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REVOLUTION ANALYTICS

Data visualization with R

San Diego R Users Group | June 2013

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What is ggplot2?

- ggplot2 is a data visualization package for R. Created by Hadley Wickham in 2005

- ggplot2 is an implementation of Leland Wilkinson's Grammar of Graphics—a general scheme for data visualization which breaks up graphs into semantic components such as scales and layers.

Advantages of ggplot2

- Consistent underlying grammar of graphics (Wilkinson, 2005)
- Plot specification at a high level of abstraction
- Theme system to refine plot appearance
- Very active development
- Active google group (3786 members as of today)

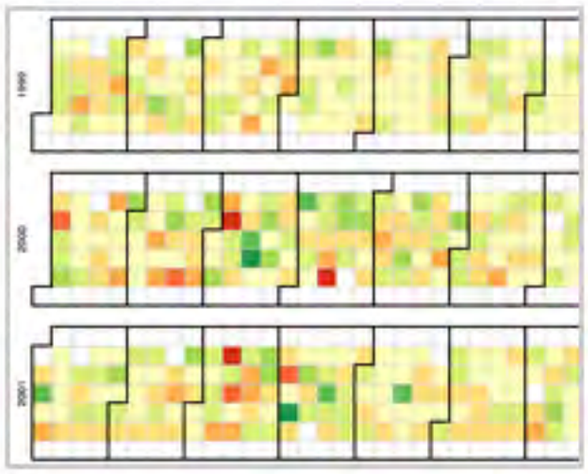
Grammar of graphics

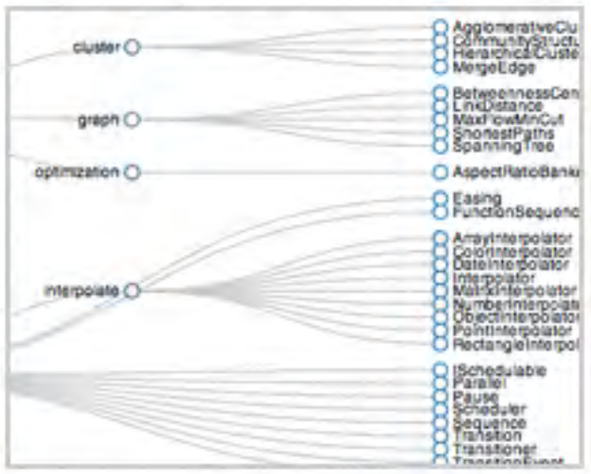
The basic idea: independently specify plot building blocks

Anatomy of a plot:

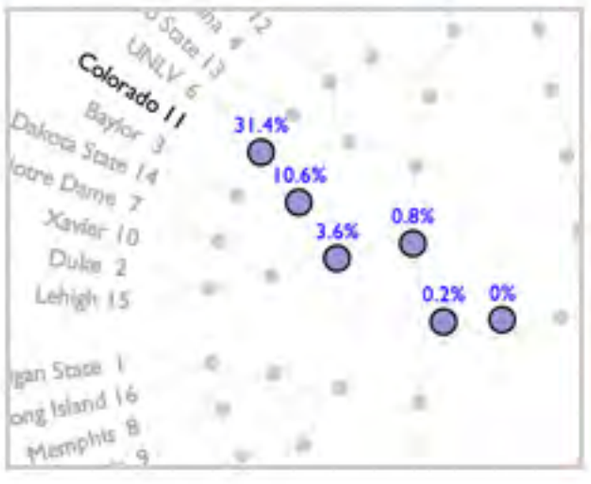
- data
- aesthetic mapping
- geometric object
- statistical transformations
- scales
- coordinate system
- position adjustments
- faceting

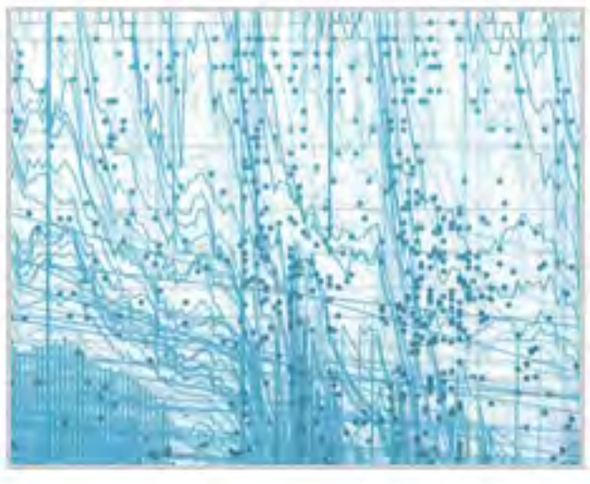
Data-Driven Documents











D3.js is a JavaScript library for manipulating documents based on data. **D3** helps you bring data to life using HTML, SVG and CSS. D3's emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization components and a data-driven approach to DOM manipulation.

See more examples.

Download the latest version here:

- d3.v3.zip

ggplot2 elements

A plot is comprised of multiple layers

A layer consists of data and a:

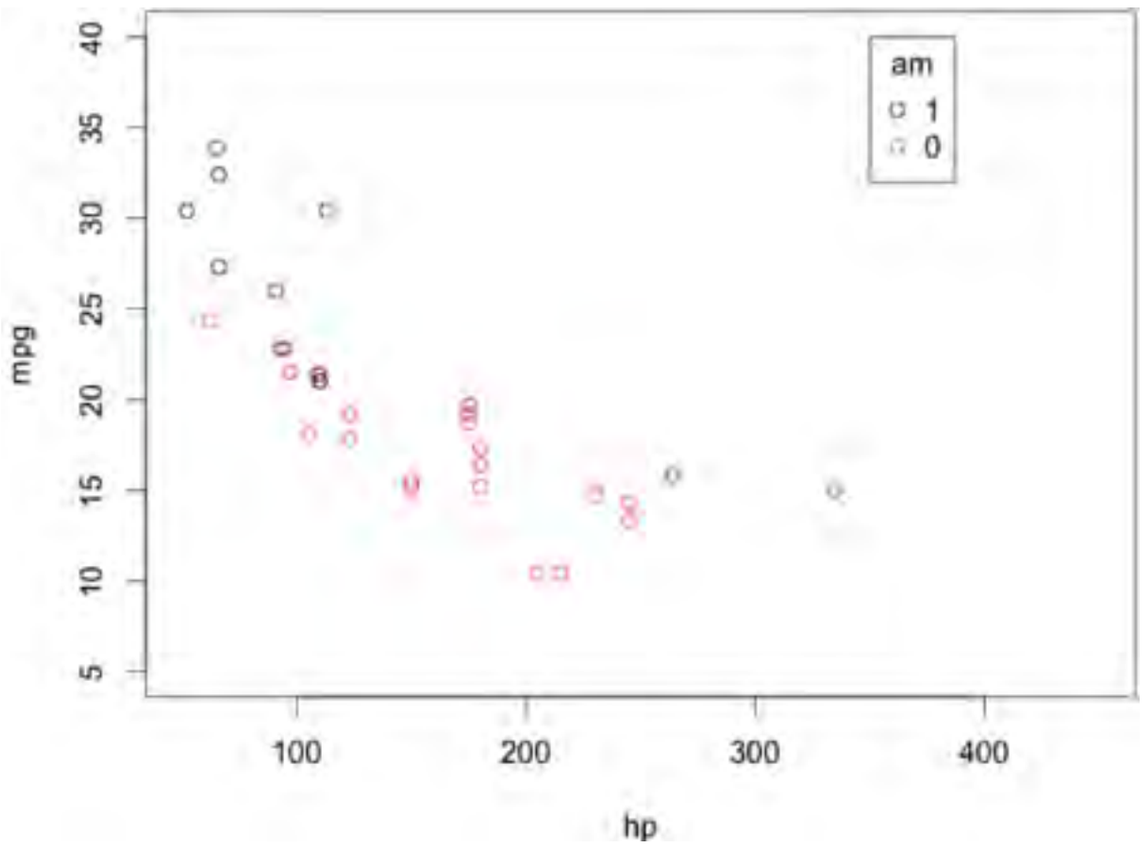
- set of mappings between variables and aesthetics
- geometric object
- statistical transformation

Scales control the details of the mapping.

All components are independent and reusable.

Base graphics vs ggplot: Scatterplots

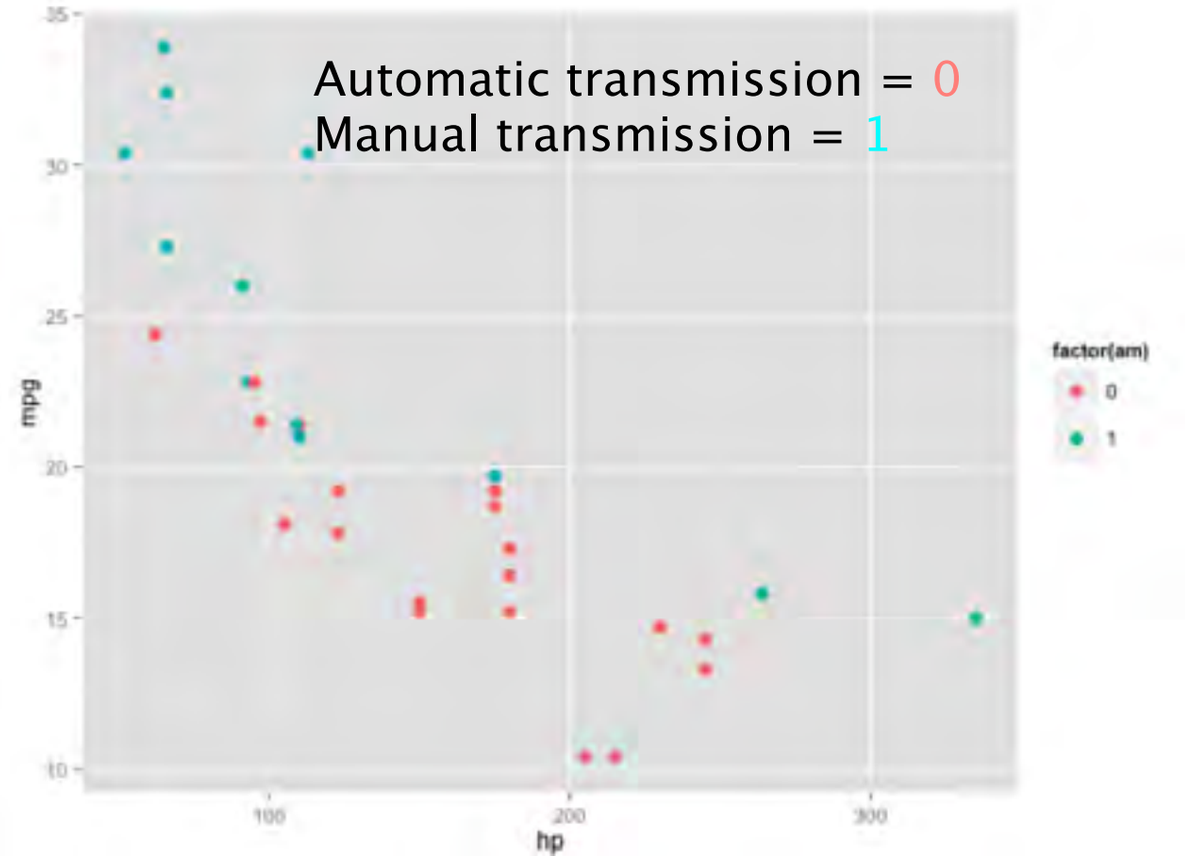
```
par(mar = c(4,4,.1,.1))
    plot(mpg ~ hp,
    data=subset(mtcars, am==1),
    xlim=c(50, 450),ylim=c(5, 40))
    points(mpg ~ hp, col="red",
    data=subset(mtcars, am==0))
    legend(350, 40,
    c("1", "0"), title="am",
    col=c("black", "red"),
    pch=c(1, 1))
```




```
ggplot(mtcars, aes(x=hp,
y=mpg,
color=factor(am)))+
geom_point()
```

OR

```
qplot(hp,mpg,data=mtcars,color=factor
(am))
```



1. Aesthetics and geometric Objects
2. Statistical Transformations
3. Scales
4. Faceting
5. Themes
6. Putting It All Together

1. Aesthetics and geometric Objects
2. Statistical Transformations
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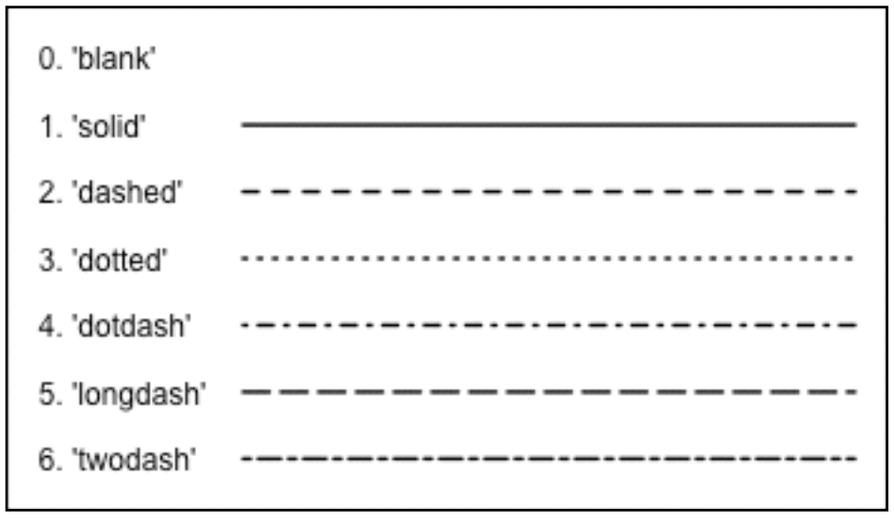
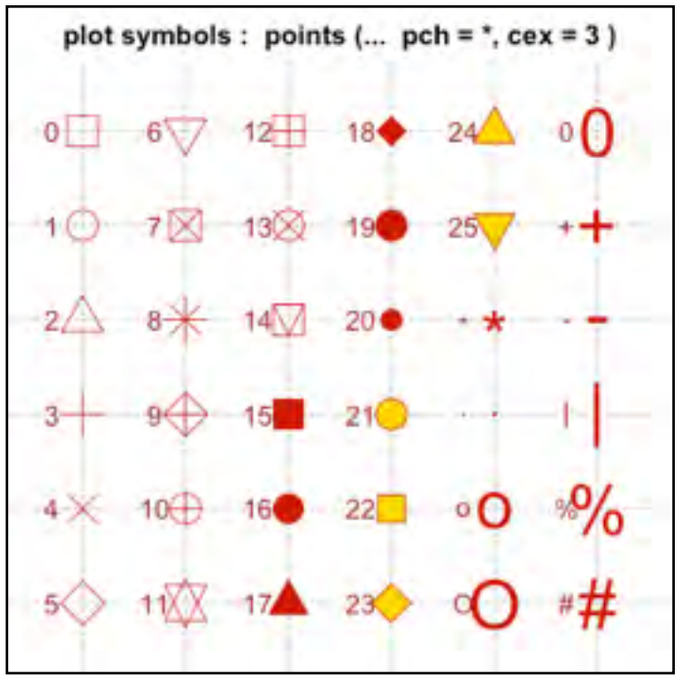
6. Project Example

