Special Crafted by

Bernardus Ari Kuncoro

Training Series No.

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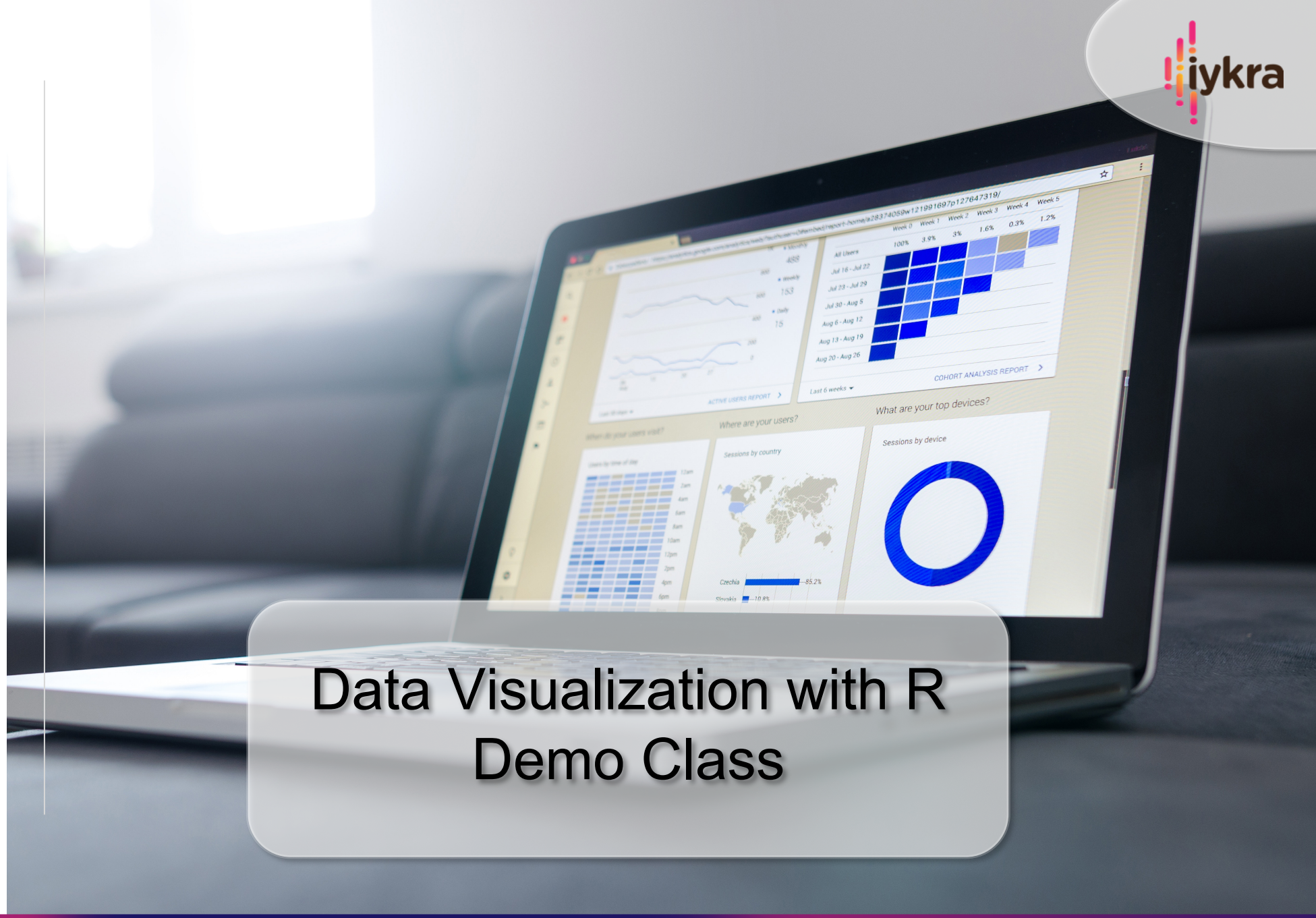

Data Visualization with R Demo Class


Trainer Bio
MacBook Pro

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In recent 5 years, Ari had experienced as a Data scientist in consultancy, ecommerce, and telecommunication companies. His background is Electrical Engineering (Telecommunication) and Computer Science. He is absolutely and utterly passionate about Data Science and teaching, thus he is looking forward to sharing his passion and knowledge with you! Please connect to one of the online channels below (blog, Instagram or LinkedIn).

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Bernardus Ari Kuncoro


Learning
Objectives

Learning Objectives

- To understand the objectives of visualization.
- To understand what suitable graphs for different purposes.
- To understand and hands on in creating basic graphs with R package: ggplot2

Today's Agenda

1. Pre-requisites
2. Exploratory vs Explanatory
3. Basic Visualization Types
4. Grammar of graphics
5. Seven most frequent used graphs
6. Summary

1

Pre-requisites

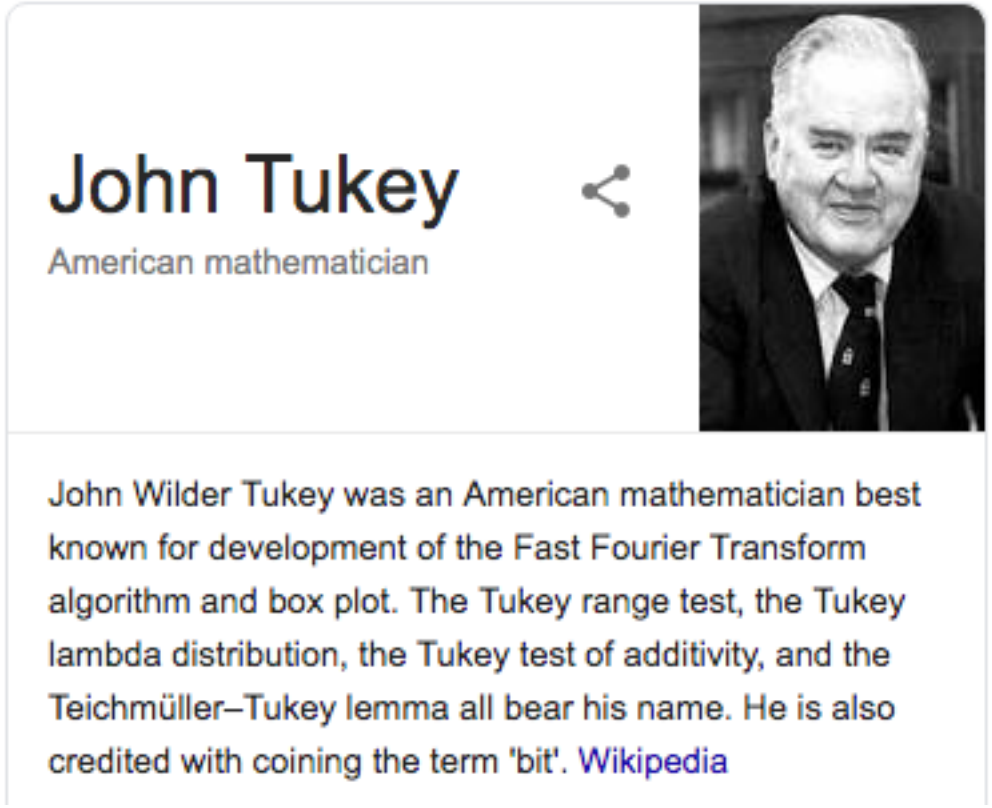
iykra

Please **prepare** the followings:

- **Install R** from CRAN on your laptop (https://cran.r-project.org)
- **Install RStudio** IDE* on your laptop (https://www.rstudio.com/products/rstudio/download)
- Clone my github: https://github.com/arikunco/visualization.git
- Install packages:

```
install.packages("tidyverse")
install.packages("corrplot")
install.packages("corrgram")
```

*IDE = Integrated Development Environment



"The **simple graph** has brought **more** information to the data analyst's mind than any other device." — John Tukey

What is Data Visualization?

Data visualization refers to the techniques used to **communicate data** or information by encoding it as visual objects (e.g., points, lines or bars) contained in graphics.

The goal is to **communicate** information clearly and efficiently to users

2

Exploratory vs Explanatory

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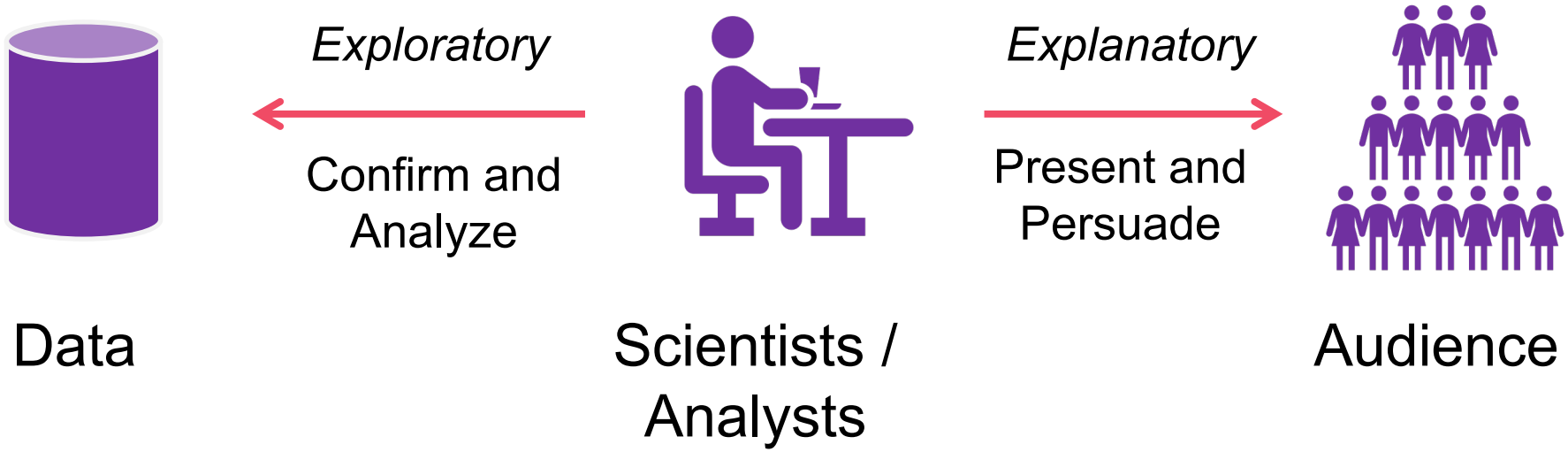

Exploratory
Confirm and Analyze
Explanatory
Present and Persuade
Data
Scientists / Analysts
Audience

Exploratory vs Explanatory

If the users are data analysts/data scientists, the objective of visualization is more on **exploratory**.

