


# Week 1: *Getting Started*

 EMSE 6035: Marketing Analytics for Design Decisions

 John Paul Helveston

 August 30, 2023

# Week 1: *Getting Started*

1. Course orientation

2. Intro to conjoint analysis

3. Introductions

BREAK: Teaming

4. Getting started with R & RStudio

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# Meet your instructor!



## John Helveston, Ph.D.

- 2018 - Present Assistant Professor, Engineering Management & Systems Engineering
- 2016-2018 Postdoc at [Institute for Sustainable Energy](#), Boston University
- 2016 PhD in Engineering & Public Policy at Carnegie Mellon University
- 2015 MS in Engineering & Public Policy at Carnegie Mellon University
- 2010 BS in Engineering Science & Mechanics at Virginia Tech
- Website: [www.jhelvy.com](http://www.jhelvy.com)

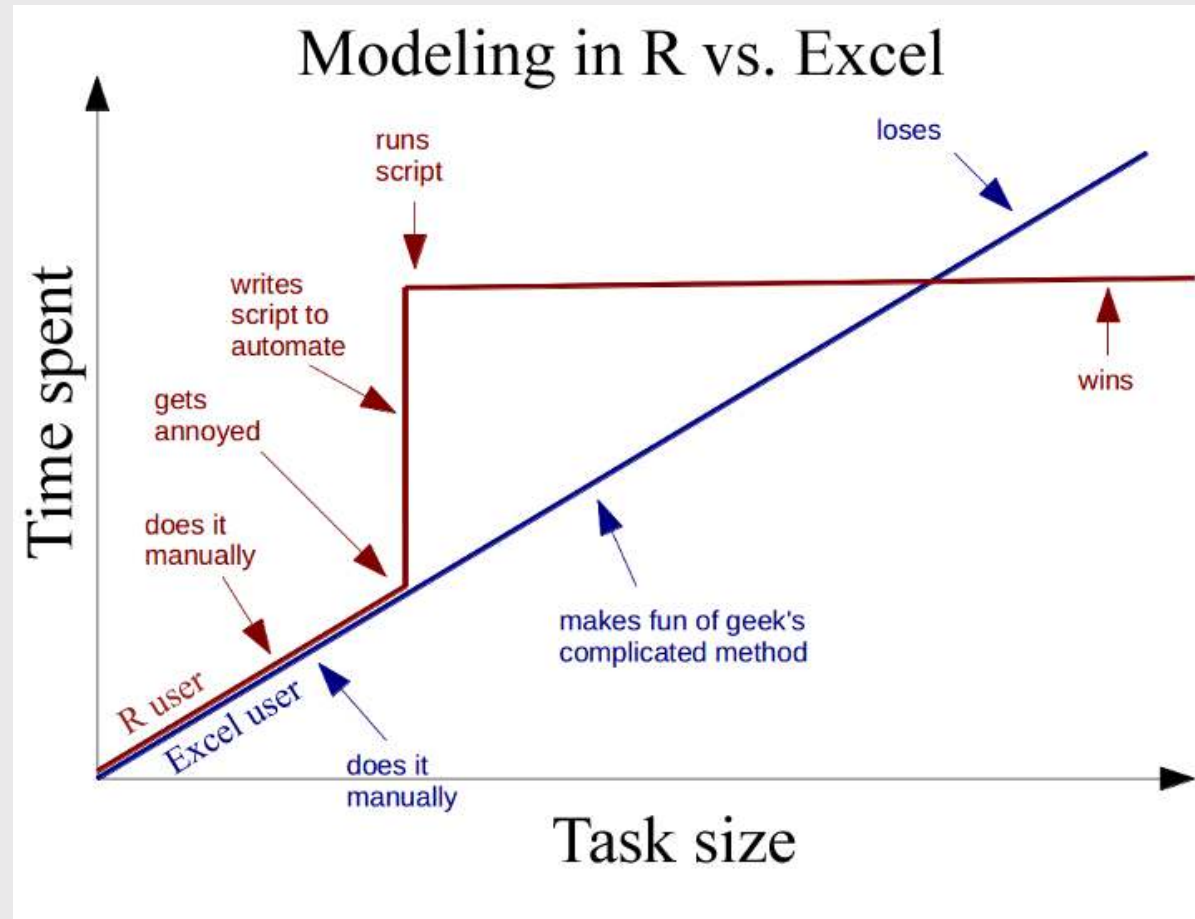
# Tools

 Course website: <https://madd.seas.gwu.edu/2023-Fall/>

 Course slack: <https://emse-madd-f23.slack.com>


 & RStudio: [Course Software Page](#)

# Why R?



# Learning Objectives

After this class, you will know how to...

