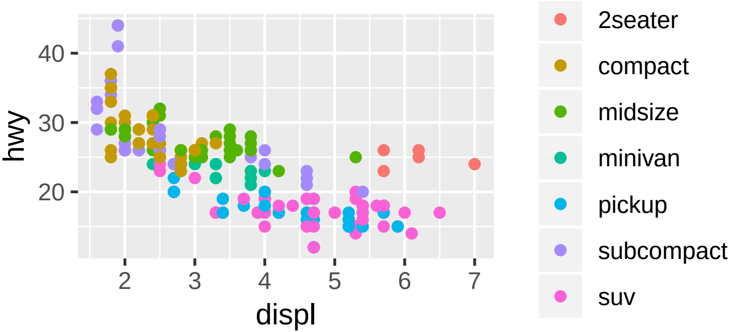
7. Exploring Data with ggplot2 (2)

CT1100 - J. Duggan

Data Exploration

“Data exploration is the art of looking at your data, rapidly generating hypotheses, quickly testing them, then repeating again and again and again.” (Wickham and Grolemund 2017).

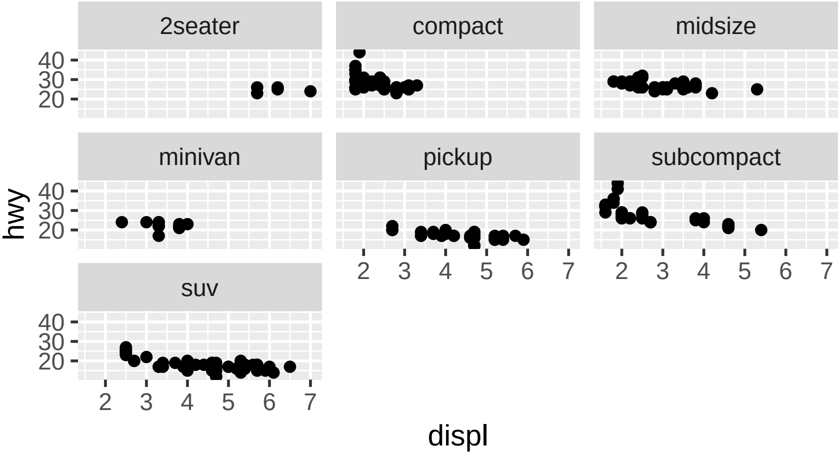


Facets

- Another way to add categorical variables is to split a plot into facets, subplots that display one subset of the data.
- To facet your plot by a single variable, use facet_wrap(), with ~ followed by the variable name

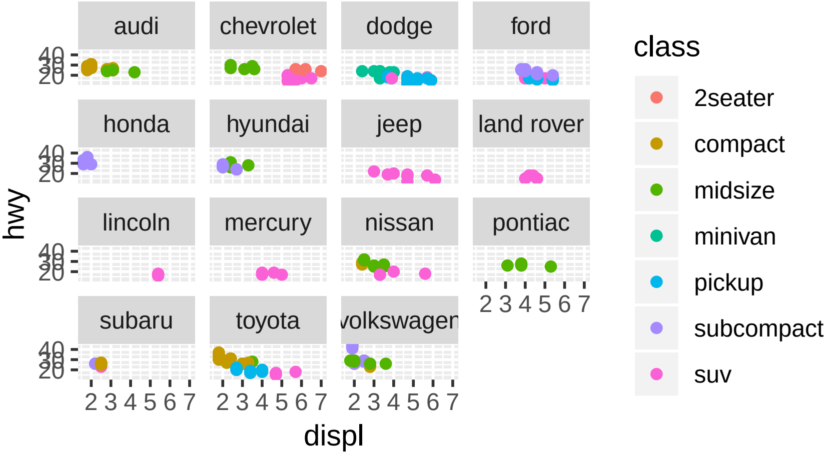
Facet Example 1

```
ggplot(data=d)+
  geom_point(aes(x=displ,y=hwy))+
  facet_wrap(~class)
```



Facet Example 2

```
ggplot(data=d)+
  geom_point(aes(x=displ,y=hwy,colour=class))+
  facet_wrap(~manufacturer)
```

