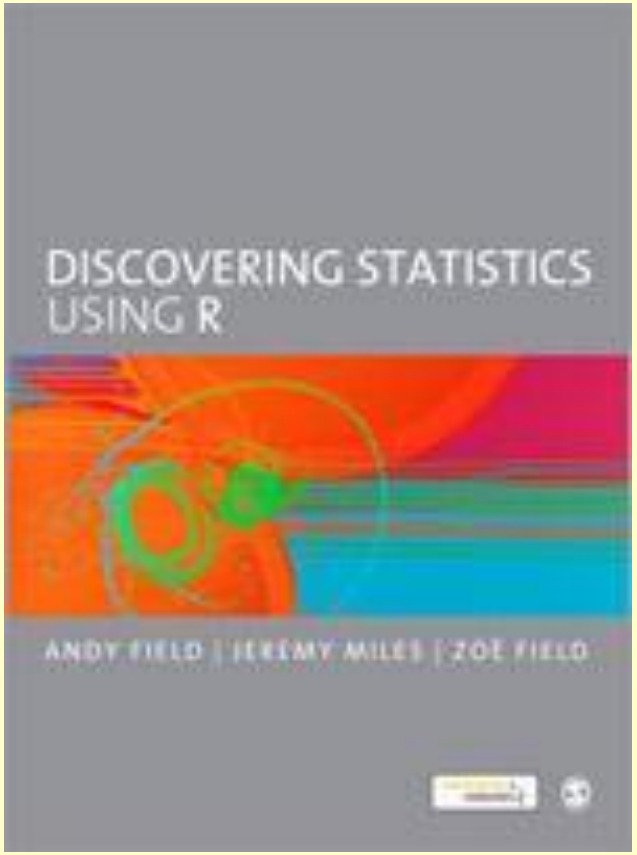
Graphical Exploration II: ggplot

http://www.pelagicos.net/classes_biometry_fa18.htm

Exploring Data With Graphs



R Packages
Used in this Chapter

ggplot2

install.packages("ggplot2")

library(ggplot2)

Chapter 4

Functions in R Package ggplot2

Introduction: ggplot2 involves two separate functions

- ggplot creates more versatile graphs.
- qplot provides faster options.

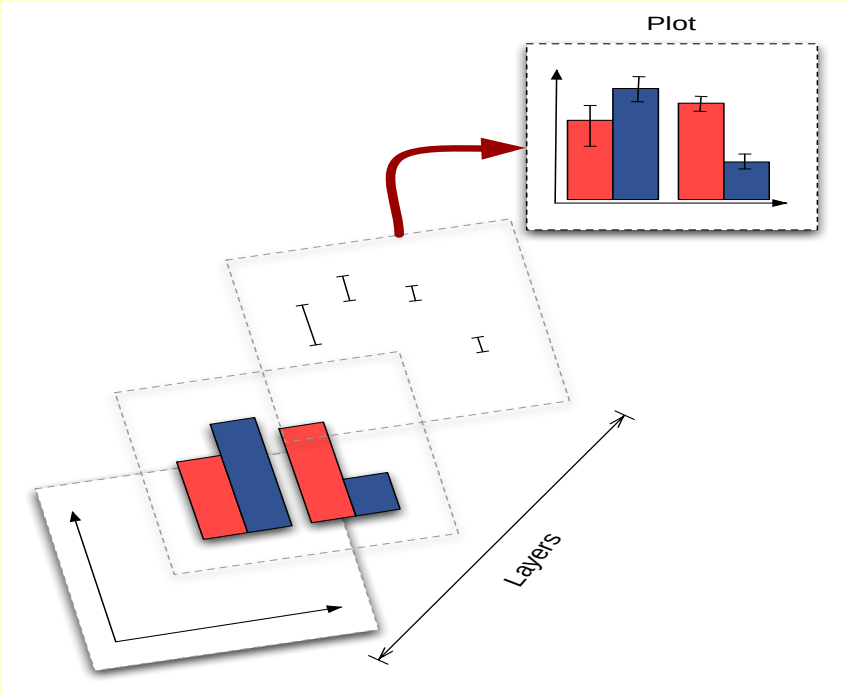
qplot is the first ggplot2 function, short for quick plot.

qplot makes it easy to produce complex plots, often requiring several lines of code using other plotting systems, in one line.

qplot can do this because it is based on the grammar of graphics, which allows the user to create a simple, yet expressive, description of the plot.

Graphs with R Package ggplot2

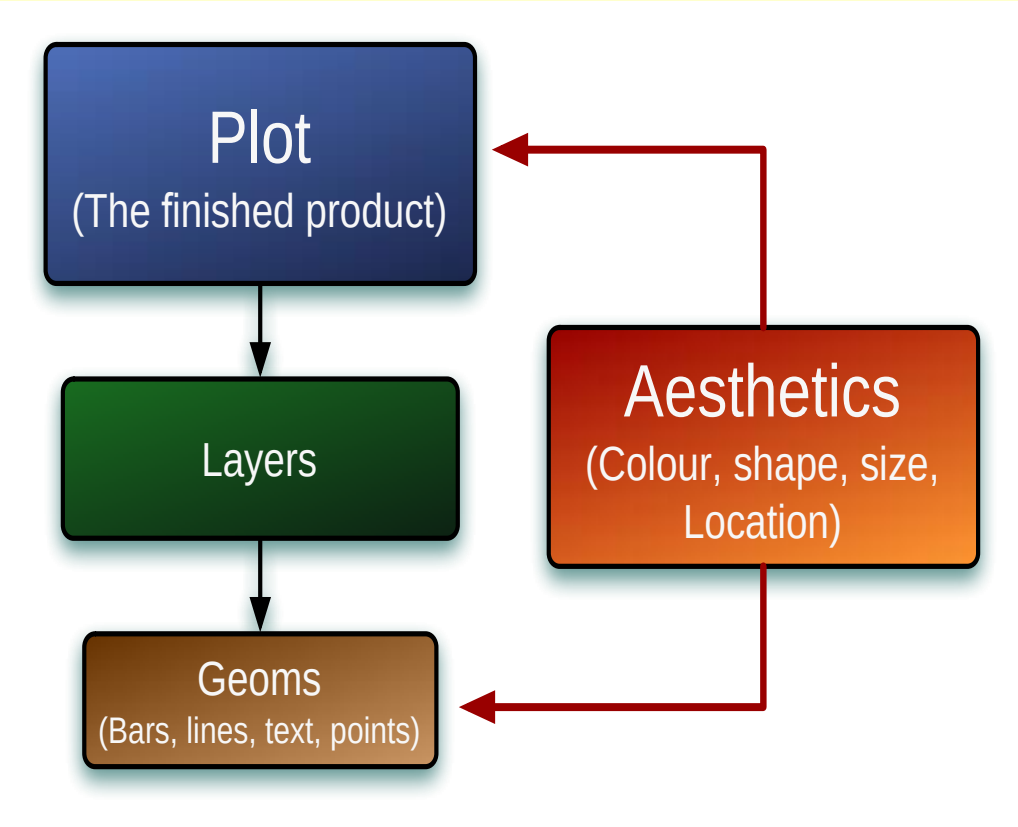
Introduction: ggplot2 creates a series of stacked layers



ggplot creates more versatile graphs.

Graphs with R Package ggplot2

The anatomy of a graph:



Geometric elements:
Basic graph elements (bars, lines, points, text) are known as geoms

Aesthetics elements:
Control the appearance of the graph layers (color, size, shapes)

Geometric Objects in ggplot2

Geoms: (See Table 4.1 in Field Textbook)

- There is a variety of geometric objects (e.g., geom_point(), geom_line(), geom_bar(), ...
- Each geom is followed by brackets "()", indicating that they can accept aesthetics attributes.