Aesthetics and geometric Objects:
Mapping aesthetics

- Aesthetic mappings are set with the aes( ) function
- Position (x and y)
- Color (outline color)
- Fill
- Shape (point shapes)
- Line type
- Size
- Each geom accepts only a subset of all aesthetics





Name	Default stat	Aesthetics
abline	abline	colour, linetype, size
area	identity	colour, fill, linetype, size, **x**, **y**
bar	bin	colour, fill, linetype, size, weight, **x**
bin2d	bin2d	colour, fill, linetype, size, weight, **xmax**, **xmin**, **ymax**, **ymin**
blank	identity	
boxplot	boxplot	colour, fill, **lower**, **middle**, size, **upper**, weight, **x**, **ymax**, **ymin**
contour	contour	colour, linetype, size, weight, **x**, **y**
crossbar	identity	colour, fill, linetype, size, **x**, **y**, **ymax**, **ymin**
density	density	colour, fill, linetype, size, weight, **x**, **y**
density2d	density2d	colour, linetype, size, weight, **x**, **y**
errorbar	identity	colour, linetype, size, width, **x**, **ymax**, **ymin**
freqpoly	bin	colour, linetype, size
hex	binhex	colour, fill, size, **x**, **y**
histogram	bin	colour, fill, linetype, size, weight, **x**
hline	hline	colour, linetype, size
jitter	identity	colour, fill, shape, size, **x**, **y**
line	identity	colour, linetype, size, **x**, **y**
linerange	identity	colour, linetype, size, **x**, **ymax**, **ymin**
path	identity	colour, linetype, size, **x**, **y**
point	identity	colour, fill, shape, size, **x**, **y**
pointrange	identity	colour, fill, linetype, shape, size, **x**, **y**, **ymax**, **ymin**
polygon	identity	colour, fill, linetype, size, **x**, **y**
quantile	quantile	colour, linetype, size, weight, **x**, **y**
rect	identity	colour, fill, linetype, size, **xmax**, **xmin**, **ymax**, **ymin**
ribbon	identity	colour, fill, linetype, size, **x**, **ymax**, **ymin**
rug	identity	colour, linetype, size
segment	identity	colour, linetype, size, **x**, **xend**, **y**, **yend**
smooth	smooth	alpha, colour, fill, linetype, size, weight, **x**, **y**
step	identity	colour, linetype, size, **x**, **y**
text	identity	angle, colour, hjust, **label**, size, vjust, **x**, **y**
tile	identity	colour, fill, linetype, size, **x**, **y**
vline	vline	colour, linetype, size

Table 4.3: Default statistics and aesthetics. Emboldened aesthetics are required.

*From Hadley Wickham's excellent book Elegant Graphics for Data Analysis

Aesthetics and geometric Objects:
Geometric objects

- Geoms are the ways of representing marks on a plot
- Points (geom_point: dot plots, scatter plots)
- Lines (geom_line: trend lines, timeseries)
- Boxplot (geom_boxplot)
- At least one geom is required (no upper limit)
- Geoms are added to the plot using the + operator

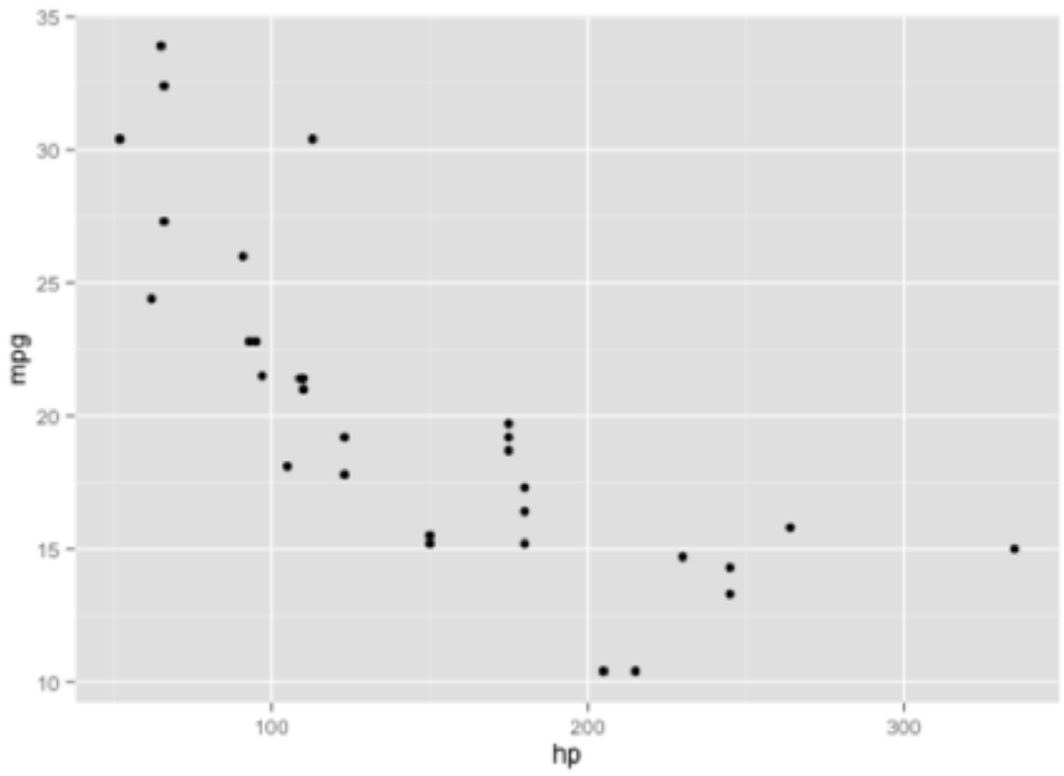
```
geoms <- help.search("geom_", package = "ggplot2")

geoms$matches[1:4, 1:2]
```

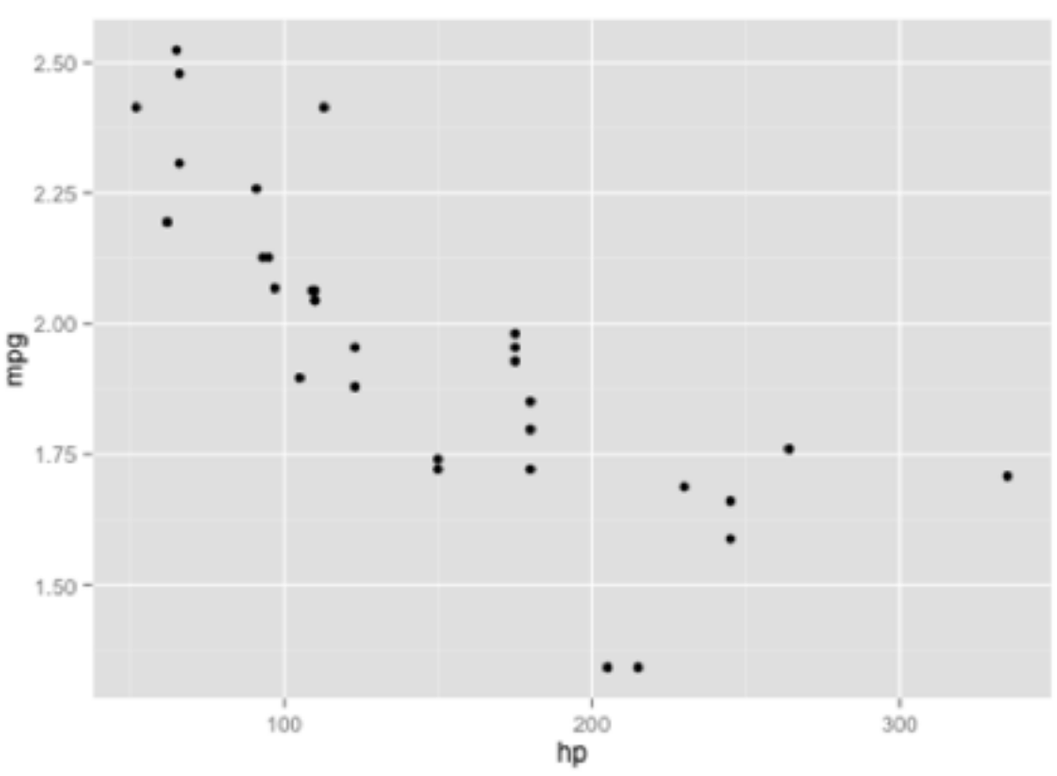
```
topic                      title
[1,] "geom_abline"   "Line specified by slope and intercept."
[2,] "geom_area"     "Area plot."
[3,] "geom_bar"      "Bars, rectangles with bases on x-axis"
[4,] "geom_bin2d"    "Add heatmap of 2d bin counts."
```

Aesthetics and geometric Objects:
geom_point

ggplot(mtcars, aes(x = hp, y = mpg)) +
geom_point()



ggplot(mtcars, aes(x = hp, y = mpg)) +
geom_point(aes(y=log(mpg)-1))



- Remember from slide 10: geom_point requires mappings for x and y, all others are optional: point identity colour, fill, shape, size, x, y
- ggplot() defaults can be overwritten by geom

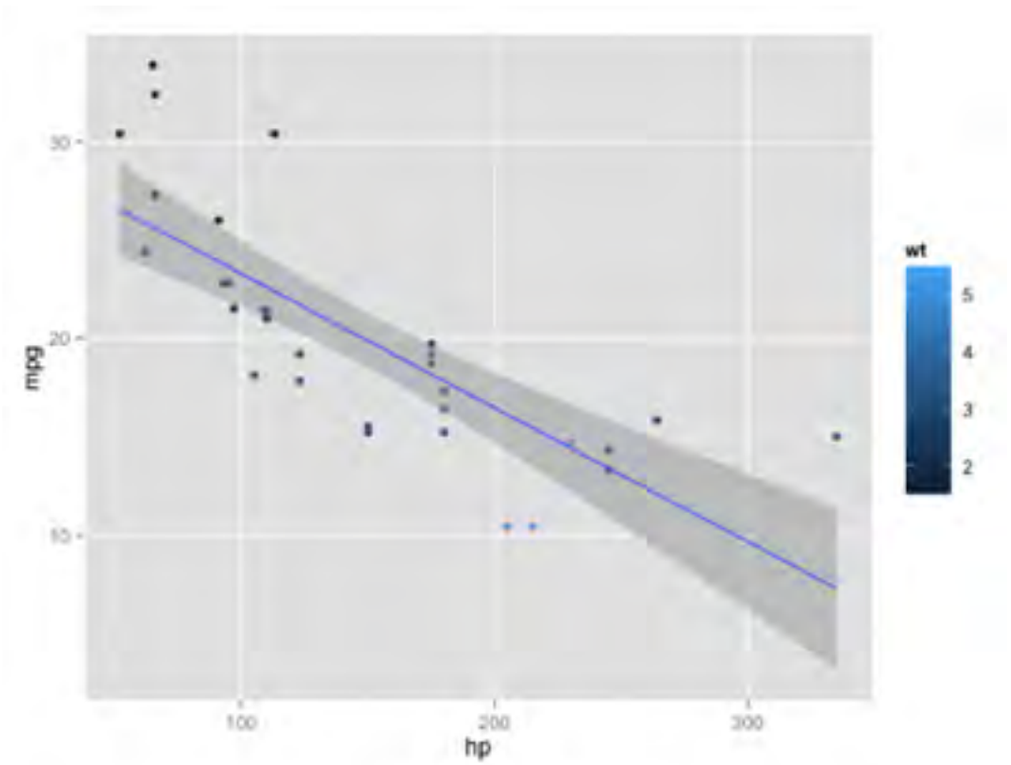
mtcars dataset

```
> head(mtcars)
                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

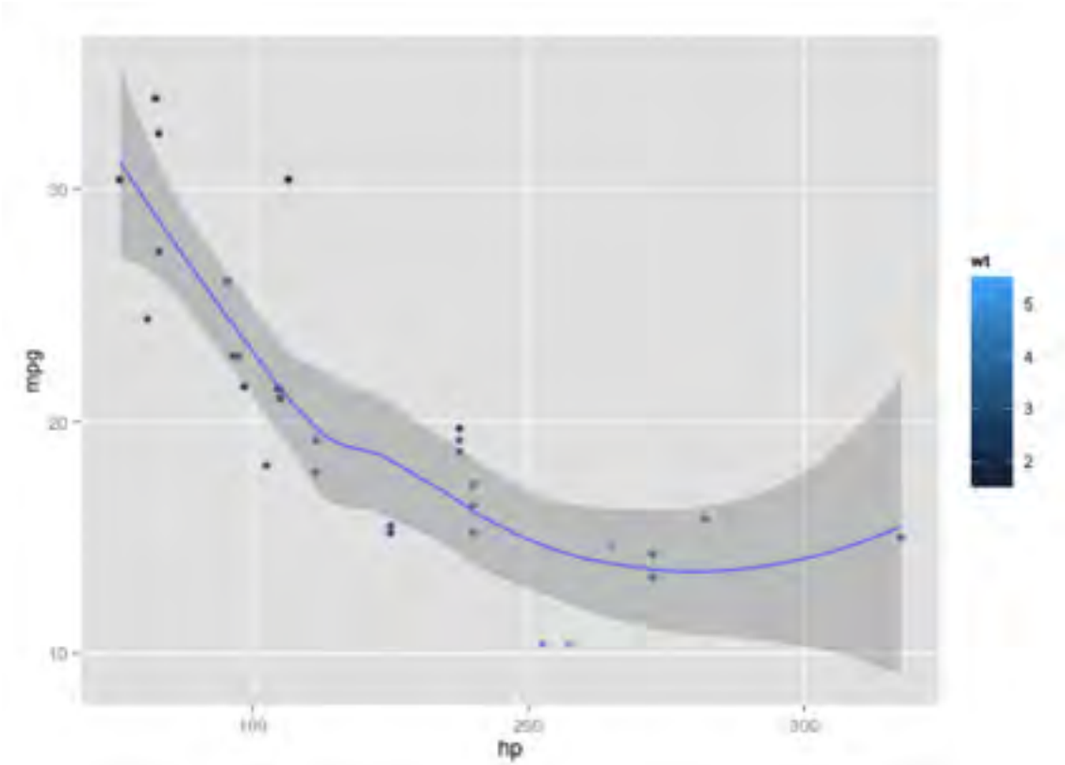
```
> str(mtcars)
'data.frame': 32 obs. of  11 variables:
 $ mpg : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
 $ cyl : num  6 6 4 6 8 6 8 4 4 6 ...
 $ disp: num  160 160 108 258 360 ...
 $ hp  : num  110 110 93 110 175 105 245 62 95 123 ...
 $ drat: num  3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...
 $ wt  : num  2.62 2.88 2.32 3.21 3.44 ...
 $ qsec: num  16.5 17 18.6 19.4 17 ...
 $ vs  : num  0 0 1 1 0 1 0 1 1 1 ...
 $ am  : num  1 1 1 0 0 0 0 0 0 0 ...
 $ gear: num  4 4 4 3 3 3 3 4 4 4 ...
 $ carb: num  4 4 1 1 2 1 4 2 2 4 ...
```

Aesthetics and geometric Objects:
geom_smooth/geom_line

```
plot <- ggplot(mtcars, aes(x = hp, y = mpg))
plot + geom_point(aes(color = wt)) +
geom_smooth(method = lm)
```




