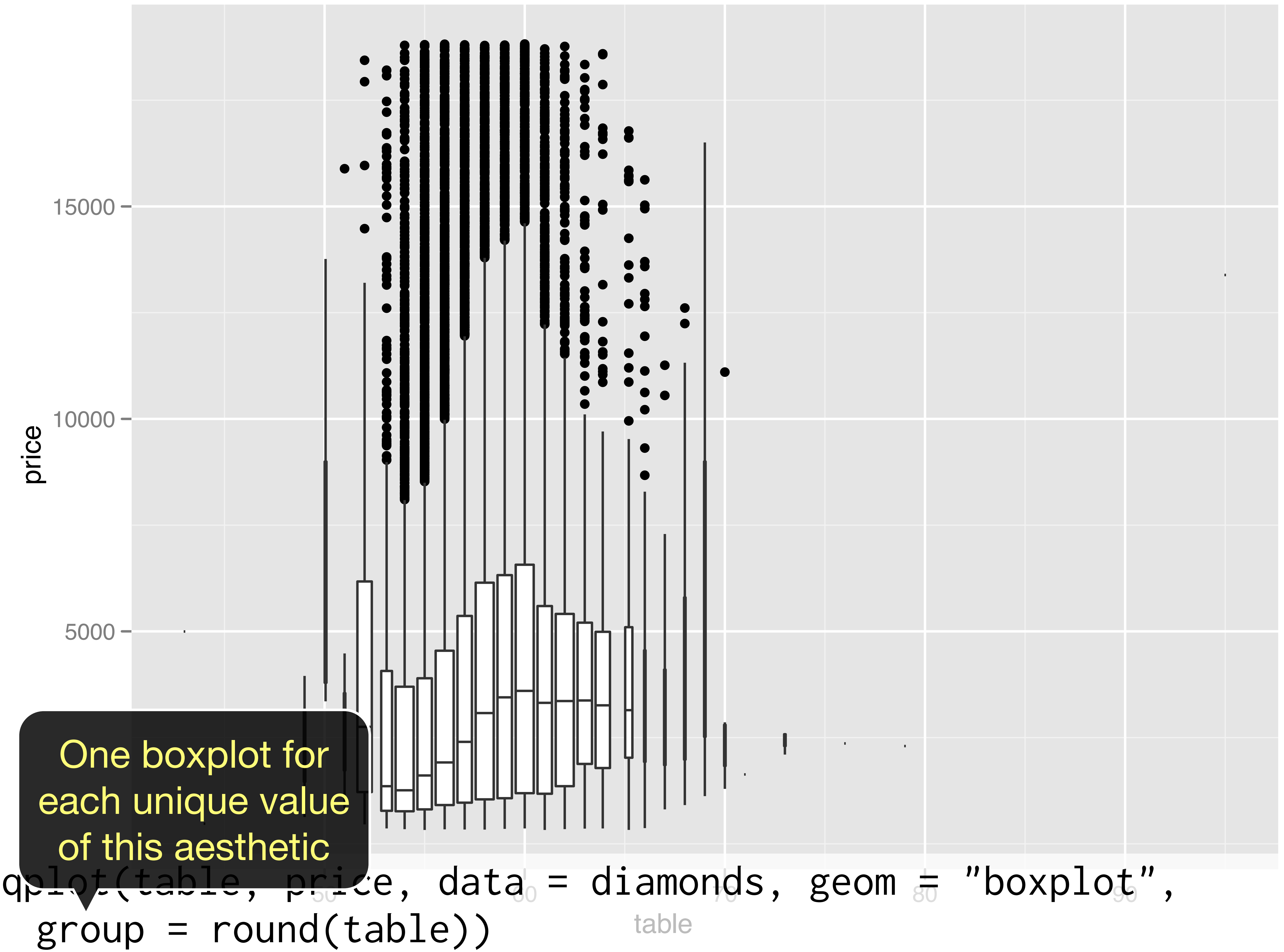
```
qplot(table, price, data = diamonds)
```



```
qplot(table, price, data = diamonds, geom = "boxplot")
```



```
qplot(table, price, data = diamonds, geom = "boxplot",
  group = round(table))
```



```
qplot(table, price, data = diamonds, geom = "boxplot",
 group = round(table))
```