DATA
SCIENCE
INDONESIA

Data Visualization

Universitas Airlangga, 28 Agustus 2018

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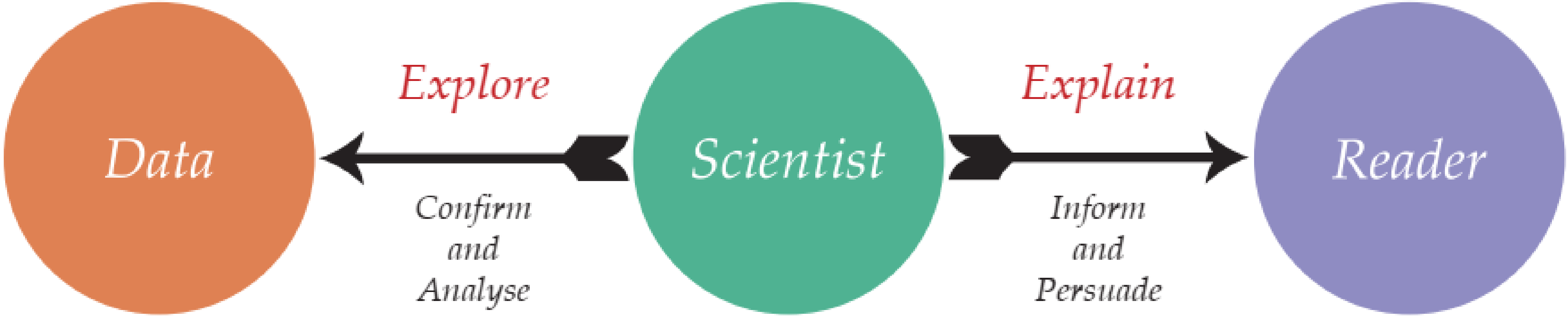
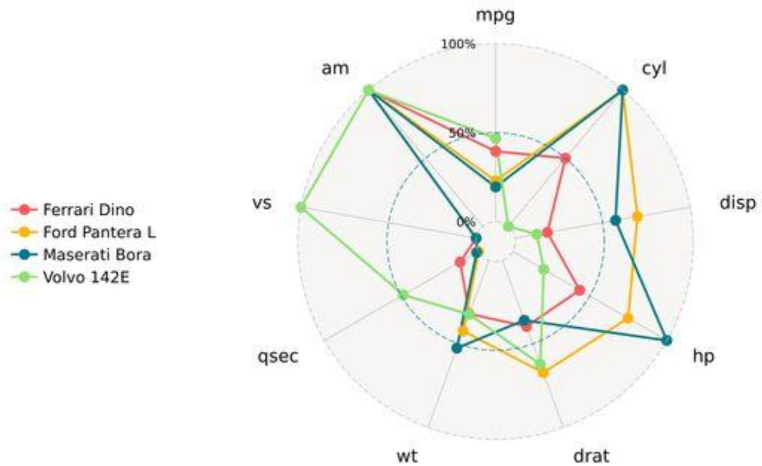

Data
Explore
Confirm and Analyse
Scientist
Explain
Inform and Persuade
Reader

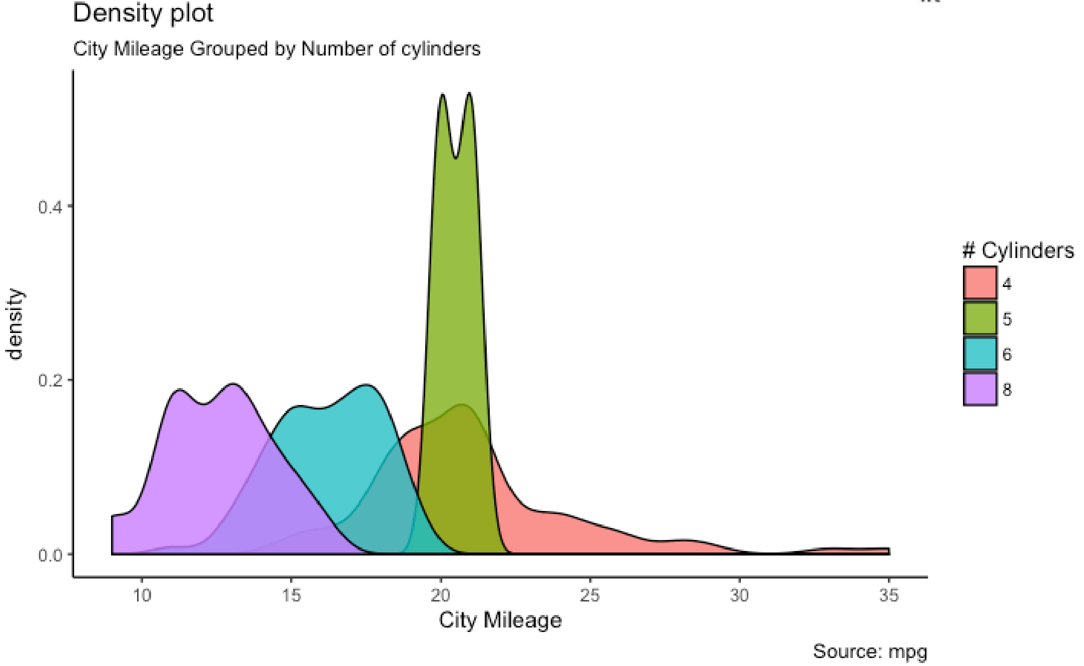
Outline

DATA SCIENCE INDONESIA

- Base Graphics vs ggplot2
- The Grammar Of Graphics
- Geometric Objects And Aesthetics
- Points
- Statistical Transformation
- Scales