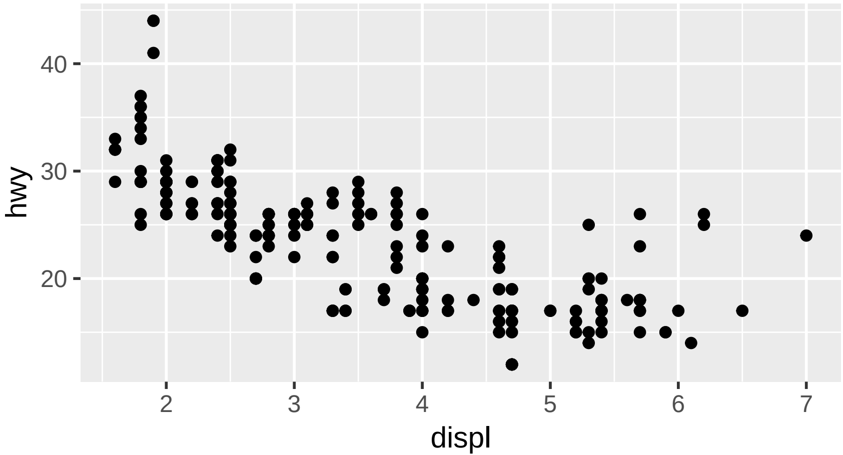


Geoms

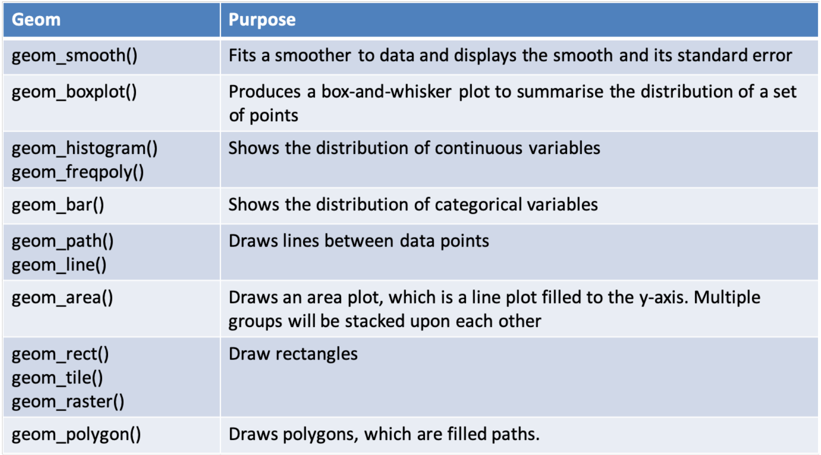
- A geom is a geometrical object that a plot uses to represent data
- Bar charts use bar geoms, line charts use line geoms, and scatter plots use the point geom.
- To change the geom in your plot, simply change the geom function that is added to the ggplot call.

geom_point()

```
ggplot(data=d)+
  geom_point(aes(x=displ,y=hwy))
```



Sample plot geoms



Geom	Purpose
geom_smooth()	Fits a smoother to data and displays the smooth and its standard error
geom_boxplot()	Produces a box-and-whisker plot to summarise the distribution of a set of points

geom_histogram()
geom_freqpoly()
	Shows the distribution of continuous variables

geom_bar()	Shows the distribution of categorical variables

geom_path()
geom_line()
	Draws lines between data points

geom_area()	Draws an area plot, which is a line plot filled to the y-axis. Multiple groups will be stacked upon each other

geom_rect()
geom_tile()
geom_raster()
	Draw rectangles

geom_polygon()	Draws polygons, which are filled paths.