```
plot <- ggplot(mtcars, aes(x = hp, y = mpg))
plot + geom_point(aes(color = wt)) +
geom_smooth(method = loess)
```



- A plot constructed with ggplot can have more than one geom
- We can add a regression line to our previous hp vs mpg plot

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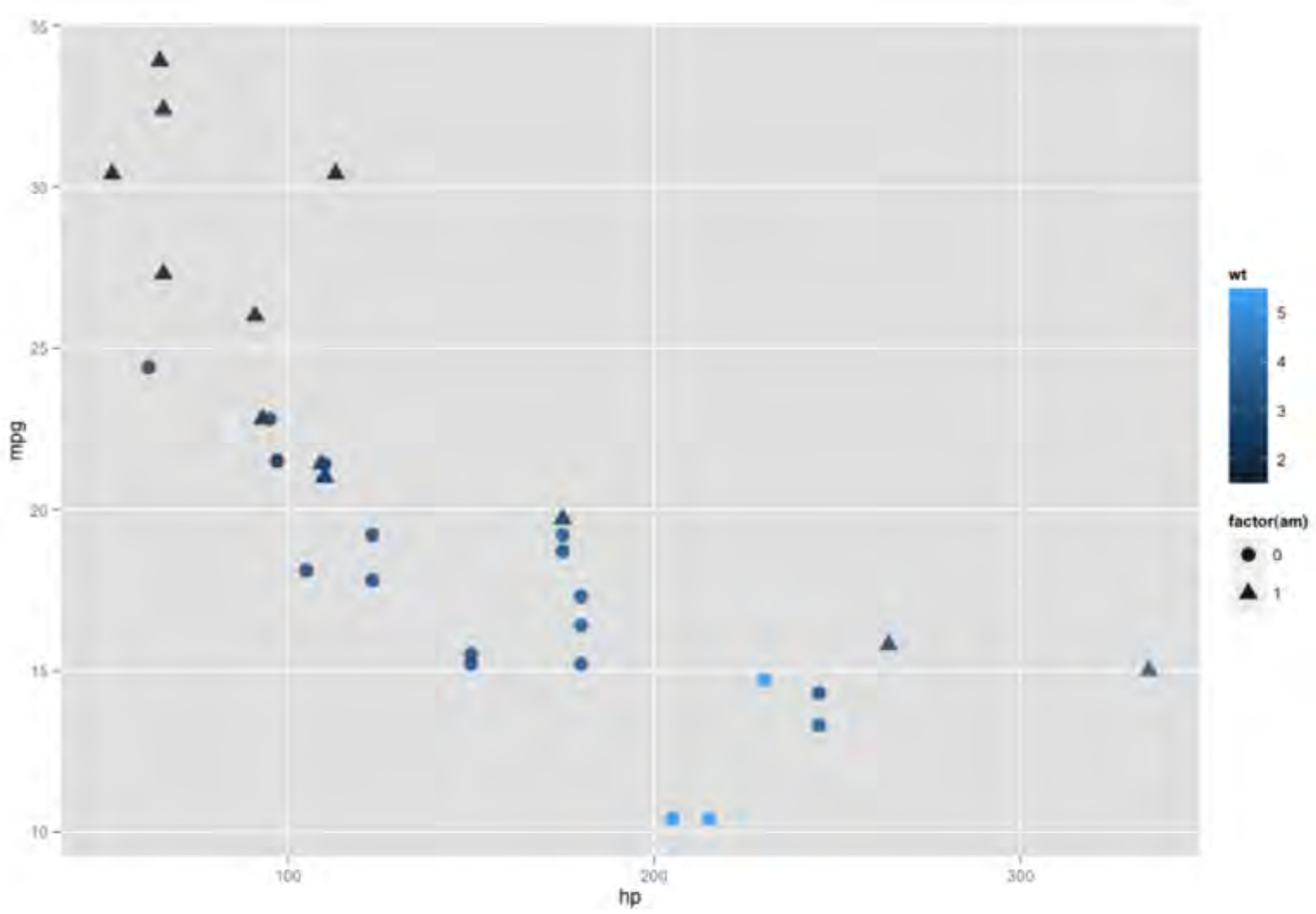
CENTER FOR SOCIAL RESEARCH
UNIVERSITY OF NOTRE DAME

GENERALIZED ADDITIVE MODELS

GETTING STARTED WITH ADDITIVE MODELS IN R

Aesthetics and geometric Objects:
Mapping variables to aesthetics

```
ggplot(mtcars, aes(x = hp, y = mpg)) +
geom_point(aes(color = wt, shape = factor(am)), size = 3, alpha = .9)
```



1.Aesthetics and geometric Objects
2.Statistical Transformations
3.Scales
4.Faceting
5.Themes
6.Project Example

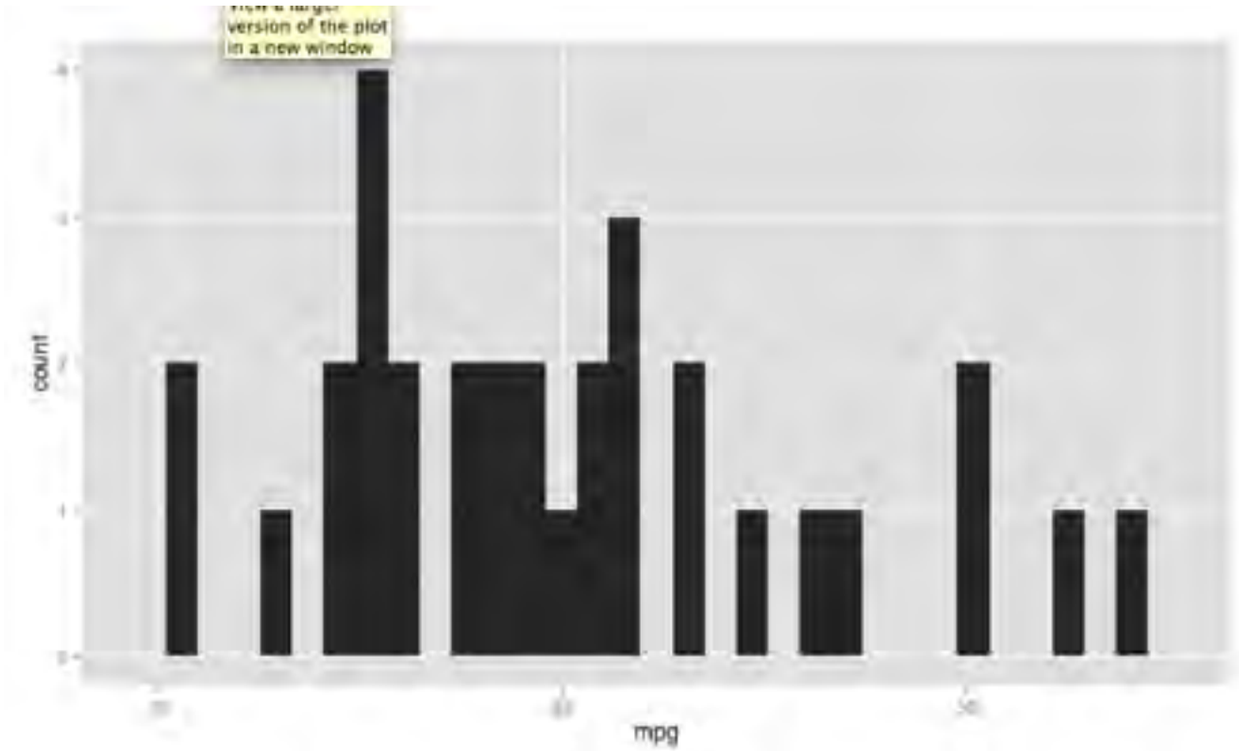
Statistical Transformations:
Intro

- Each geom has default statistics, but these can be changed

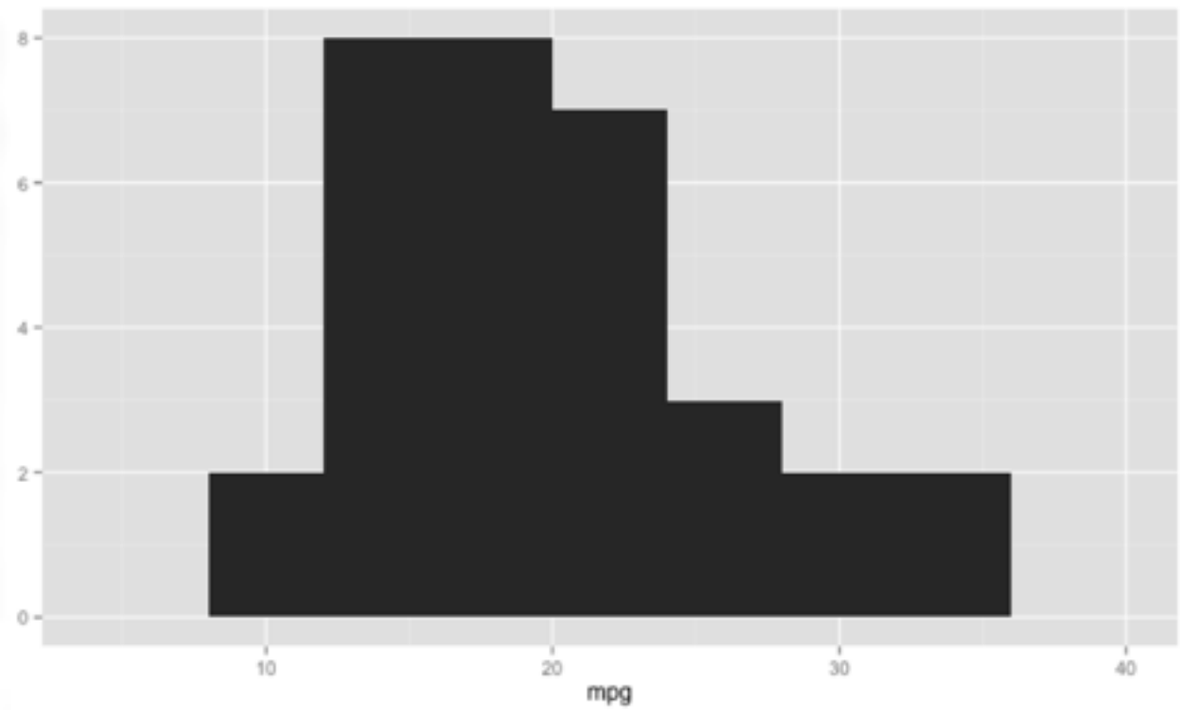
```
args(geom_bar)
function (mapping = NULL, data = NULL, stat = "bin", position = "stack",
    ...)

args(geom_boxplot)
function (mapping = NULL, data = NULL, stat = "boxplot", position = "dodge",
    outlier.color = "black", outlier.shape = 16, outlier.size = 2,
    notch = FALSE, notchwidth = 0.5, ...)

args(geom_histogram)
function (mapping = NULL, data = NULL, stat = "bin", position = "stack",
    ...)
```

Statistical Transformations:
Arguments

```
ggplot(mtcars, aes(x = mpg)) +
geom_bar()
```




```
ggplot(mtcars, aes(x = mpg)) +
geom_bar(stat = "bin", binwidth=4)
```



- Arguments to **stat**_ functions are passed through **geom**_ functions

Statistical Transformations:
Transformation

```
> head(mtcars)
                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

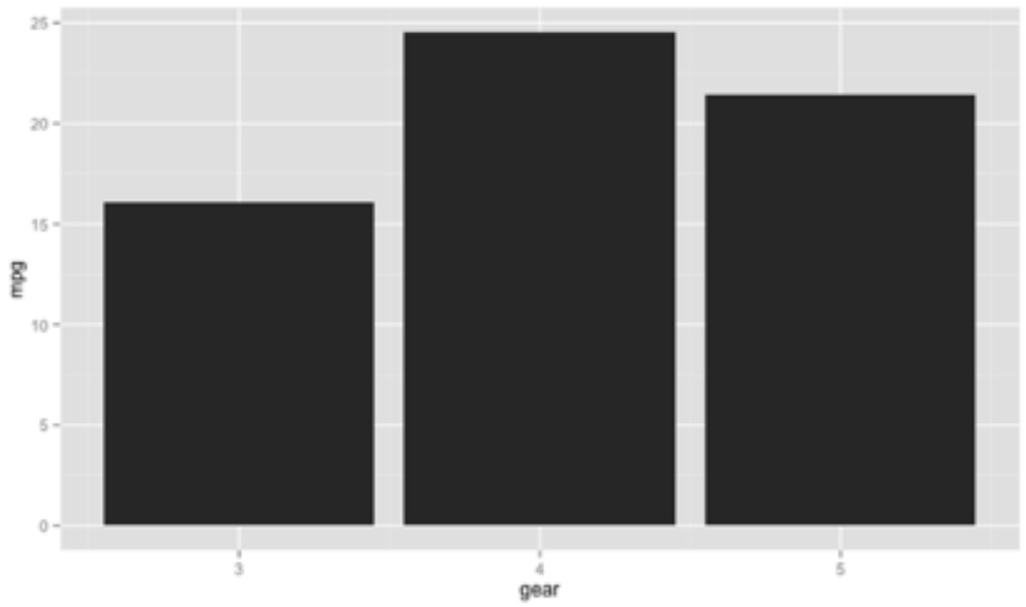
```
> (mtcarsSum <- aggregate(mtcars["mpg"], mtcars["gear"], FUN=mean))
  gear      mpg
1    3 16.10667
2    4 24.53333
3    5 21.38000
```

- With geom_bar(), the default behavior is to use stat="bin", which counts up the number of cases for each group (each x position, in this example).

```
ggplot(mtcarsSum, aes(x=gear, y=mpg)) +
  geom_bar()
```

```
Mapping a variable to y and also using stat="bin".
  With stat="bin", it will attempt to set the y value to the count of cases in each group.
  This can result in unexpected behavior and will not be allowed in a future version of ggplot2.
  If you want y to represent counts of cases, use stat="bin" and don't map a variable to y.
  If you want y to represent values in the data, use stat="identity".
  See ?geom_bar for examples. (Deprecated; last used in version 0.9.2)
stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
Error in pmin(y, 0) : object 'y' not found
```

```
ggplot(mtcarsSum, aes(x=gear, y=mpg)) +
  geom_bar(stat="identity")
```



1.Aesthetics and geometric Objects
2.Statistical Transformations
3.Scales
4.Faceting
5.Themes
6.Project Example

Scales:
Intro

- The domain of each scale corresponds to the range of the variable supplied to the scale, and can be continuous or discrete, ordered or unordered.