Required aesthetics: the variables involved in the plot (others will take on the default values, unless specified)

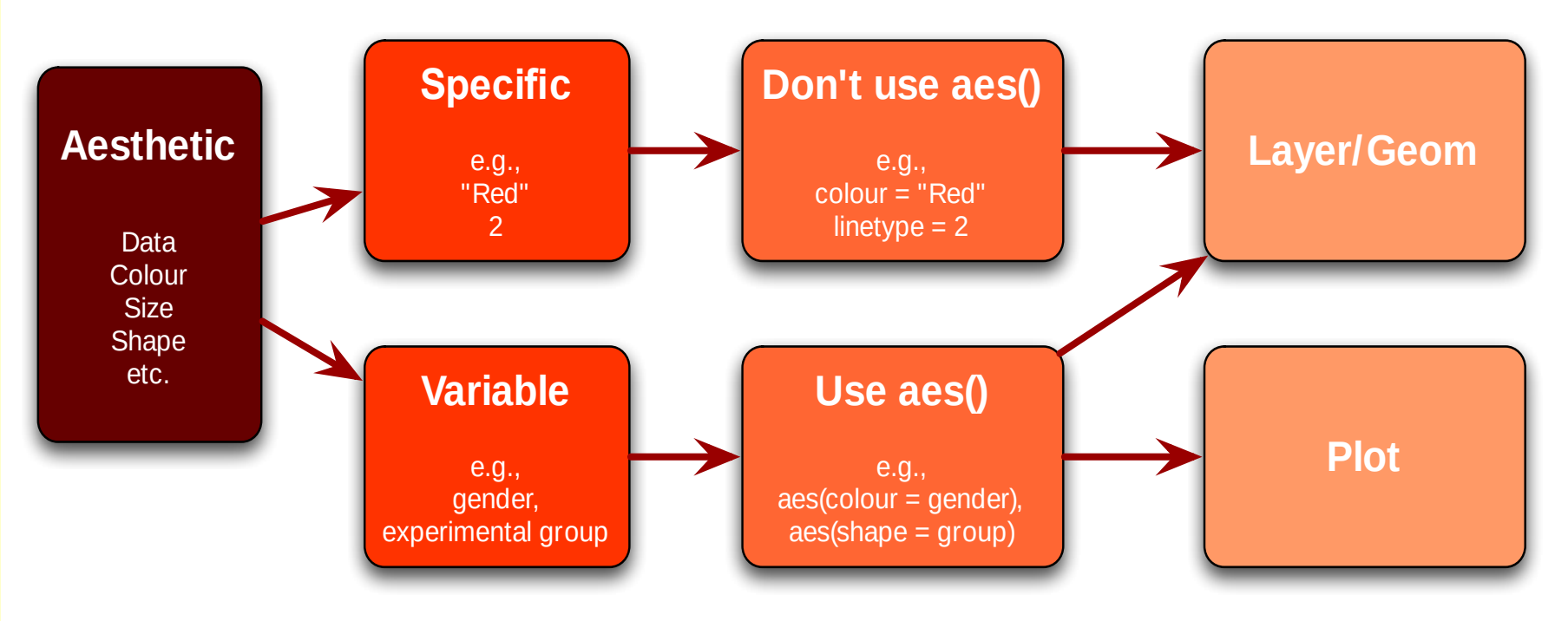
Optional aesthetics: Over-ride default values, determine color of the geom, color to fill geom, type of line used...

(See Optional Aesthetics Table 4.2 in Field Textbook)

Geometric Objects in ggplot2

Specifying aesthetics in ggplot2:

- Specific settings apply to entire figure; do not use aes()
- Variable settings defined by a changing variable; use aes()



Anatomy of ggplot() function

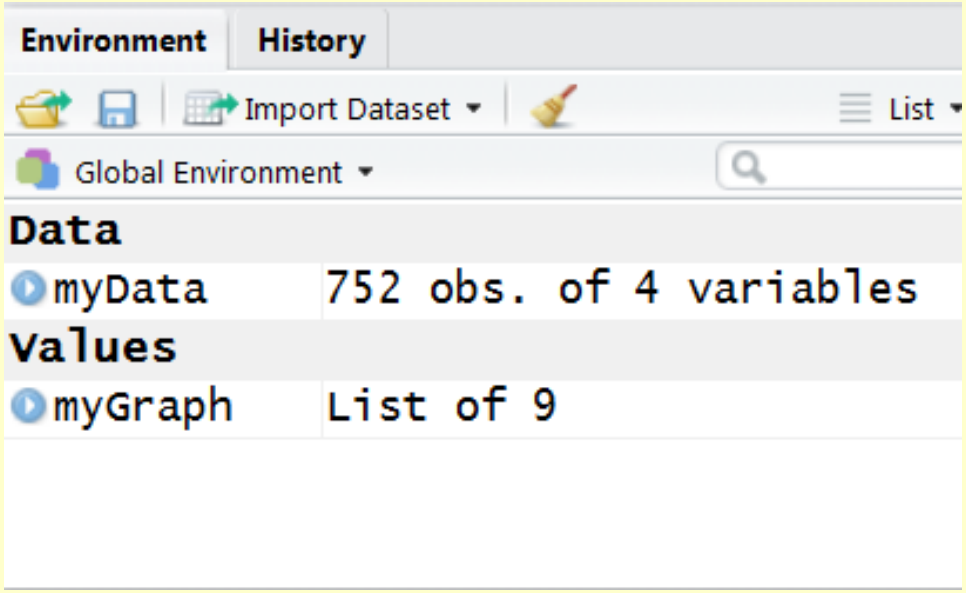
1) Create object that specifies the plot. You can set any aesthetic properties that apply to all layers (geoms) in plot.

```
myGraph <- ggplot(myData, aes())
```

```
myGraph <- ggplot(myData, aes(x variable, y variable))
```

NOTE: We created a graph object, called myGraph, but it has no graphical elements and it cannot be plotted.

We need to add other layers, with the necessary graphical elements: figure, bars, labels



Anatomy of ggplot() function

2) Add options, like a title: + opts (title = "Title")

3) Add other layers, using the "add" symbol (+):

options, like a title: + opts (title = "Title")

```
myGraph <- ggplot(myData, aes())
```

```
myGraph <- ggplot(myData, aes(x variable, y variable))
```

NOTE: This command has created a graph object, called myGraph, which has no graphical elements and cannot be plotted. We need to add other layers, with the necessary graphical elements, before we can plot this figure.

Examples of ggplot() function

Goals: In this assignment, you will practice creating 4 types of figures, using ggplot function:

- 1. Scatterplots
- 2. Histograms
- 3. Boxplots / Density Plots
- 4. Error bar charts

1. Scatterplots with ggplot()

- Use Dataset "ExamAnxiety.xlsx"
  - Anxiety and exam performance
  - Participants:
    - 103 students
  - Measures
    - Time spent revising (hours)
    - Exam performance (%)
    - Exam Anxiety (the EAQ, score out of 100)
    - Gender

1a. Scatterplots with ggplot()

- Imported "ExamAnxiety" with Rcmdr and renamed it "examData"

- To make scatterplot of Anxiety and Exam:

```
scatter <- ggplot(examData, aes(Anxiety, Exam))
```

- This creates an object using the examData dataframe, and the variables Anxiety and Exam. However, no plot is created… yet.
- To print the figure, you need to add a layer with a visual element to the scatter object.