Exploratory has more freedom and usually only few of the visuals are used to be documented.

If the users are both data analysts, data scientists and general audience, the objective of visualization is more on **explanatory**.

The audience will be explained by your visuals, so they will be easy to understand.

3

Basic Visualization Types

Basic Visualization Types

Visualization objectives can be generally derived into 4 things:

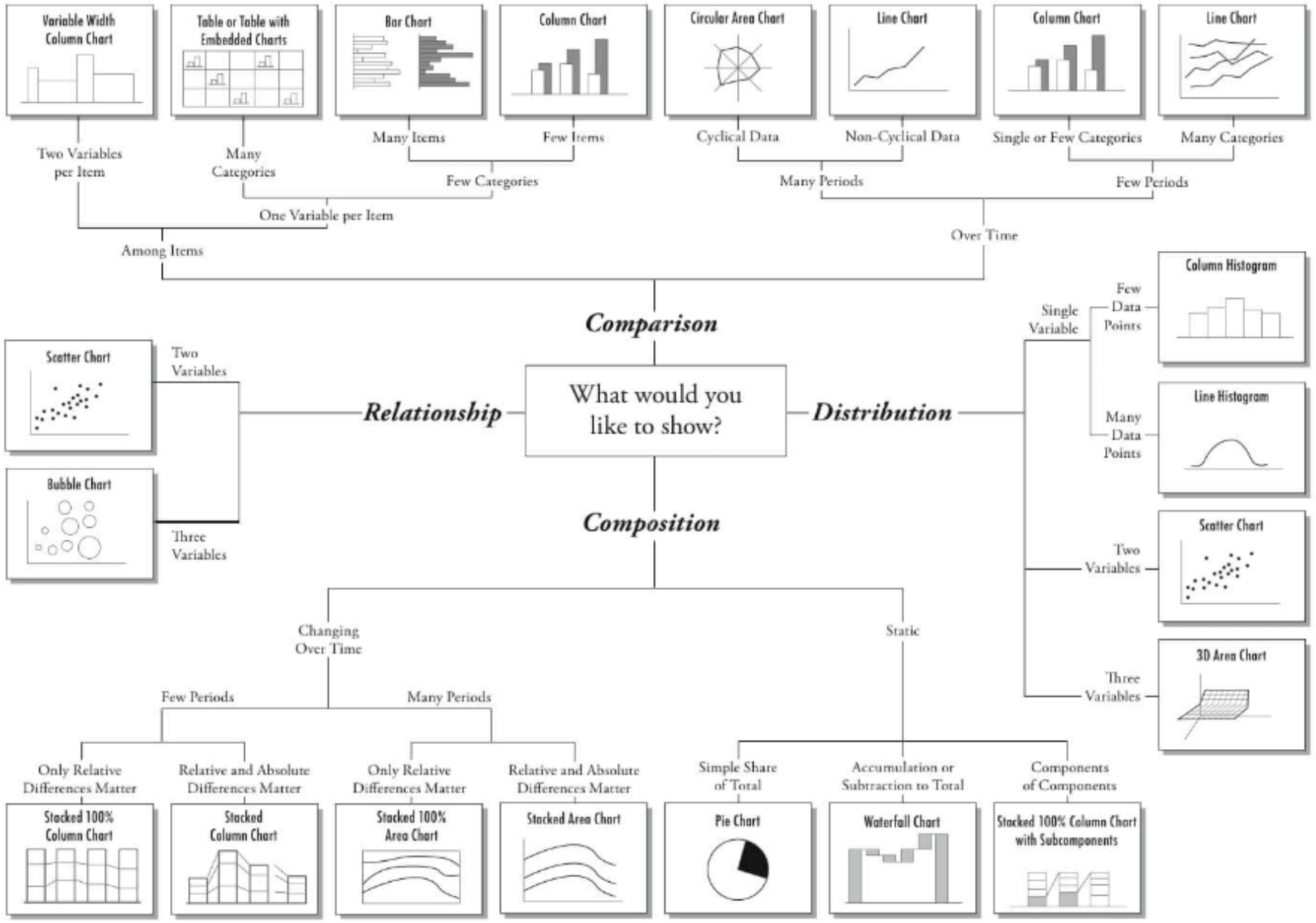
- Comparison
- Composition
- Distribution
- Relationship

3 Minimum Questions to guide you ...

To determine which amongst these is best suited for your data, I suggest you should answer a few questions like:

- How many variables do you want to show in a single chart?
- How many data points will you display for each variable?
- Will you display values over a period of time, or among items or groups?

Chart Suggestions—A Thought-Starter



a [right chart type](#) by Dr. Andrew Abela.

You can also get inspiration also from

http://labs.juiceanalytics.com/chartchooser/index.html

4

Grammar of graphics

Layer of ggplot (1) - Data

Let's handshake with the data

```
# Perform the
# following command

?mpg
```

Files | Plots | Packages | Help | Viewer

R: Fuel economy data from 1999 and 2008 for 38 popular models of... | Find in Topic

mpg {ggplot2} R Documentation

Fuel economy data from 1999 and 2008 for 38 popular models of car

Description

This dataset contains a subset of the fuel economy data that the EPA makes available on http://fueleconomy.gov. It contains only models which had a new release every year between 1999 and 2008 - this was used as a proxy for the popularity of the car.

Usage

```
mpg
```

Format

A data frame with 234 rows and 11 variables

manufacturer
model

Let's handshake with the data

```
# Perform the following command
```

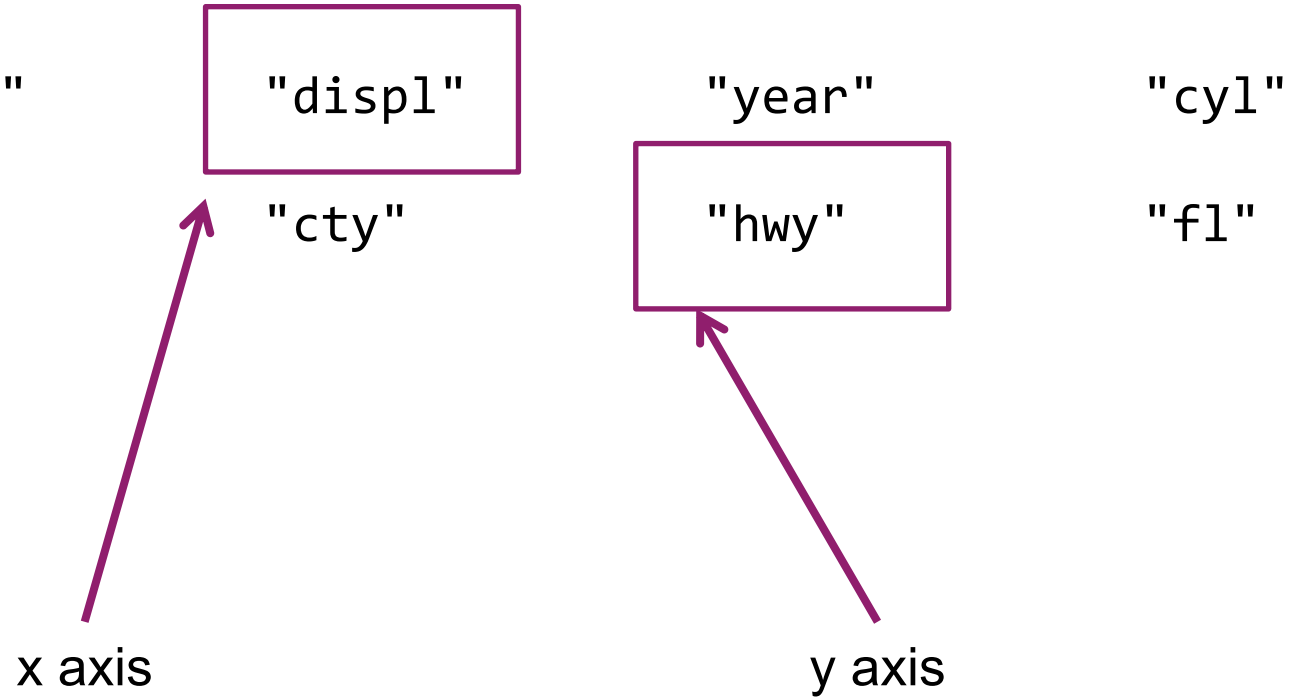
```
mpg
```

```
# A tibble: 234 x 11
   manufacturer model     displ  year   cyl trans    drv     cty   hwy fl    class
   <chr>        <chr>     <dbl> <int> <int> <chr>    <chr> <int> <int> <chr> <chr>
 1 audi         a4          1.8  1999     4 auto(l5) f        18    29 p     compa~
 2 audi         a4          1.8  1999     4 manual(~ f        21    29 p     compa~
 3 audi         a4          2    2008     4 manual(~ f        20    31 p     compa~
 4 audi         a4          2    2008     4 auto(av) f        21    30 p     compa~
 5 audi         a4          2.8  1999     6 auto(l5) f        16    26 p     compa~
 6 audi         a4          2.8  1999     6 manual(~ f        18    26 p     compa~
 7 audi         a4          3.1  2008     6 auto(av) f        18    27 p     compa~
 8 audi         a4 quat~    1.8  1999     4 manual(~ 4        18    26 p     compa~
 9 audi         a4 quat~    1.8  1999     4 auto(l5) 4        16    25 p     compa~
10 audi         a4 quat~    2    2008     4 manual(~ 4        20    28 p     compa~
# ... with 224 more rows
```