- The range consists of the concrete aesthetics that you can perceive and that R can understand: position, color, shape, size and line type

- **name**: the first argument gives the axis or legend title

- **limits**: the minimum and maximum of the scale

- **breaks**: the points along the scale where labels should appear

- **labels**: the labels that appear at each break

Colorbrewer: Color Advice

colorbrewer2.org

number of data classes on your map

3 learn more >

the nature of your data

sequential learn more >

sequential
diverging
qualitative

pick a color scheme

multihue single hue

(optional) only show schemes that are:

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229, 245, 249
153, 216, 201
44, 162, 95

RGB CMYK HEX

adjust map context

roads
cities
borders

select a background

solid color
terrain

color transparency

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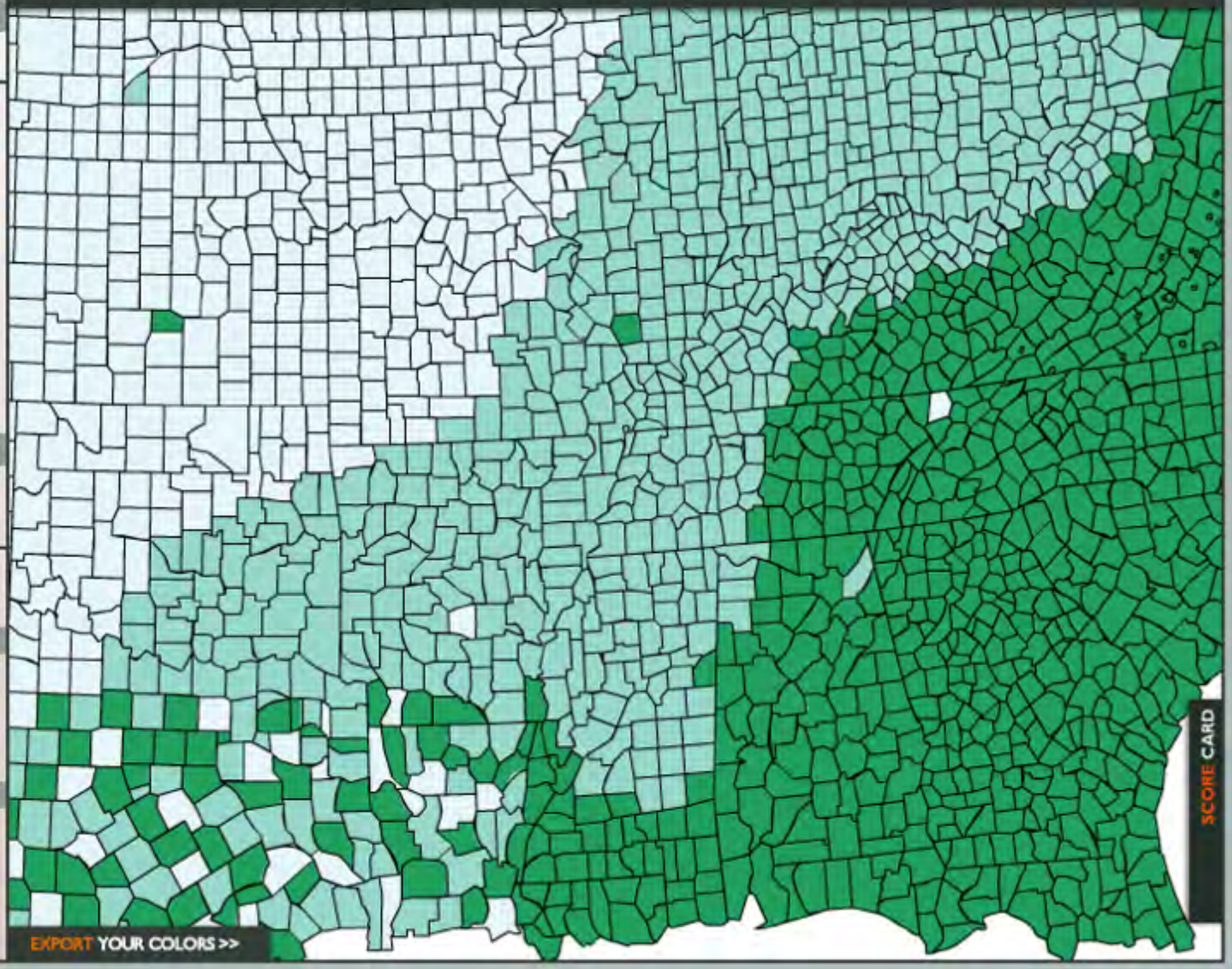
COLORBREWER 2.0
color advice for cartography



Support
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http://colorbrewer2.org/

Colorbrewer: Color Advic

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number of data classes on your map

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pick a color system

216, 179, 101

245, 245, 245

90, 180, 172

RGB CMYK HEX

adjust map context

roads

cities

borders

select a background

solid color

terrain

color transparency

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EXPORT YOUR COLORS >>

Support

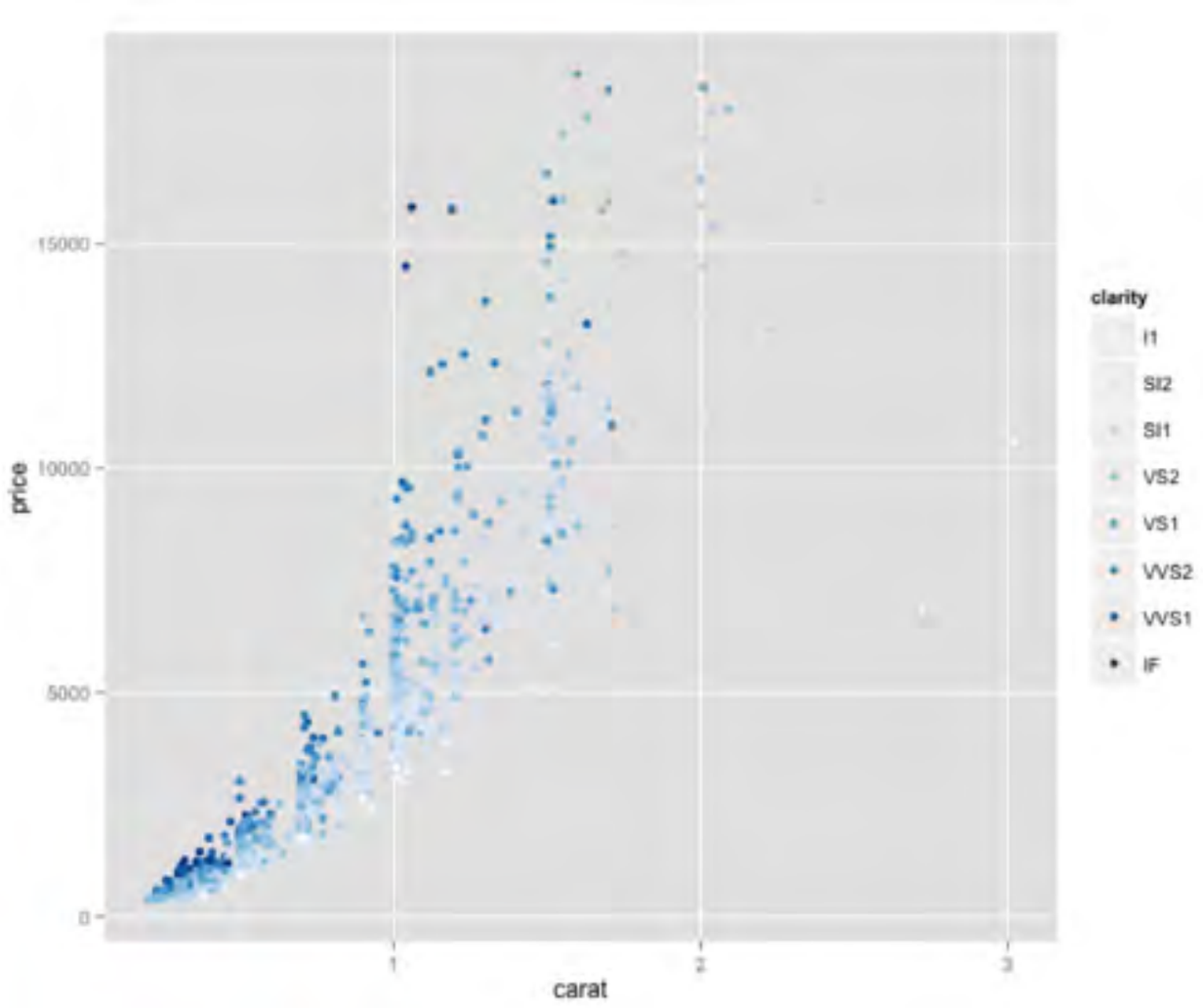
Back to ColorBrewer 1.0

diamonds dataset

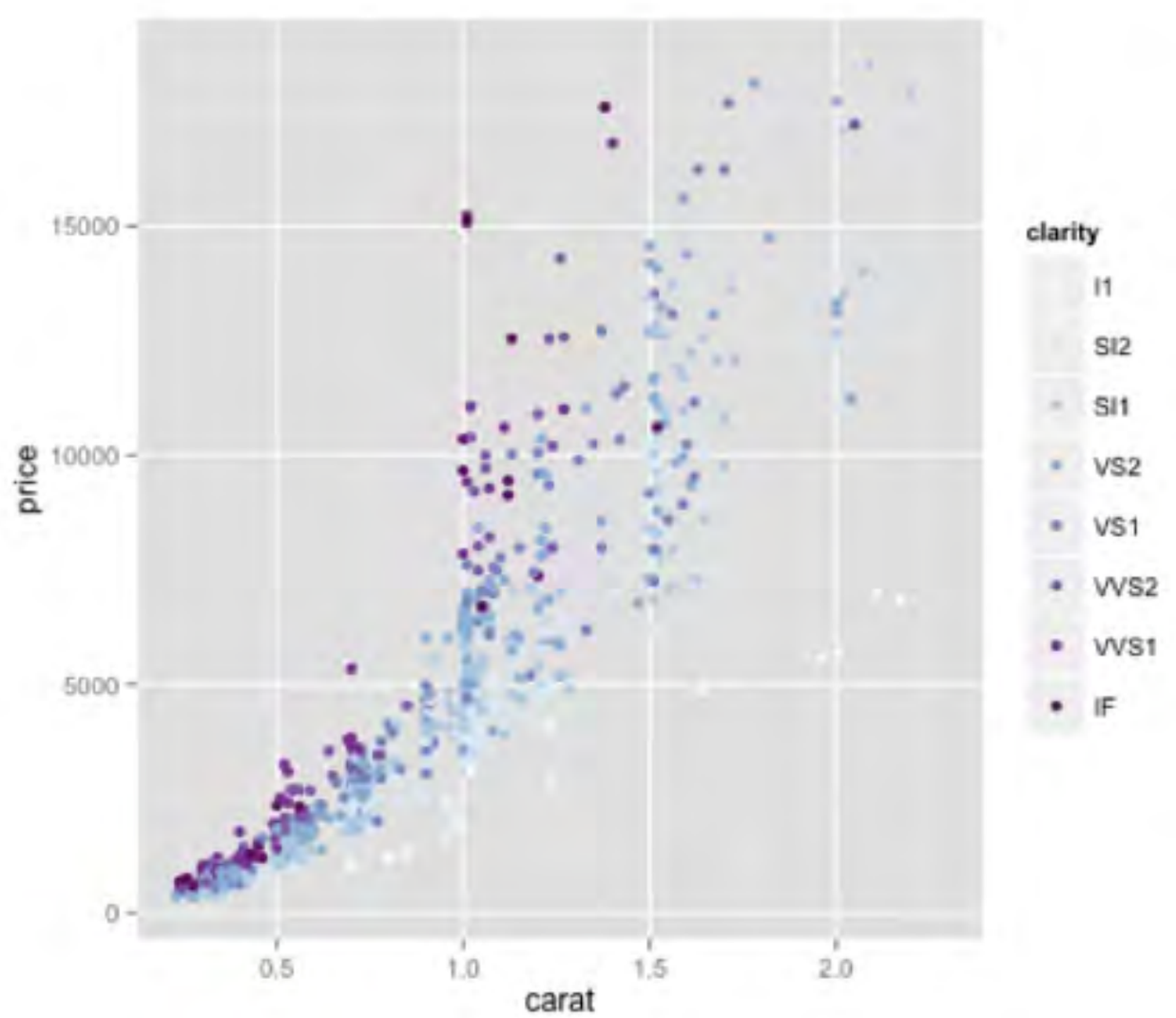
```
> head(diamonds)
  carat       cut color clarity depth table price    x    y    z
1  0.23     Ideal     E     SI2  61.5    55   326 3.95 3.98 2.43
2  0.21   Premium     E     SI1  59.8    61   326 3.89 3.84 2.31
3  0.23      Good     E     VS1  56.9    65   327 4.05 4.07 2.31
4  0.29   Premium     I     VS2  62.4    58   334 4.20 4.23 2.63
5  0.31      Good     J     SI2  63.3    58   335 4.34 4.35 2.75
6  0.24 Very Good     J    VVS2  62.8    57   336 3.94 3.96 2.48
> str(diamonds)
'data.frame': 53940 obs. of  10 variables:
 $ carat  : num  0.23 0.21 0.23 0.29 0.31 0.24 0.24 0.26 0.22 0.23 ...
 $ cut    : Ord.factor w/ 5 levels "Fair"<"Good"<..: 5 4 2 4 2 3 3 3 1 3 ...
 $ color  : Ord.factor w/ 7 levels "D"<"E"<"F"<"G"<..: 2 2 2 6 7 7 6 5 2 5 ...
 $ clarity: Ord.factor w/ 8 levels "I1"<"SI2"<"SI1"<..: 2 3 5 4 2 6 7 3 4 5 ...
 $ depth  : num  61.5 59.8 56.9 62.4 63.3 62.8 62.3 61.9 65.1 59.4 ...
 $ table  : num  55 61 65 58 58 57 57 55 61 61 ...
 $ price  : int  326 326 327 334 335 336 336 337 337 338 ...
 $ x      : num  3.95 3.89 4.05 4.2 4.34 3.94 3.95 4.07 3.87 4 ...
 $ y      : num  3.98 3.84 4.07 4.23 4.35 3.96 3.98 4.11 3.78 4.05 ...
 $ z      : num  2.43 2.31 2.31 2.63 2.75 2.48 2.47 2.53 2.49 2.39 ...
```

Scales:
Color

```
dSample <- diamonds[sample(nrow(diamonds), 1000), ]
diamond <- ggplot(dSample,aes(x = carat, y = price, color
= clarity)) + geom_point()
diamond
```

