Base R Graphics

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COMPASS Workshops

Computing for Data Analysis in the Social Sciences

- Free, open-source statistical programming and data analysis workshops using R and RStudio
- Open to everyone with a Princeton ID
- No programming experience is necessary or expected
- Attendees should bring a laptop computer to fully participate in the workshops

COMPASS Workshops

Computing for Data Analysis in the Social Sciences

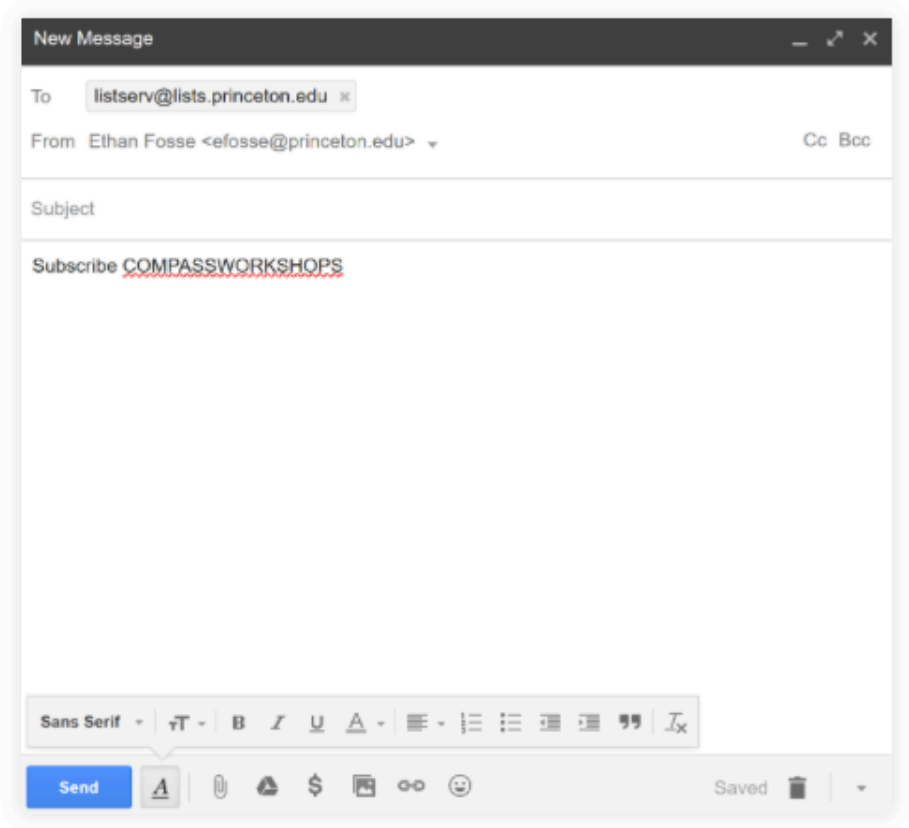
OVERVIEW

The COMPASS Workshops are a series of free, open-source statistical programming and data science workshops held weekly during the academic year at Princeton University. Supported by the Department of Sociology, Department of Politics, and the Office of the President, the workshops focus on using R with RStudio in a variety of real-world applications relevant to social scientists. Topics covered include data wrangling, data visualization, Monte Carlo simulations, linear regression, social network analysis, and text mining.

The COMPASS Workshops are held on **Tuesdays** from **7:30 to 9:00pm** at **Friend Center Auditorium 101** at Princeton University during the academic year. The workshops are open to all students, staff, and affiliates of Princeton as well as the larger research community. To fully participate in the workshops attendees should bring a laptop.

To find out more about the workshops, join the COMPASS Workshops mailing list by sending an email to listserv@lists.princeton.edu with "Subscribe COMPASSWORKSHOPS" in the body and all other lines blank including the subject.

Our Mailing List



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People

- **Teaching Staff**
  - Ethan Fosse (Research Associate, Department of Sociology)
  - Yunkyu Sohn (Research Associate, Department of Politics)
- **Faculty Sponsors**
  - Margaret Frye (Assistant Professor, Department of Sociology)
  - Kosuke Imai (Professor, Department of Politics)
  - Marc Ratkovic (Assistant Professor, Department of Politics)
  - Matthew Salganik (Professor, Department of Sociology)

Todays' Contents

1. Before You Begin
2. Today's Project
3. Things to Cover
4. Learning by Doing
5. Research Questions

Before You Begin

1. You should have a computer with Internet connection.
2. You should have R and RStudio (latest version preferred) installed.
3. Download Slides and Codes for Week 3 (right click -> save as) at https://compass-workshops.github.io/info/
4. Start Rstudio

That's all!