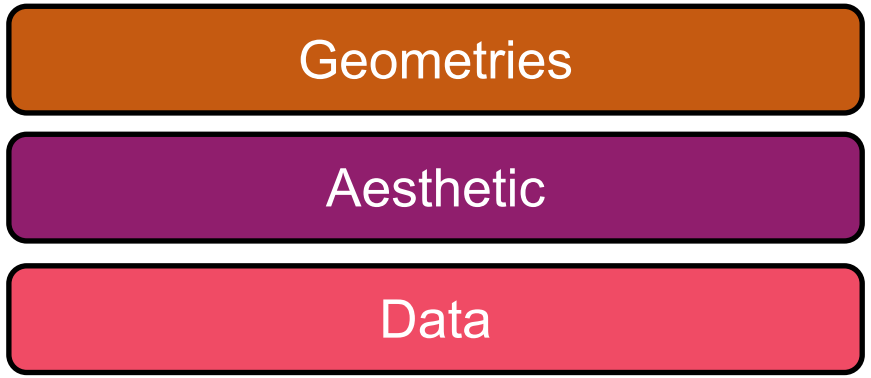
Layer of ggplot (2) - Aesthetic

Layer of ggplot (2) - Aesthetic

```
> colnames(data_mpg)
 [1] "manufacturer" "model"        "displ"        "year"         "cyl"
 [6] "trans"        "drv"          "cty"          "hwy"          "fl"
[11] "class"
```



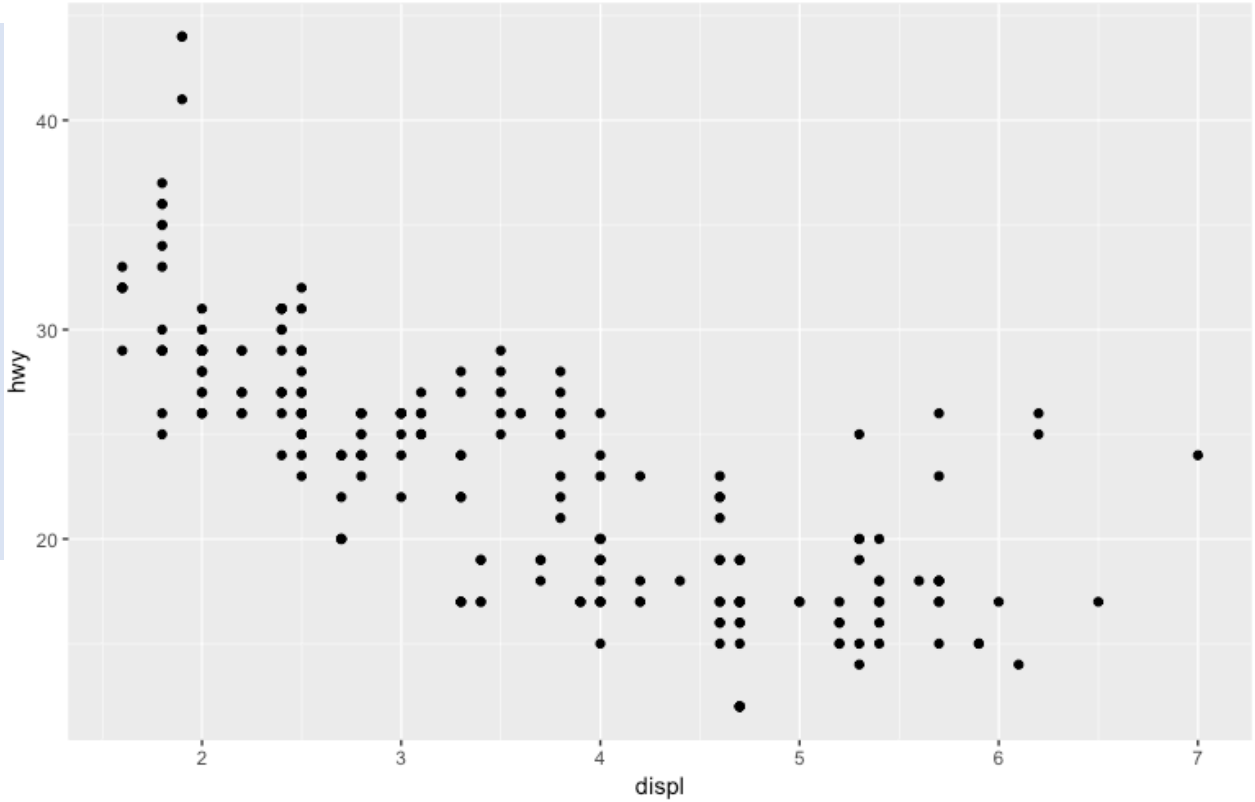
Layer of ggplot (3) - Geometries



Create basic graph with ggplot

```
# TEMPLATE:
# ggplot(data = <DATA>) +
      <GEOM_FUNCTION>(
#   mapping = aes(<MAPPINGS>))

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

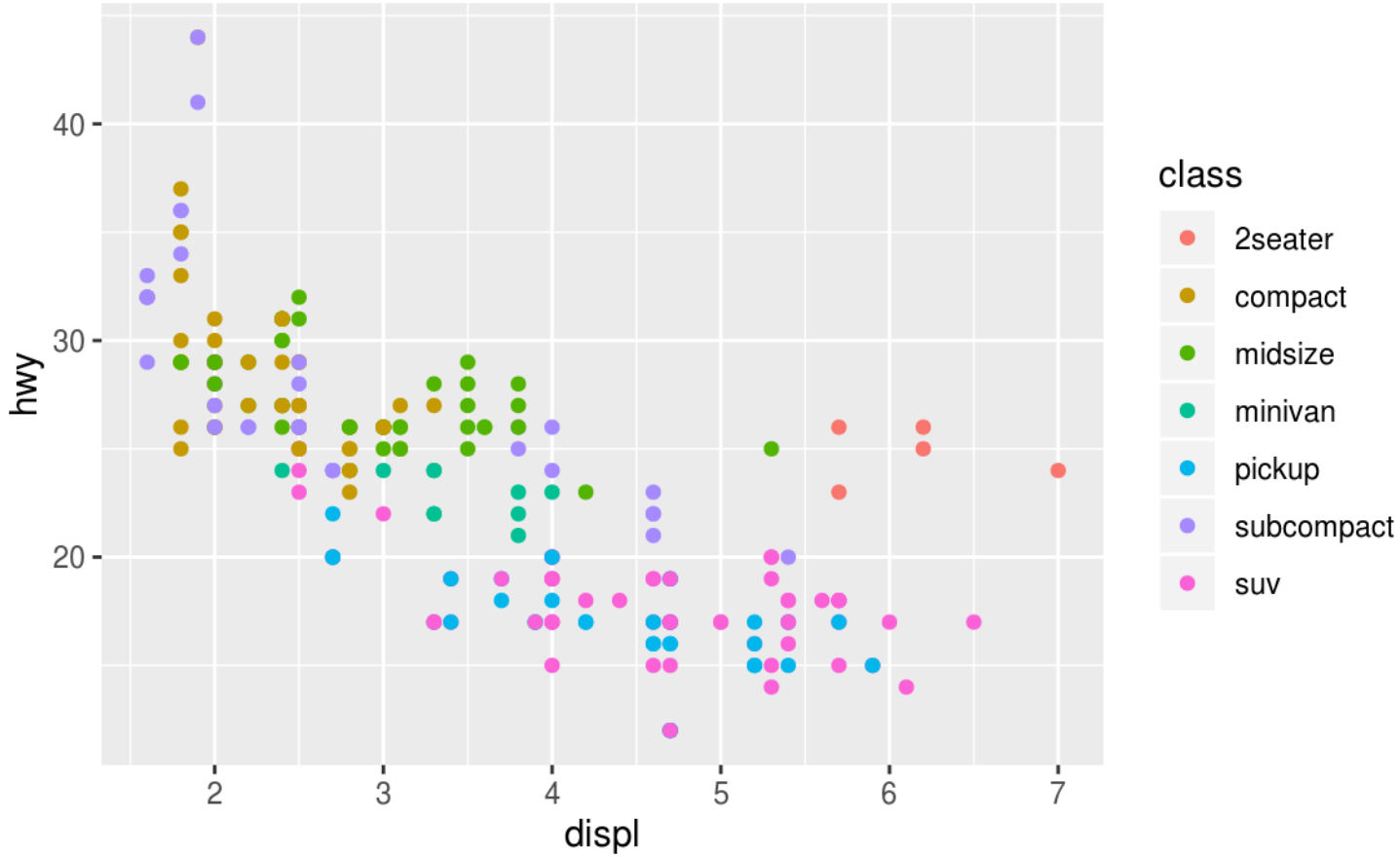


Exercise #1

1. Run `ggplot(data = mpg)`. What do you see?
2. How many rows are in `mpg`? How many columns?
3. What does the `drv` variable describe? Read the help for `?mpg` to find out.
4. Make a scatterplot of `hwy` vs `cyl`.
5. What happens if you make a scatterplot of `class` vs `drv`? Why is the plot not useful?

Aesthetic Mapping

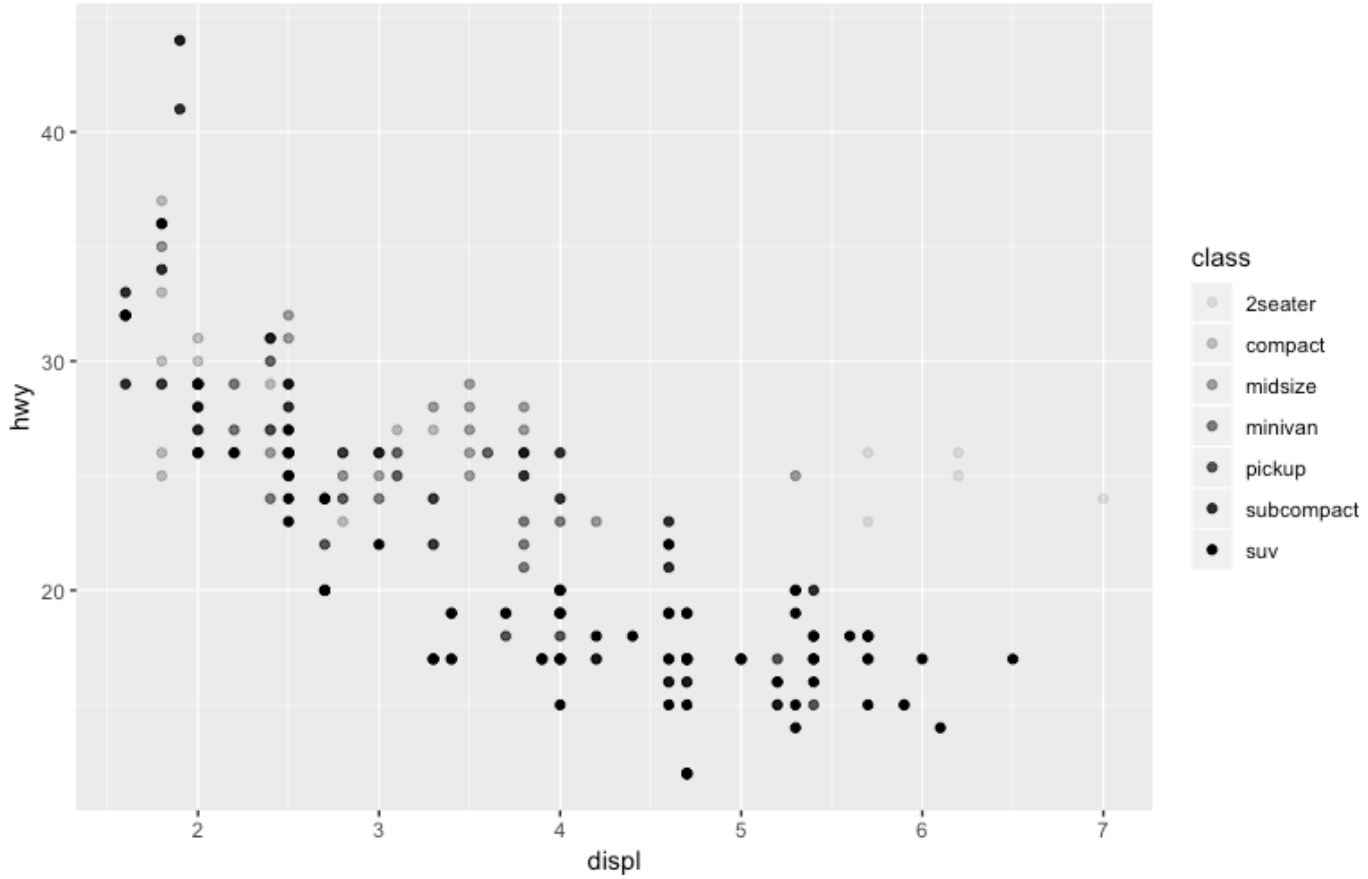
```
ggplot(data = mpg) + geom_point(mapping = aes(x = displ, y = hwy, color = class))
```



You can change with other variables:
shape,
size,
alpha

Aesthetic Mapping