Example

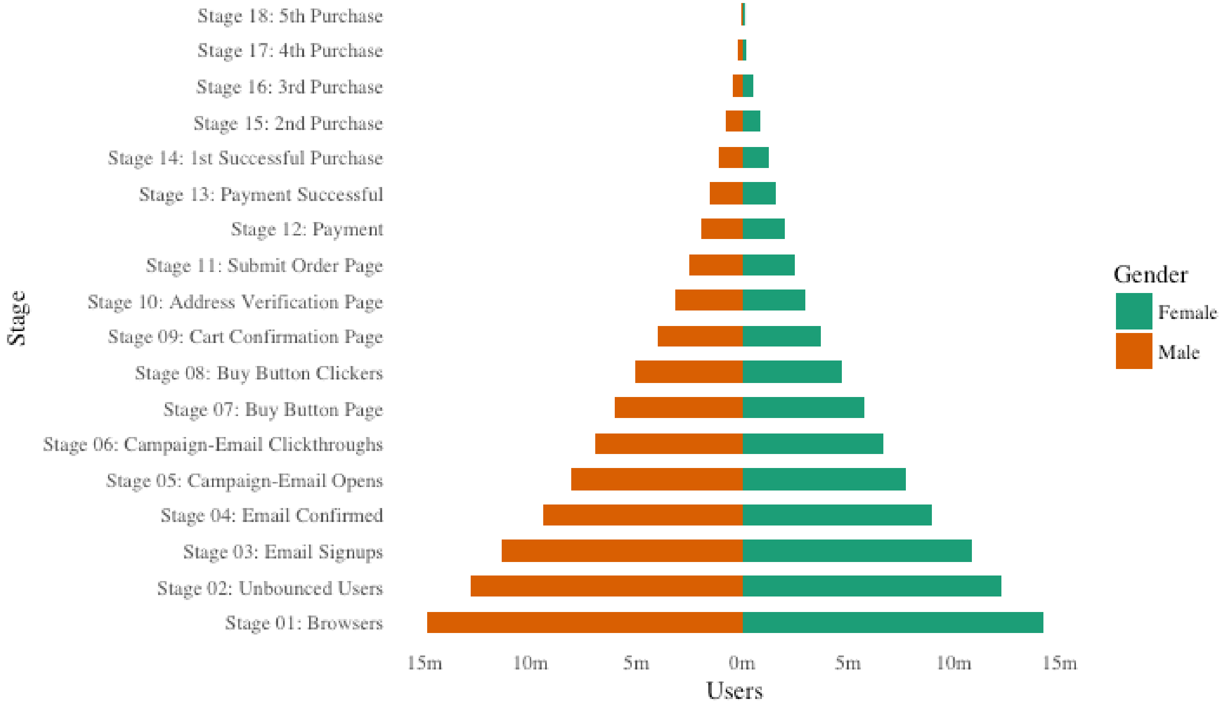



Density plot

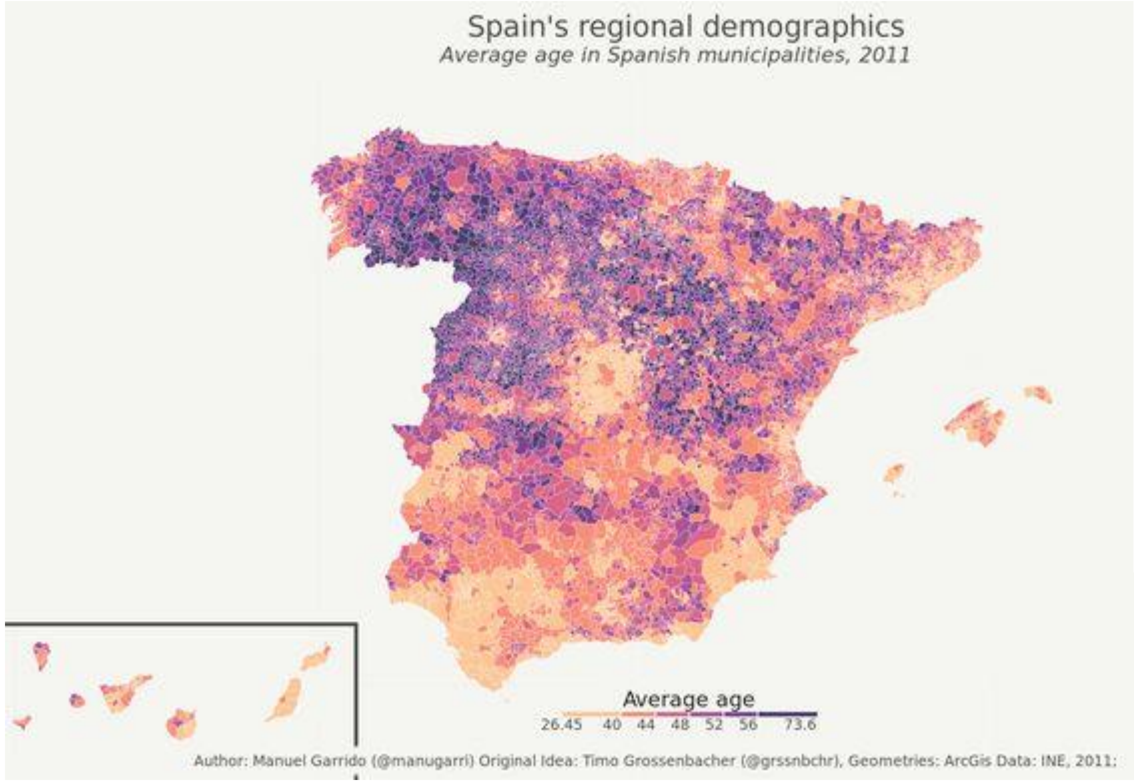
City Mileage Grouped by Number of cylinders

Source: mpg

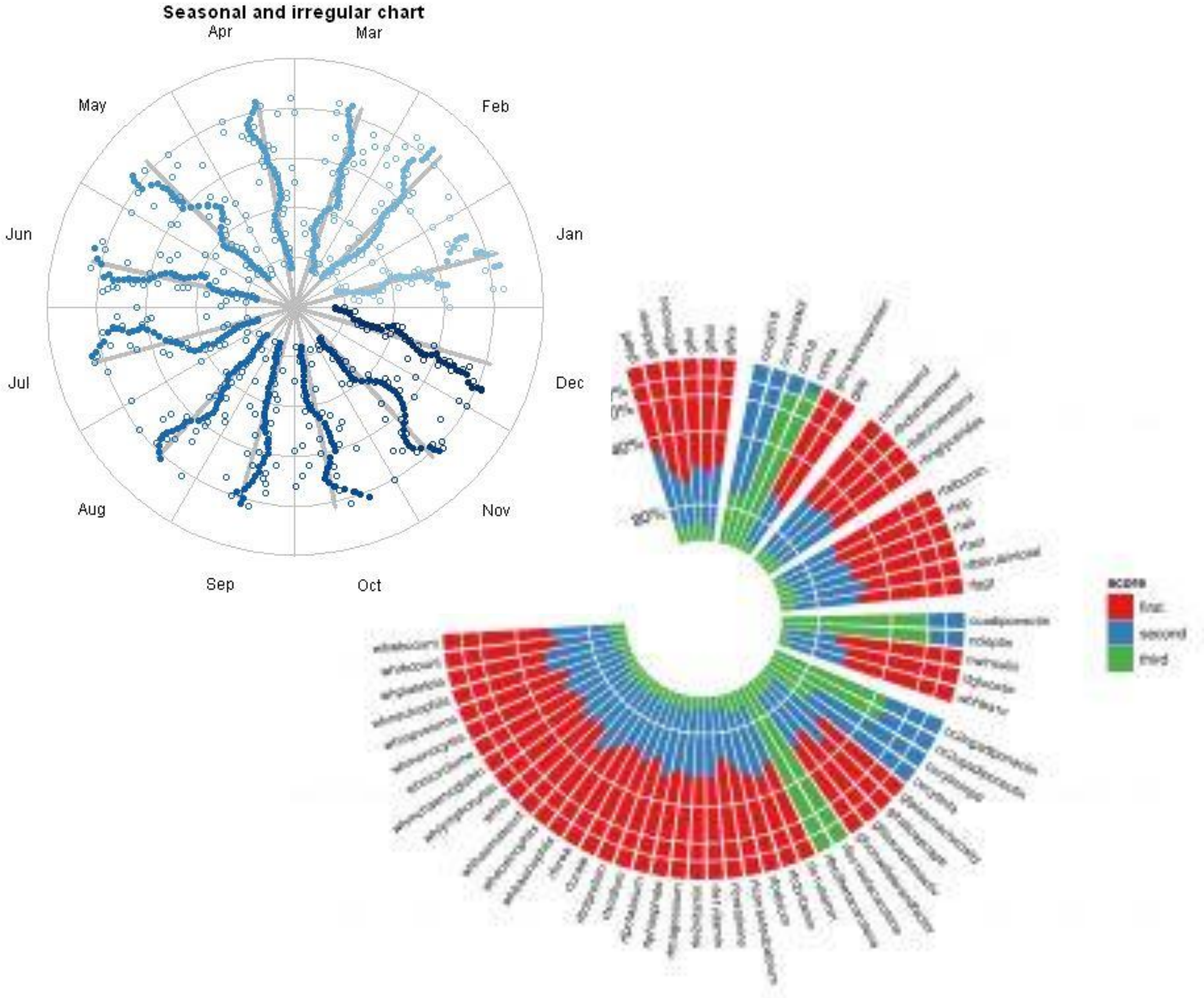
Email Campaign Funnel



Example


Spain's regional demographics
Average age in Spanish municipalities, 2011
Average age
26.45
40
44
48
52
56
73.6