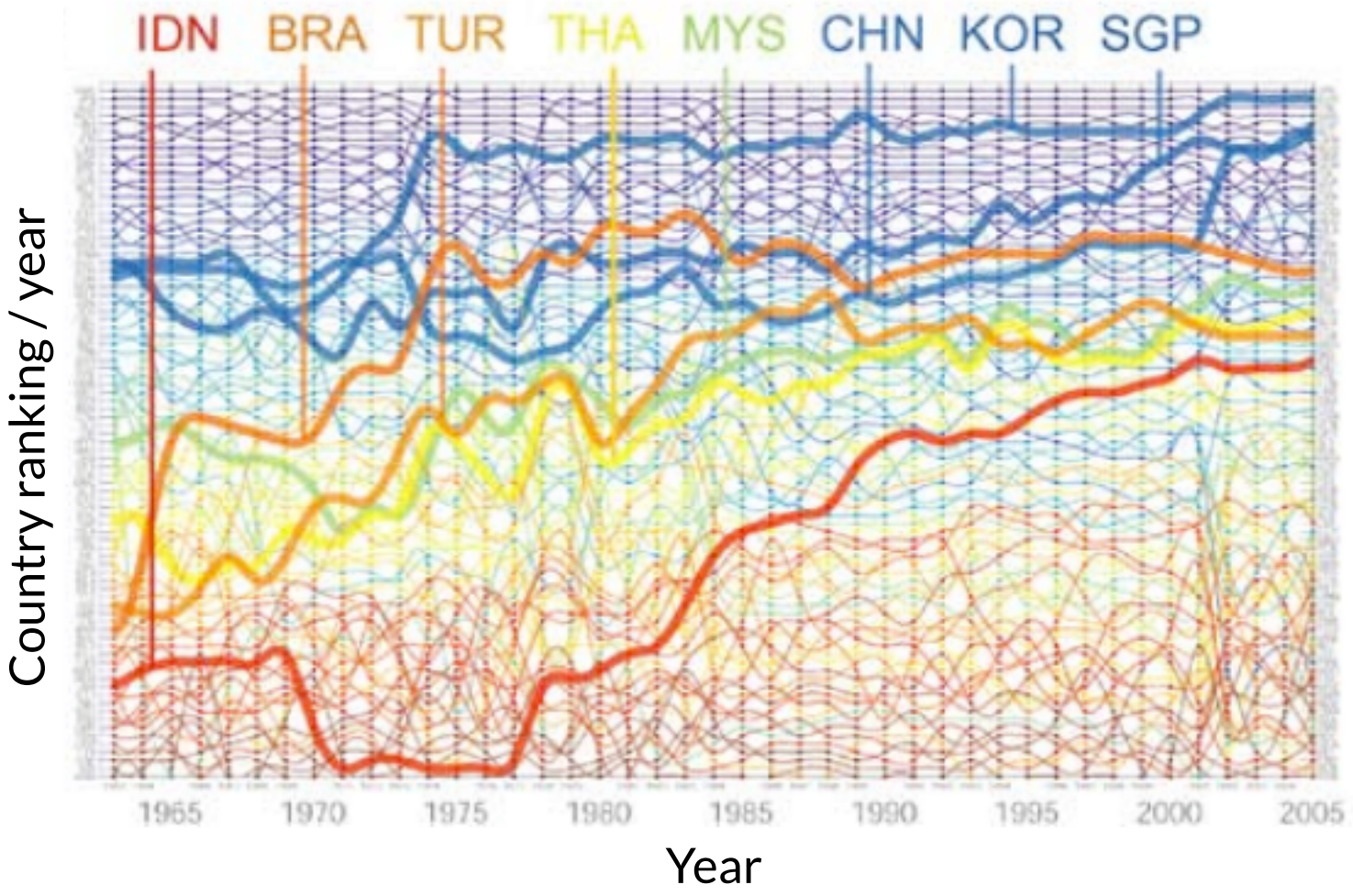
Motivation

A dataset is just a collection of numbers and strings (very complex not understandable in its naïve format). In order to understand the systemic patterns behind a dataset, we use statistics and graphs (simpler understandable).