```
ggplot(data = mpg) + geom_point(mapping = aes(x = displ, y = hwy, alpha = class))
```

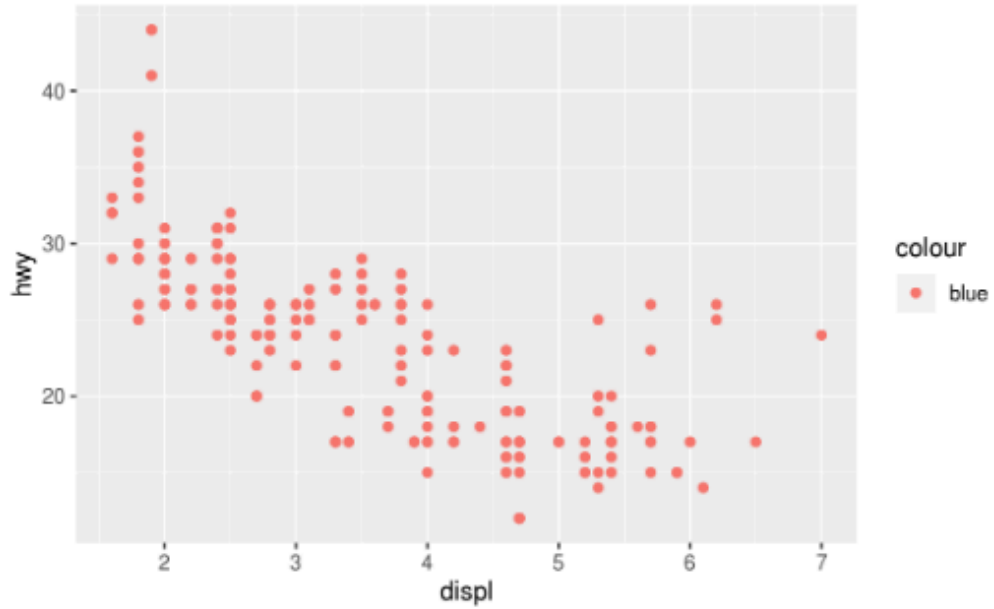


You can change with other variables:
shape,
size,
alpha

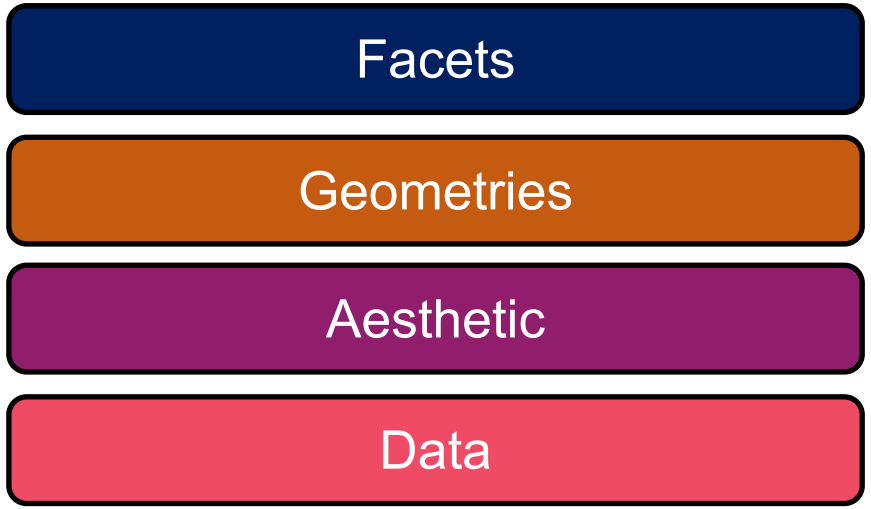
Exercise #2

1. What's gone wrong with this code? Why are the points not blue?

```
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy, color = "blue"))
```

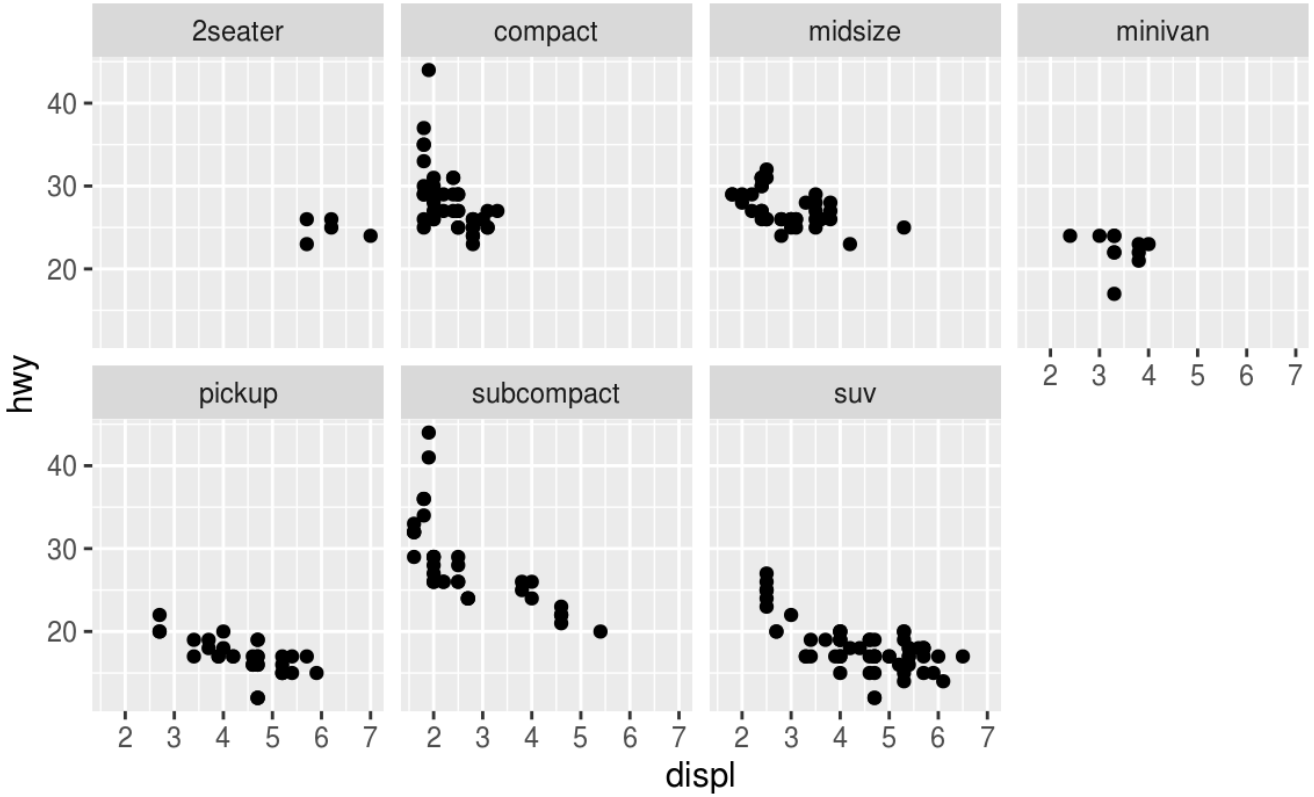


Layer of ggplot (4) - Facets

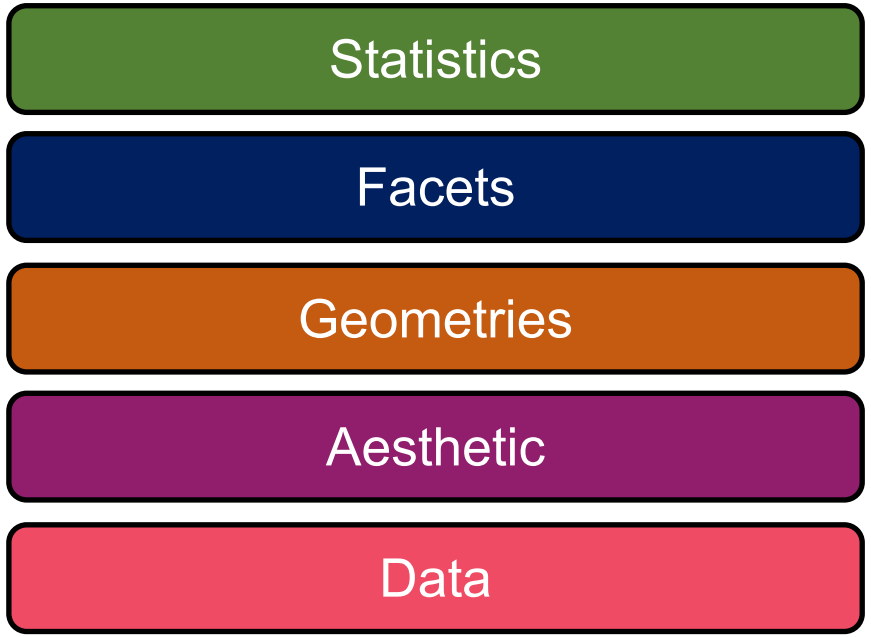


Facets

