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HDS Tutorial 1

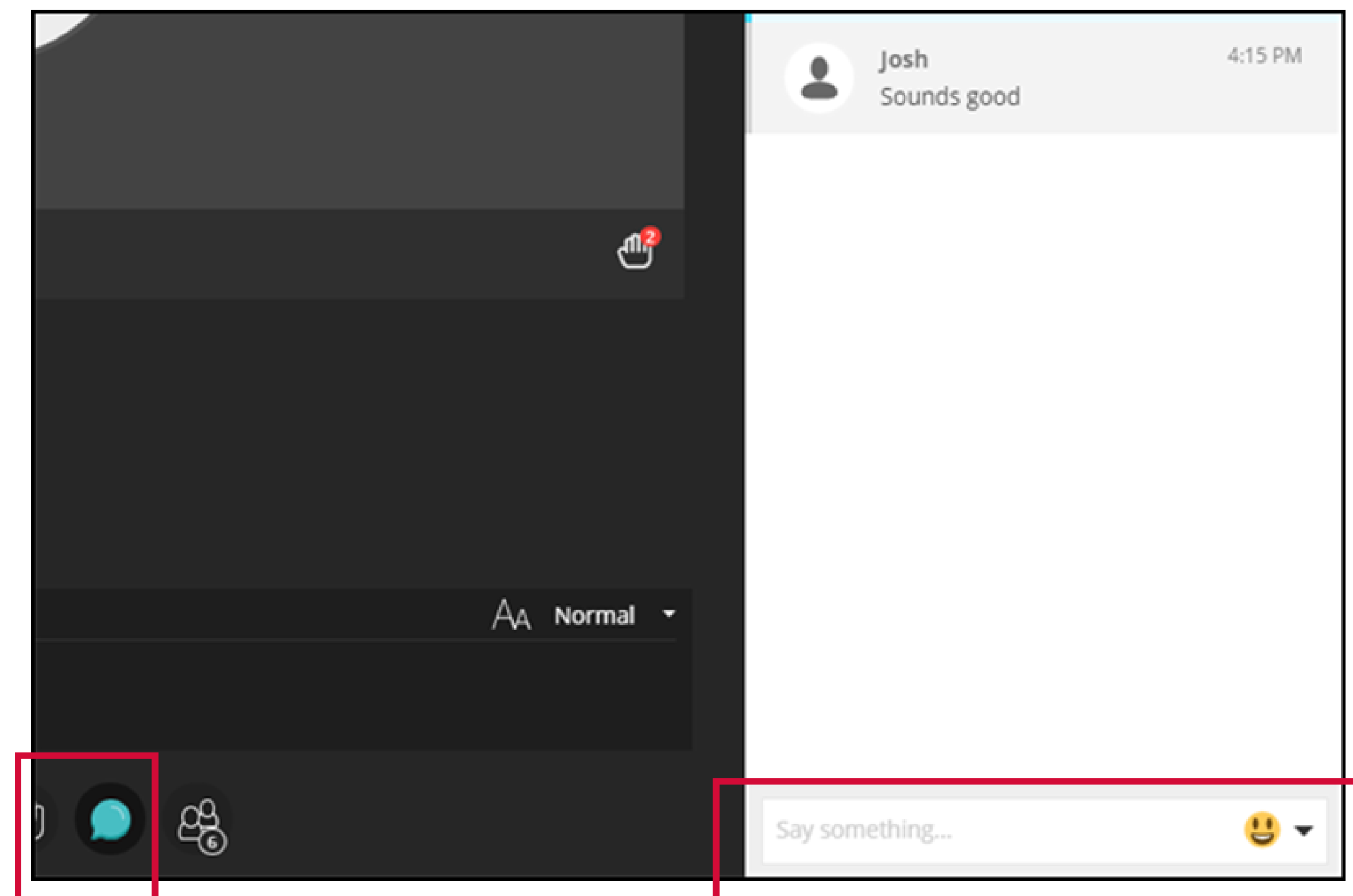
Week 2

Can you hear the presenter talking?

Please type **yes** or **no** in the “Text chat area”

If you can't hear:

- Check your Audio/Visual settings in the Collaborate Panel
- Try signing out and signing back into the session
- Type into the chat box and a moderator will try to assist you