- ...work with data in 
- ...design effective surveys to get rich data
- ...analyze consumer choice data to model consumer preferences
- ...design effective charts to communicate insights

# Course prerequisites

This course requires prior exposure to:

- Probability theory
- Multivariable calculus
- Linear algebra
- Regression

**Not sure?**

Take [this self assessment](#)



# Reflections (30% of grade)

Do some readings, recorded lectures, practice problems

Write a short reflection

 ~Every week (10 total)

 Due 11:59pm Tues. before class

✓ Graded for completion (looking for engagement)

# Quizzes (10% of grade)

📅 At the start of class every other week-is. Make ups only for excused absences (i.e. don't be late).

📅 5 total, lowest dropped

🕒 ~5 - 10 minutes

**Why quiz at all?** The "retrieval effect" - basically, you have to *practice* remembering things, otherwise your brain won't remember them (see the book ["Make It Stick: The Science of Successful Learning"](#))

# Exam (10% of grade)

Take home exam, 2nd to last week of class

We'll go over exam solutions on last day of class

# Semester Project (45% of grade)

Teams of 3-4 students

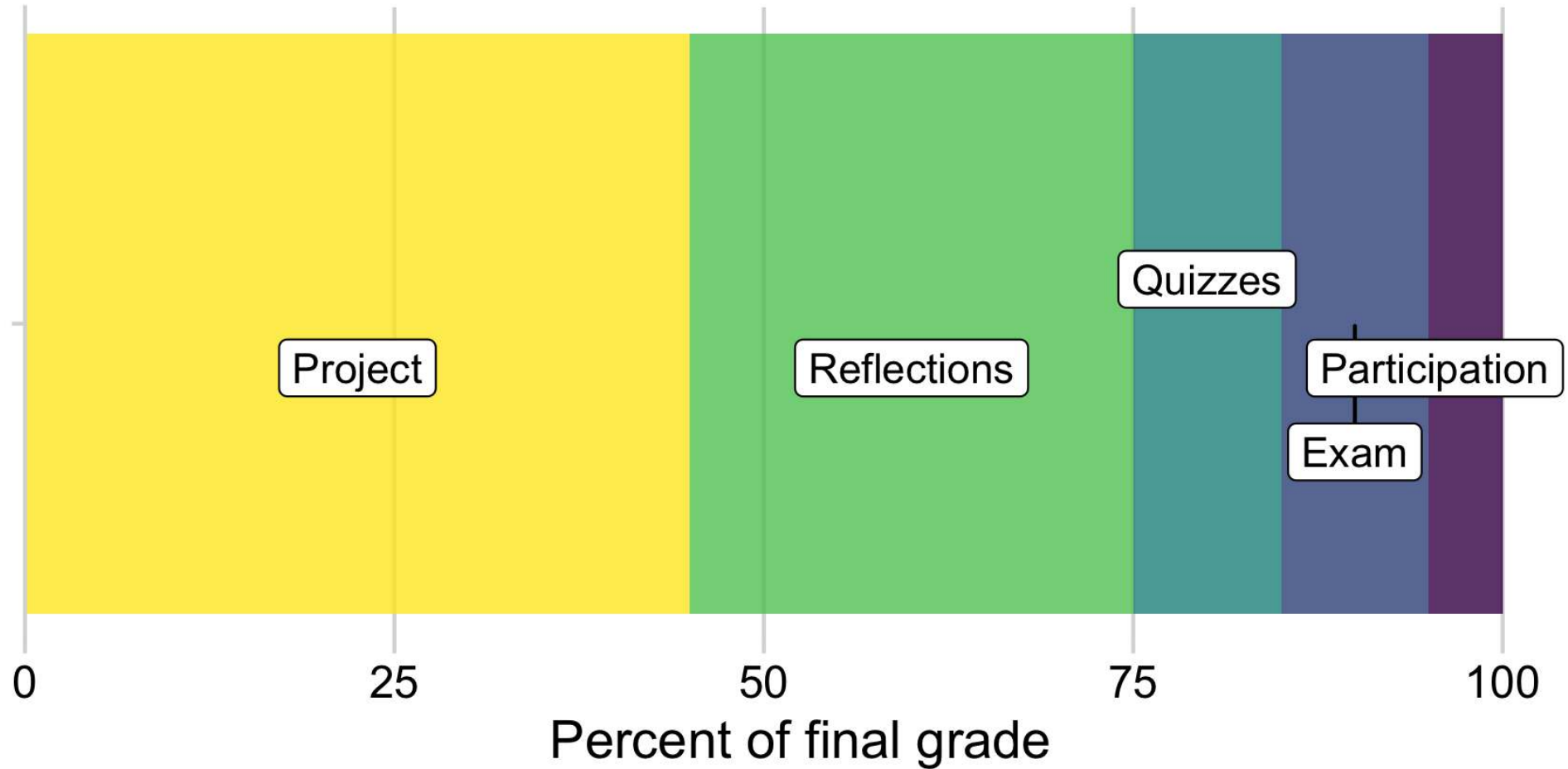
Goals:

- Assess market viability of a new technology or design
- Recommend best design choices for target market or application

Key deliverables:

| Item                  | Weight | Due     |
|-----------------------|--------|---------|
| Project Proposal      | 5 %    | Sep. 24 |
| Survey Plan           | 5 %    | Oct. 03 |
| Pilot Survey          | 5 %    | Oct. 17 |
| Pilot Analysis        | 5 %    | Nov. 05 |
| Final Survey          | 5 %    | Nov. 19 |
| Final Analysis Report | 15 %   | Dec. 10 |
| Final Presentation    | 5 %    | Dec. 12 |

# Grades



# Grades

| Item                       | Weight | Notes                                       |
|----------------------------|--------|---|
| Participation / Attendance | 5%     | (Yes, I take attendance)                    |
| Reflections                | 30 %   | Weekly assignment (10 × 3%, lowest dropped) |
| Quizzes                    | 10 %   | 5 quizzes, lowest dropped                   |
| Final Exam                 | 10 %   | Take home exam                              |
| Project Proposal           | 5 %    | Teams of 3-4 students                       |
| Survey Plan                | 5 %    |   |
| Pilot Survey               | 5 %    |   |
| Pilot Analysis             | 5 %    |   |
| Final Survey               | 5 %    |   |
| Final Analysis Report      | 15 %   |   |
| Final Presentation         | 5 %    |   |

# Course policies

- BE NICE
- BE HONEST
- DON'T CHEAT

Copying is good, stealing is bad

"Plagiarism is trying to pass someone else's work off as your own. Copying is about reverse-engineering."

-- Austin Kleon, from [Steal Like An Artist](#)

# Use of chatGPT and other AI tools

- Large language models (LLMs) are pretty good...but sometimes suck.
- Use of AI tools is generally permitted, but **be transparent**.
- All assignments must include a **Use of AI on this assignment** section where you:
  - Describe any AI tool and how it was used along with prompt(s) used.
  - Include a link to the chat transcript.

## **Use AI as an assistant, not a solutions manual**

Curious how LLMs actually work? Check out [this article](#), which provides a simplified description of how they work (which itself is still quite complicated).



# Late submissions

- **5** late days - use them anytime, no questions asked
- No more than **2** late days on any one assignment
- Contact me for special cases

# How to succeed in this class


 Participate during class!

 Start assignments early and **read carefully!**

 Get sleep and take breaks often!

 Ask for help!

# Getting Help

 Use [Slack](#) to ask questions.

 [Schedule a meeting](#) w/Prof. Helveston:

- Mondays from 8:00-4:30pm
- Tuesdays from 8:00-4:30pm
- Fridays from 8:00-4:00pm

 [GW Coders](#)

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Engineers often design things nobody wants!

We want to answers to questions like...

- Higher prices decrease demand, but by how much?
- How much more is a consumer willing to pay for increased performance in X?
- How will my product compete against competitors in the market?

**Answers depend on knowing what people want**

Directly asking people what they want isn't always helpful

(People want everything)



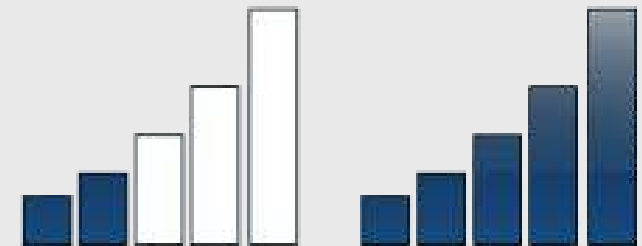
# Which feature do you care more about?