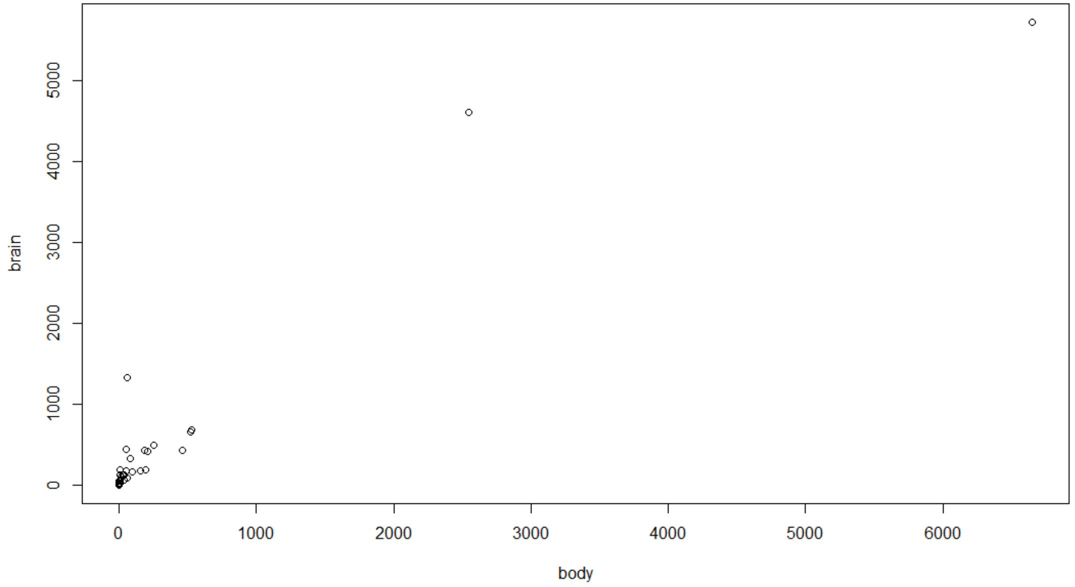
Author: Manuel Garrido (@manugarri) Original Idea: Timo Grossenbacher (@grssnbchr), Geometries: ArcGis Data: INE, 2011;

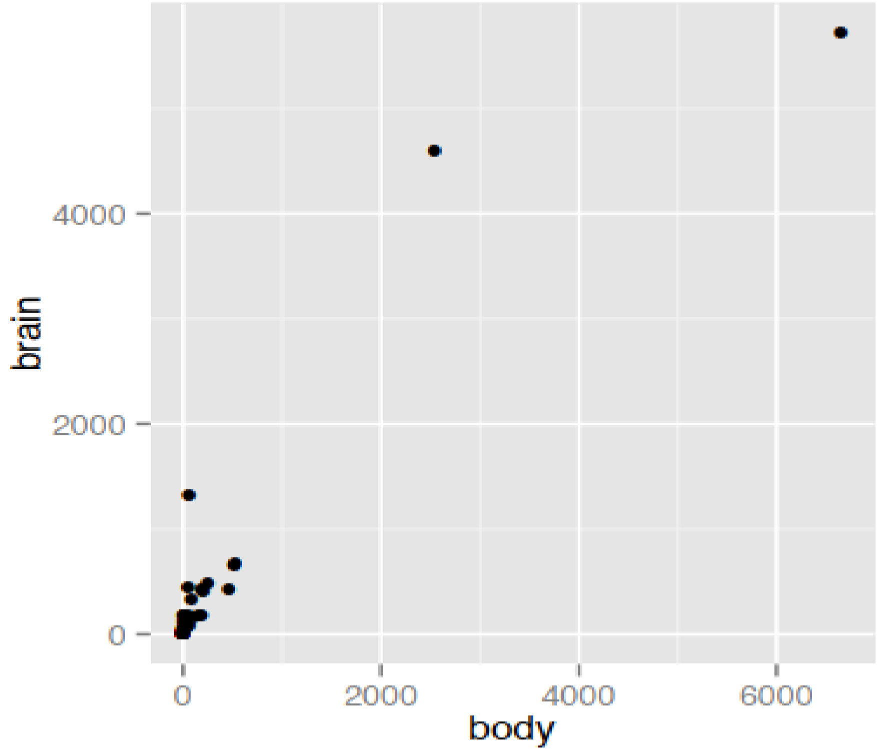


Base Graphics vs ggplot2

```
> plot(mammals)
```

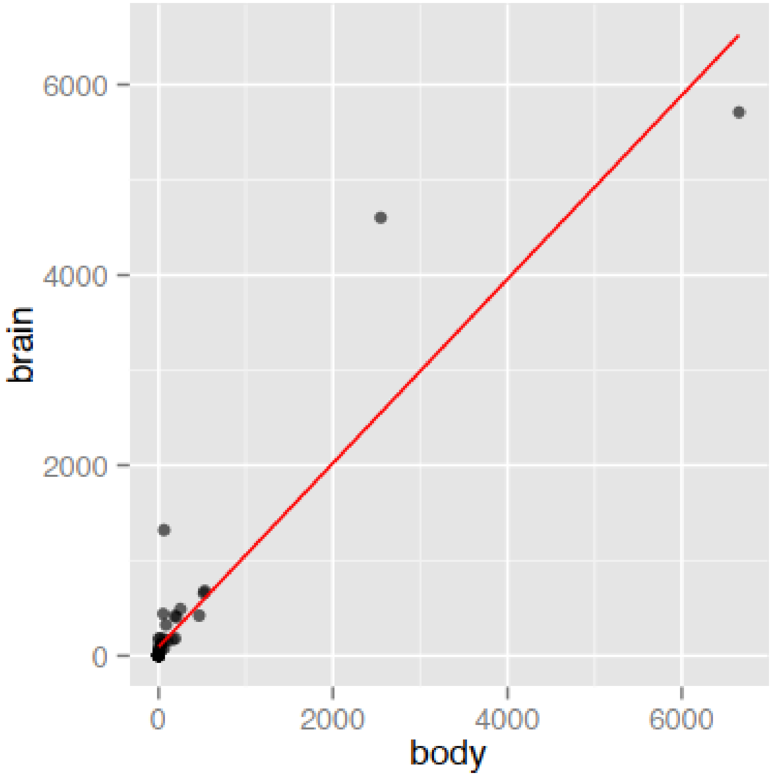
```
> ggplot(mammals, aes(x =
  body, y = brain)) +
  geom point()
```





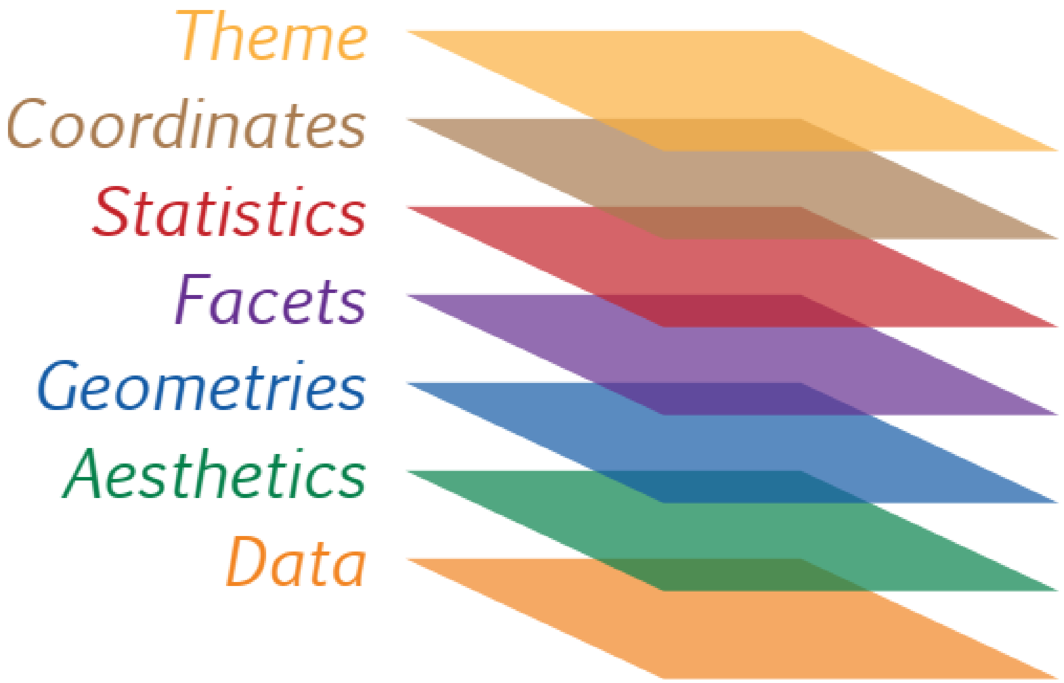
Base Graphics vs ggplot2

```
> ggplot(mammals, aes(x = body, y = brain)) +
      geom_point(alpha = 0.6) +
      stat_smooth(method = "lm", col = "red", se = FALSE)
```