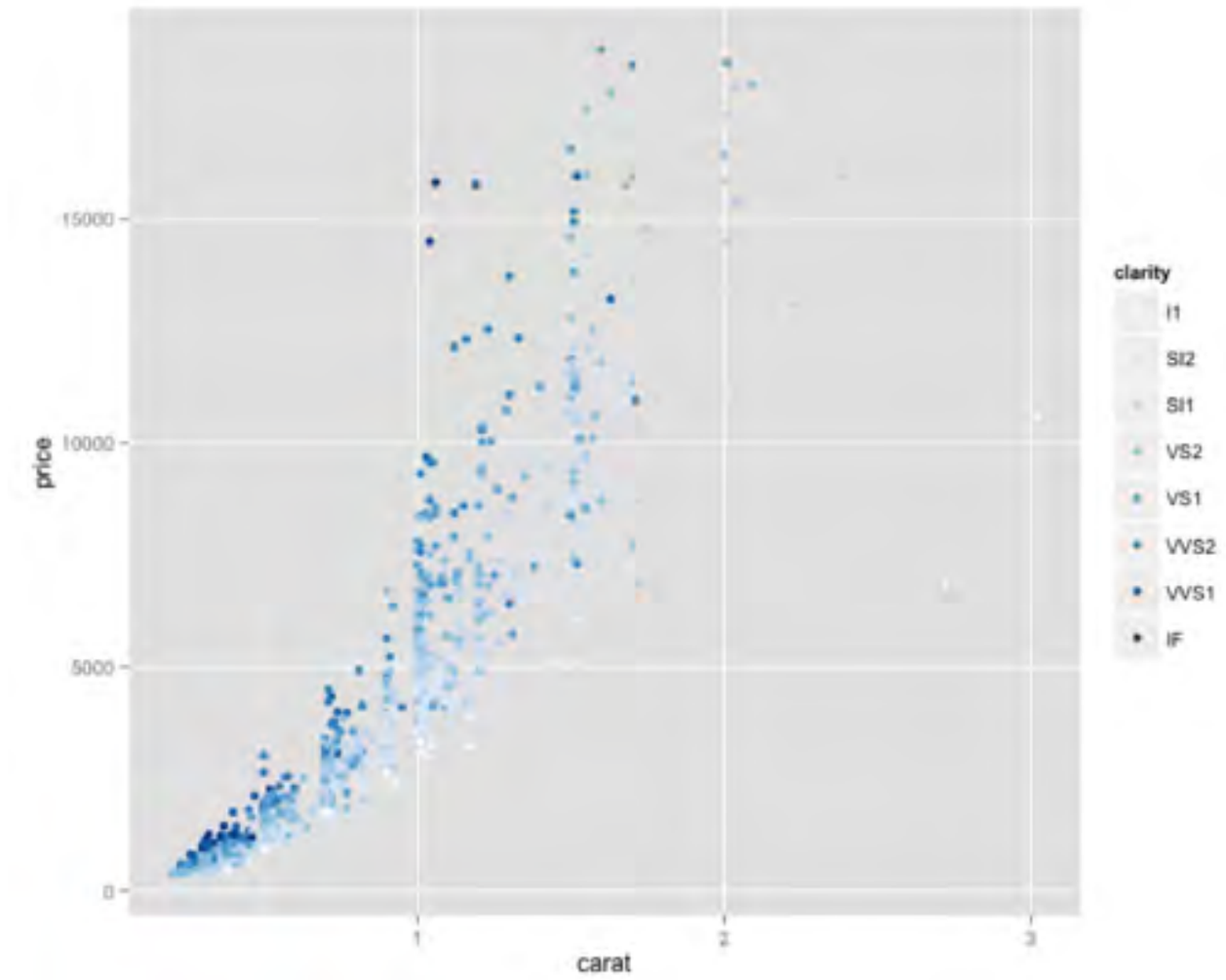



```
diamond + scale_color_brewer(type="seq", palette=3)
```

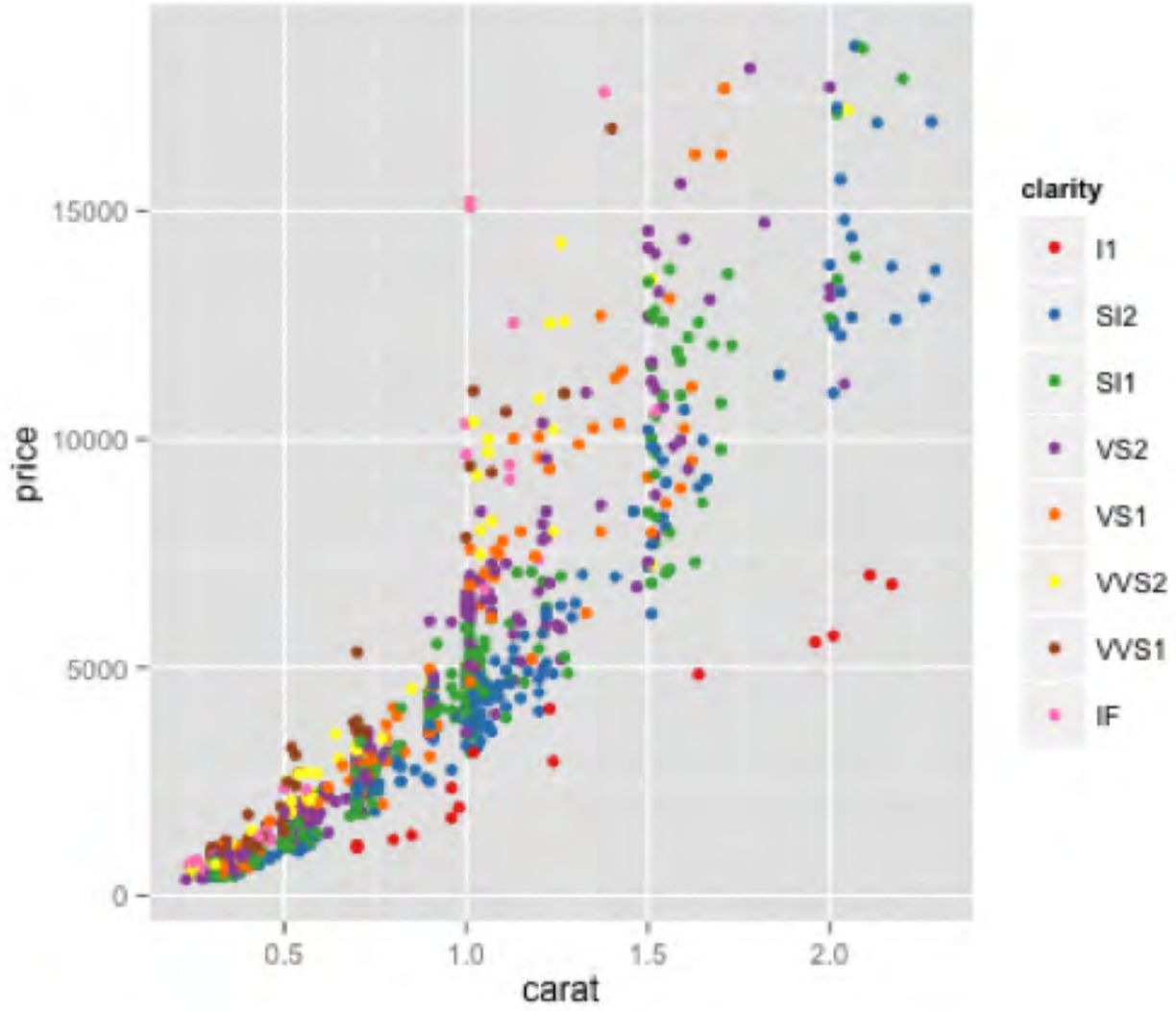


Scales:
Color

```
dSample <- diamonds[sample(nrow(diamonds), 1000), ]
diamond <- ggplot(dSample,aes(x = carat, y = price, color
= clarity)) + geom_point()
diamond
```

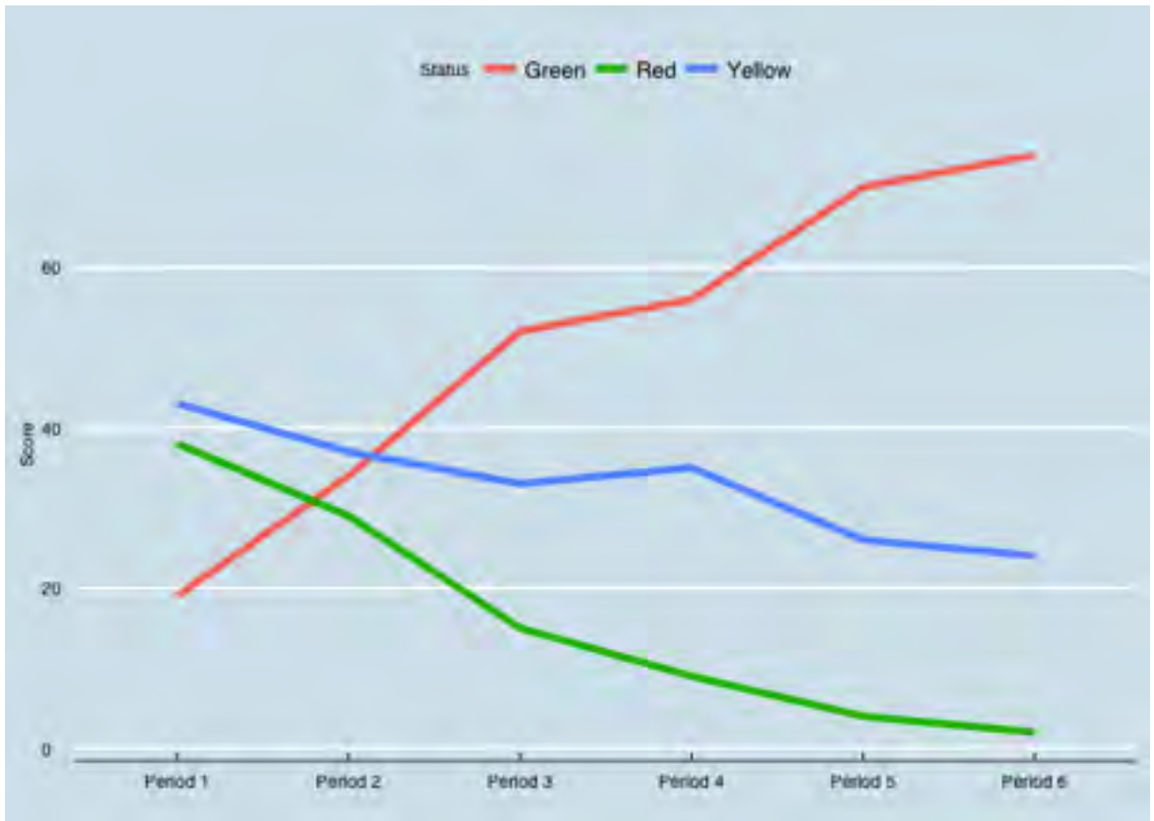


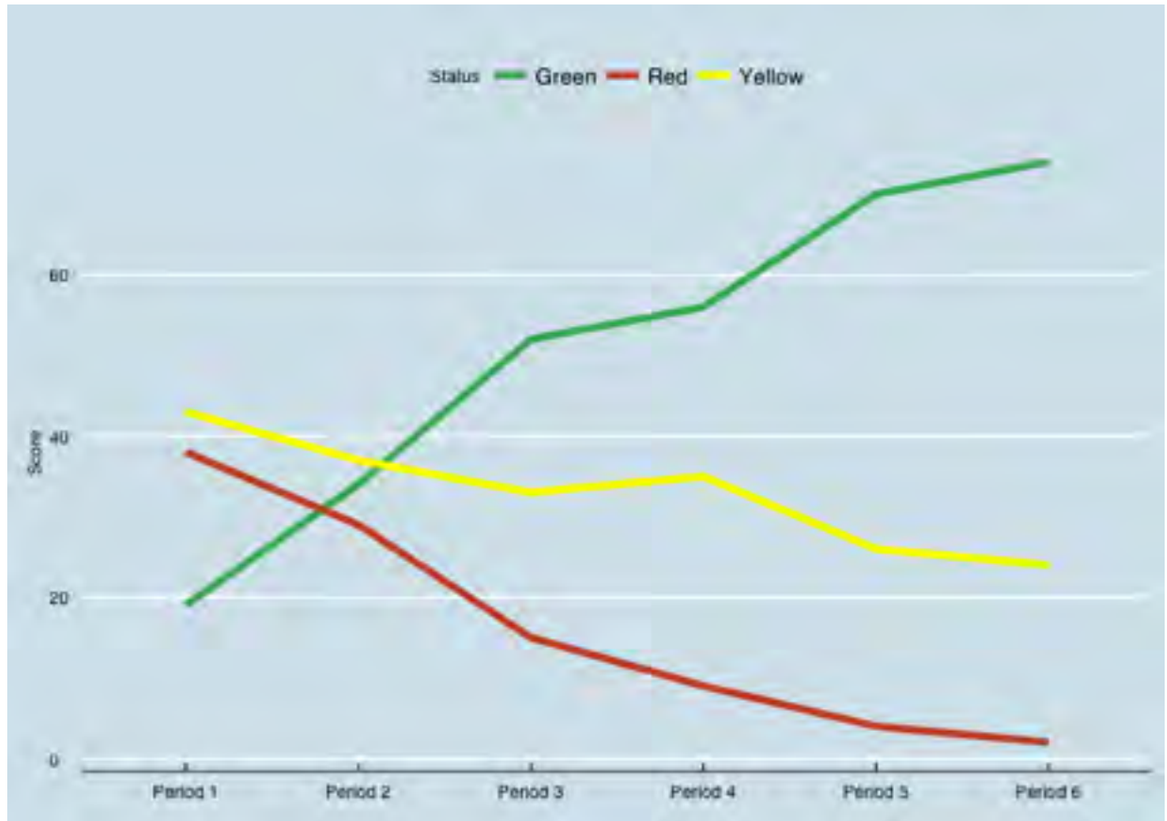

```
diamond + scale_color_brewer(palette="Set1")
```



Scales:
Color (Stroop test)

```
library(ggthemes)
customPalette <- c("mediumseagreen", "tomato3", "yellow1", "#009E73", "#F0E442", "#0072B2")

ggplot(data = df, aes(x = Period, y = Score, group = Status)) + geom_line(aes(color = Status),size = 2) +
theme_economist() + theme(axis.title.x=element_blank()) +  scale_colour_manual(values= customPalette)
```





i want hue

Colors for data scientists. Generate and refine palettes of optimally distinct colors.

Color space

Presets...

H 0 — 360

C 0 — 3

L 0 — 1.5

☐ Dark background

Palette

7 colors | soft (k-Means)

Reroll palette

Colors

#7EC1AA 126,193,170

#C14FAB 193,79,171

JSON

HEX json

```
["#7EC1AA",
"#C14FAB",
"#C25D3C",
"#99BF4E",
"#4F4038",
"#C89B9C",
"#737486"]
```

RGB json

```
[[126,193,170],
[193,79,171],
[194,93,60],
[153,191,78],
[79,64,56],
[200,155,156]
```

CSS

HEX list for CSS

```
#7EC1AA
#C14FAB
#C25D3C
#99BF4E
#4F4038
#C89B9C
#737486
```