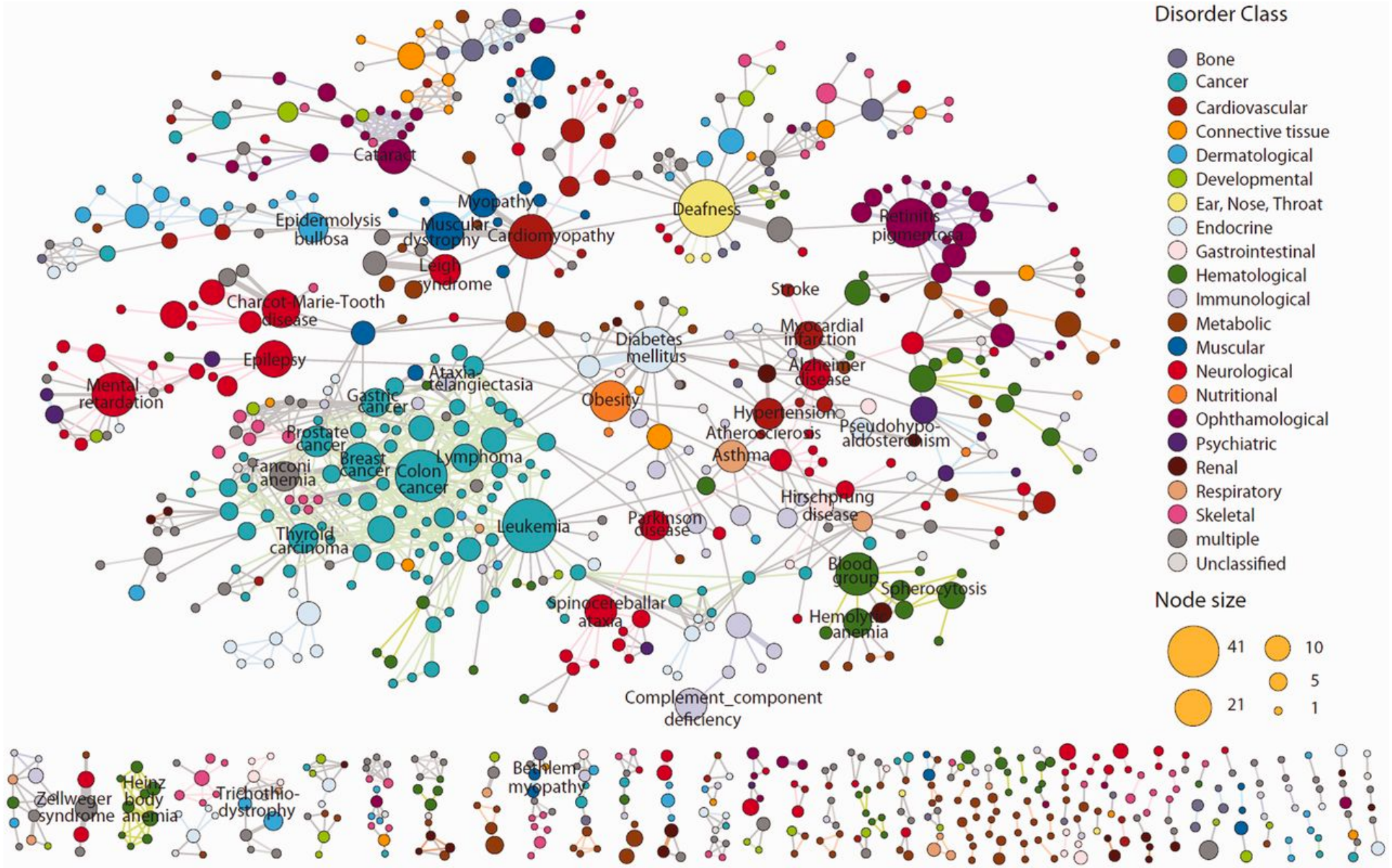
Power of Graphs

Often, graphs convey more information with less complexity in a very effective way.