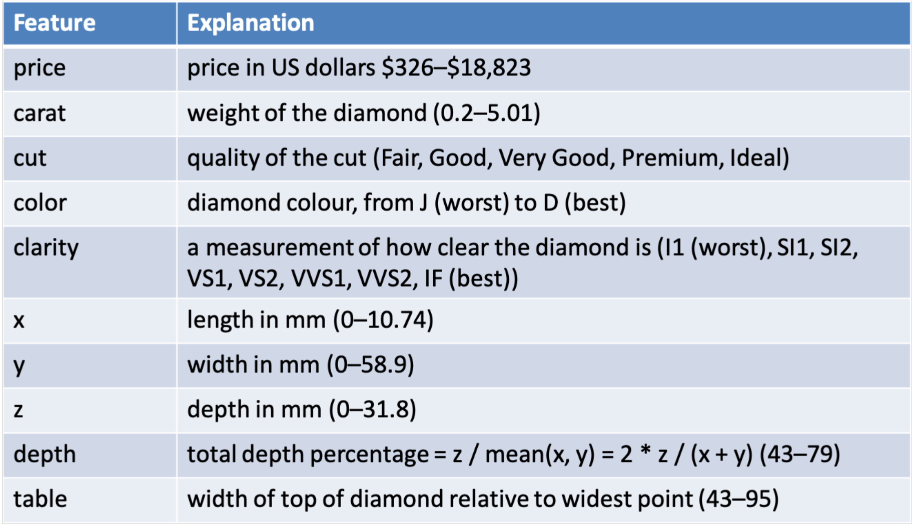
Diamonds Data Set

A dataset containing the prices and other attributes of almost 54,000 diamonds

Table 1: Selected sample from diamonds data set

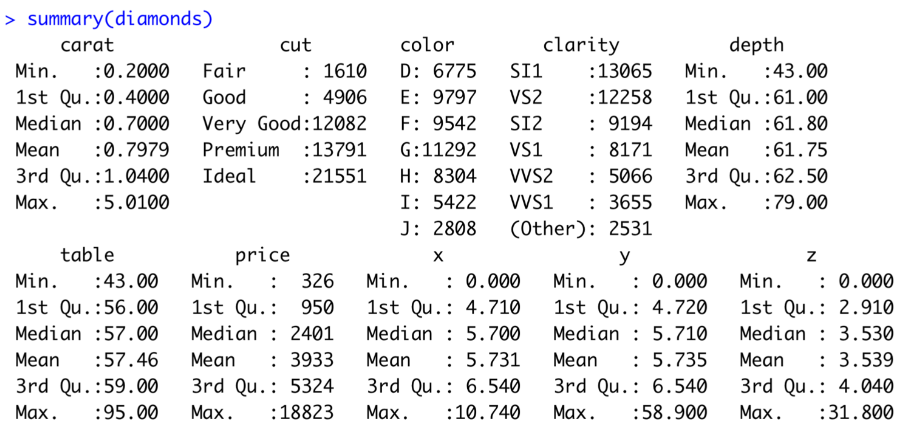
carat	cut	color	clarity	depth	table	price	x	y	z
0.23	Ideal	E	SI2	61.5	55	326	3.95	3.98	2.43
0.21	Premium	E	SI1	59.8	61	326	3.89	3.84	2.31
0.23	Good	E	VS1	56.9	65	327	4.05	4.07	2.31
0.29	Premium	I	VS2	62.4	58	334	4.20	4.23	2.63
0.31	Good	J	SI2	63.3	58	335	4.34	4.35	2.75
0.24	Very Good	J	VVS2	62.8	57	336	3.94	3.96	2.48
0.24	Very Good	I	VVS1	62.3	57	336	3.95	3.98	2.47
0.26	Very Good	H	SI1	61.9	55	337	4.07	4.11	2.53
0.22	Fair	E	VS2	65.1	61	337	3.87	3.78	2.49
0.23	Very Good	H	VS1	59.4	61	338	4.00	4.05	2.39

Explanation of Variables



Feature	Explanation
price	price in US dollars \$326–\$18,823
carat	weight of the diamond (0.2–5.01)
cut	quality of the cut (Fair, Good, Very Good, Premium, Ideal)
color	diamond colour, from J (worst) to D (best)
clarity	a measurement of how clear the diamond is (I1 (worst), SI1, SI2, VS1, VS2, VVS1, VVS2, IF (best))
x	length in mm (0–10.74)
y	width in mm (0–58.9)
z	depth in mm (0–31.8)
depth	total depth percentage = z / mean(x, y) = 2 * z / (x + y) (43–79)
table	width of top of diamond relative to widest point (43–95)