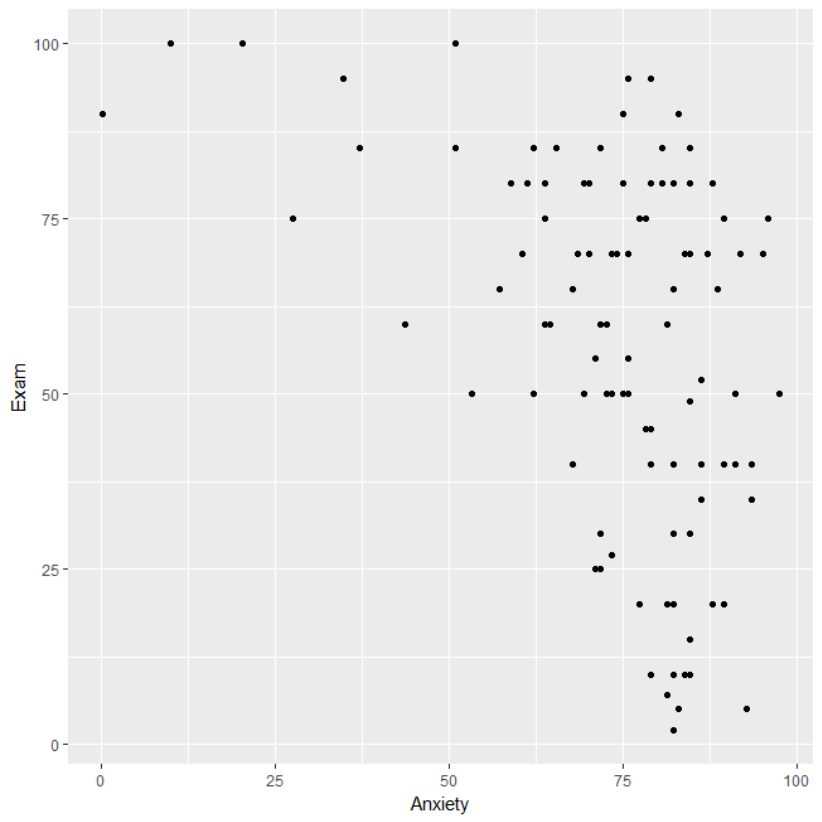
1a. Scatterplots with ggplot()

- To print the scatterplot of Anxiety and Exam

Add the dots using the geom_point() function:

scatter + geom_point()

This command creates a simple scatterplot

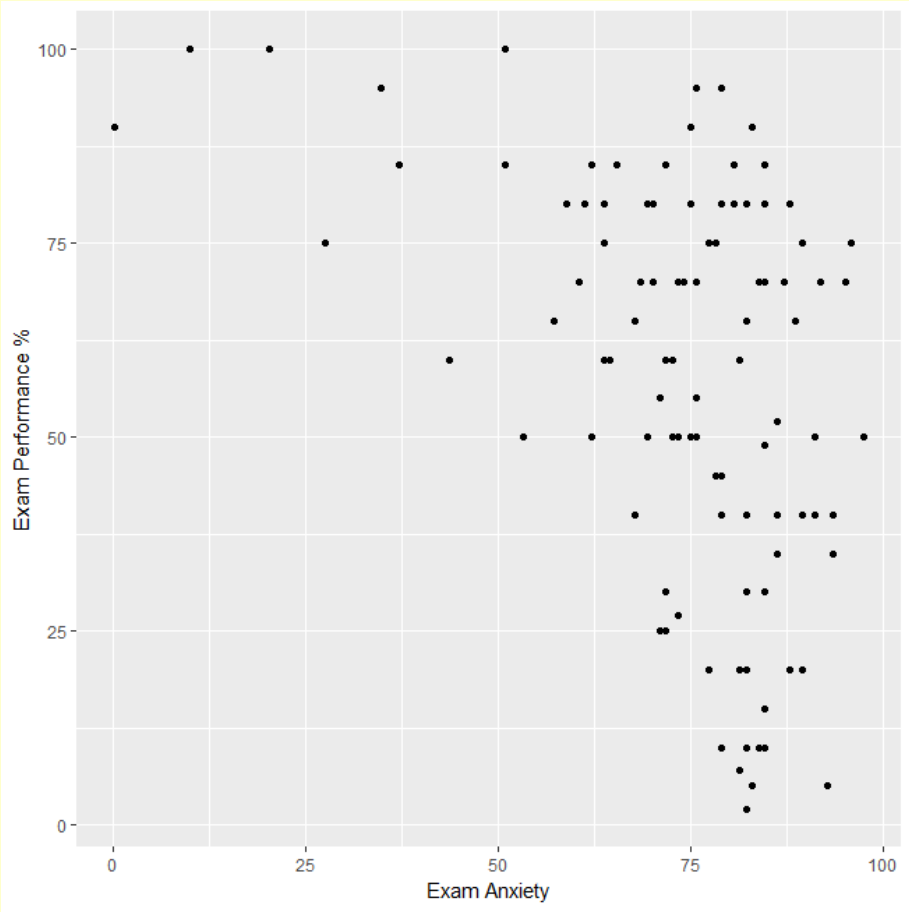


1a. Scatterplots with ggplot()

- To add labels to the scatterplot

Use the labs() function:

```
scatter + geom_point() +
labs(x = "Exam Anxiety",
y = "Exam Performance %")
```

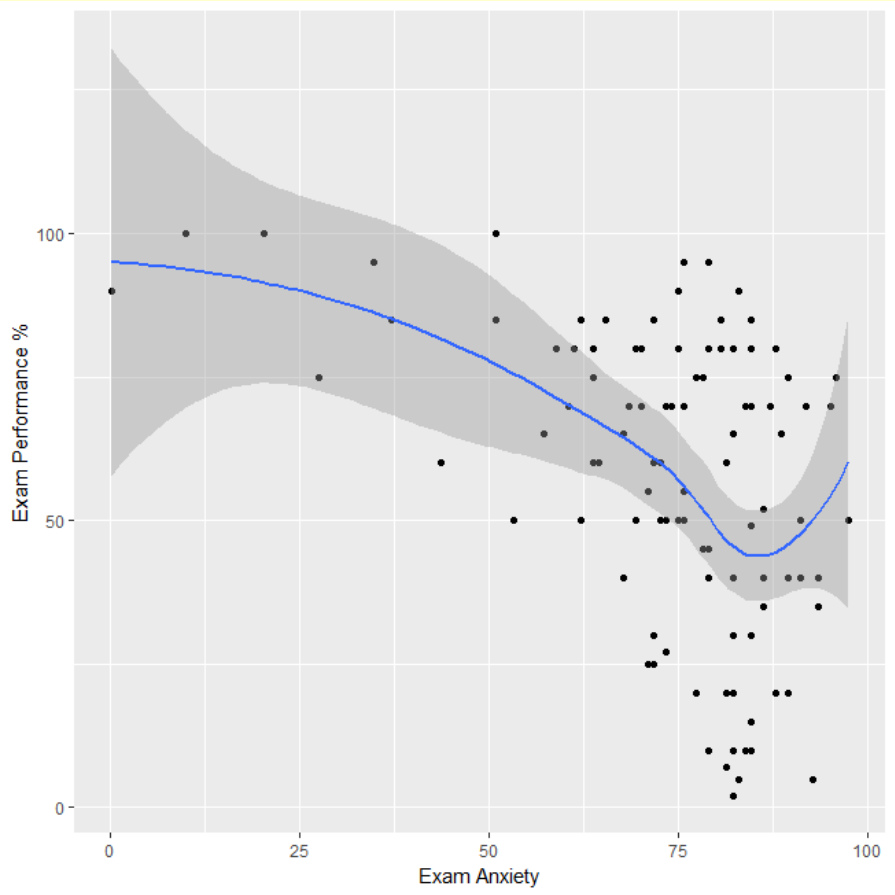


1a. Scatterplots with ggplot()

- To add a smooth line through the data

Use the geom_smooth() function:

```
scatter + geom_point() +
geom_smooth() +
labs(x = "Exam Anxiety",
y = "Exam Performance %")
```