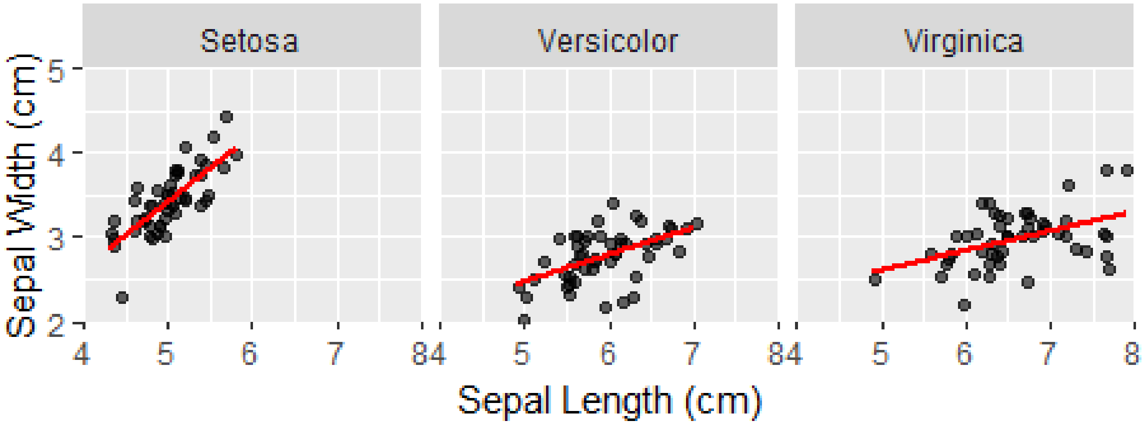
The Grammar Of Graphics

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



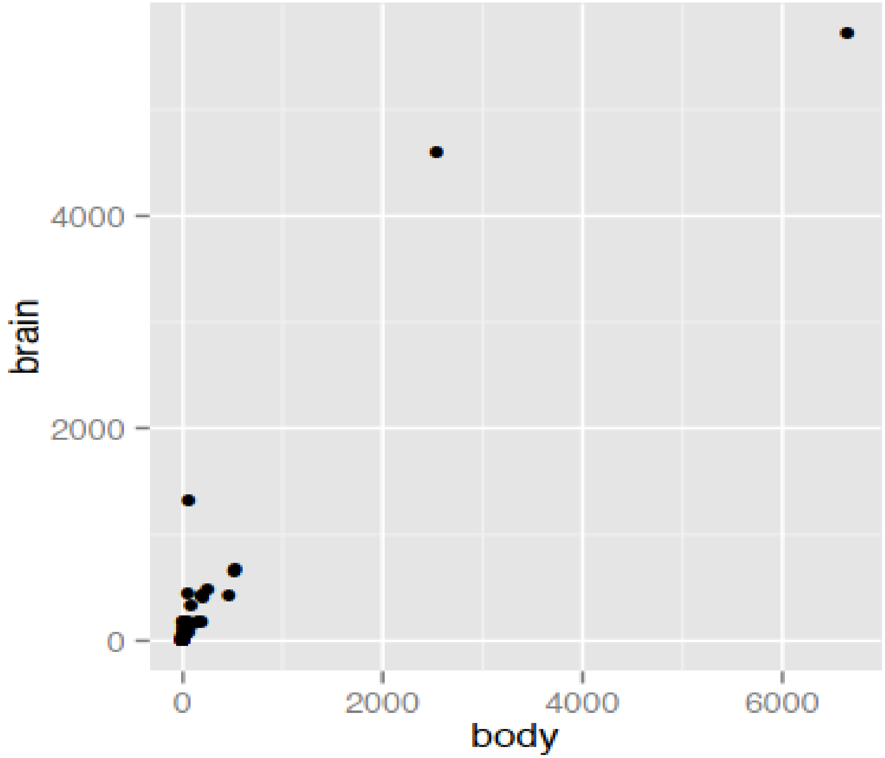
The Grammar Of Graphics

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +
     geom_jitter(alpha = 0.6) +
     facet_grid(. ~ Species) +
     stat_smooth(method = "lm", se = F, col = "red") +
     scale_y_continuous("Sepal Width (cm)",
             limits = c(2,5), expand = c(0,0)) +
     scale_x_continuous("Sepal Length (cm)",
             limits = c(4,8), expand = c(0,0)) +
     coord_equal()
```



Geometric Objects And Aesthetics