Evolution (Ranking) of Industrial Complexity

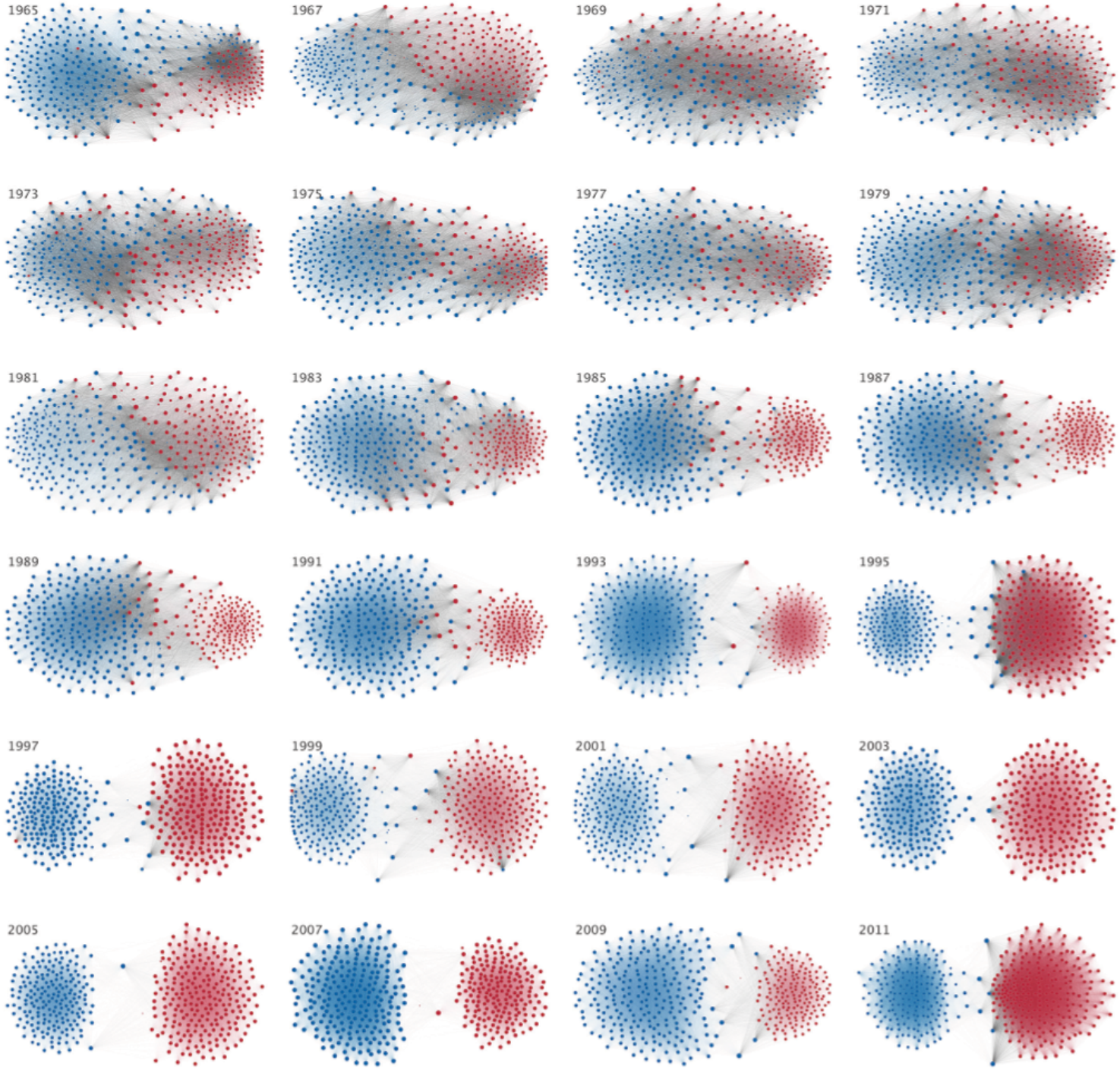


Hidalgo and Hausmann (2009)



Two disease nodes (circles) are connected if they share a common genetic component according to disorder disease-gene associations list

Koh et al (2007)



Rise of Polarization in US House

Blue: Democrat

Red: Republican

Tie weight: roll call vote similarity

Layout: High weight pairs more likely to be located closely.

Andris et al (2015)

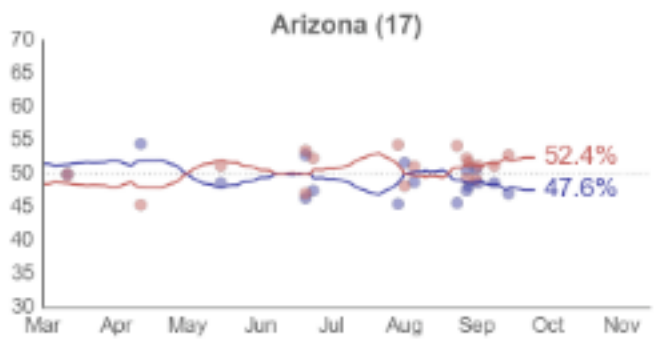
Things to Cover :: Base R Graphics

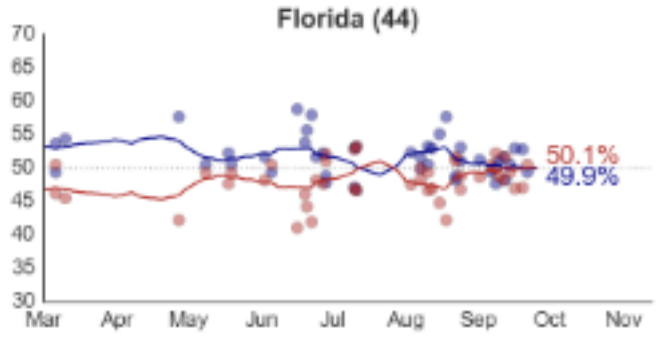
- Bar plot
- Box plot
- Scatter plot
- Histogram