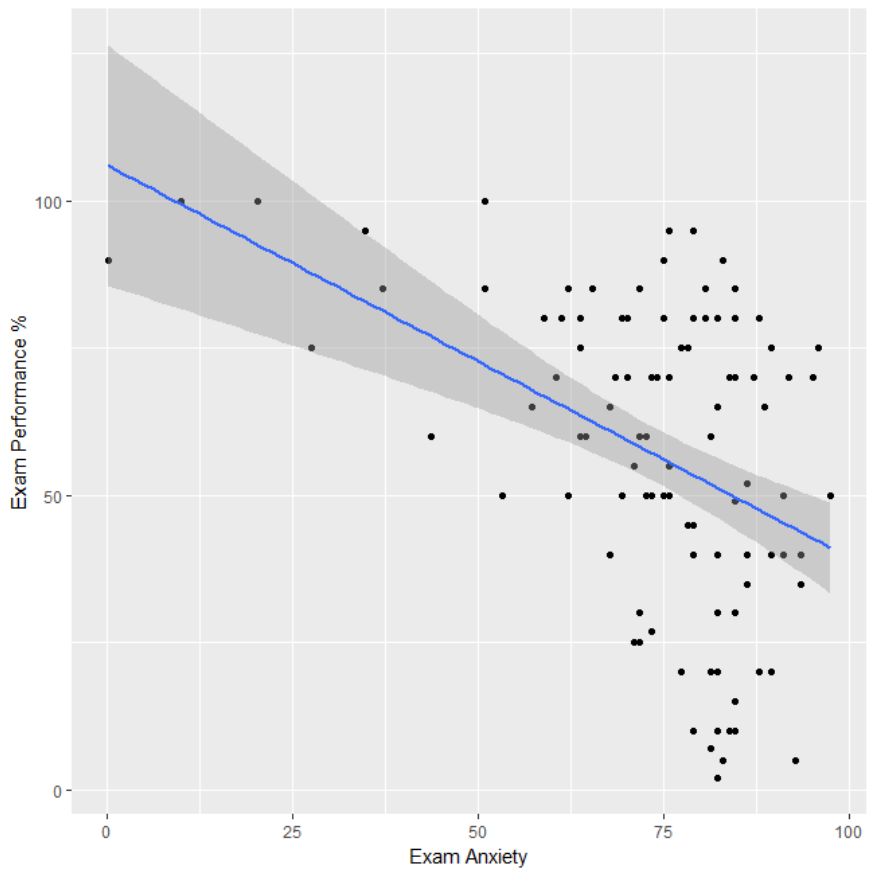


1a. Scatterplots with ggplot()

- To add a straight line through the data:

Modify the geom_smooth() Function, by defining the method as “lm”

```
scatter + geom_point() +
geom_smooth(method = “lm”) +
labs(x = "Exam Anxiety",
y = "Exam Performance %")
```



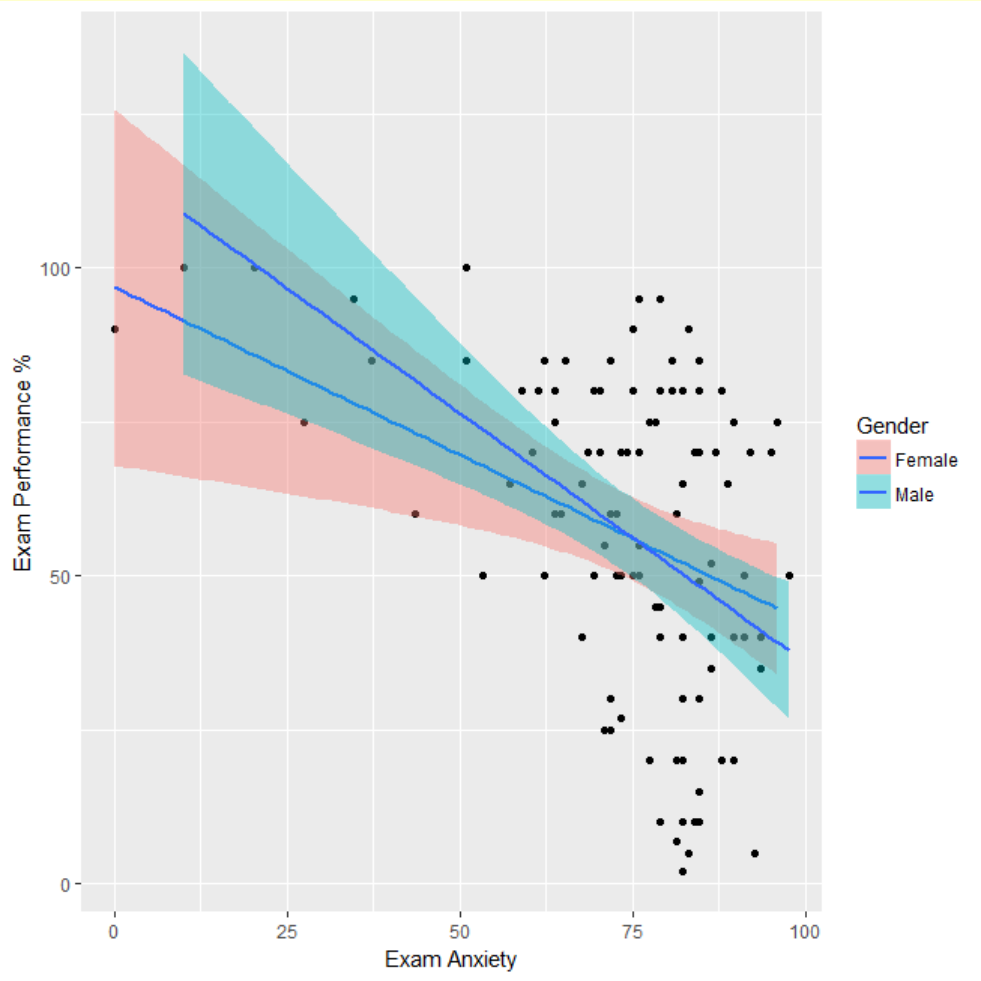
1b. Scatterplots with ggplot()

- Grouped Scatterplot:

Create two scatterplots, with the male / female data plotted separately

```
scatter <- ggplot(examData,
aes(Anxiety, Exam,
colour = Gender))

scatter + geom_point() +
geom_smooth(method = "lm",
aes(fill = Gender)) +
labs(x = "Exam Anxiety",
y = "Exam Performance %",
colour = "Gender")
```



2a. Histograms with ggplot()

- Imported "MusicFestival.xlsx" with Rcmdr and renamed it "festival"

- To make histogram of the daily data:

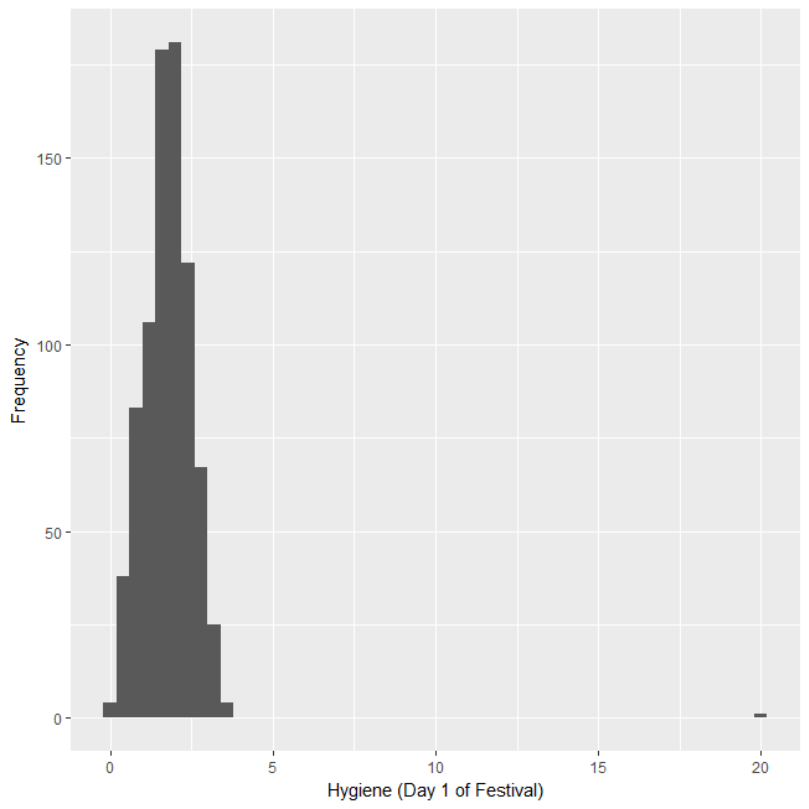
```
festivalHistogram <- ggplot(festival, aes(day1))
```