Diamonds summary



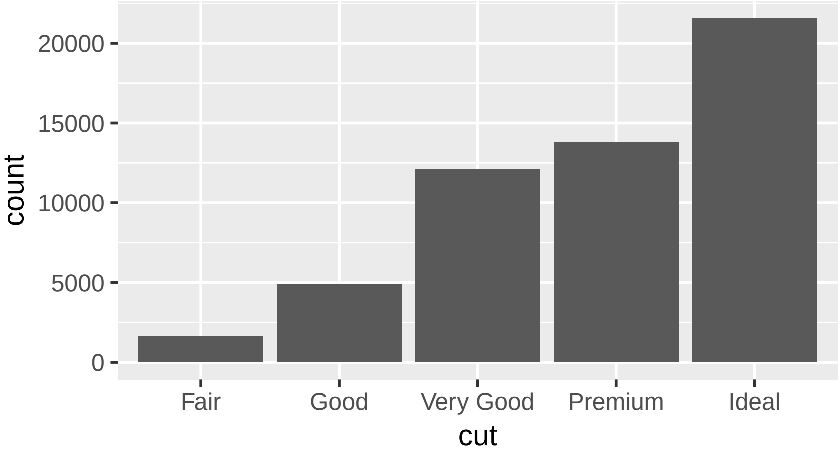
```
> summary(diamonds)
     carat               cut        color        clarity          depth      
 Min.   :0.2000   Fair     : 1610   D: 6775   SI1    :13065   Min.   :43.00  
 1st Qu.:0.4000   Good     : 4906   E: 9797   VS2    :12258   1st Qu.:61.00  
 Median :0.7000   Very Good:12082   F: 9542   SI2    : 9194   Median :61.80  
 Mean   :0.7979   Premium  :13791   G:11292   VS1    : 8171   Mean   :61.75  
 3rd Qu.:1.0400   Ideal    :21551   H: 8304   VVS2   : 5066   3rd Qu.:62.50  
 Max.   :5.0100                     I: 5422   VVS1   : 3655   Max.   :79.00  
                                    J: 2808   (Other): 2531                  
     table           price             x                y                z         
 Min.   :43.00   Min.   :  326   Min.   : 0.000   Min.   : 0.000   Min.   : 0.000  
 1st Qu.:56.00   1st Qu.:  950   1st Qu.: 4.710   1st Qu.: 4.720   1st Qu.: 2.910  
 Median :57.00   Median : 2401   Median : 5.700   Median : 5.710   Median : 3.530  
 Mean   :57.46   Mean   : 3933   Mean   : 5.731   Mean   : 5.735   Mean   : 3.539  
 3rd Qu.:59.00   3rd Qu.: 5324   3rd Qu.: 6.540   3rd Qu.: 6.540   3rd Qu.: 4.040  
 Max.   :95.00   Max.   :18823   Max.   :10.740   Max.   :58.900   Max.   :31.800  
```

Statistical Transformations

- Many graphs, like scatterplots, plot the raw values of the dataset
- However, other graphs (e.g. bar charts) calculate new values to plot
    - Bar charts, histograms and frequency polygons bin your data and plot bin counts, the number of points that fall in each bin
    - Smoothers fit a model to your data and the plot predictions from the model
    - Boxplots compute a robust summary of the distribution and display a specially formatted box

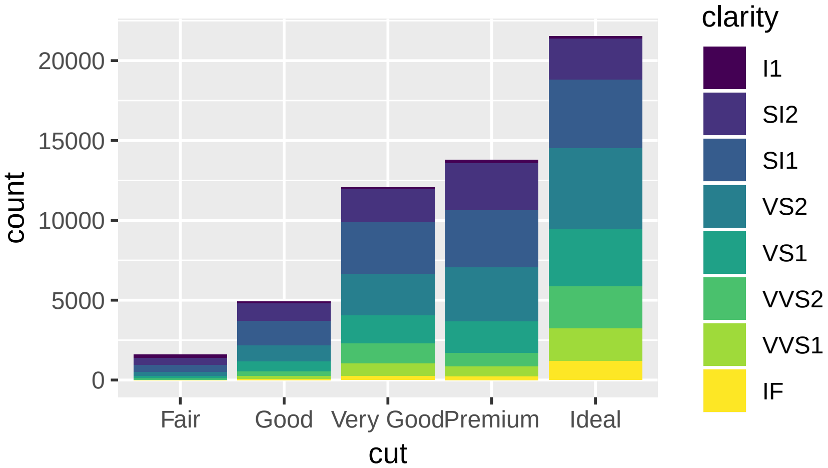
Bar Chart

```r
ggplot(data=diamonds)+
  geom_bar(aes(x=cut))
```