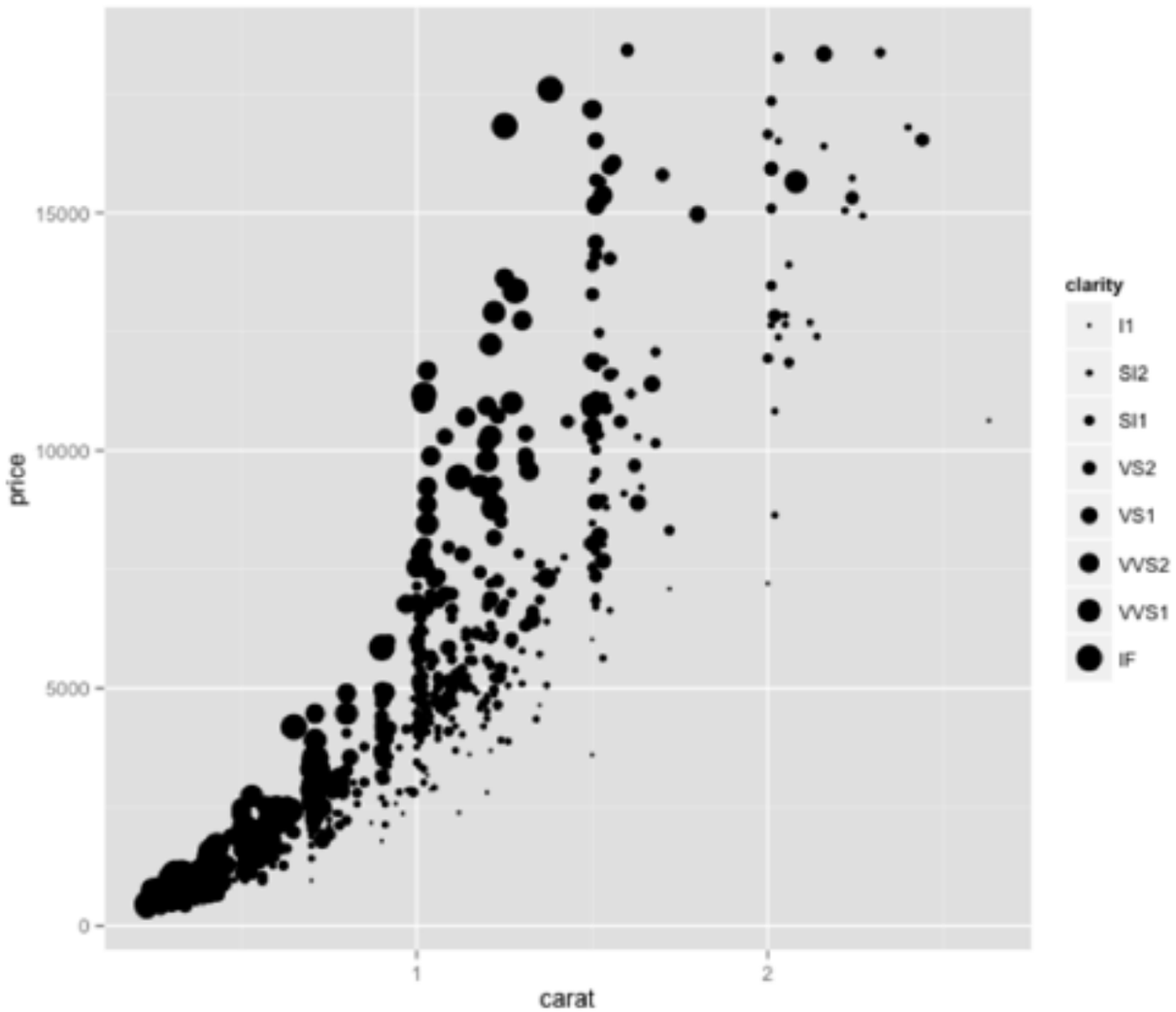
RGB list for CSS

```
rgb(126,193,170)
rgb(193,79,171)
rgb(194,93,60)
rgb(153,191,78)
rgb(79,64,56)
rgb(200,155,156)
```

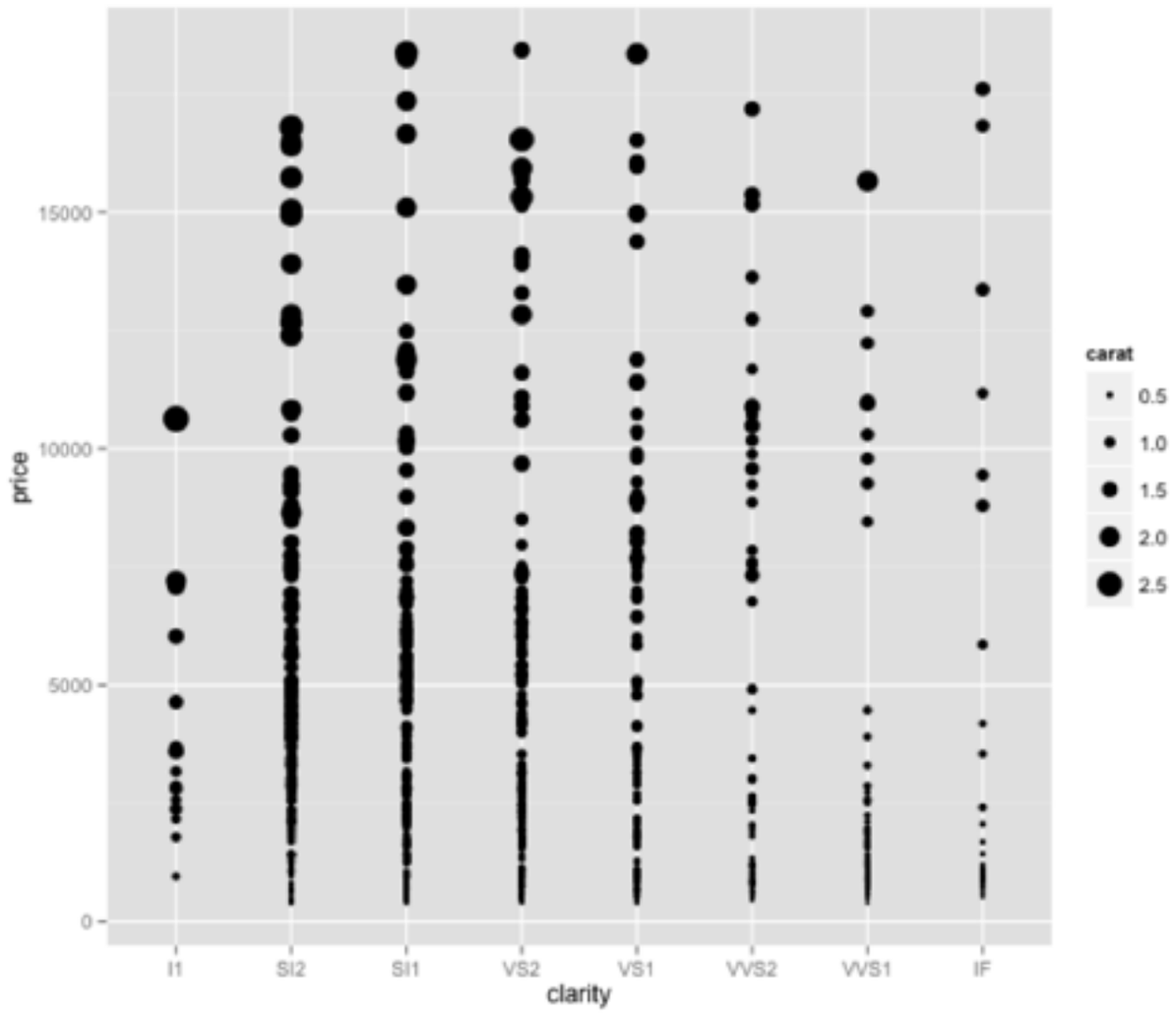
http://tools.medialab.sciences-po.fr/iwanthue/

Scales:
Shapes

```
cars <- ggplot(dSample, aes(x = carat, y = price))
cars + geom_point(aes(size = clarity))
```




```
cars <- ggplot(dSample, aes(x = clarity, y = price))
cars + geom_point(aes(size = carat))
```



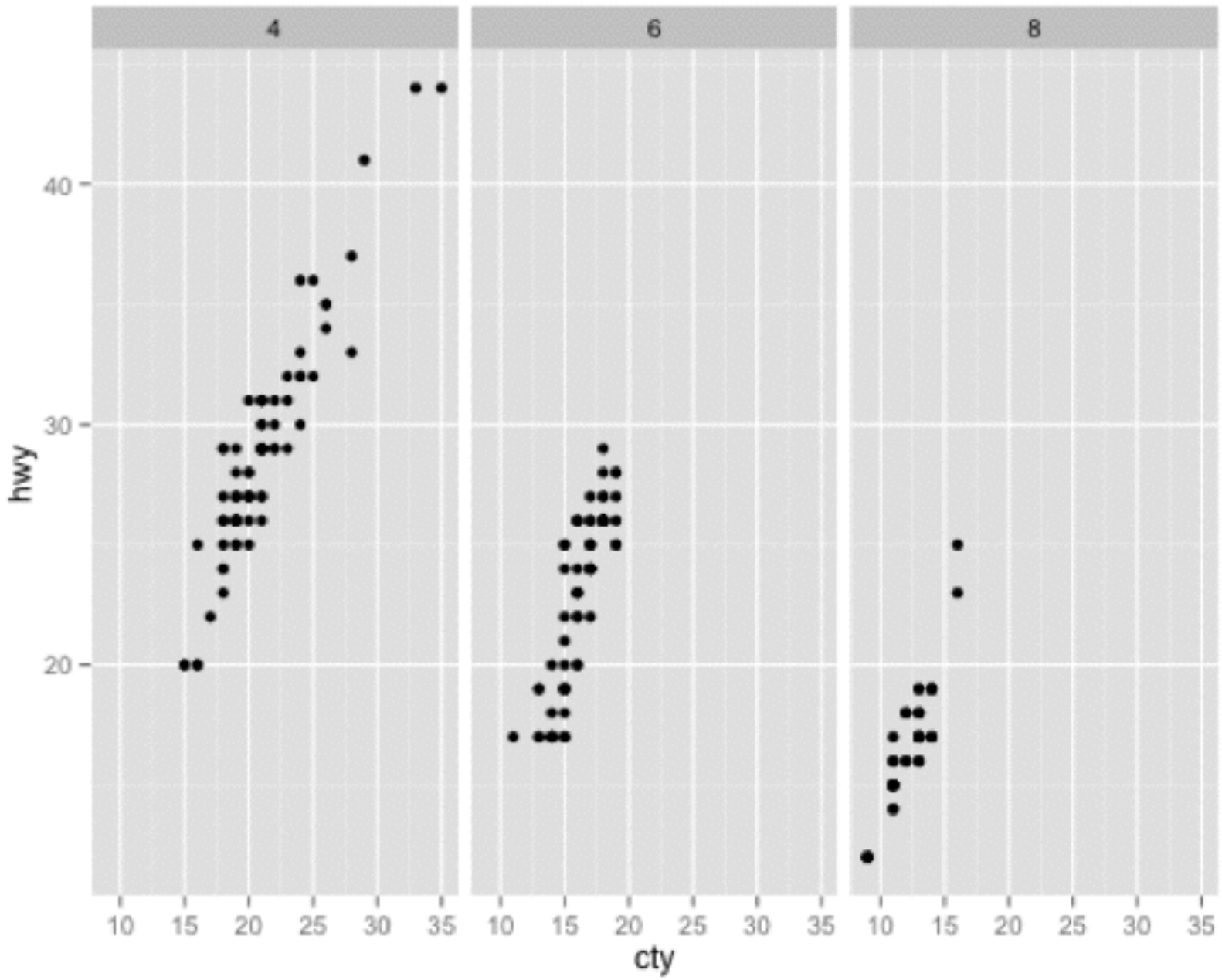
1. Aesthetics and geometric Objects
2. Statistical Transformations
3. Scales
4. Faceting
5. Themes
6. Project Example

mpg dataset

```
> head(mpg)
  manufacturer model displ year cyl      trans drv cty hwy fl   class
1         audi    a4   1.8 1999   4   auto(l5)   f  18  29  p compact
2         audi    a4   1.8 1999   4 manual(m5)   f  21  29  p compact
3         audi    a4   2.0 2008   4 manual(m6)   f  20  31  p compact
4         audi    a4   2.0 2008   4   auto(av)   f  21  30  p compact
5         audi    a4   2.8 1999   6   auto(l5)   f  16  26  p compact
6         audi    a4   2.8 1999   6 manual(m5)   f  18  26  p compact
> str(mpg)
'data.frame': 234 obs. of  11 variables:
 $ manufacturer: Factor w/ 15 levels "audi","chevrolet",..: 1 1 1 1 1 1 1 1 1 1 ...
 $ model       : Factor w/ 38 levels "4runner 4wd",..: 2 2 2 2 2 2 2 3 3 3 ...
 $ displ       : num  1.8 1.8 2 2 2.8 2.8 3.1 1.8 1.8 2 ...
 $ year        : int  1999 1999 2008 2008 1999 1999 2008 1999 1999 2008 ...
 $ cyl         : int  4 4 4 4 6 6 6 4 4 4 ...
 $ trans       : Factor w/ 10 levels "auto(av)","auto(l3)",..: 4 9 10 1 4 9 1 9 4 10 ...
 $ drv         : Factor w/ 3 levels "4","f","r": 2 2 2 2 2 2 2 1 1 1 ...
 $ cty         : int  18 21 20 21 16 18 18 18 16 20 ...
 $ hwy         : int  29 29 31 30 26 26 27 26 25 28 ...
 $ fl          : Factor w/ 5 levels "c","d","e","p",..: 4 4 4 4 4 4 4 4 4 4 ...
 $ class       : Factor w/ 7 levels "2seater","compact",..: 2 2 2 2 2 2 2 2 2 2 ...
```

Faceting:
facet_grid

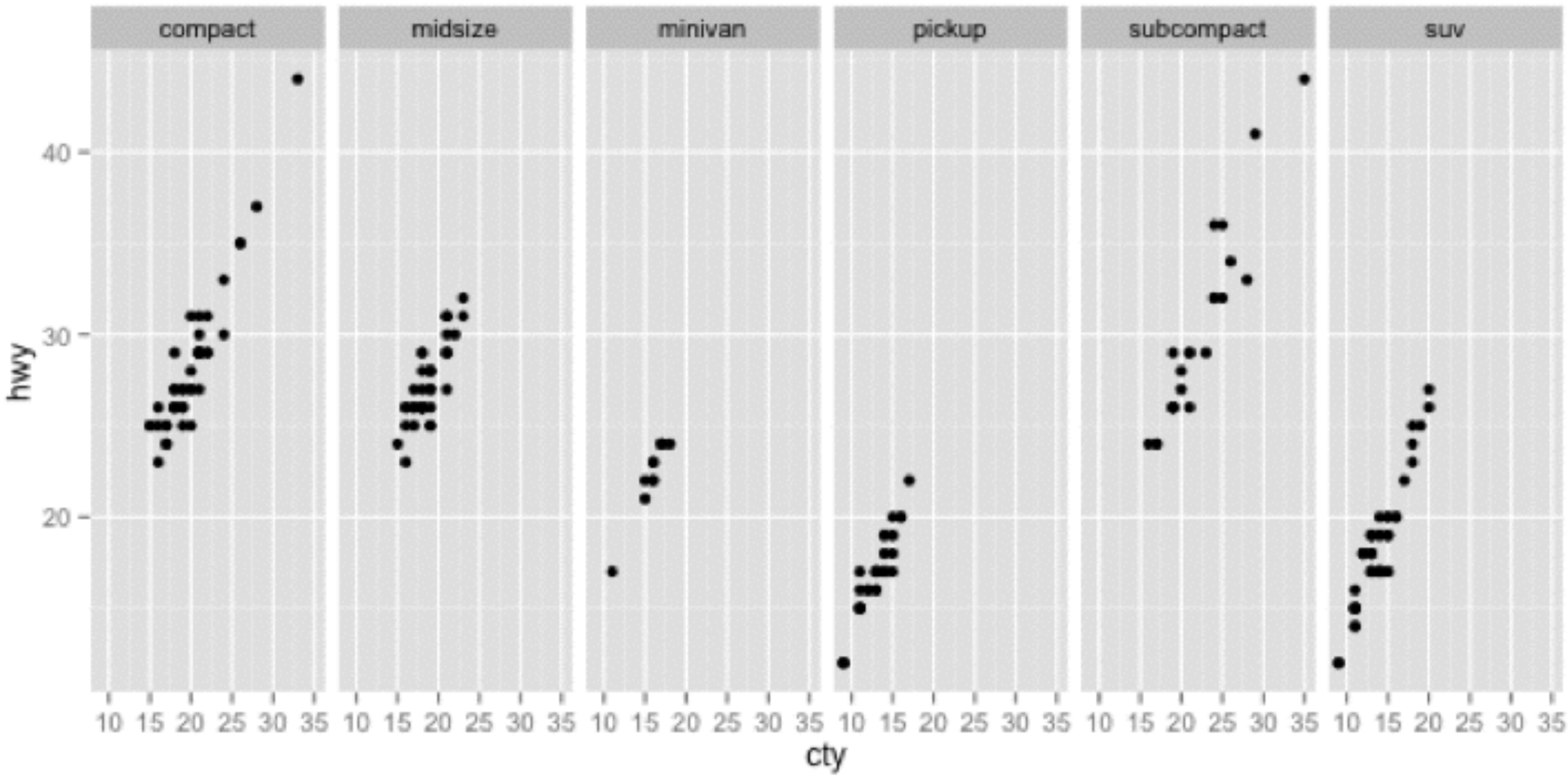
```
mpg2 <- subset(mpg, cyl != 5 & drv %in% c("4", "f"))

qplot(data = mpg2, cty, hwy) + facet_grid(. ~ cyl)
```