```
> ggplot(mammals, aes(x = body, y = brain)) +
  geom_point()
```



Geometric Objects And Aesthetics

Aesthetic Mapping (`aes`)

aesthetic properties to represent variables and "something you can see"

- position (i.e., on the x and y axes)
- color ("outside" color)
- fill ("inside" color)
- shape (of points)
- alpha (transparency)
- linetype
- labels (text on a plot or axes)
- size

Geometic Objects (`geom`)

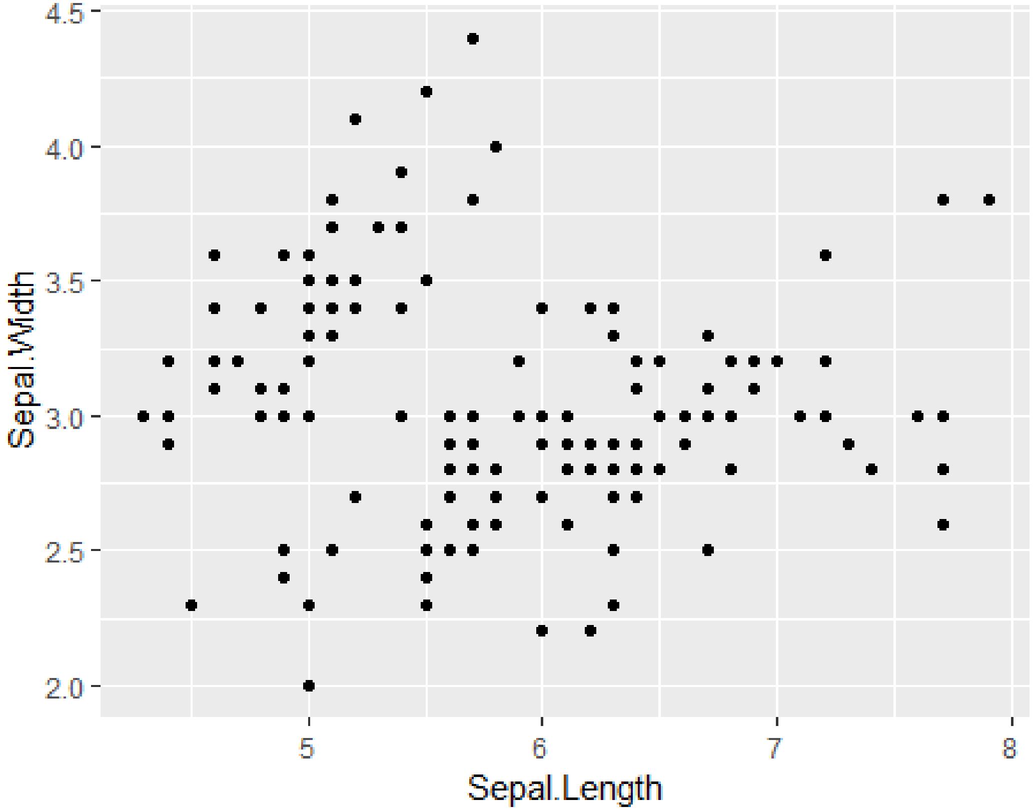
Use a geom function to represent data points.

A plot must have at least one **geom**; there is no upper limit. You can add a geom to a plot using the + operator

- points (`geom_point`, for scatter plots, dot plots, etc)
- lines (`geom_line`, for time series, trend lines, etc)
- boxplot (`geom_boxplot`)
- …

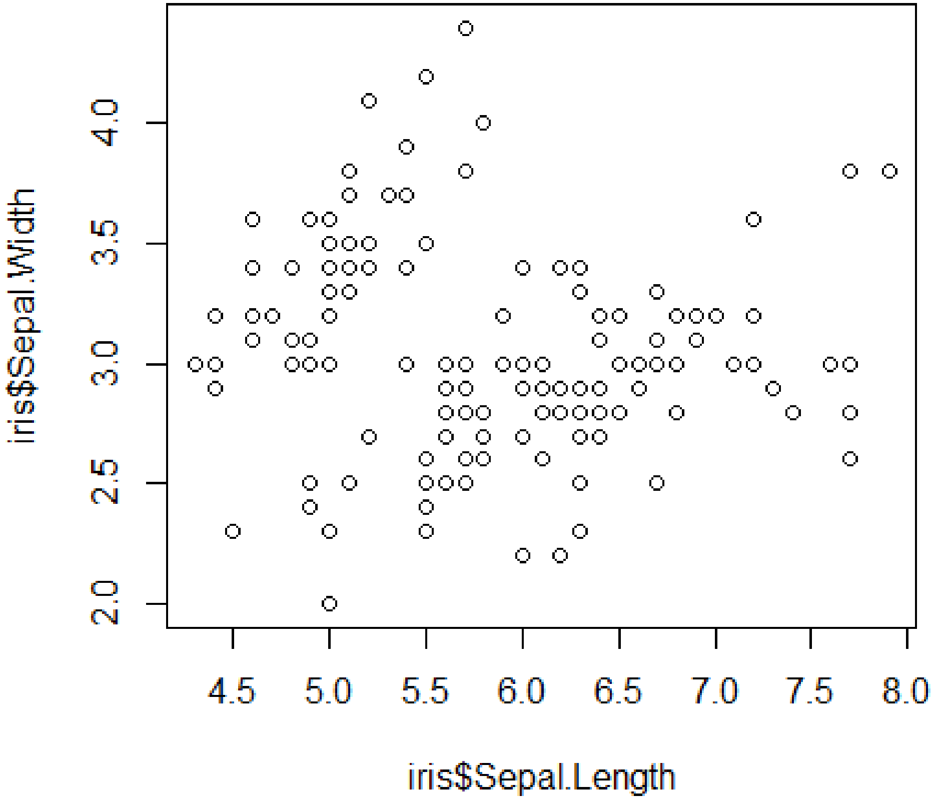
Points (geom_point)

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +
      geom_point()
```



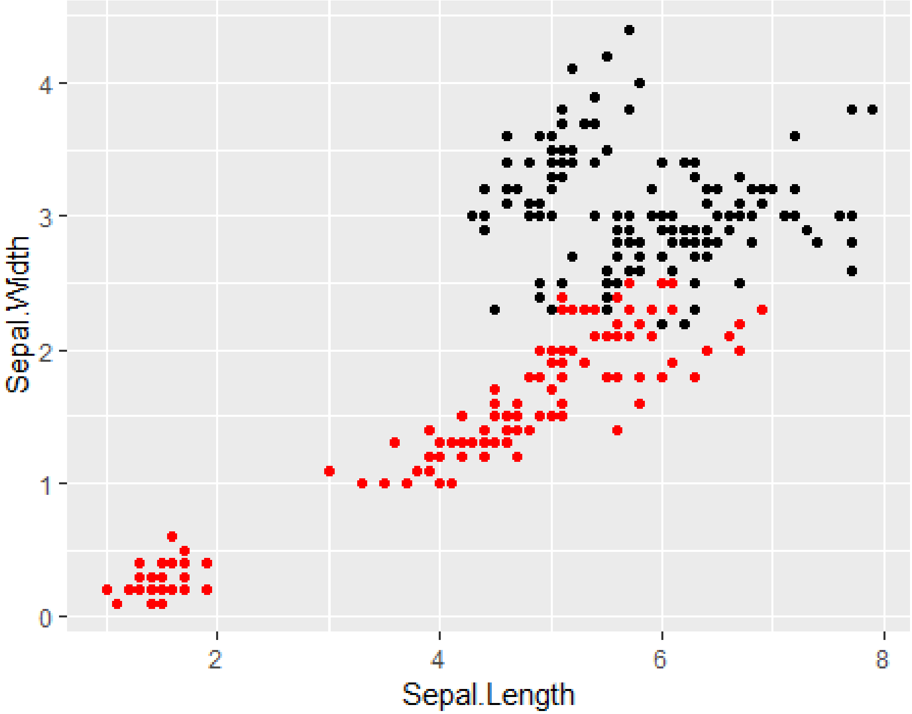
Points (geom_point)

```
> plot(iris$Sepal.Length, iris$Sepal.Width)
```



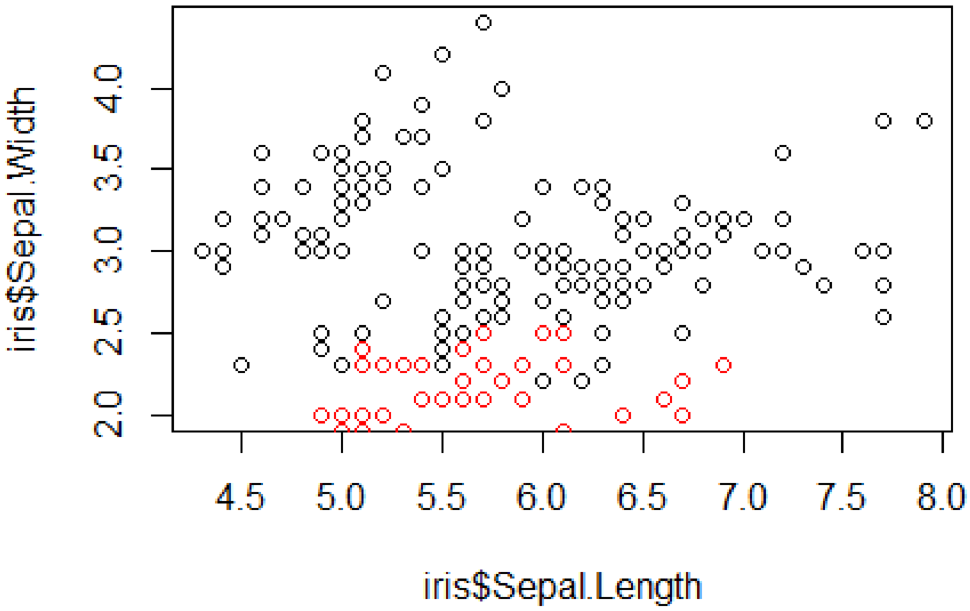
Points (geom_point)