Bar Chart: Adding information with fill

```
ggplot(data=diamonds)+
  geom_bar(aes(x=cut,fill=clarity))
```

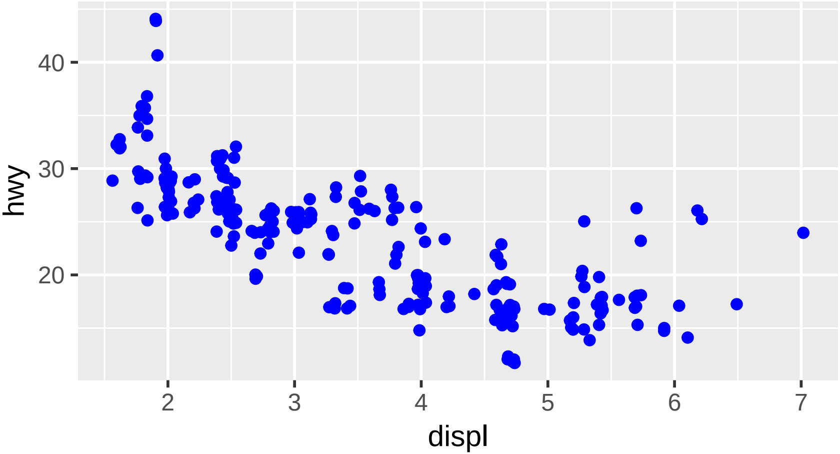


Additional Adjustment

- Recall our first scatterplot
- 126 points displayed, yet there are 234 observations
- Many points can overlap, so it makes it hard to see where the mass of data is
- Are all points spread equally, or is there one special combination that contains 129 values?
- “jitter” adds random noise to each point

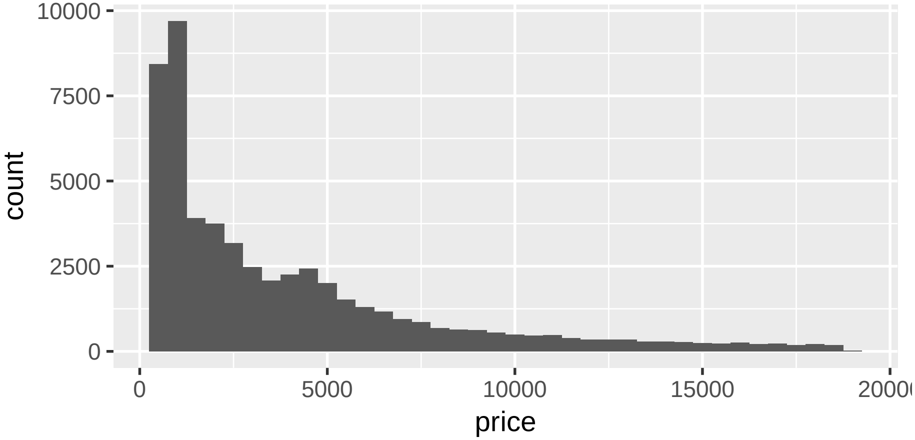
Using jitter

```
ggplot(data=mpg)+
  geom_point(aes(x=displ,y=hwy),
             colour="blue", position="jitter")
```



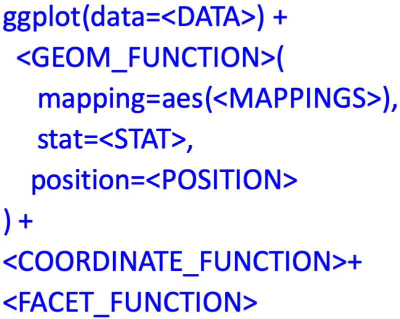
Histogram

```r
ggplot(data=diamonds,aes(x=price))+
  geom_histogram(binwidth = 500)
```



Summary

- The ggplot2 approach can be summarised by a template
- It can take seven parameters, but usually not all need to be applied (defaults used)
- These seven parameters comprise the **grammar of graphics**



```
ggplot(data=<DATA>) +
 <GEOM_FUNCTION>(
   mapping=aes(<MAPPINGS>),
   stat=<STAT>,
  position=<POSITION>
) +
<COORDINATE_FUNCTION>+
<FACET_FUNCTION>
```