Faceting:
facet_grid

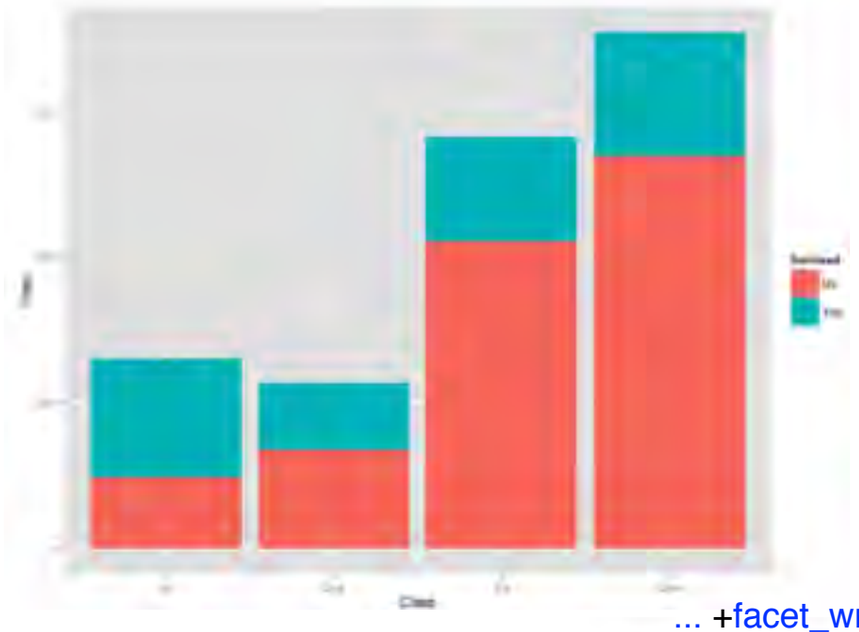
---

qplot(cty, hwy, data = mpg2) + facet_grid(. ~ class)

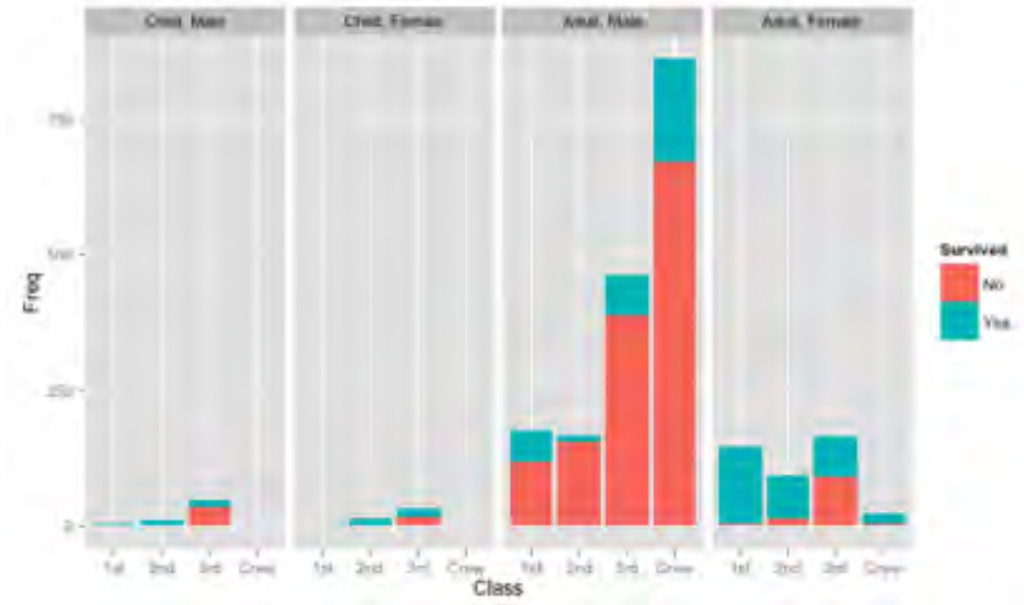


Faceting:
facet_wrap

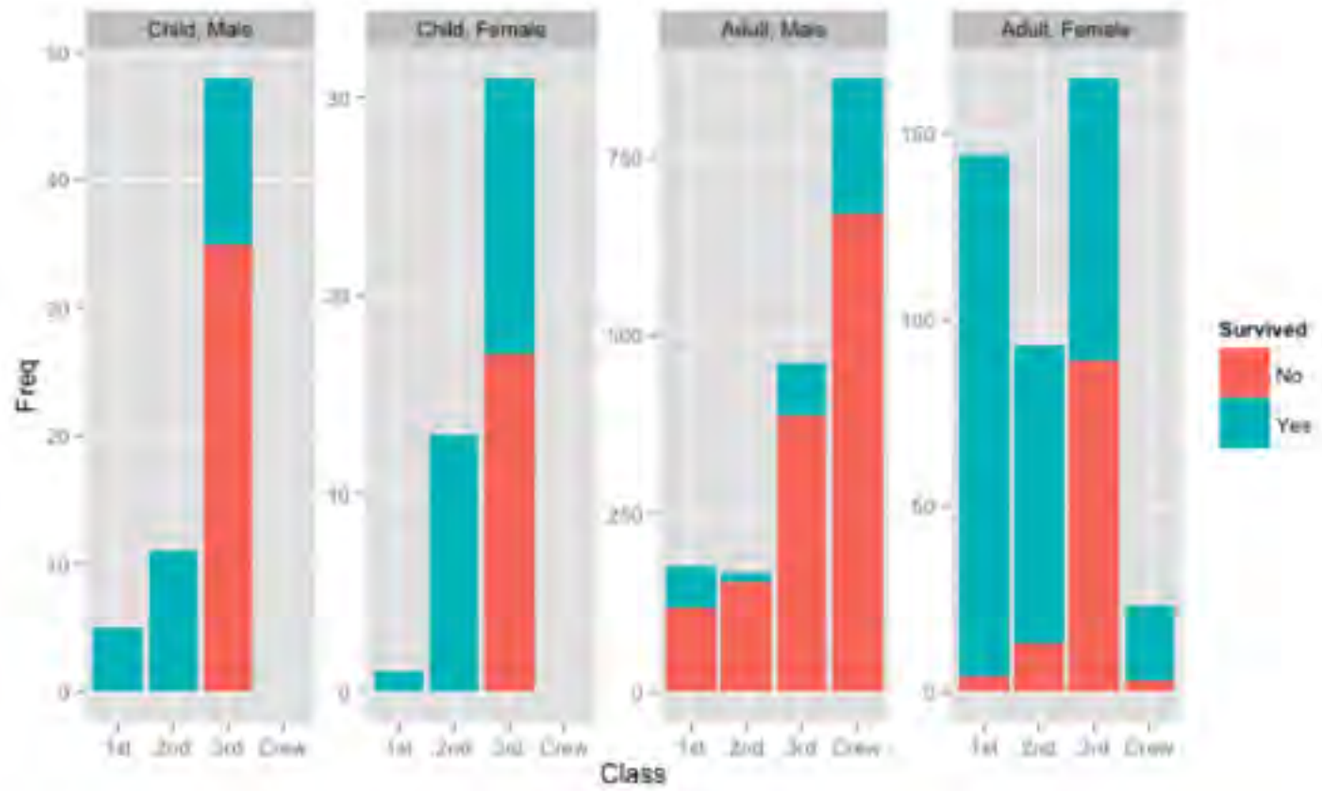
ggplot(as.data.frame(Titanic), aes(x = Class, y = Freq, fill = Survived)) +
geom_bar(stat = "identity")



ggplot(as.data.frame(Titanic), aes(x = Class, y = Freq, fill = Survived)) +
geom_bar(stat = "identity") + **facet_wrap(~Age + Sex, nrow = 1)**



... +facet_wrap(~Age + Sex, nrow = 1, **scales = "free"**)



1. Aesthetics and geometric Objects
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Themes:
Theme system

- The theme system handles non-data plot elements:
- Axis labels
- Facet label background
- Legend appearance
- Plot background

https://github.com/hadley/ggplot2/wiki/Themes

https://github.com/jrnold/ggthemes

Themes:
A lot of granularity

line all line elements (element_line)
rect all rectangluar elements (element_rect)
text all text elements (element_text)
title all title elements: plot, axes, legends (element_text; inherits from text)
axis.title

label of axes (element_text; inherits from text)
axis.title.x x axis label (element_text; inherits from axis.title)
axis.title.y y axis label (element_text; inherits from axis.title)
axis.text tick labels along axes (element_text; inherits from text)
axis.text.x x axis tick labels (element_text; inherits from axis.text)
axis.text.y y axis tick labels (element_text; inherits from axis.text)
axis.ticks tick marks along axes (element_line; inherits from line)
axis.ticks.x x axis tick marks (element_line; inherits from axis.ticks)
axis.ticks.y y axis tick marks (element_line; inherits from axis.ticks)
axis.ticks.length length of tick marks (unit)
axis.ticks.margin space between tick mark and tick label (unit)
axis.line lines along axes (element_line; inherits from line)
axis.line.x line along x axis (element_line; inherits from axis.line)
axis.line.y line along y axis (element_line; inherits from axis.line)

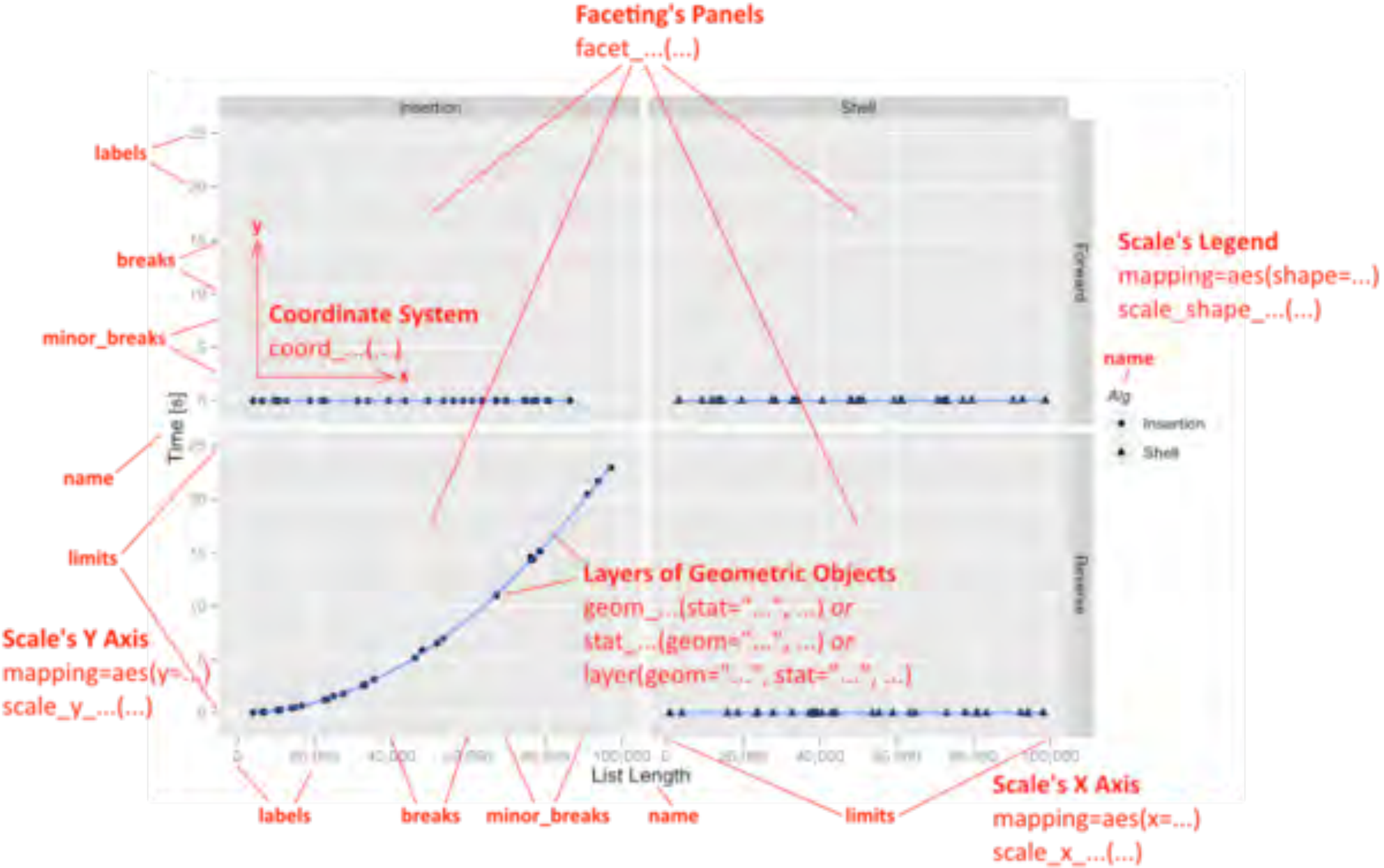
legend.background

background of legend (element_rect; inherits from rect)
legend.margin extra space added around legend (unit)
legend.key background underneath legend keys (element_rect; inherits from rect)
legend.key.size size of legend keys (unit; inherits from legend.key.size)
legend.key.height key background height (unit; inherits from legend.key.size)
legend.key.width key background width (unit; inherits from legend.key.size)
legend.text legend item labels (element_text; inherits from text)
legend.text.align alignment of legend labels (number from 0 (left) to 1 (right))
legend.title title of legend (element_text; inherits from title)
legend.title.align alignment of legend title (number from 0 (left) to 1 (right))

legend.position the position of legends. ("left", "right", "bottom", "top", or two-element numeric vector)
legend.direction layout of items in legends ("horizontal" or "vertical")
legend.justification anchor point for positioning legend inside plot ("center" or two-element numeric vector)
legend.box arrangement of multiple legends ("horizontal" or "vertical")
panel.background
background of plotting area (element_rect; inherits from rect)
panel.border border around plotting area (element_rect; inherits from rect)
panel.margin margin around facet panels (unit)
panel.grid grid lines (element_line; inherits from line)
panel.grid.major major grid lines (element_line; inherits from panel.grid)
panel.grid.minor minor grid lines (element_line; inherits from panel.grid)
panel.grid.major.x vertical major grid lines (element_line; inherits from panel.grid.major)
panel.grid.major.y horizontal major grid lines (element_line; inherits from panel.grid.major)
panel.grid.minor.x vertical minor grid lines (element_line; inherits from panel.grid.minor)
panel.grid.minor.y horizontal minor grid lines (element_line; inherits from panel.grid.minor)
plot.background