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +
      geom_point() +
      geom_point(aes(x = Petal.Length, y = Petal.Width), col =
            "red")
```



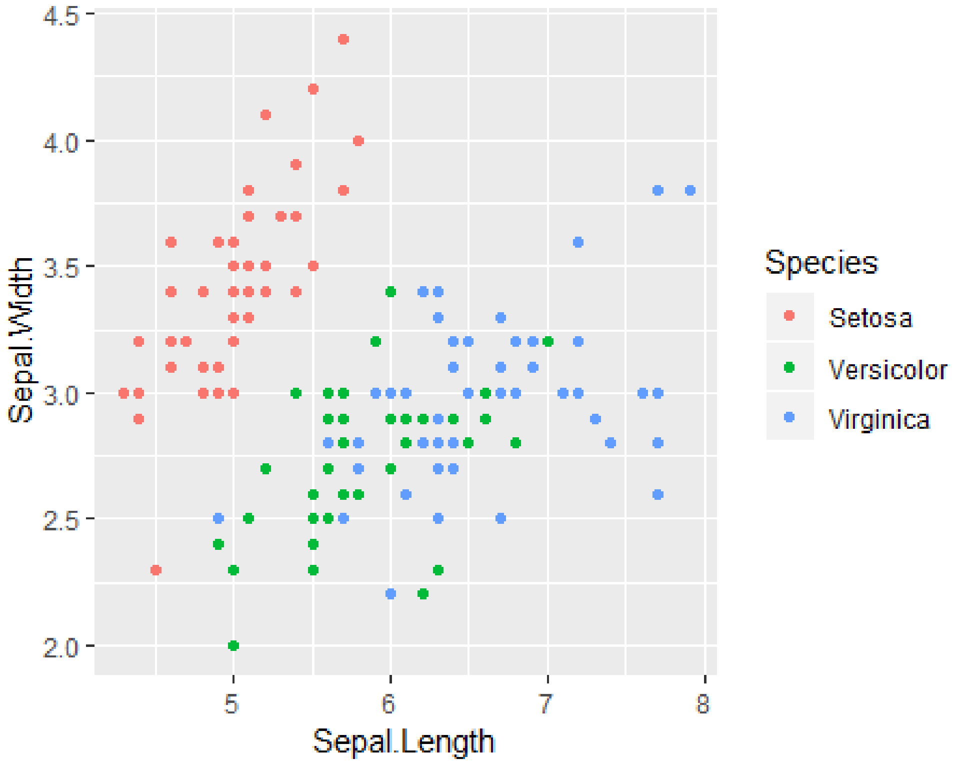
Points (geom_point)

```
> plot(iris$Sepal.Length, iris$Sepal.Width)
> points(iris$Petal.Length, iris$Petal.Width, col = "red")
```



Points (`geom_point`)

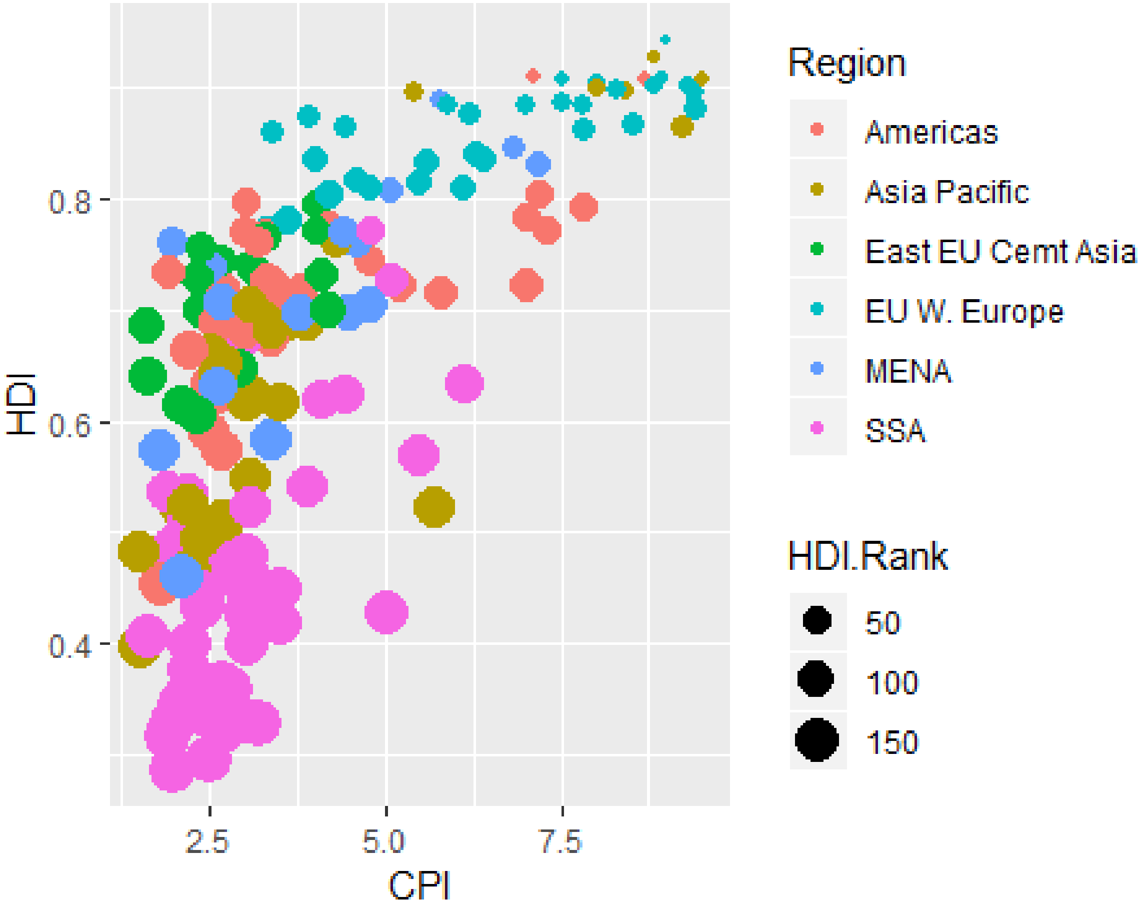
```
> ggplot(iris) +
   geom_point(aes(x = Sepal.Length, y = Sepal.Width,col = Species))
```



Exercise 1

Data = EconomistData.csv

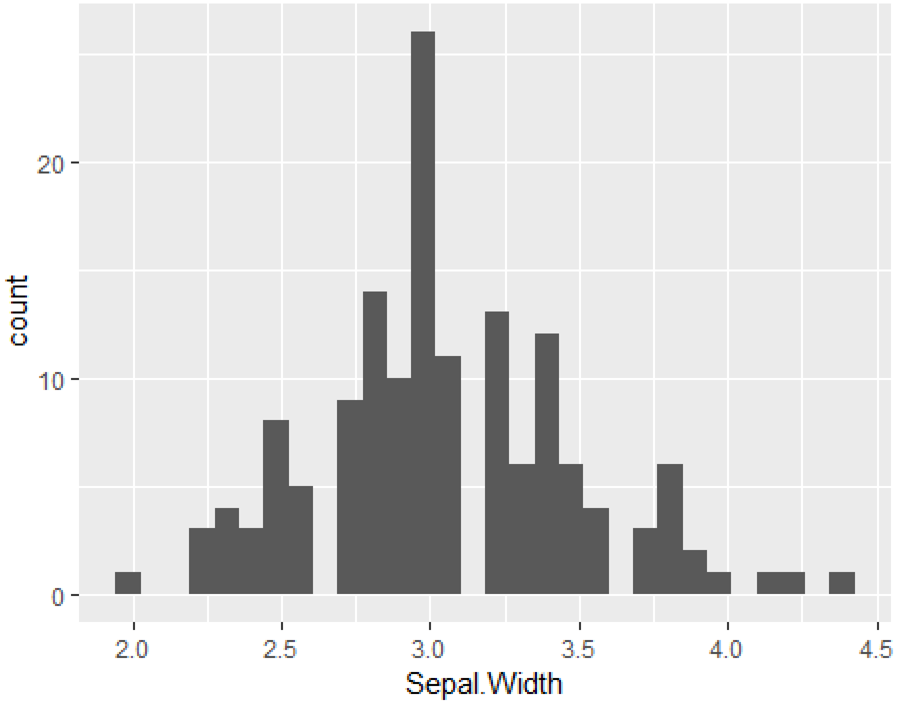
1. Create a scatter plot with CPI on the x axis and HDI on the y axis.
2. Color the points blue.
3. Map the color of the points to Region.
4. Make the points bigger by setting size to 2
5. Map the size of the points to HDI.Rank



Statistical Transformation (stat_)

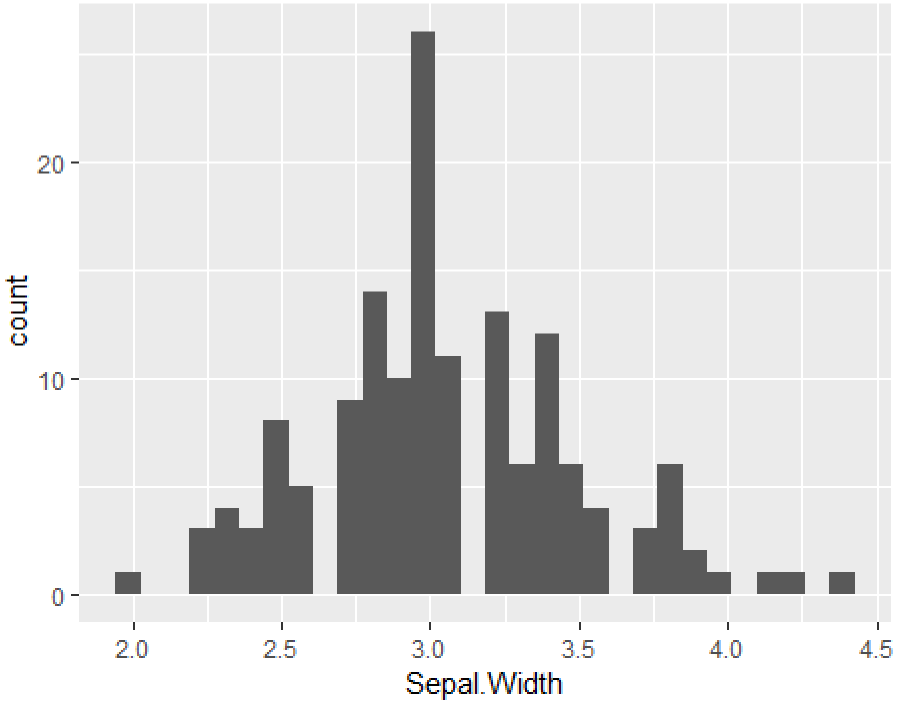
Called from within a geom