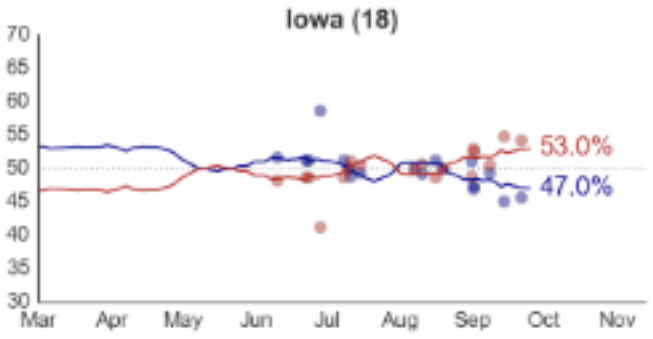
Project 1

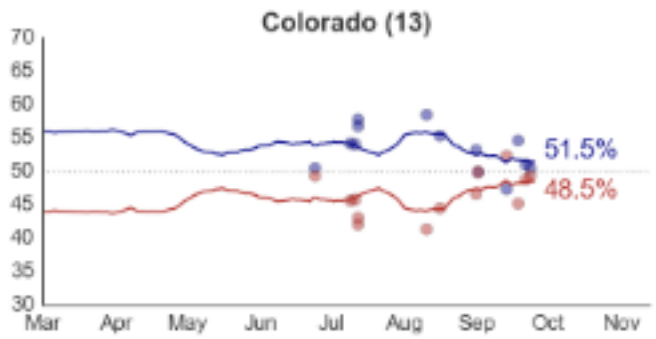
State-level Polls

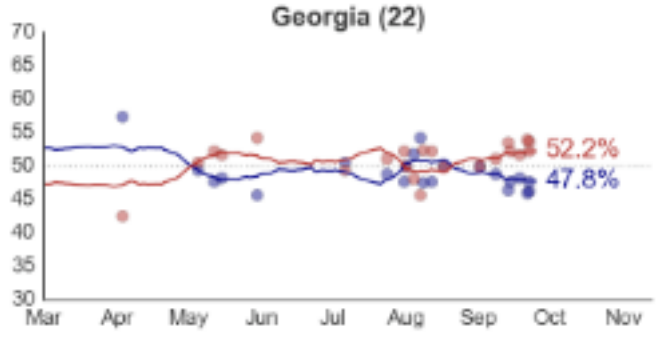
Generic Approach to Election Prediction

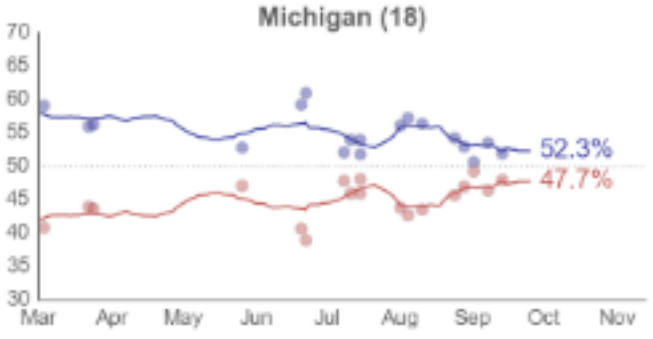








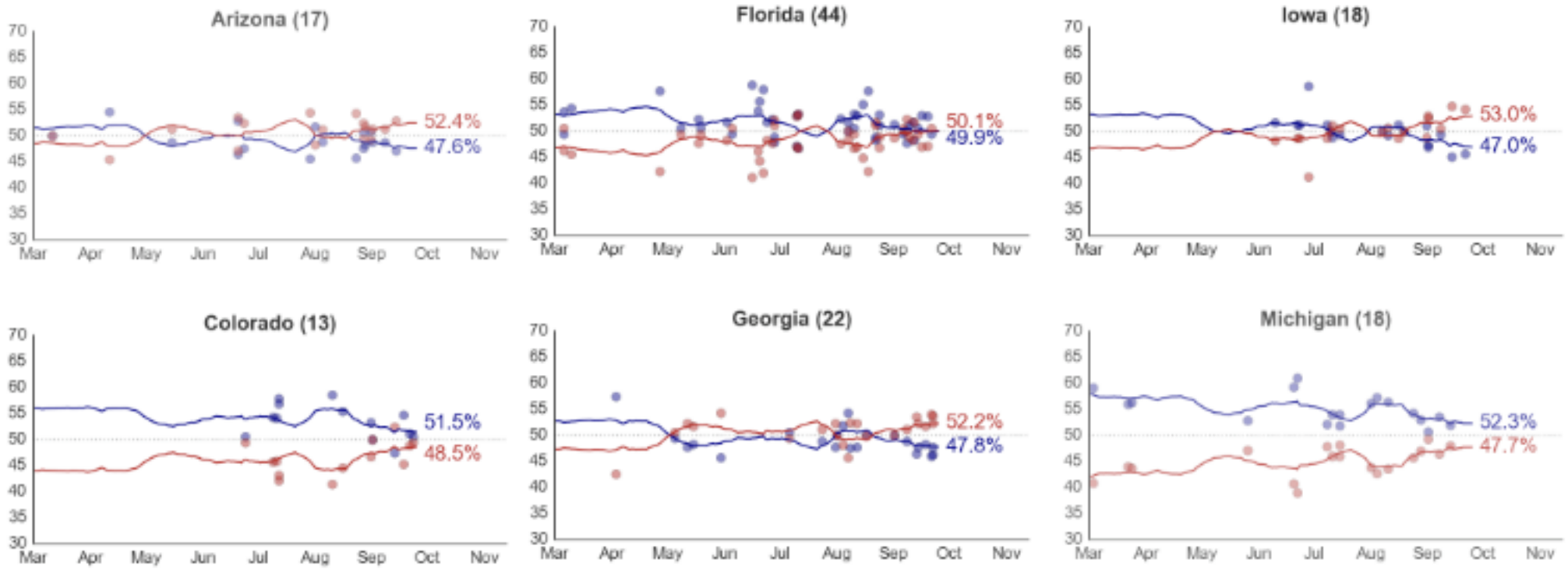




VOTAMATIC

Polling Analysis and Election Forecasting

Generic Approach to Election Prediction



Statistical **aggregation** of state **poll** results over time

Download the Dataset/Slides/Codes

https://compass-workshops.github.io/info/

1. Right click on Week 3 Data
2. Save as to a preferred location

Make sure you know the location!