Battery Life?

Brand?







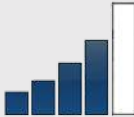
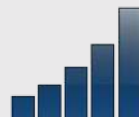
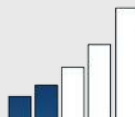
Signal quality?





# Conjoint approach:

Use consumer choice data to model preferences

| <u>Attribute</u> | <u>Phone 1</u>  | <u>Phone 2</u>   | <u>Phone 3</u>   |
|------------------|---|--|--|
| Price            | \$400   | \$450  | \$350  |
| Brand            |   |   |   |
| Battery Life     |   |   |   |
| Signal Quality   |  |  |  |
| N chosen:        | 350   | 250  | 400  |

Use random utility framework to predict probability of choosing phone  $j$

1.  $u_j = \beta_1 \text{price}_j + \beta_2 \text{brand}_j + \beta_3 \text{battery}_j + \beta_4 \text{signal}_j + \varepsilon_j$

2. Assume  $\varepsilon_j \sim$  iid extreme value

3. Probability of choosing phone  $j$ :  $P_j = \frac{e^{\beta' x_j}}{\sum_k^J e^{\beta' x_k}}$

4. Estimate  $\beta_1, \beta_2, \beta_3, \beta_4$  by minimizing  $-L = -\sum_n^N \sum_j^J y_{nj} \ln P_{nj}$

# Willingness to Pay

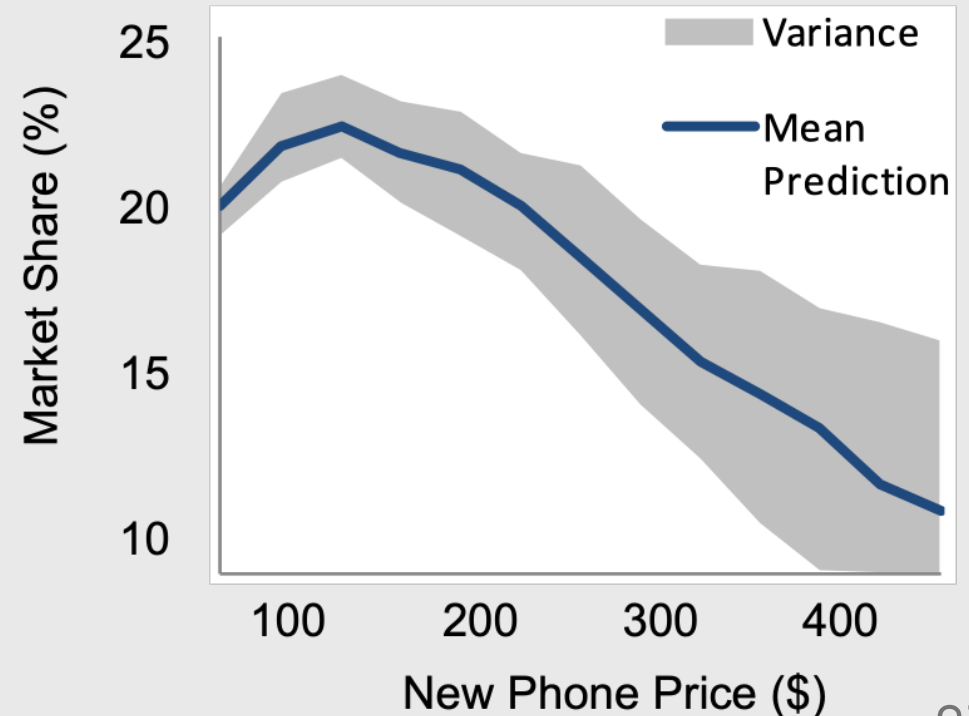
$$u_j = \beta' x_j + \alpha p_j + \varepsilon_j$$

$$\omega = \frac{\beta}{-\alpha}$$

"Respondents on average are willing to pay \$XX to improve battery life by XX%"