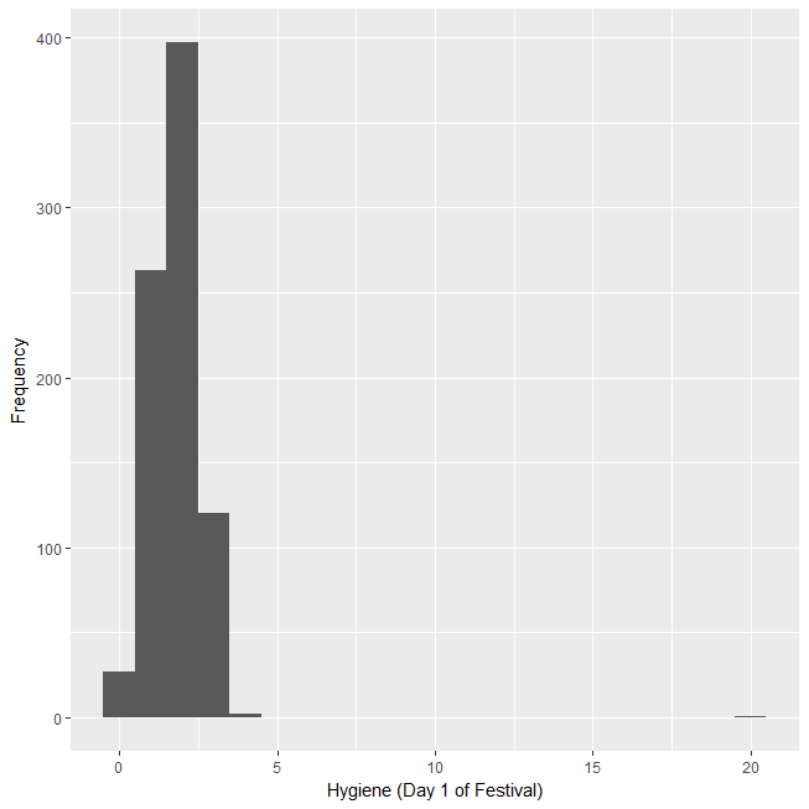
- This command creates plot object for day1:
- To print the figure, you need to add a layer with a visual element to the scatter object.

```
festivalHistogram + geom_histogram(binwidth = 0.4 )
+ labs(x = "Hygiene (Day 1 of Festival)", y = "Frequency")
```

2a. Histograms with ggplot()

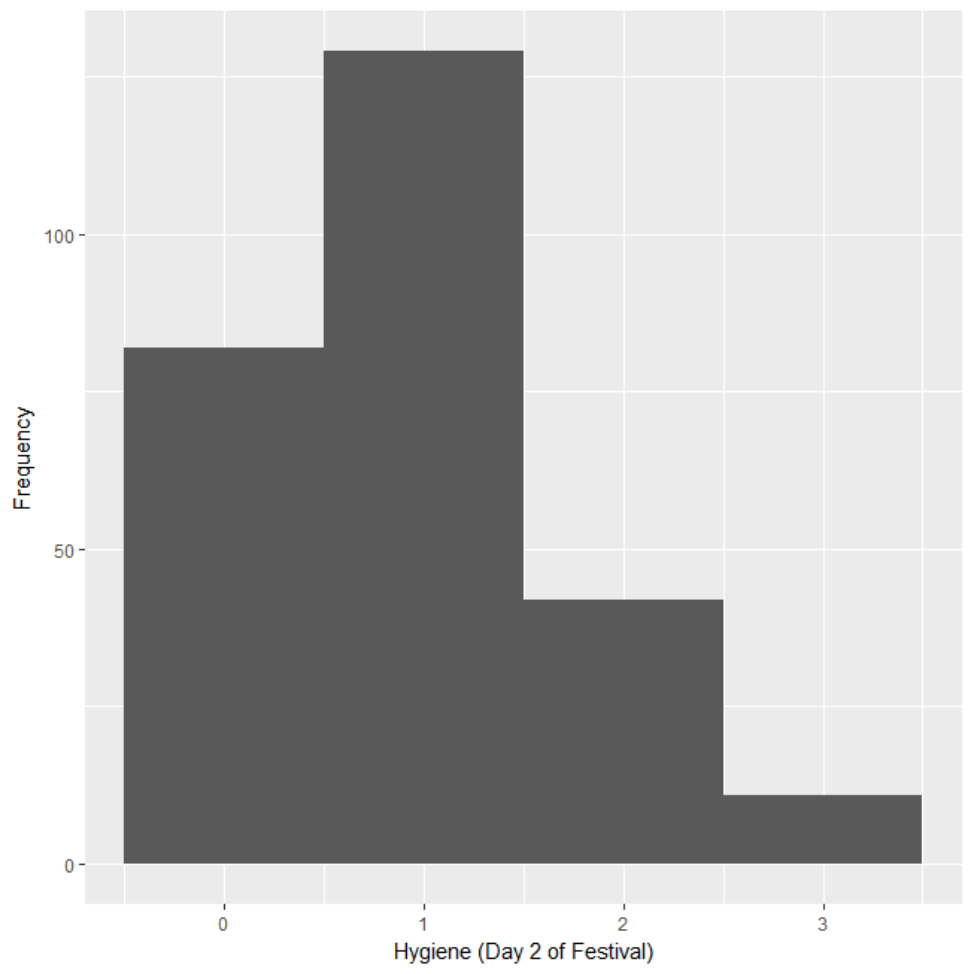
- Modify this Histogram to have a binwidth of 1





2b. Histograms with ggplot()

- Make Histogram of day2 data with binwidth of 1



3a. Boxplots with ggplot()

- Make boxplots of males / females using the Day1 data from the MusicFestival dataset.

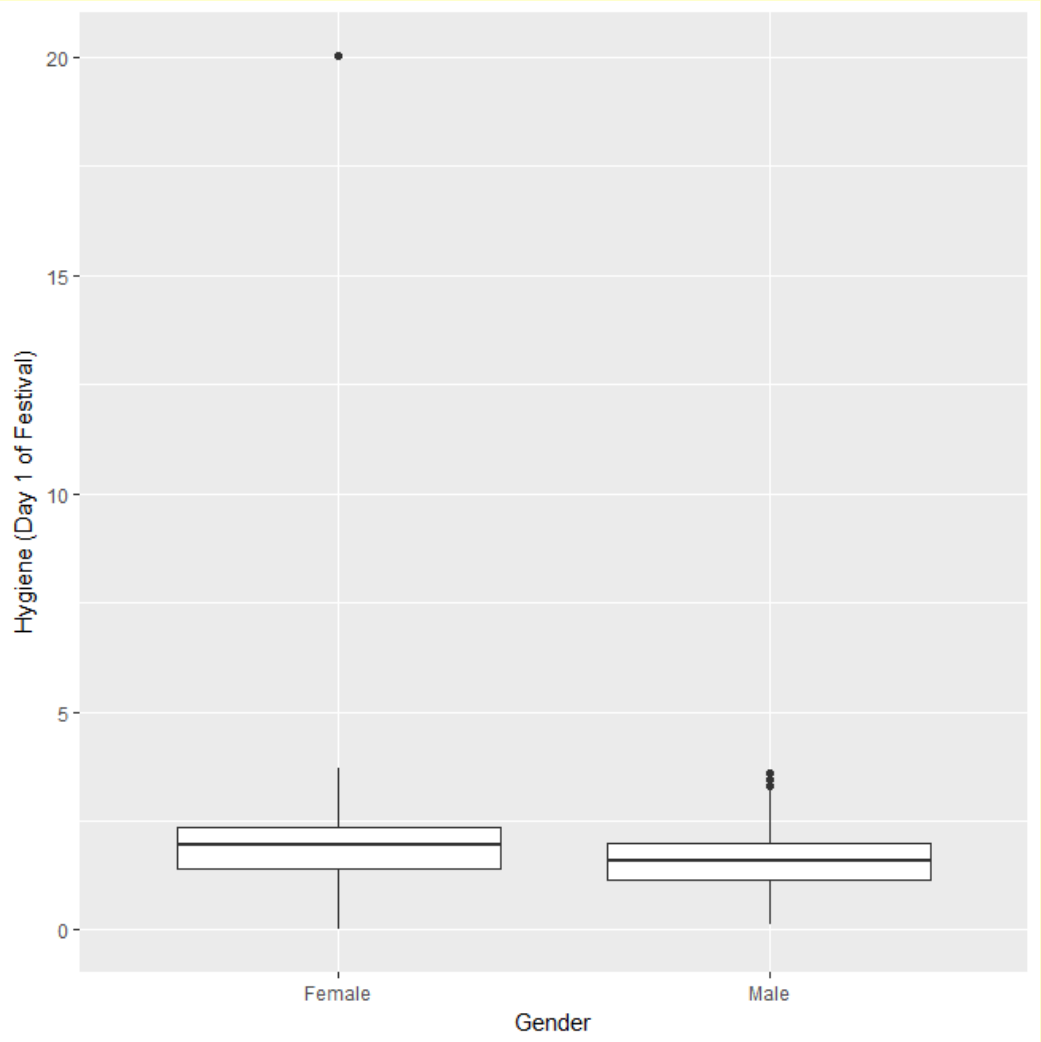
```
festivalBoxplot <- ggplot(festival, aes(gender, day1))
```