```
ggplot(data = mpg) +
       geom_point(mapping = aes(x = displ, y = hwy)) +
              facet_wrap(~ class, nrow = 2)
```

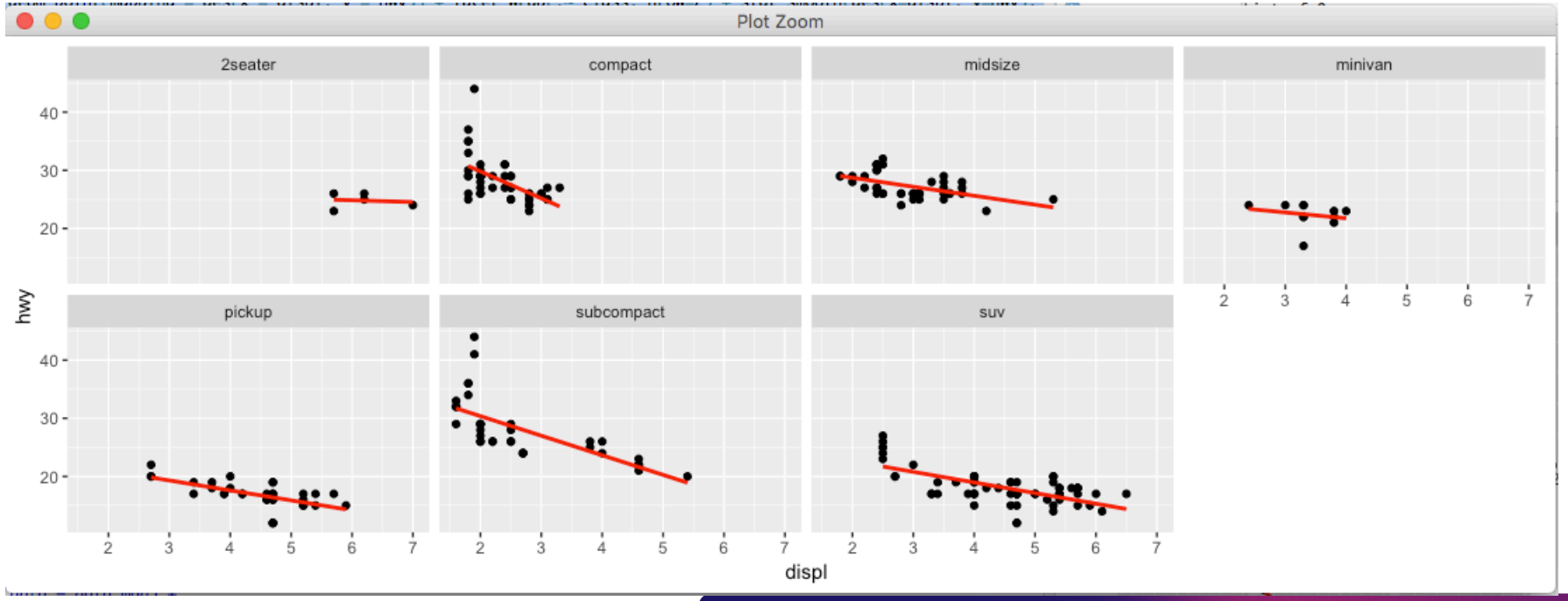


Layer of ggplot (5) - Statistics

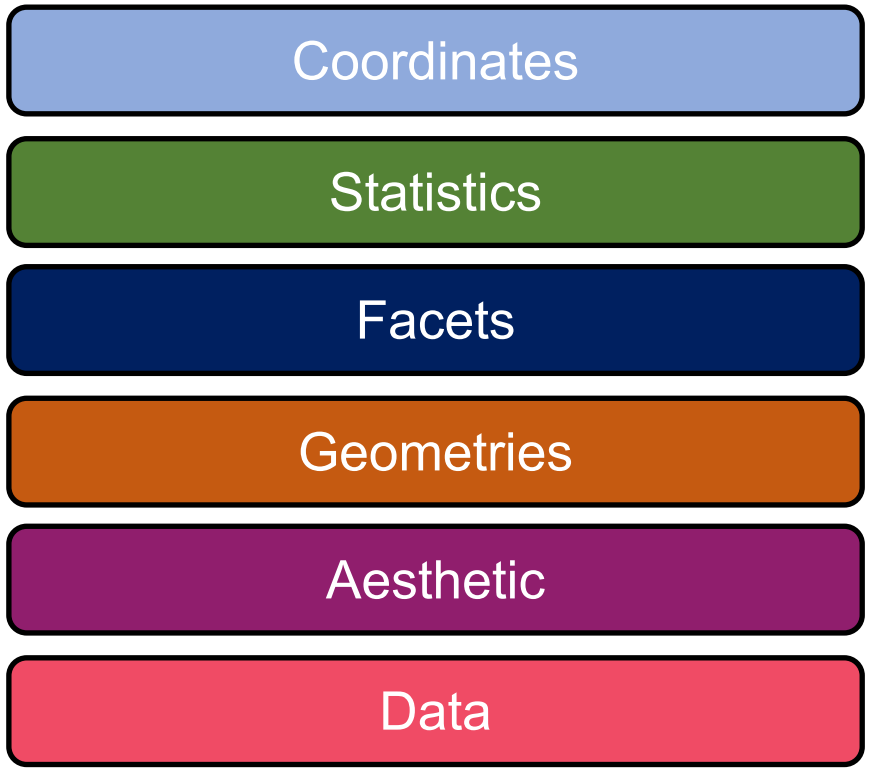


Statistical Transformation

```
ggplot(data = data_mpg) +
  geom_point(mapping = aes(x = displ, y = hwy)) +
  facet_wrap(.~ class, nrow=2) +
  stat_smooth(aes(x=displ, y=hwy), method = 'lm', se = F, col="red")
```

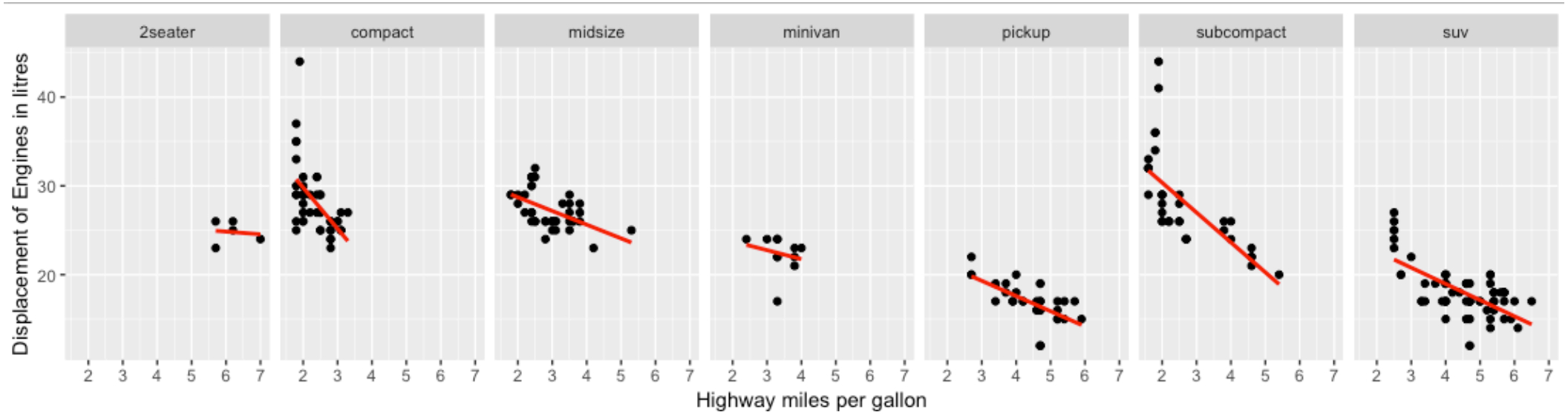


Layer of ggplot (6) - Coordinates

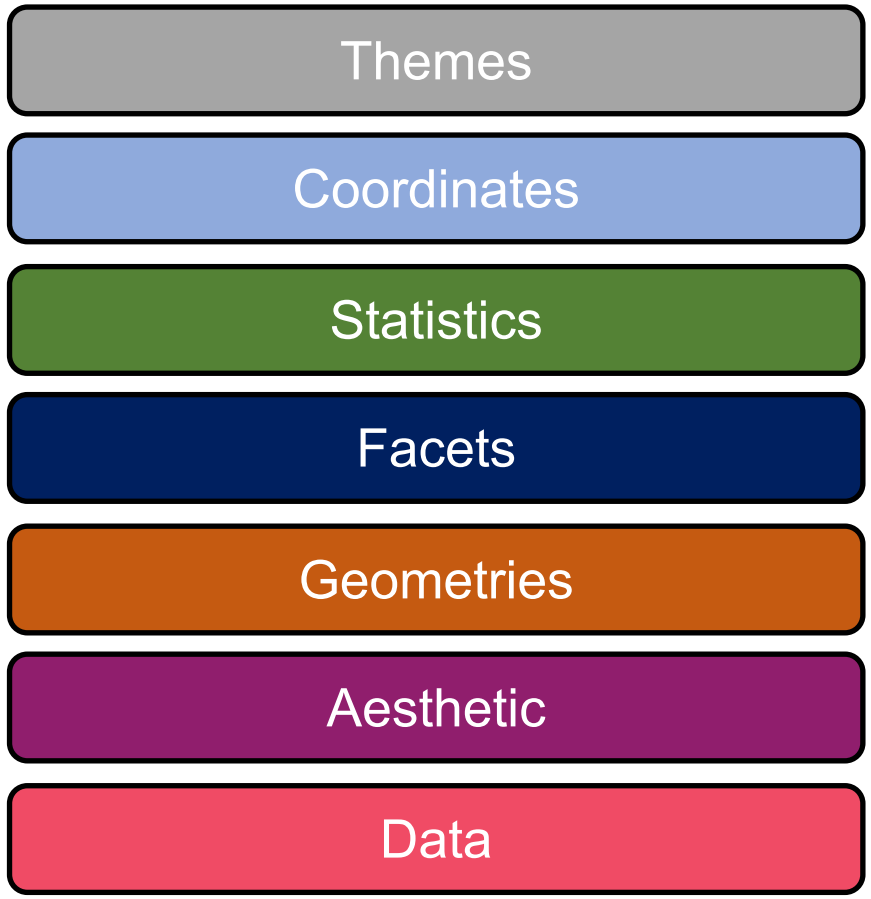


Coordinates