background of the entire plot (element_rect; inherits from rect)
plot.title plot title (text appearance) (element_text; inherits from title)
plot.margin margin around entire plot (unit)
strip.background

background of facet labels (element_rect; inherits from rect)
strip.text facet labels (element_text; inherits from text)
strip.text.x facet labels along horizontal direction (element_text; inherits from strip.text)
strip.text.y facet labels along vertical direction (element_text; inherits from strip.text)



http://sape.inf.usi.ch/quick-reference/

ggplot2 resources

Hadley's ggplot2 book
http://amzn.com/0387981403

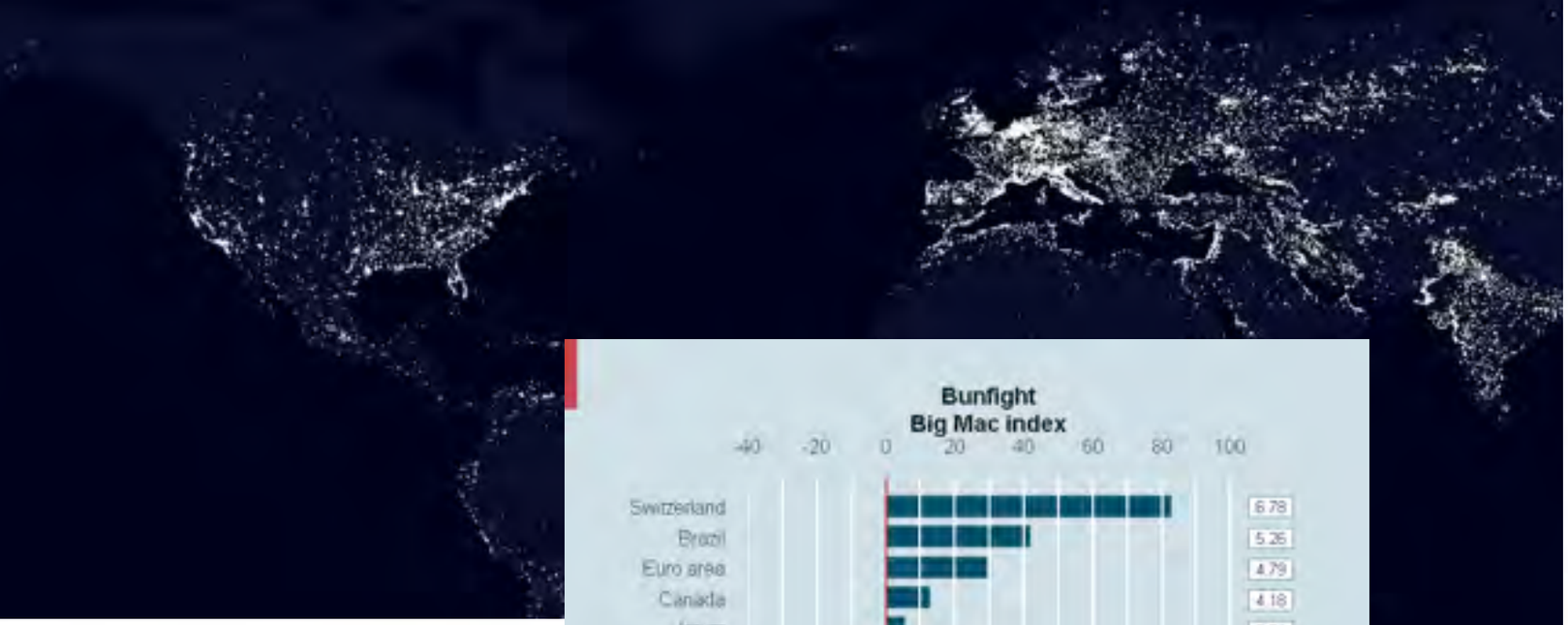
ggplot2 google group
http://groups.google.com/group/ggplot2

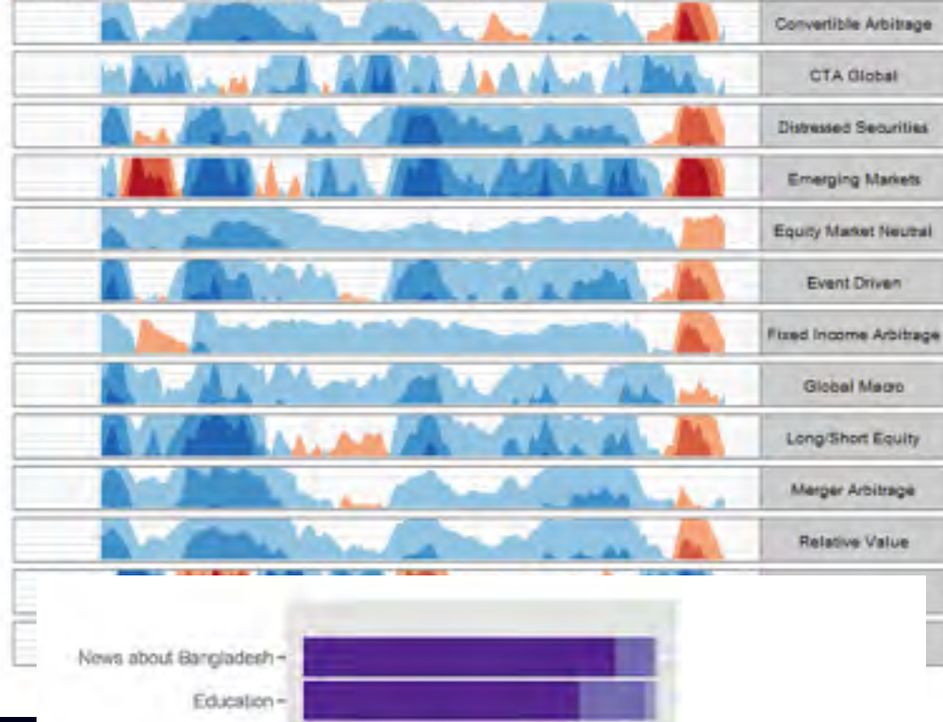
stackoverflow
http://stackoverflow.com/tags/ggplot2

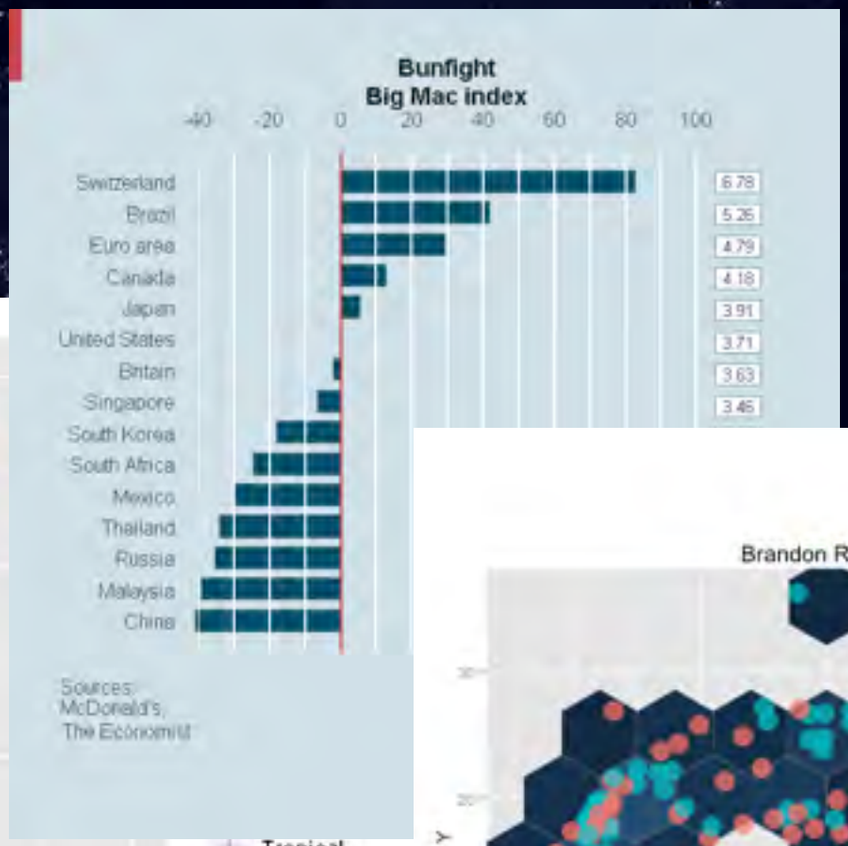
Lattice to ggplot2 conversion
http://learnr.wordpress.com/?s=lattice

Winston Chang's Cookbook for common graphics
http://wiki.stdout.org/rcookbook/Graphs/

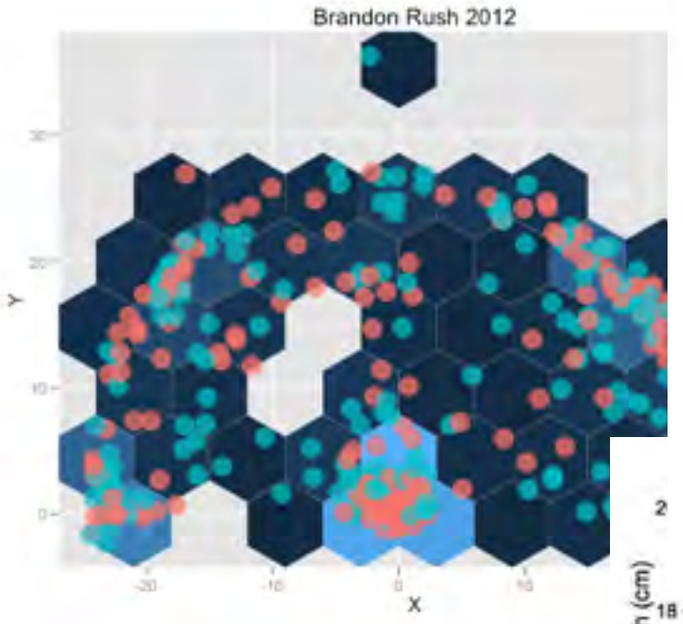
Winston Chang's R Graphics Cookbook
http://www.amazon.com/R-Graphics-Cookbook-Winston-Chang/dp/1449316956

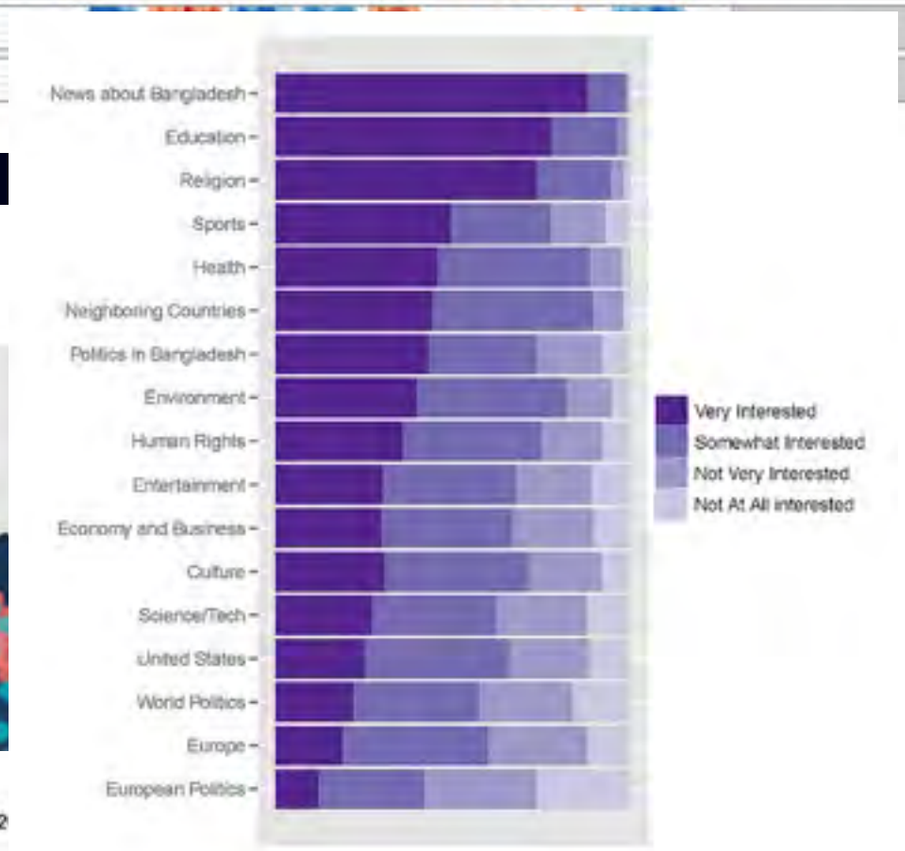



Convertible Arbitrage
CTA Global
Distressed Securities
Emerging Markets
Equity Market Neutral
Event Driven
Fixed Income Arbitrage
Global Macro
Long/Short Equity
Merger Arbitrage
Relative Value

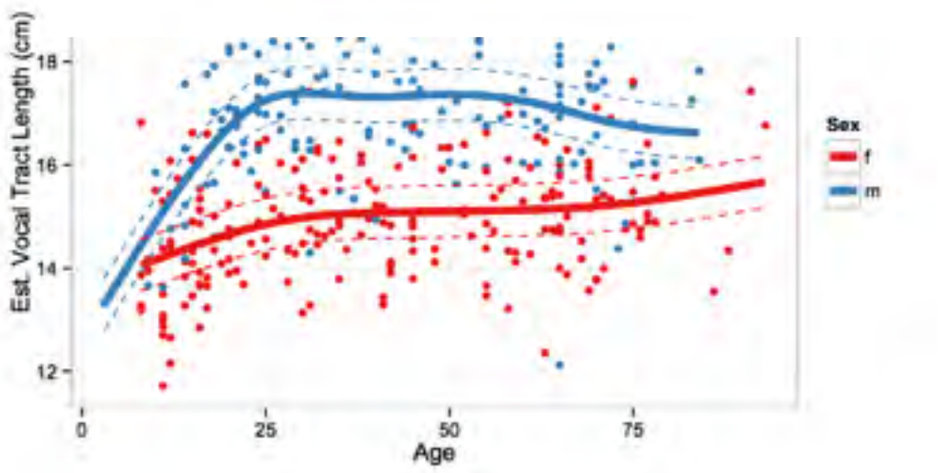

Bunfight
Big Mac index
-40
-20
0
20
40
60
80
100
Switzerland
Brazil
Euro area
Canada
Japan
United States
Britain
Singapore
South Korea
South Africa
Mexico
Thailand
Russia
Malaysia
China
6.78
5.26
4.79
4.18
3.91
3.71
3.63
3.45
Sources:
McDonald's;
The Economist


25
50
75
100
Field
Tropical


Brandon Rush 2012
Y
X


News about Bangladesh
Education
Religion
Sports
Health
Neighboring Countries
Politics in Bangladesh
Environment
Human Rights
Entertainment
Economy and Business
Culture
Science/Tech
United States
World Politics
Europe
European Politics
Very Interested
Somewhat Interested
Not Very Interested
Not At All Interested

0
Latitude
MAP (mm/yr)
2500
2000
1500
1000


Est. Vocal Tract Length (cm)
18
16
14
12
0
25
50
75
Age
Sex
f
m