# Make predictions

$$P_j = \frac{e^{\hat{\beta}' x_j}}{\sum_k^J e^{\hat{\beta}' x_k}}$$



# Example: *Pocket Charge*

A Flexible, Portable Solar Charger

# Product Diagram



Durability

Degradation Protections

## Attribute Units

Price – USD  
Weight – Kg  
Power Output – Watts  
Durability – Months  
Portability – LxWxH

Portability



Power Output

Power Density

Packing Design

## Decision Variable Units

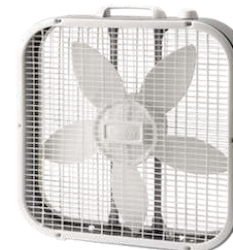
Power Density – W/Kg  
Degradation Rate – Hours  
Packing Design –  $\text{Cm}^3$

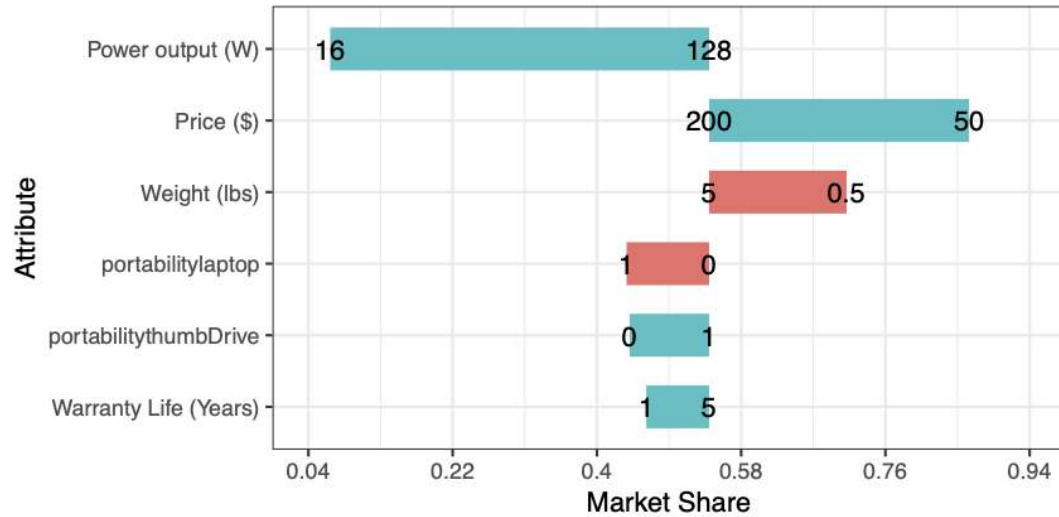
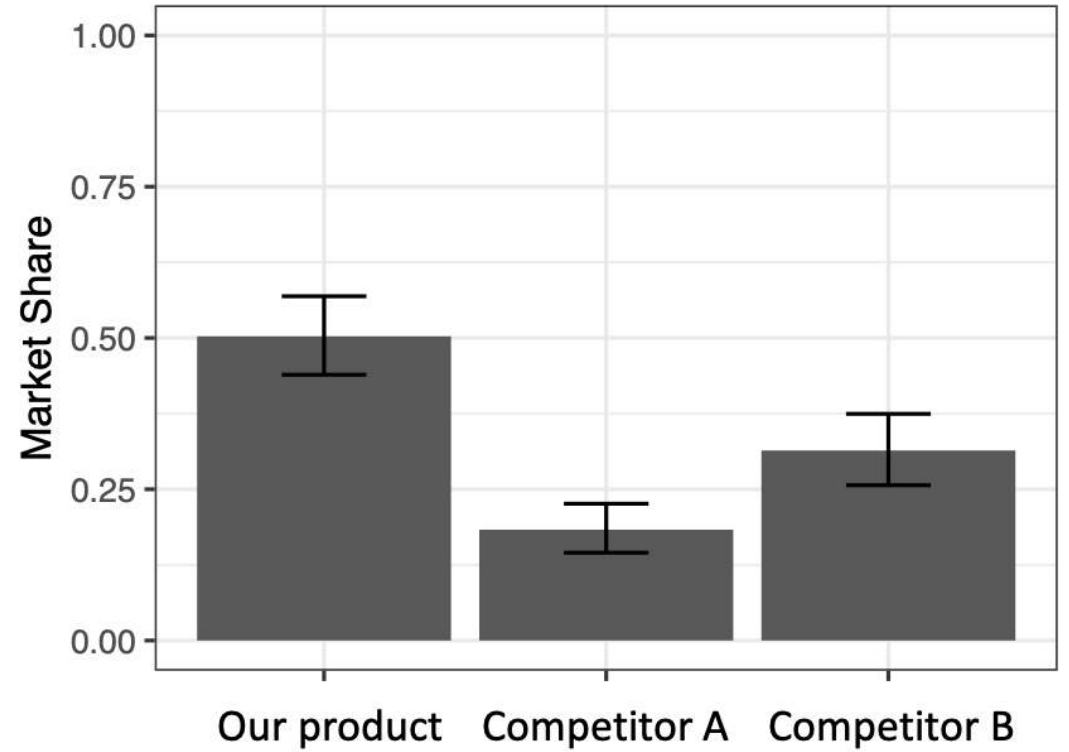
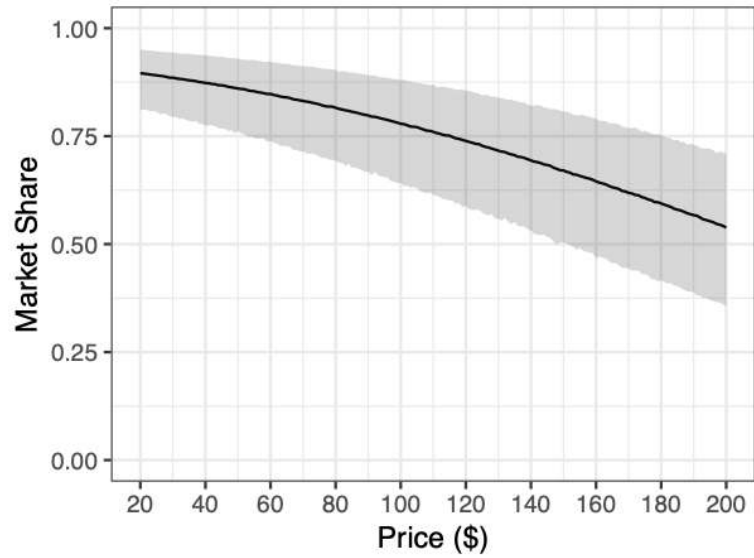