- This command creates box plot object for day1:
- To print the figure, you need to add a layer with a visual element to the boxplot object.

```
festivalBoxplot + geom_boxplot() +
labs(x = "Gender", y = "Hygiene (Day 1 of Festival)")
```

3a. Boxplots with ggplot()

- Make a boxplof of day1 data by gender



3b. Density plot with ggplot()

- Make density plots of males / females using the Day1 data from the MusicFestival dataset.

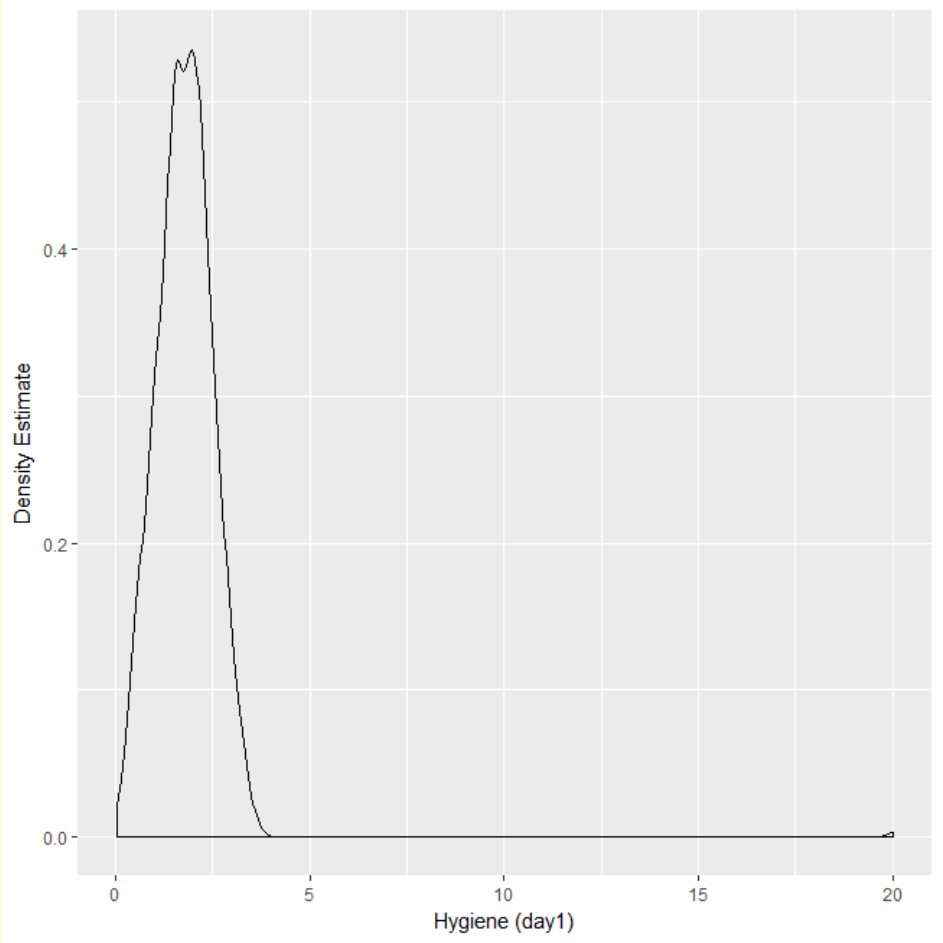
```
festivalDensity <- ggplot(festival, aes(day1))
```

- This command creates density plot object for day1:
- To print the figure, you need to add a layer with a visual element to the boxplot object.

```
festivalDensity + geom_density() +
labs(x = "Hygiene (Day 1)", y = "Density Estimate")
```

3b. Density plots with ggplot()

- Make a density plof of day1



4a. Bar Charts with ggplot()

- Load the ChickFlick.xlsx dataset, which involves the following data (1 dependent variable and 2 independent variables: movie and gender):

  - Question: Is there such a thing as a 'chick flick'?
  - Participants:
    - 20 men
    - 20 women
  - Half of each sample saw one of two films:
    - A 'chick flick' (*Bridget Jones's Diary*),
    - A control film (*Memento*).
  - Outcome measure
    - Physiological arousal as an indicator of how much they enjoyed the film.

4a. Bar Charts with ggplot()

- First, make bar of mean arousal score (y-axis) for each film (x-axis), combining male / female data)