Downloaded from http://election.princeton.edu/

Get back to Rstudio: Loading your Dataset

Task 1: Convert the downloaded CSV (Comma Separated Values) File into an R object.

```
rm(list=ls())
## Delete your workspace
getwd()
## Check your current working directory
setwd("<location of your dataset>")
## Set your working directory
polls = read.csv("2016_StatePolls_final.csv")
## Load data
```

Quick Inspection of Poll Data Frame

```
polls         1345 obs. of 19 variables
 State : Factor w/ 34 levels "AK","AZ","CA",.…
 pollster : Factor w/ 208 levels "Abt SRBI Inc…
 pop : int 409 2609 2712 2777 4092 2419 1823 1…
 vtype : Factor w/ 3 levels "Adults","Likely V…
 method : Factor w/ 8 levels "Automated Phone"…
 begmm : int 11 11 11 11 11 11 11 11 11 11 ...
 begdd : int 1 1 1 1 1 1 1 1 1 1 ...
 begyy : int 2016 2016 2016 2016 2016 2016 201…
 endmm : int 11 11 11 11 11 11 11 11 11 11 ...
 enddd : int 7 7 7 7 7 7 7 7 7 7 ...
 endyy : int 2016 2016 2016 2016 2016 2016 201…
 trump : num 48 42 31 40 45 45 35 52 47 49 ...
 clinton : num 31 45 56 43 47 45 52 35 38 36 .…
 other : num NA NA NA NA NA NA NA NA NA NA ...
 undecided: num NA NA NA NA NA NA NA NA NA NA
 Begdate : Factor w/ 205 levels
 Enddate : Factor w/ 200 levels "1/18/2016","1…
 Middate : Factor w/ 196 levels "1/15/2016","1…
 etc : num 21 13 13 17 8 10 13 13 15 15 ...
```

pop : int 409 2609 2712 2777 4092 241
1823 1700 1781 1311 ...

```
View(polls)
## Spreadsheet-style data viewer
summary(polls)
## Summarize variables on your console
names(polls)
## Names of all variables
dim(polls)
nrow(polls)
ncol(polls)
## Dimensional information
head(polls)
tail(polls)
```

Generate etc for miscellaneous responses

```
summary(polls$other)
summary(polls$undecided)
polls$etc<-100-polls$trump-polls$clinton
```

- Now polls$etc contains rest of the responses other than Clinton and Trump

plot command structure

```
plot_command(command-specific,main="title",xlab="xlabel",ylab="ylabel")
```

e.g.
- plot
- barplot
- pie
- hist

e.g.
- single variable, x
- multiple variables: x,y
- variables, **parameters**

generic parameters
- symbol
- color
- line style
- line width
- ……

plot.new() :: starting a new plot

```
plot.new()
```

dev.off() :: reset/complete graphic device

```
dev.off()
```

barplot() :: values by factor

```
barplot(table,main="title",xlab="xlabel",ylab="ylabel")
```

N by 2 table:
[categorical, numeric]

e.g.

States	Frequency

factor

numeric value

Question 1

- Are contested states more likely to be polled?

  (with the assumption that our dataset contains almost all of the poll records w/o bias)

```
Goal: First compute the frequency table of polling by state
table(polls$State)
```

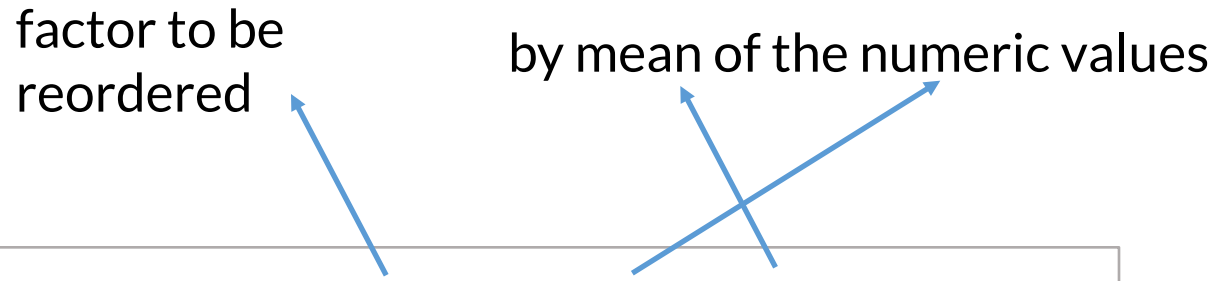
```
barplot(table(polls$State),main="Unordered")
## simple bar plot (Q: what is the order in the x values?)
```

- Goal: Reorder x values depending on support rate

Question 1

- Are contested states more likely to be polled?

(with the assumption that our dataset contains almost all of the poll records w/o bias)



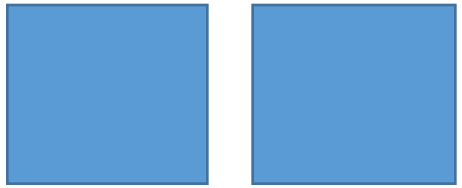

```
polls_r <- transform(polls,State = reorder(State, trump, mean))
## reorder states by Trump support rate
barplot(table(polls_r$State),main="Ordered by %Trump")
## ordered plot!
mean(polls_r$trump[polls_r$State=="MD"])
```

par() :: subplots

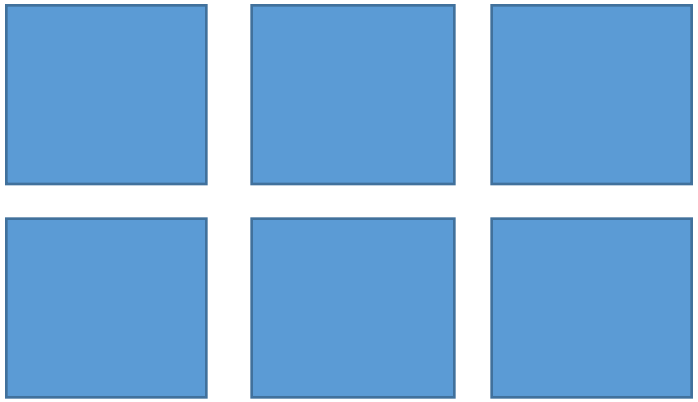
```
par(mfrow=c(#rows,#cols))
```

e.g.

```
par(mfrow=c(1,2))
```



```
par(mfrow=c(2,3))
```



Question 1

- Are contested states more likely to be polled?