Weight

# Example survey choice question

| Choice 1                        |  | Choice 2                        |  | Choice 3                        |                                      |
|---------------------------------|--|---------------------------------|--|---------------------------------|--------------------------------------|
| Price (USD)                     | <b>200</b>                             | Price (USD)                     | <b>50</b>                                | Price (USD)                     | <b>100</b>                           |
| Weight (lbs)                    | <b>3</b>                               | Weight (lbs)                    | <b>0.5</b>                               | Weight (lbs)                    | <b>0.5</b>                           |
| Power Output (Watts)            | <b>16 (One cellphone in 2 hours)</b>   | Power Output (Watts)            | <b>16 (One cellphone in 2 hours)</b>     | Power Output (Watts)            | <b>16 (One cellphone in 2 hours)</b> |
| Years of Manufacturers Warranty | <b>1</b>                               | Years of Manufacturers Warranty | <b>1</b>                                 | Years of Manufacturers Warranty | <b>3</b>                             |
| Portability                     | <b>Compacted size of a thumb drive</b> | Portability                     | <b>Compacted size of a deck of cards</b> | Portability                     | <b>Compacted size of a box fan</b>   |
|                                 | <input type="radio"/>                  |                                 | <input type="radio"/>                    |                                 | <input type="radio"/>                |





Your project starts now!

[View project Ideas](#)



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BREAK: Teaming

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# Introduce yourself

- Preferred name
- Degree program
- Prior experience
- What do you hope to gain from this class?
- Project interests?

# *Break*

1. If you haven't already, install everything on the [software page](#)
2. Stand up, meet each other, (maybe form teams?...use [this sheet](#))