```
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy)) +
  facet_wrap(.~ class, nrow = 1) +
  stat_smooth(aes(x=displ, y=hwy), method = 'lm', se = F, col="red") +
  scale_y_continuous("Displacement of Engines in litres") +
  scale_x_continuous("Highway miles per gallon") + coord_cartesian()
```

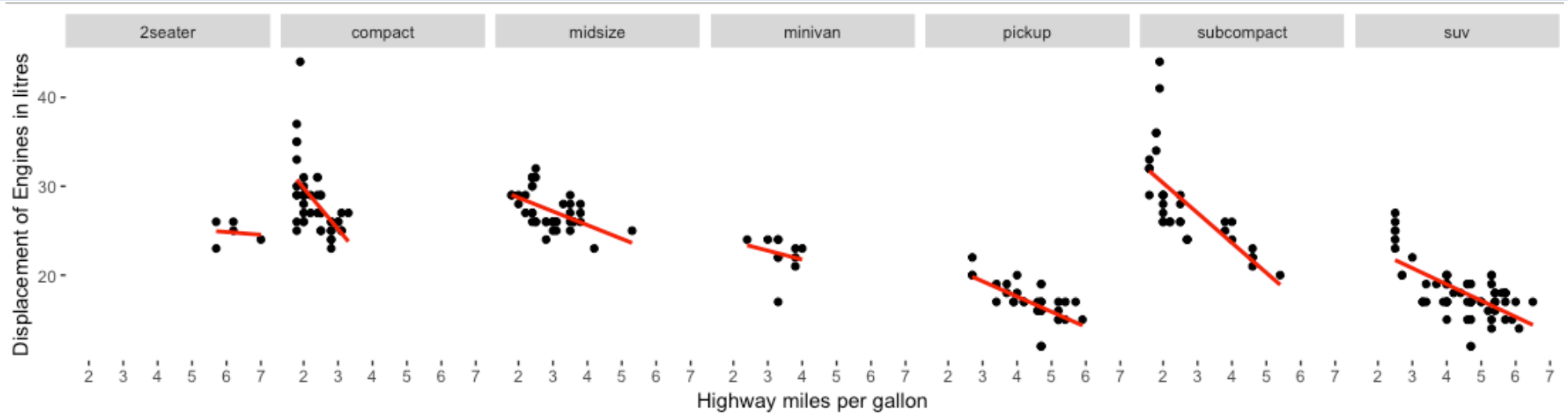


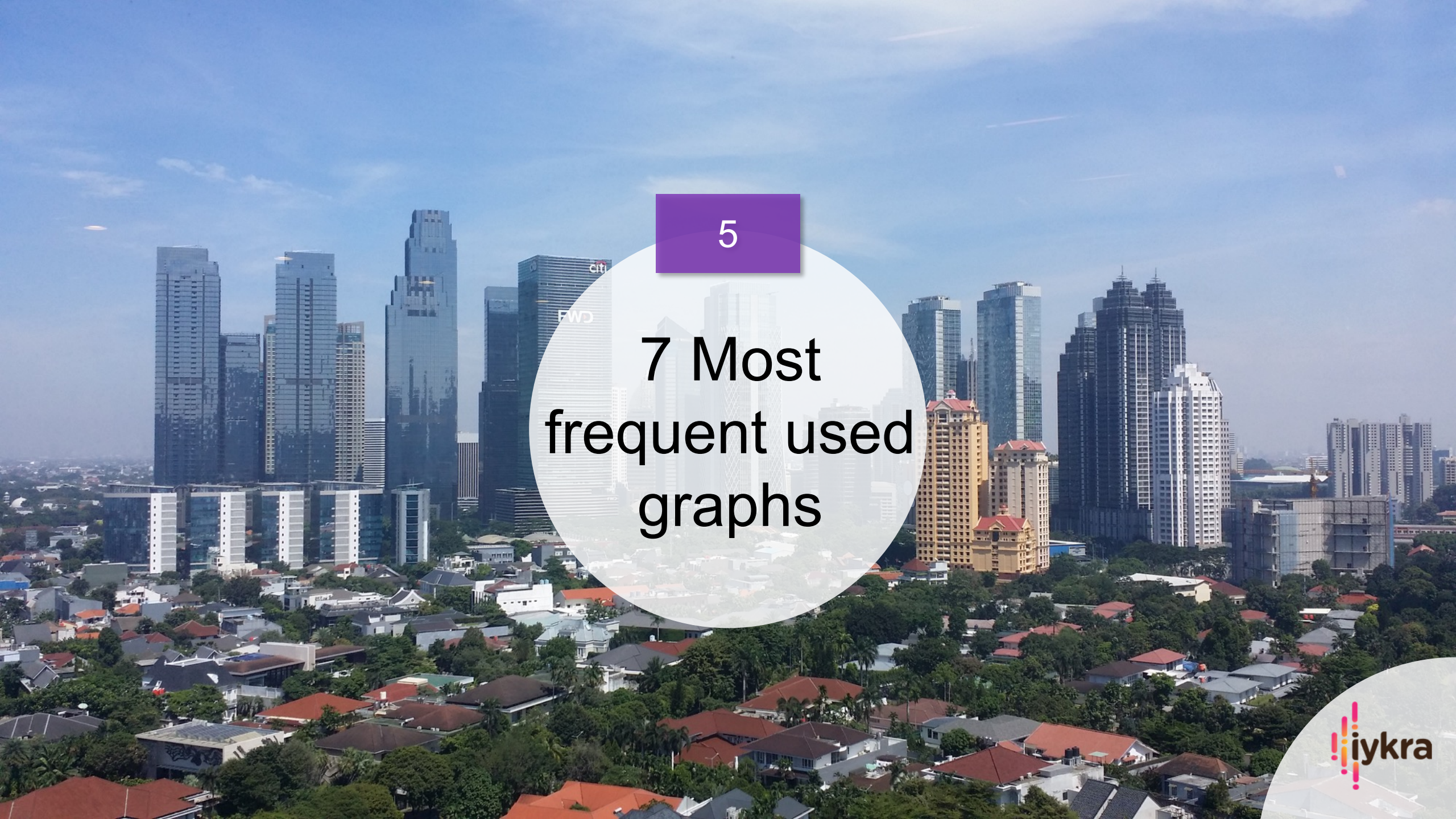
Layer of ggplot (6) - Themes



Themes