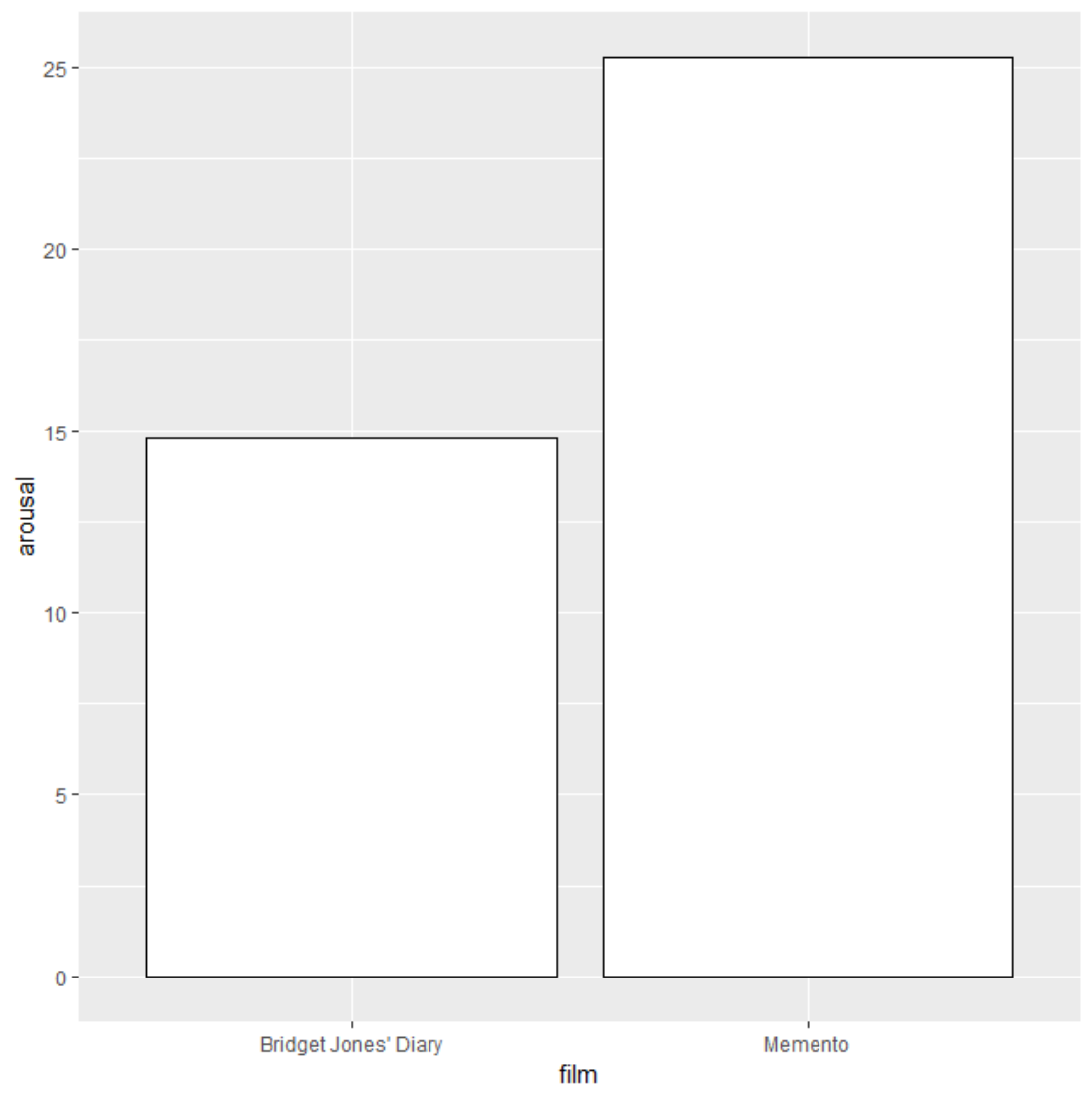
```
bar <- ggplot(chickFlick, aes(film, arousal))
```

- To add the mean displayed as bars, we add a layer to *bar* using the *stat_summary()* function:

```
+ bar + stat_summary(fun.y = mean, geom = "bar", fill = "White",
colour = "Black“)
```

- NOTE: the bars are white with a black outline

4a. Bar Charts with ggplot()



4a. Bar Charts with ggplot()

- Next, add 95% confidence intervals to the bars:

```
+ stat_summary(fun.data = mean_cl_normal, geom = "pointrange")
```

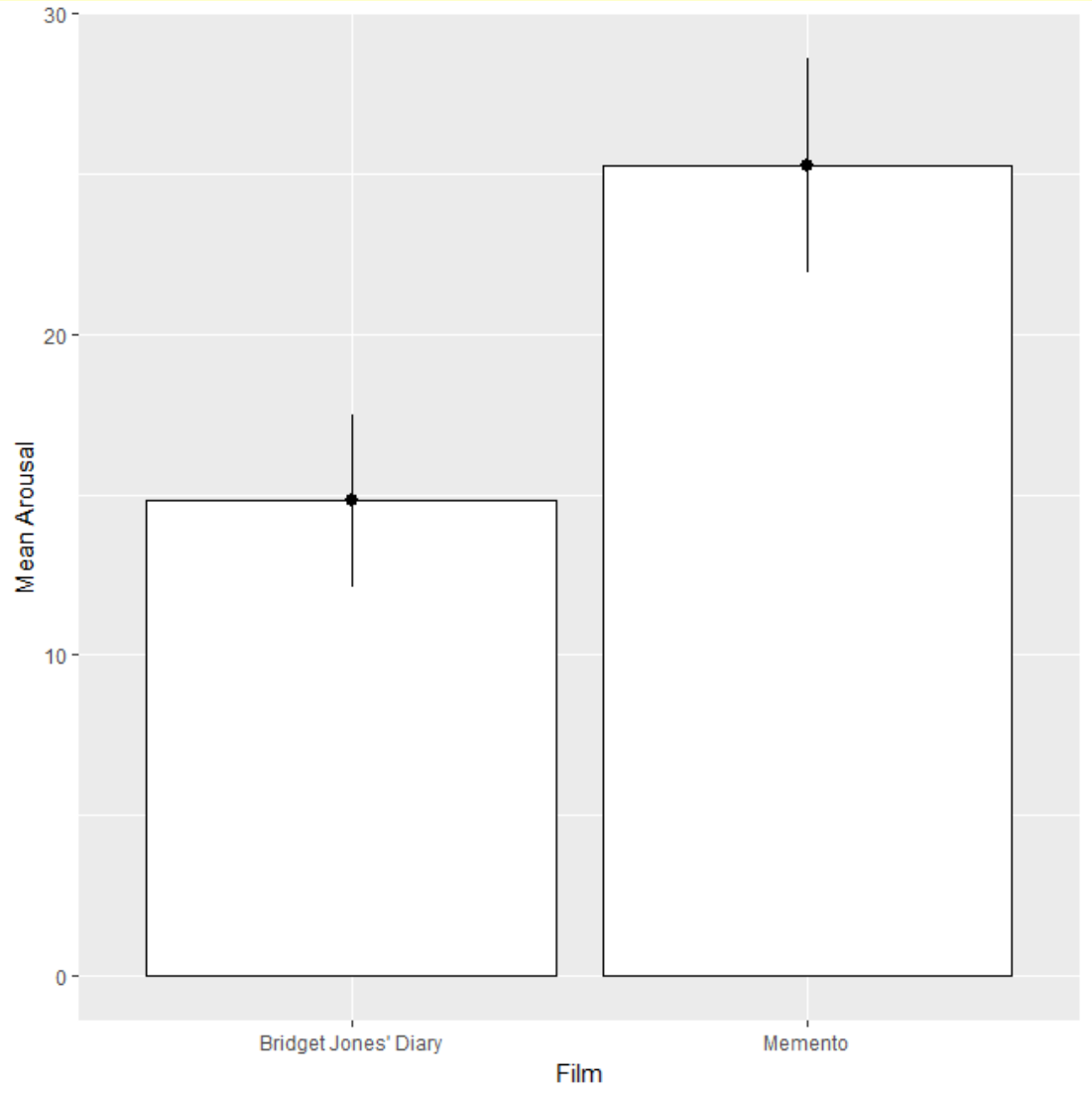
- Finally, add labels to the graph using *lab()*:

```
+ labs(x = "Film", y = "Mean Arousal")
```

- The overall command is as follows:

```
bar + stat_summary(fun.y = mean, geom = "bar", fill = "White",
colour = "Black") + stat_summary(fun.data = mean_cl_normal,
geom = "pointrange") + labs(x = “Film", y = "Mean Arousal")
```

4a. Bar Charts with ggplot()



4b. Bar Charts with ggplot()

- Finally, make bar graph of mean arousal score (y-axis) for the two genders (x-axis), combining both films).

Makethe same plot, with 95% CI error bars.