05:00

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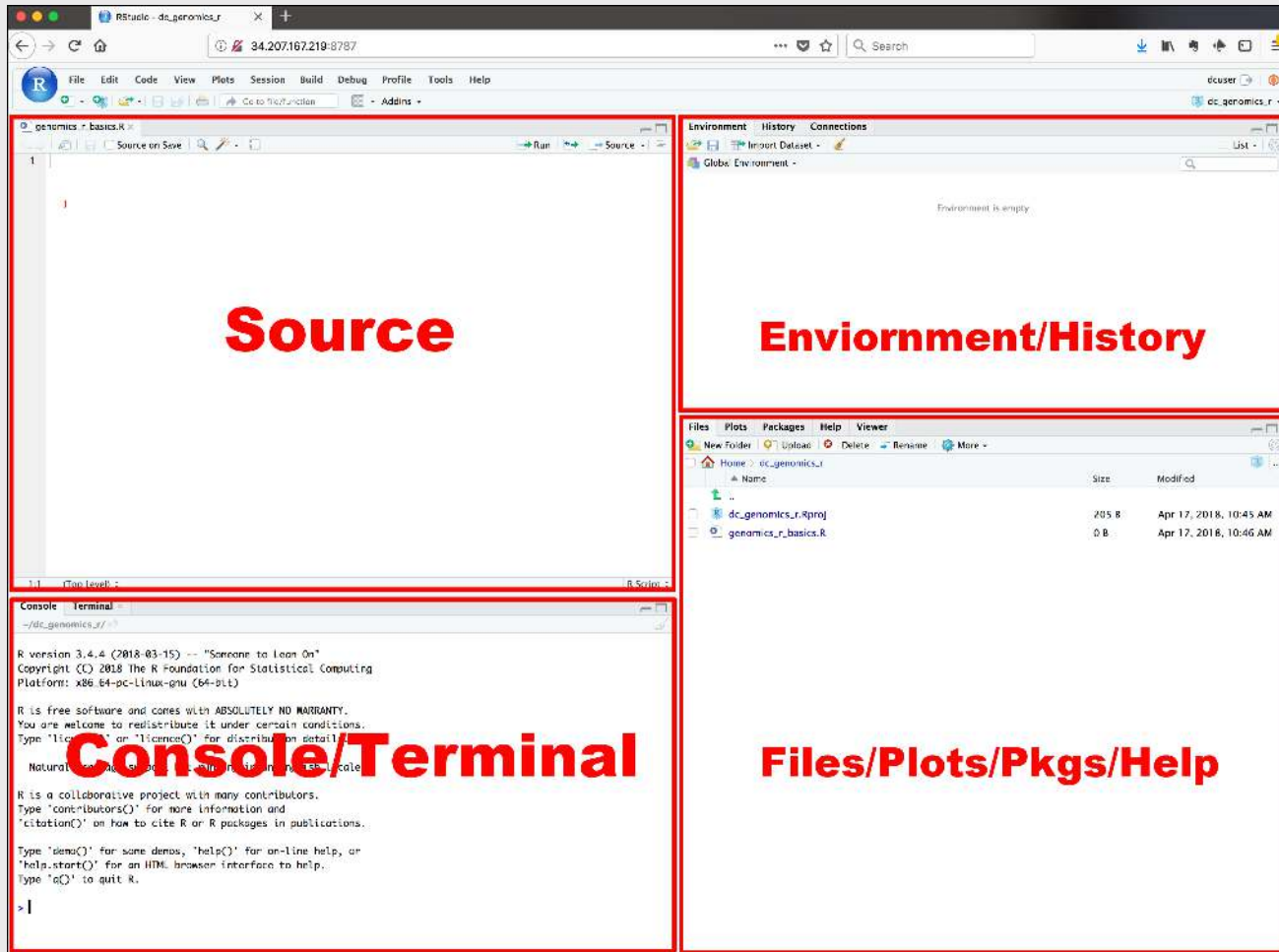
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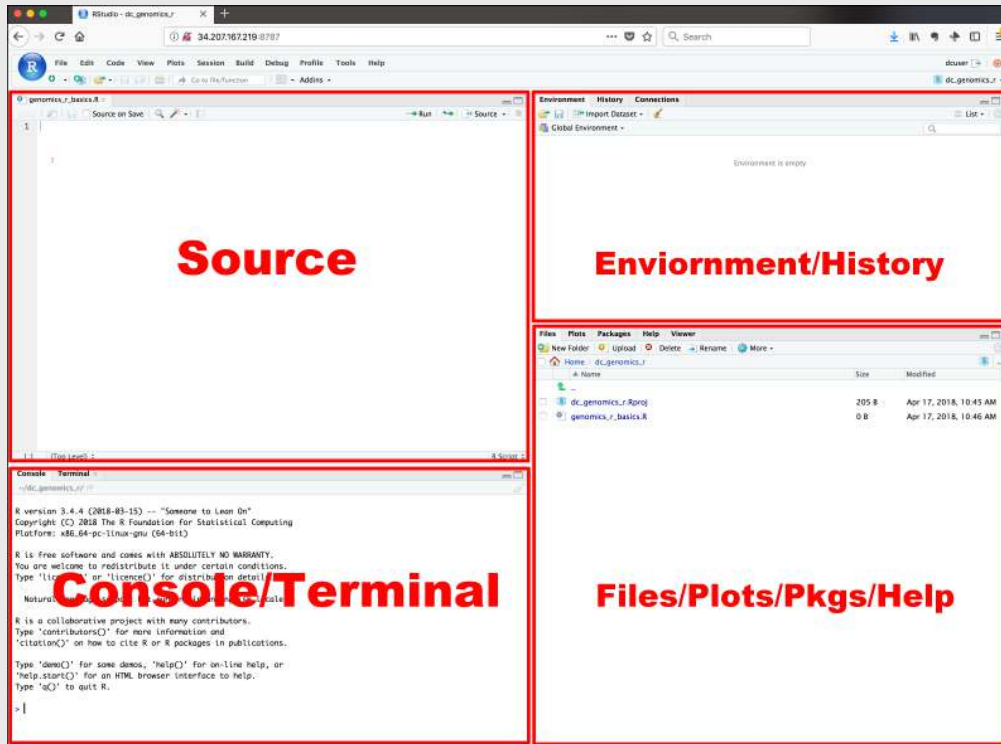
# RStudio Orientation