```
ggplot(data = mpg) +
  geom_point(mapping = aes(x = displ, y = hwy)) +
  facet_wrap(.~ class, nrow = 1) +
  stat_smooth(aes(x=displ, y=hwy), method = 'lm', se = F, col="red") +
  scale_y_continuous("Displacement of Engines in litres") +
  scale_x_continuous("Highway miles per gallon")  + coord_cartesian() +
theme(panel.background = element_blank())
```




5
7 Most frequent used graphs
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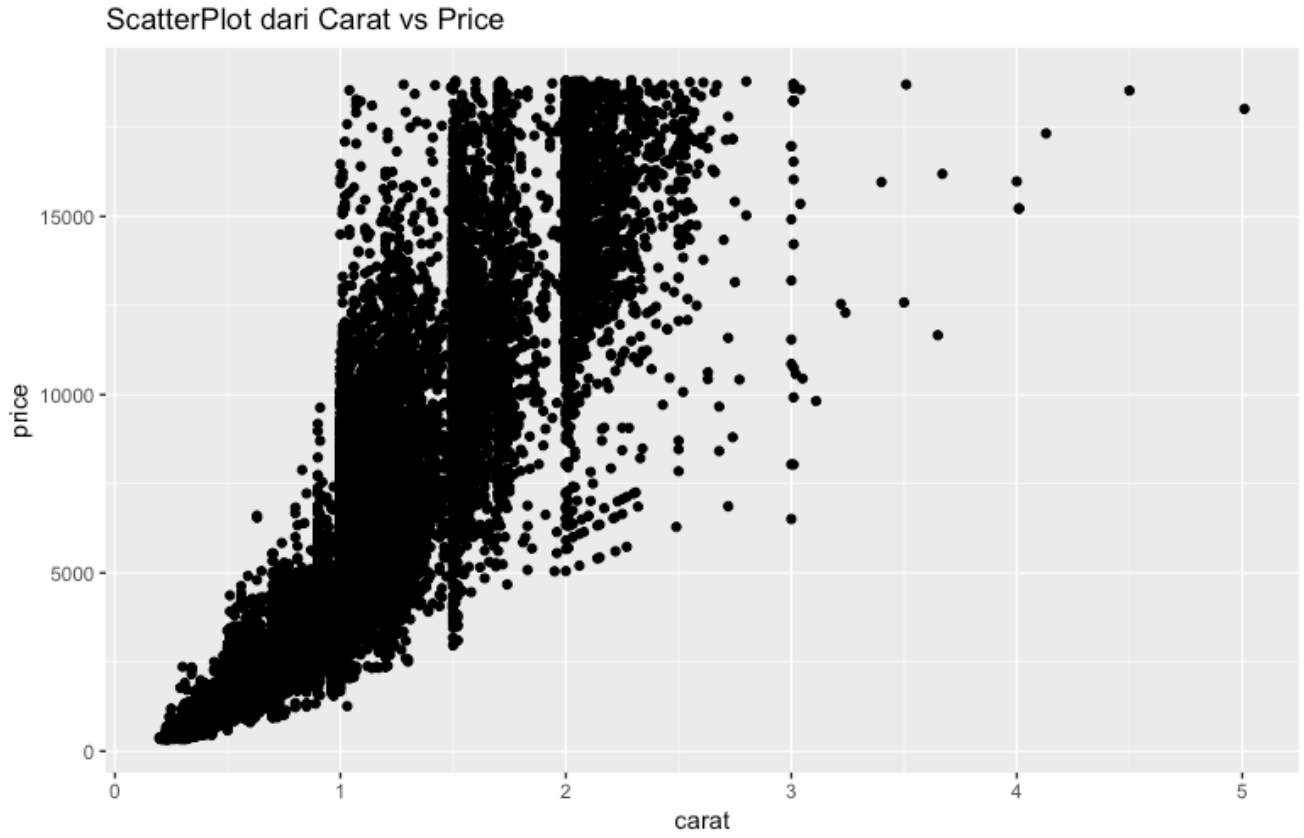
1. Scatter Plot

When to use: Scatter Plot is used to see the relationship between two continuous variables.

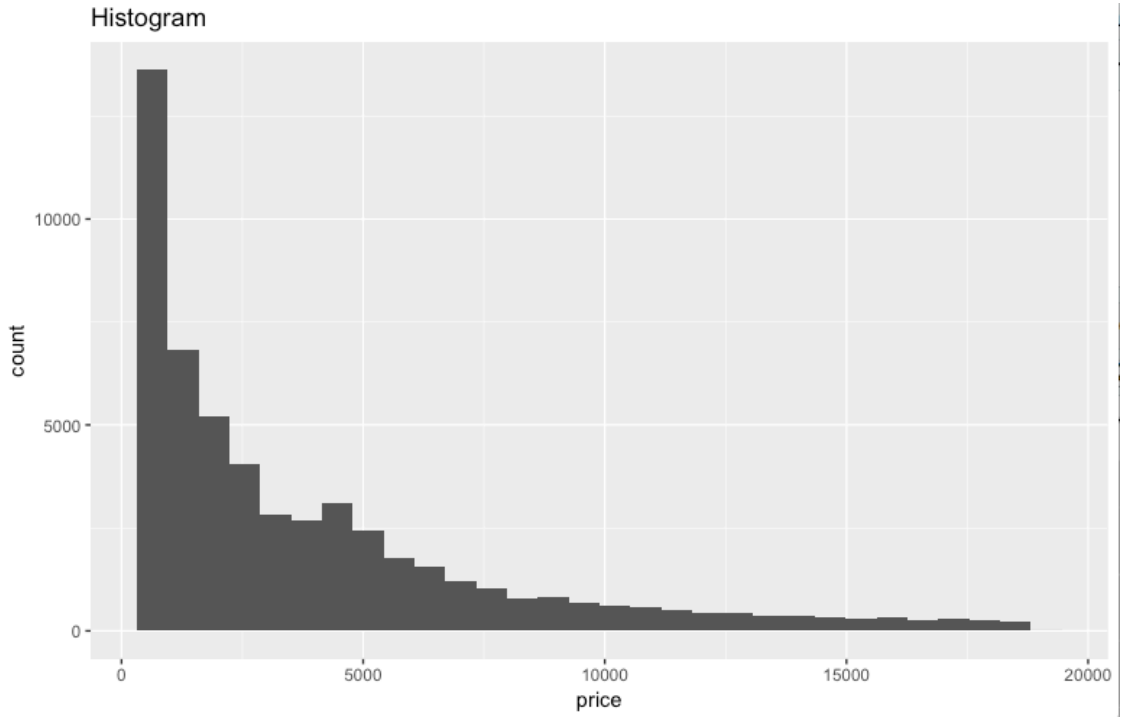
```
ggplot(diamonds) +
geom_point(mapping = aes(x = carat,
y = price)) +
labs(title="ScatterPlot Carat vs
Price")
```



2. Histogram

When to use: Histogram is used to plot continuous variable. It breaks the data into bins and shows frequency distribution of these bins. We can always change the bin size and see the effect it has on visualization.

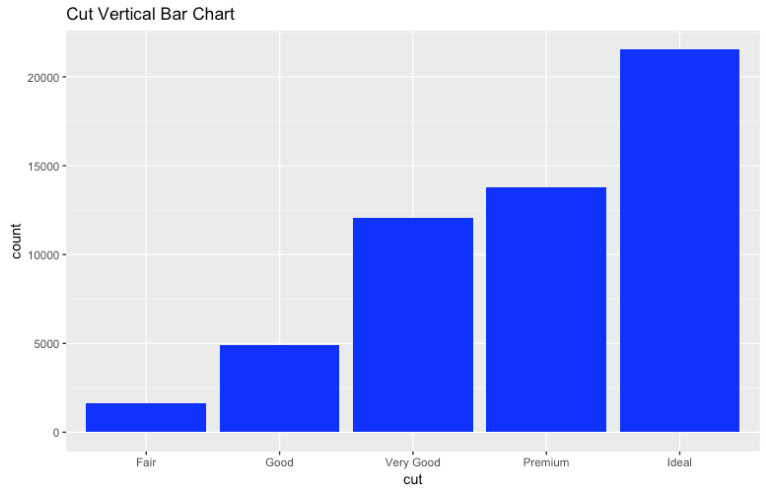
```
ggplot(diamonds) + geom_histogram(mapping= aes(x=price), bins=30) + labs(title="Histogram")
```



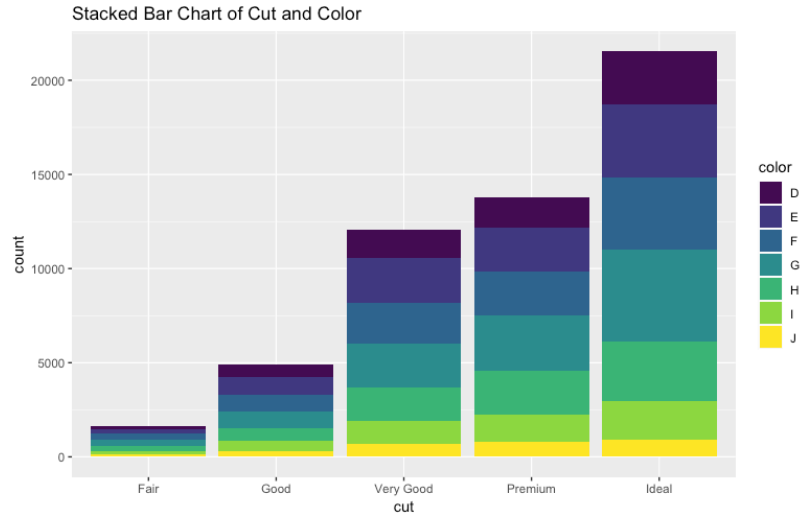
3. Bar and Stack Bar Chart

When to use: Bar charts are recommended when you want to plot a categorical variable or a combination of continuous and categorical variable.

```
ggplot(diamonds) + geom_bar(aes(x=cut)) +
labs(title="Cut Vertical Bar Chart")
```



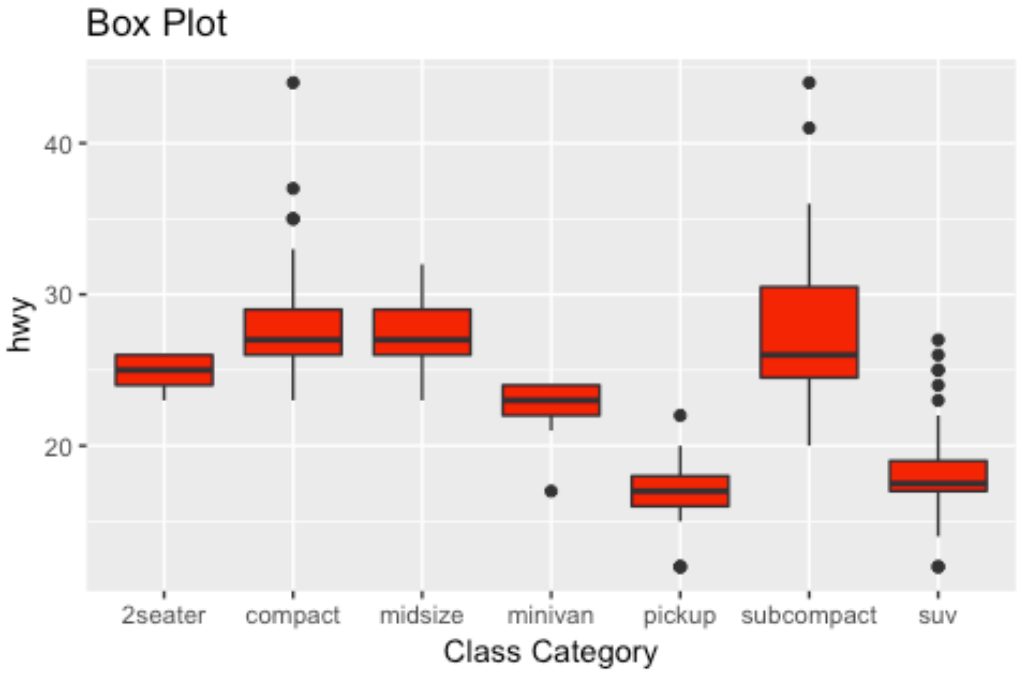

```
ggplot(diamonds) + geom_bar(aes(x=cut,
fill=color)) + labs(title="Stacked Bar
Chart of Cut and Color")
```



4. Boxplot

When to use: Box Plots are used to plot a combination of categorical and continuous variables.