4c. Bar Charts with ggplot()

- First, make bar of mean arousal score (y-axis) for each film and gender (x-axis)

```
bar <- ggplot(chickFlick, aes(film, arousal, fill = gender))
```

- To add the error bars and the legend, use this:

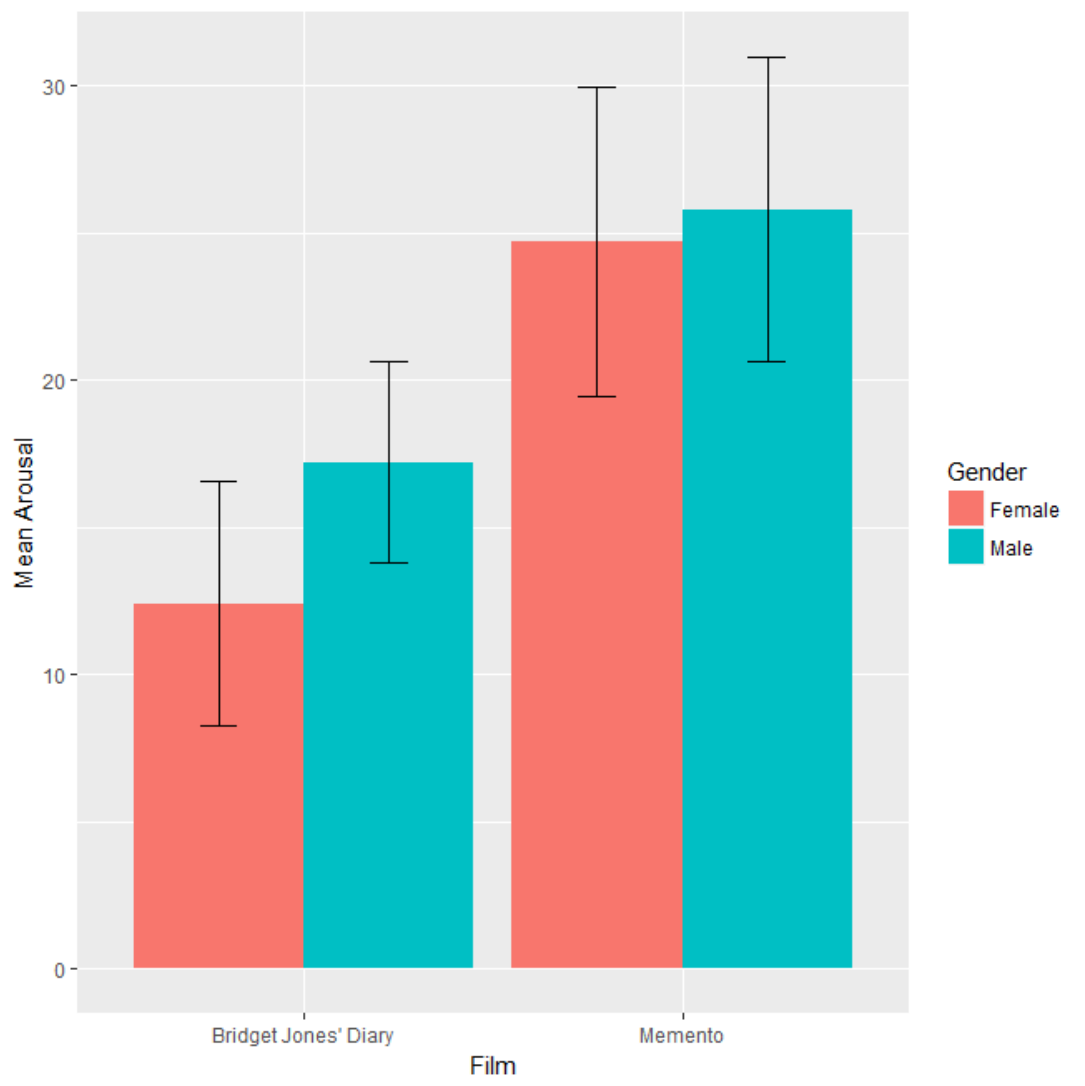
```
bar + stat_summary(fun.y = mean, geom = "bar",
position="dodge") + stat_summary(fun.data =
mean_cl_normal, geom = "errorbar", position =
position_dodge(width = 0.90), width = 0.2) + labs(x =
"Film", y = "Mean Arousal", fill = "Gender")
```

- NOTE: the bars are the default colors (red / blue)

4c. Bar Charts with ggplot()

- Bar graph of mean arousal score (y-axis) with 95% CI for each film and gender combination (x-axis)

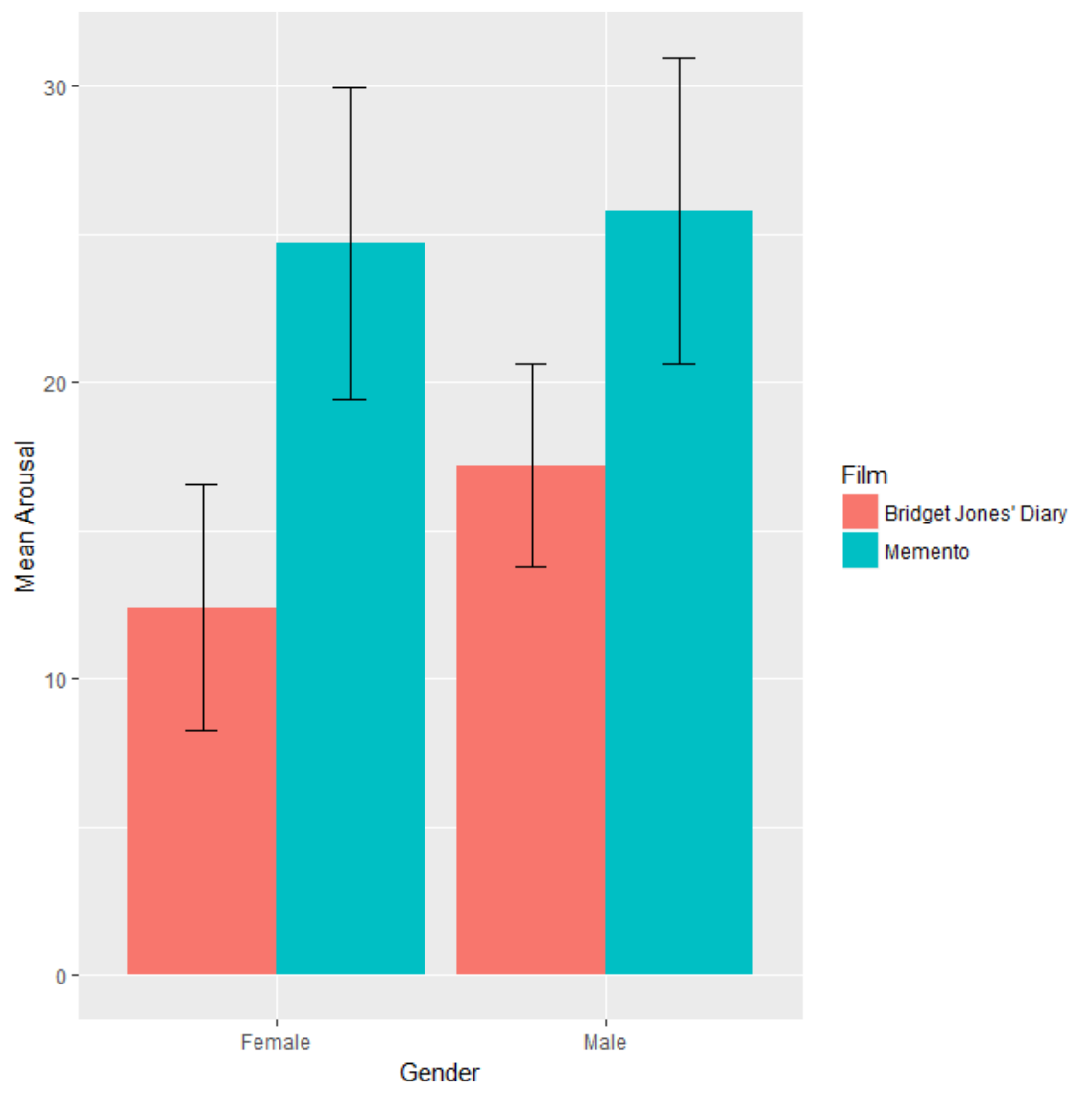
- NOTE:
  bars are the default colors (red / blue)



4d. Bar Charts with ggplot()

- Bar graph of mean arousal score (y-axis) with 95% CI for each film and gender combination (x-axis)

- NOTE:
  bars are the default colors (red / blue)



Graphs with R Package ggplot2

References:

https://cran.rproject.org/web/packages/ggplot2/ggplot2.pdf

http://ggplot2.org/

Other Resources:

You might also find the following presentations useful:

ggplot2: past, present and future.

ggplot2 workshop given at Vanderbilt, 2007. (r code)