```
> ggplot(iris, aes(x =
      Sepal.Width)) +
      geom_histogram()
```



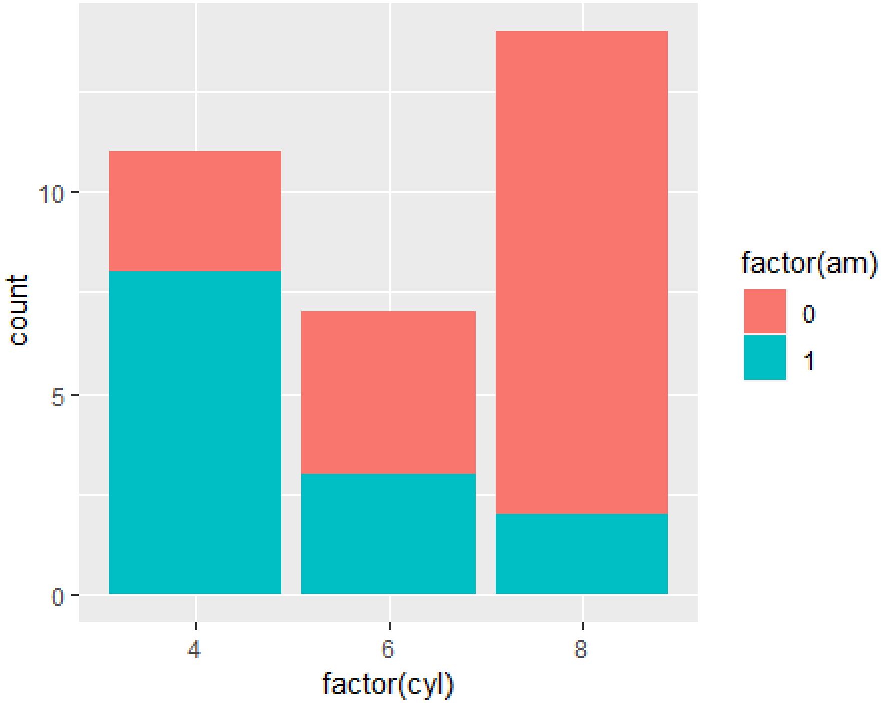
Called independently with stat_

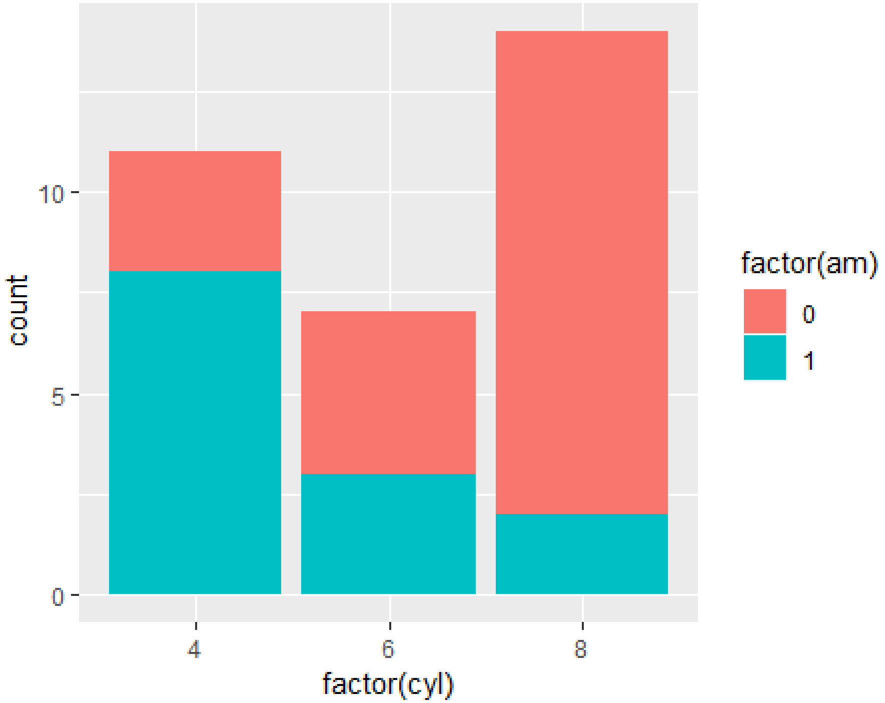
```
> ggplot(iris, aes(x =
      Sepal.Width)) +
      stat_bin()
```



Statistical Transformation (`stat_`)