```
ggplot(mpg) + geom_boxplot(aes(class,
hwy), fill="red") +  labs(title = "Box
Plot", x = "Class Category")
```

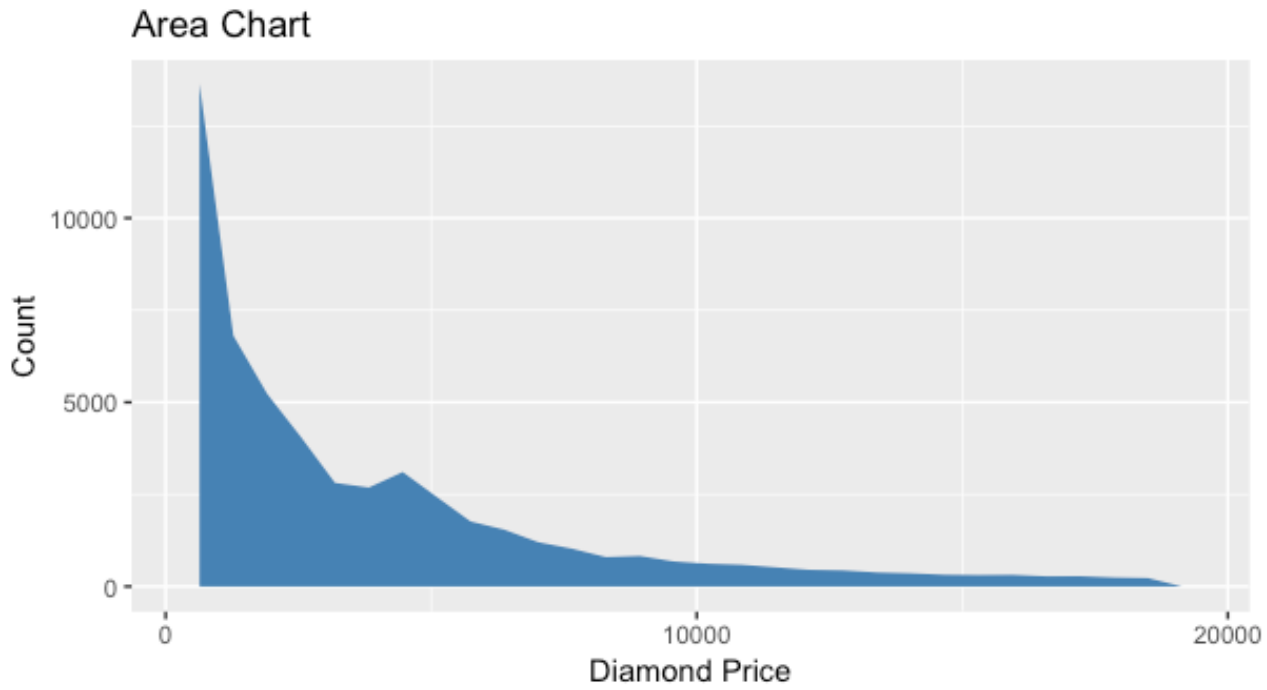


This plot is useful for visualizing the spread of the data and detect outliers. It shows five statistically significant numbers- the minimum, the 25th percentile, the median, the 75th percentile and the maximum.

5. Area Chart

When to use: Area chart is used to show continuity across a variable or data set. It is very much same as line chart and is commonly used for time series plots.

```
ggplot(diamonds) + geom_area(aes(price),
stat="bin", bins=30, fill="steelblue") +
scale_x_continuous(breaks=seq(0,20000,1000
0)) + labs(title = "Area Chart",
x="Diamond Price", y= "Count")
```

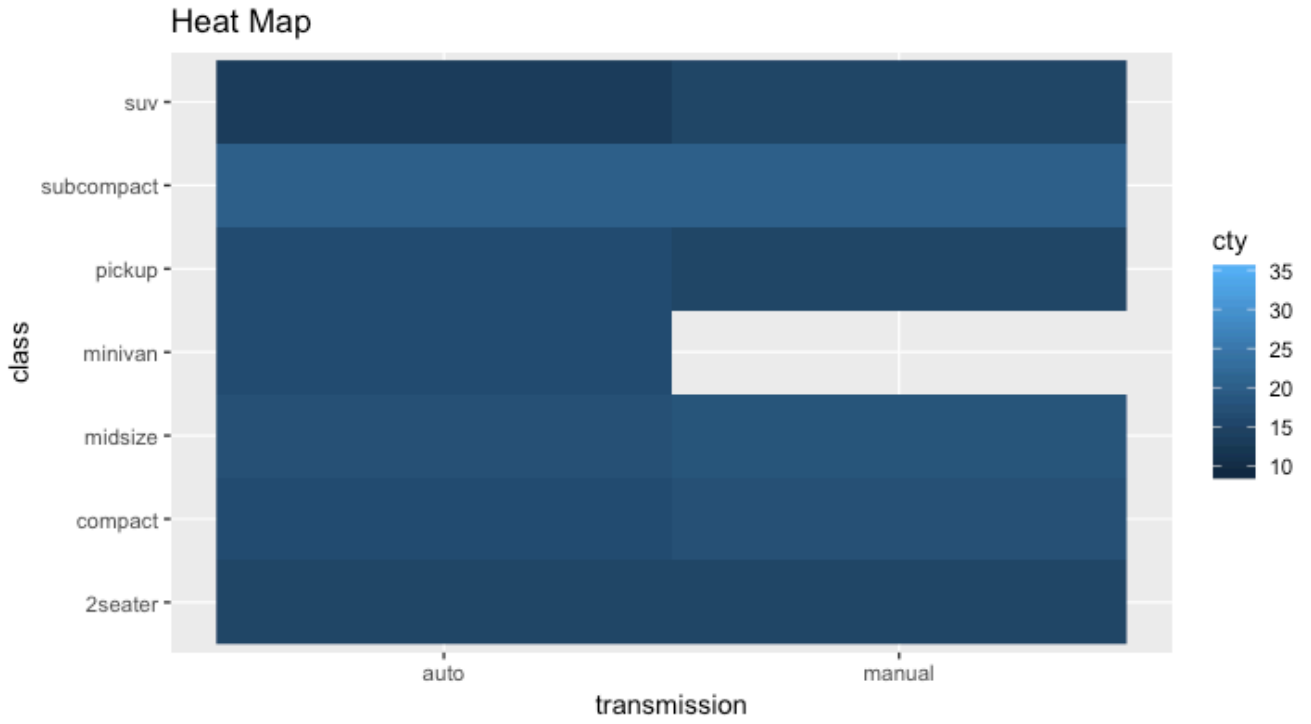


6. Heatmap

When to use: Heat Map uses intensity (density) of colors to display relationship between two or three or many variables in a two dimensional image.

```
mpg$transmission <- ifelse(grepl("auto",
mpg$trans), "auto", "manual" )

ggplot(mpg, aes(transmission, class)) +
geom_raster(aes(fill=cty)) +
labs(title="Heat Map", x="transmission",
y="class") +
scale_fill_continuous(name="cty")
```

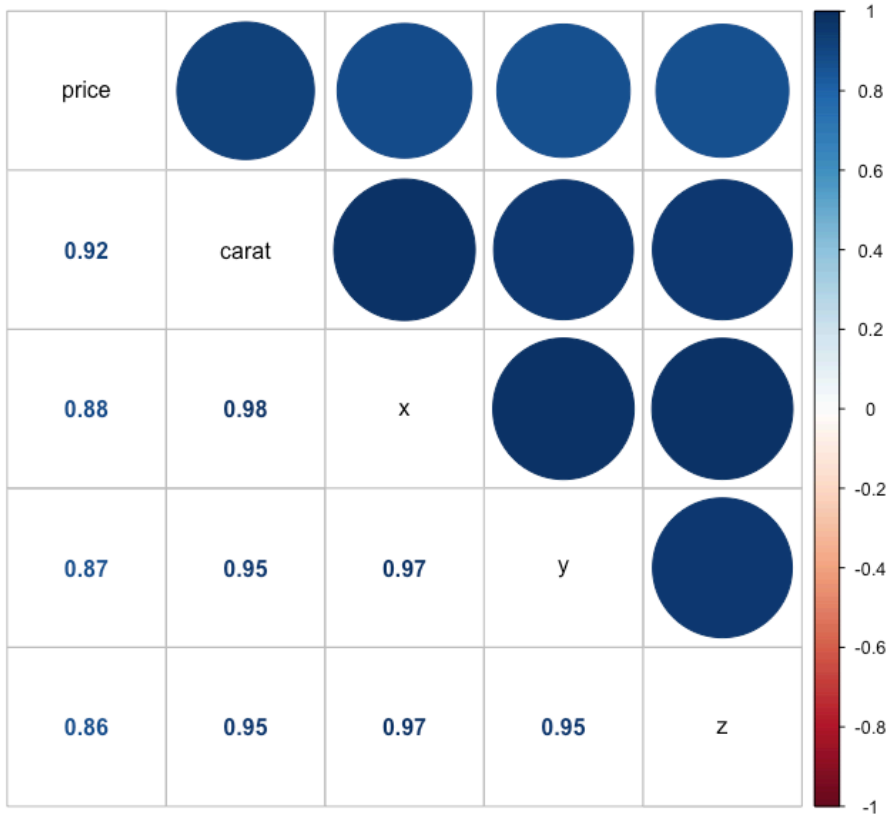


7. Correlogram

When to use: Correlogram is used to test the level of co-relation among the variable available in the data set. The cells of the matrix can be shaded or colored to show the co-relation value.

```
library(corrplot)

corrplot.mixed(cor_numVar, tl.col="black")
```



Let’s practice!

Under this github, please open exercise.R

https://github.com/arikunco/visualization.git

Summary

- Exploratory vs Explanatory
- Basic presentation types: Comparison, Composition, Distribution, Relationship
- Grammar of graphics
- 7 most frequent used graphs: (scatterplot, histogram, bar & stack bar chart, box plot, area chart, heatmap, correlogram)