  (with the assumption that our dataset contains almost all of the poll records w/o bias)

```
par(mfrow=c(2,1))
barplot(table(polls$State),main="Simple Bar Plot")
barplot(table(polls_r$State),main="Ordered by %Trump")
## with subplot function
```

Project 2

Information for 136 movies released from Hollywood in 2011

Loading your Dataset

Import Hollywood movie dataset using a package **Lock5Data**

```
install.packages("Lock5Data")
## Install package Lock5Data which contains the Hollywood dataset
data(HollywoodMovies2011)
## Load data
movies<- na.omit(HollywoodMovies2011)
## drop all observations with at least one NA
```

Information for 136 movies released from Hollywood in 2011

Quick Inspection of Poll Data Frame

```
movies                    111 obs. of 14 variables
  Movie : Factor w/ 136 levels "30 Minutes or Less",..: 50 73
  LeadStudio : Factor w/ 34 levels "20th Century Fox",..: 24 1
  RottenTomatoes : int 67 68 44 96 90 93 75 35 69 69 ...
  AudienceScore : int 65 58 38 92 77 84 91 58 73 72 ...
  Story : Factor w/ 22 levels "","Comedy","Discovery",..: 10 1
  Genre : Factor w/ 9 levels "Action","Adventure",..: 7 7 4 6
  TheatersOpenWeek : int 2408 3321 3049 4375 2918 944 2534 361
  BOAverageOpenWeek: int 5511 15829 10365 38672 8995 6177 1027
  DomesticGross : num 54 104 100 381 169 ...
  ForeignGross : num 43 98.2 115.9 947.1 119.3 ...
  WorldGross : num 97 202 216 1328 288 ...
  Budget : num 1.5 5 20 125 32.5 17 25 80 27 35 ...
  Profitability : num 64.67 40.38 10.81 10.62 8.87 ...
  OpeningWeekend : num 13.3 52.6 31.6 169.2 26.2 ...
  attr(*, "na.action")=Class 'omit' Named int [1:25] 9 21 22 2
  .. ..- attr(*, "names")= chr [1:25] "9" "21" "22" "25" ...
```

```
View(movies)
## Spreadsheet-style data viewer
summary(movies)
## Summarize variables on your console
names(movies)
## Names of all variables
dim(movies)
nrow(movies)
ncol(movies)
## Dimensional information
head(movies)
tail(movies)
```

hist () :: distribution of values

```
hist(x,breaks=bins,main="title",xlab="xlabel",ylab="ylabel")
```

breaks: number of bins

x,: numeric

```
hist(movies$RottenTomatoes, breaks=10, col="red", xlab="Rating",
main="Colored histogram with 10 bins")
```

TOP BOX OFFICE Get Tickets

65%	Miss Peregrine's Home for Peculi...	$28.9M
83%	Deepwater Horizon	$20.2M
63%	The Magnificent Seven	$15.6M
62%	Storks	$13.5M
82%	Sully	$8.3M
36%	Masterminds	$6.5M

Question 2

- What is more correlated with gross income, budget or critics rating?

Question 2

- What is more correlated with gross income, budget or critics rating?
- Check bivariate correlations of each pair on different graphs

Question 2

- What is more correlated with gross income, budget or critics rating?
- Check bivariate correlations of each pair on different graphs

```
par(mfrow=c(1,2))
## 1 by 2 subplots
plot(movies$RottenTomatoes,log10(movies$WorldGross))
plot(log10(movies$Budget),log10(movies$WorldGross))
## log10: logarithm function with base 10
```

Question 2

- What is more correlated with gross income, budget or critics rating?
- Check bivariate correlations of each pair on different graphs

```
par(mfrow=c(1,2))
## 1 by 2 subplots
plot(movies$RottenTomatoes,log10(movies$WorldGross),col=movies$Genre)
plot(log10(movies$Budget),log10(movies$WorldGross),col=movies$Genre)
## log10: logarithm function with base 10
```

plot() :: add linear trend plot

```
lines(x,y_predicted,main="title",xlab="xlabel",ylab="ylabel")
```


x, y_predicted: numeric

plot() :: add linear trend plot

```
lines(x,y_predicted,main="title",xlab="xlabel",ylab="ylabel")
```

x, y_predicted: numeric

```
mod1 <- lm(log10(movies$WorldGross) ~ movies$RottenTomatoes)
## Linear regression
preds1 <- predict(mod1)
## predicted value obtained by linear regression
plot(movies$RottenTomatoes,log10(movies$WorldGross))
lines(movies$RottenTomatoes, preds1)
```

plot() :: add linear trend plot

```
lines(x,y_predicted,main="title",xlab="xlabel",ylab="ylabel")
```


x, y_predicted: numeric

```
mod2 <- lm(log10(movies$WorldGross) ~ log10(movies$Budget))
## Linear regression
preds2 <- predict(mod2)
## predicted value obtained by linear regression
plot(log10(movies$Budget),log10(movies$WorldGross))
lines(log10(movies$Budget), preds2)
```

Feed Back Survey

https://goo.gl/forms/GbNI7fhCx70IRVpi1

Question 3

- Is there significant difference in rating/budget by genre?