- Know the boxes
- Customize the layout
- Customize the look
- **Extra themes**

Open `intro-to-R.R` file and follow along

# View prior code in history pane



Use "up" arrow see previous code

# Staying organized

## 1) Save your code in .R files

File > New File > R Script

## 2) Keep work in R Project files

File > New Project...



# Your turn

## A. Practice getting organized

1. Open RStudio and create a new R project called **week1**.
2. Create a new R script and save it as **practice.R**.
3. Open the **practice.R** file and write your answers to these questions in it.

10:00

## B. Creating & working with objects

1). Create objects to store the values in this table:

| City              | Area (sq. mi.) | Population (thousands) |
|-------------------|----------------|------------------------|
| San Francisco, CA | 47             | 884                    |
| Chicago, IL       | 228            | 2,716                  |
| Washington, DC    | 61             | 694                    |

2) Using the objects you created, answer the following questions:

- Which city has the highest density?
- How many *more* people would need to live in DC for it to have the same population density as San Francisco?

>15,000 packages on the CRAN



# Installing packages

```
install.packages("packagename")
```

(The package name **must** be in quotes)

```
install.packages("packagename") # This works  
install.packages(packagename)   # This doesn't work
```

**You only need to install a package once!**

# Loading packages

`library(packagename)`: Loads all the functions in a package

(The package name *doesn't* need to be in quotes)

```
library("packagename") # This works  
library(packagename)  # This also works
```

**You need to *load* the package every time you use it!**

# Installing vs. Loading

INSTALL ONCE:

```
install.packages("light")
```



USE MANY TIMES:

```
library("light")
```



# Example: **wikifacts**

Install the [Wikifacts](#) package, by Keith McNulty:

```
install.packages("wikifacts")
```

Load the package:

```
library(wikifacts) # Load the library
```

Use one of the package functions

```
wiki_randomfact()
```

```
#> [1] "Did you know that when Josette Simon appeared as Rosaline in Love's Labour's  
Lost, she was the first black woman in a lead role at the Royal Shakespeare Company?  
(Courtesy of Wikipedia)"
```

# Example: **wikifacts**

Now, restart your RStudio session:

Session -> Restart R

Try using the package function again:

```
wiki_randomfact()
```

```
#> Error in wiki_randomfact(): could not find function "wiki_randomfact"
```

# Using only *some* package functions

You don't always have to load the whole library.

Functions can be accessed with this pattern:

```
packagename::functionname()
```

```
wikifacts::wiki_randomfact()
```

```
#> [1] "Did you know that on March 21 in 2006 – A man using a hammer smashed the statue of Phra Phrom (pictured) in the Erawan Shrine in Bangkok, Thailand, and was subsequently beaten to death by bystanders. (Courtesy of Wikipedia)"
```



If you haven't yet, install [these packages](#)

Back `intro-to-R.R` for the rest of class!