```
> ggplot(mtcars, aes(x = factor(cyl), fill = factor(am)) +
      geom_bar()
> ggplot(mtcars, aes(x = factor(cyl), fill = factor(am)) +
       stat_bin()
```



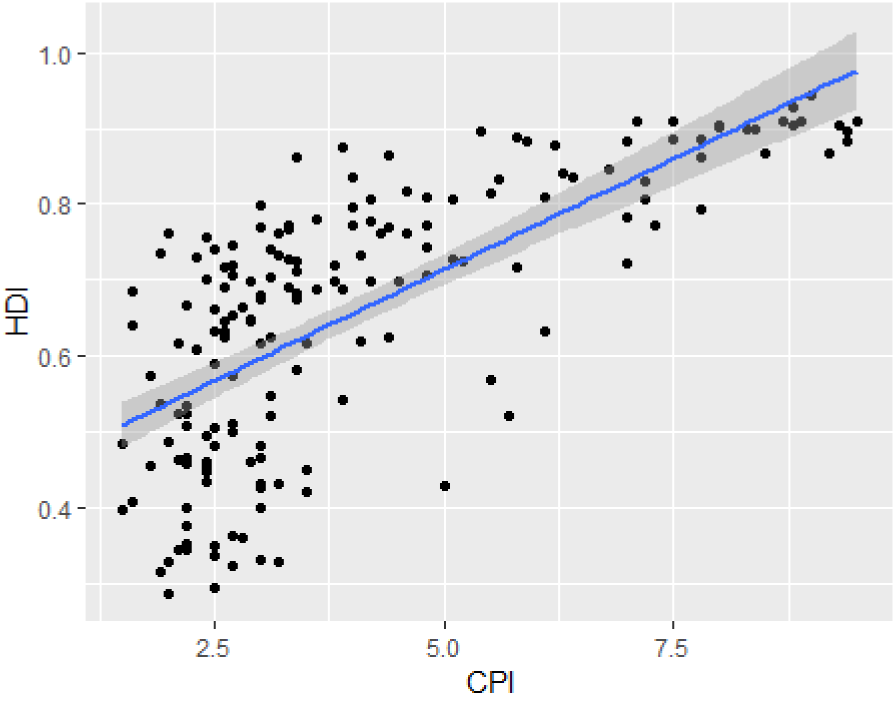


Statistical Transformation (stat_)

stat_	geom_
stat_bin()	geom_histogram()
stat_bin()	geom_bar()
stat_bin()	geom_freqpoly()
stat_smooth()	geom_smooth()
stat_boxplot()	geom_boxplot()
stat_bindot()	geom_dotplot()
stat_bin2d()	geom_bin2d()
stat_binhex()	geom_hex()
stat_contour()	geom_contour()
stat_quantile()	geom_quantile()
stat_sum()	geom_count()

Exercise 2

1. Re-create a scatter plot with CPI on the x axis and HDI on the y axis (as you did in the previous exercise).
2. Overlay a smoothing line on top of the scatter plot using geom_smooth / stat_smooth .
3. Overlay a smoothing line on top of the scatter plot using geom_smooth / stat_smooth, but use a linear model for the predictions.

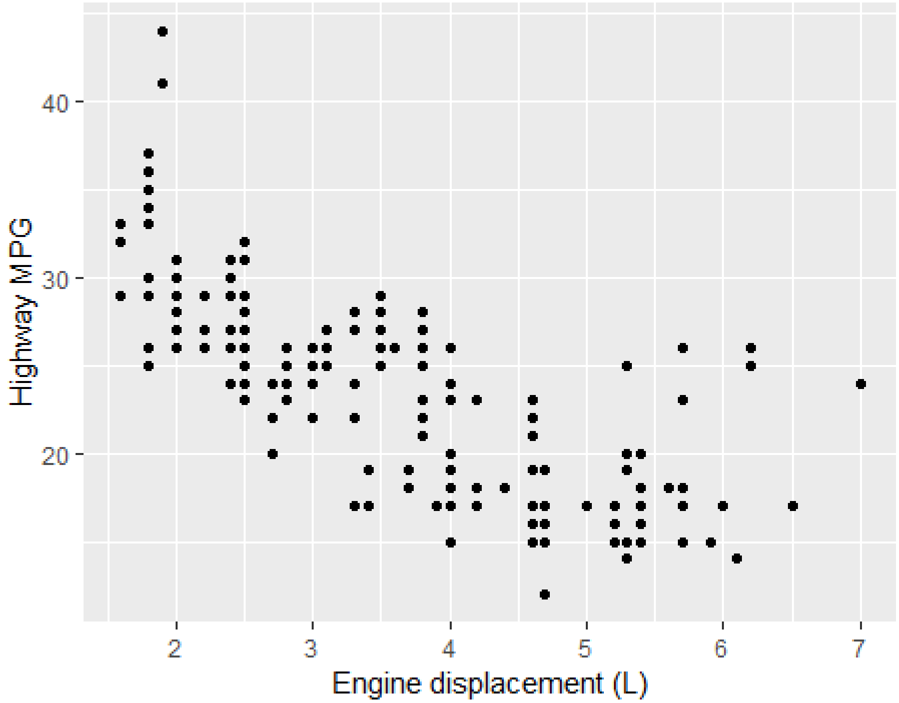


Scales

map data values to the visual values of an aesthetic.

Scales are reported on the plot using axes and legends

```
> ggplot(mpg, aes(displ, hwy)) +
   geom_point() +
   scale_x_continuous("Engine displacement (L)")+
   scale_y_continuous("Highway MPG")
```

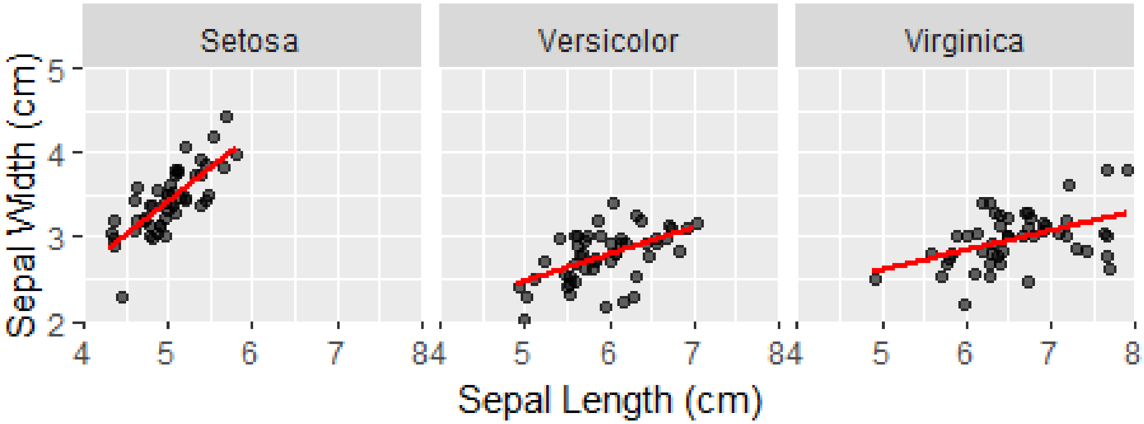


Exercise 3

1. Create a scatter plot with CPI on the x axis and HDI on the y axis. Color the points to indicate region.
2. Modify the x, y, and color scales so that they have more easily-understood names (e.g., spell out “Human development Index” instead of “HDI”).

Putting it All Together

```
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +
    geom_jitter(alpha = 0.6) +
    facet_grid(. ~ Species) +
    stat_smooth(method = "lm", se = F, col = "red") +
    scale_y_continuous("Sepal Width (cm)",
              limits = c(2,5), expand = c(0,0)) +
    scale_x_continuous("Sepal Length (cm)",
              limits = c(4,8), expand = c(0,0)) +
    coord_equal()
```


Setosa
Versicolor
Virginica
Sepal Width (cm)
Sepal Length (cm)