Question 3

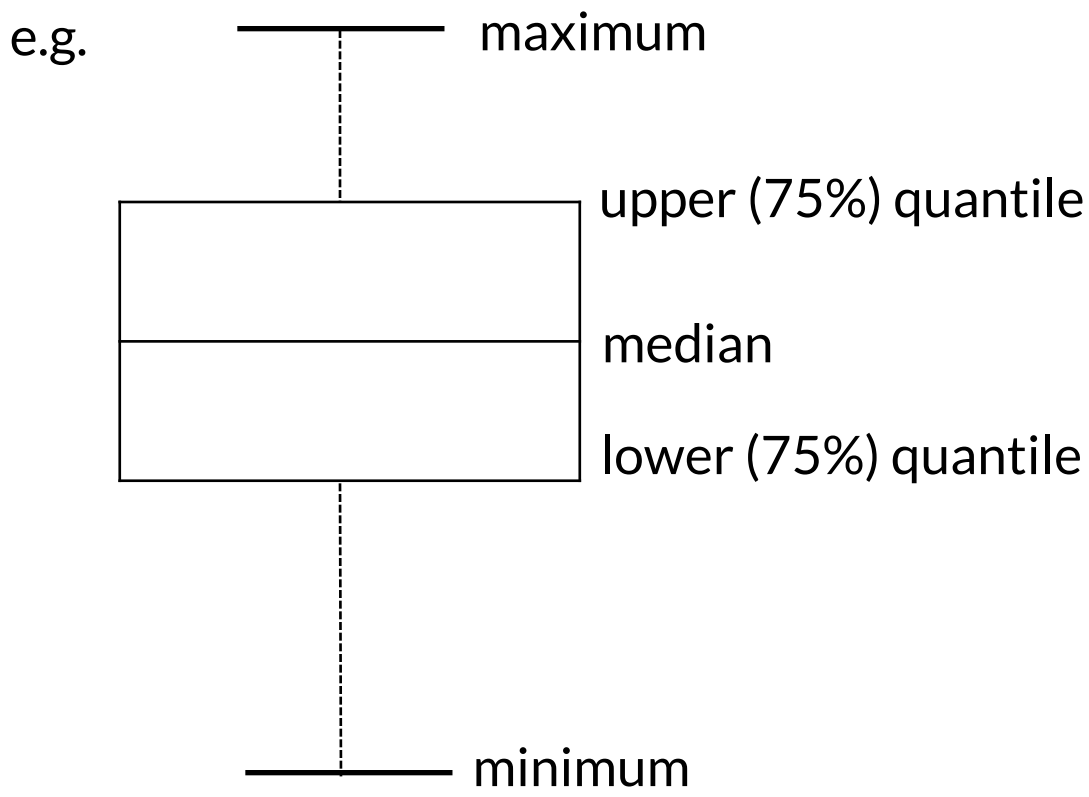
- Is there significant difference in rating/budget by genre?
- Check bivariate correlations of each pair on different graphs

boxplot() :: include distributional information

```
boxplot(y~x,main="title",xlab="xlabel",ylab="ylabel")
```

numeric

categorical(factor)



Question 3

- Is there significant difference in rating/budget by genre?
- Check bivariate correlations of each pair on different graphs.

```
par(las=2)
## horizontal text
par(mfrow=c(1,2))
boxplot(movies$RottenTomatoes~movies$Genre,xlab="Genre",ylab="Rating")
## Genre VS Rating
boxplot(movies$Budget~movies$Genre,xlab="Genre",ylab="Budget")
## Genre VS Budget
```

pdf() :: save graph as pdf

```
pdf("file_name.pdf",width=width_length,height=heigth_length)
```

```
dev.off() ## defaulting
pdf("boxplots.pdf")
par(las=2)
## horizontal text
par(mfrow=c(1,2))
boxplot(movies$RottenTomatoes~movies$Genre,xlab="Genre",ylab="Rating")
## Genre VS Rating
boxplot(movies$Budget~movies$Genre,xlab="Genre",ylab="Budget")
## Genre VS Budget
dev.off() ## This needs to be added let R know the drawing is complete!!
```

Thank you

FALL 2017 SCHEDULE

September 21	**Introduction to R and RStudio** (Ethan)	Slides	Data	Code
September 28	**Data Wrangling in R** (Yunkyu)	Slides	Data	Code
October 5	**Base R Graphics** (Yunkyu)			
October 12	**Programming Loops in R** (Ethan)			