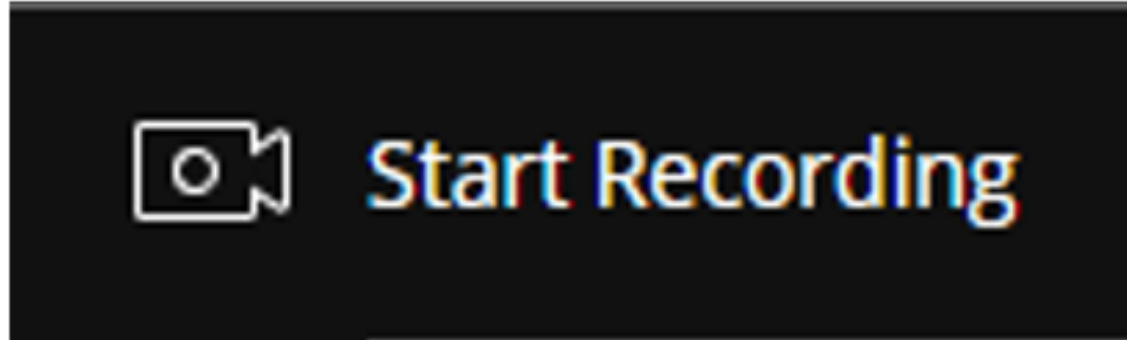
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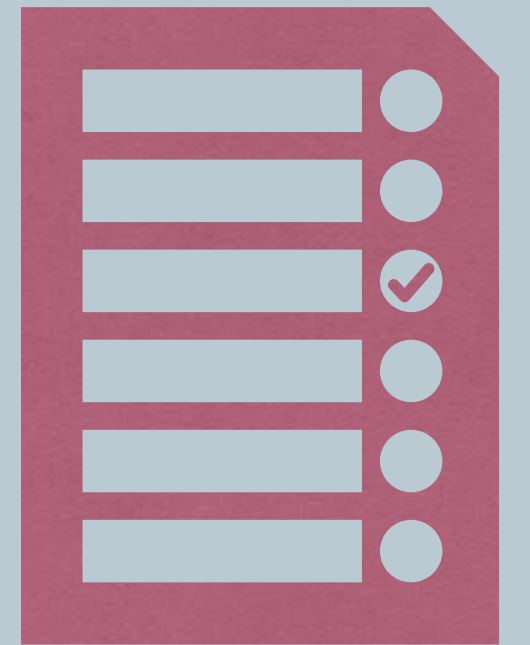
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HDS Tutorial 1

Week 2

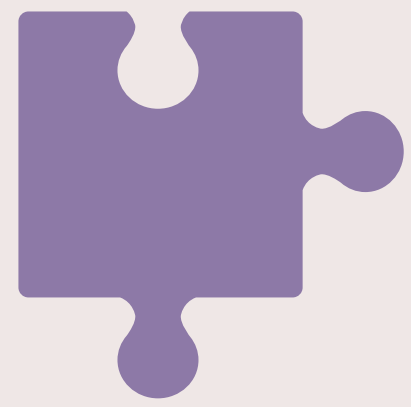
Agenda

- **What is R**
- **Why use R**
- **Example data flow presentation using health data**
- **Tips for starting out with R**
- **How to search for help online**
- **Q&A**



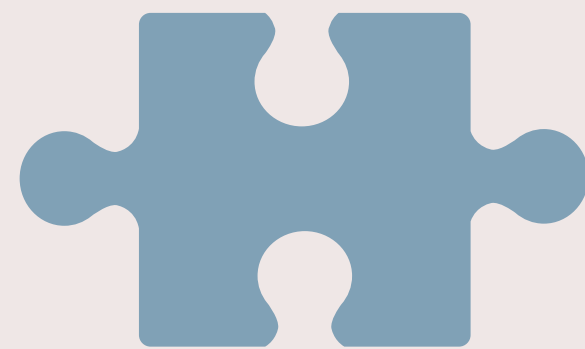
Has everyone downloaded R/R
Studio?

Or are you using Noteable?



Organisations behind R

- The R Project
- Comprehensive R Archive Network (CRAN)
- R Studio



The Comprehensive R Archive Network



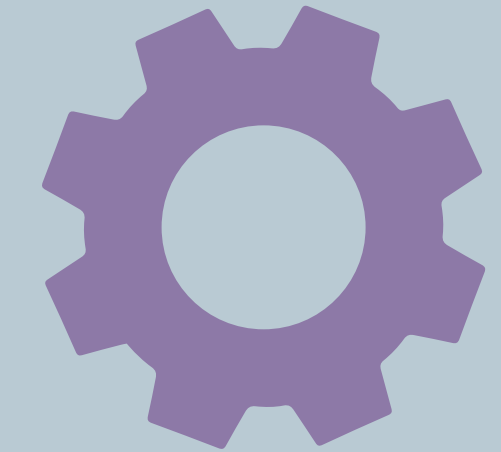
What are some of the reasons you want to learn R?

What benefits have you heard over other programming languages?

Advantages



- **“Open source” software**
 - Free (!!)
- **New methods implemented faster**
- **More flexible/customizable**
- **Anyone can contribute**
 - Do not have to work at R to contribute to R



Disadvantages

- **No centralized support**
- **Many find it harder to learn** - but that is why we are here!
- **Less consistency across procedures**
 - other software you rely on the programmers
- **...anyone can contribute (some packages are far better than others)**

Further Reasons for Why R...

- **High quality and robust data visualization**
 - e.g., ggplot2 — covered in depth in Week 4
- **Go-to language for statistics and data science; used in almost every industry**
- **Vast R community support**
 - Stack Overflow !
 - Twitter Rstats
 - etc.

- **The most comprehensive statistical analysis package new technology & ideas often appear first in R**
- **tidyverse**
- **RMarkdown (covered in Week 6)**
- **you can do so many things beyond data analysis/processing... maps, calendars, etc.!**
- **It can be very satisfying and fun once you get the hang of it!**



Formalized set of packages and tools that have a consistently structured programming interface

- as opposed to base R, which is more complex/varied and less user friendly

`library(tidyverse)` loads the core tidyverse packages

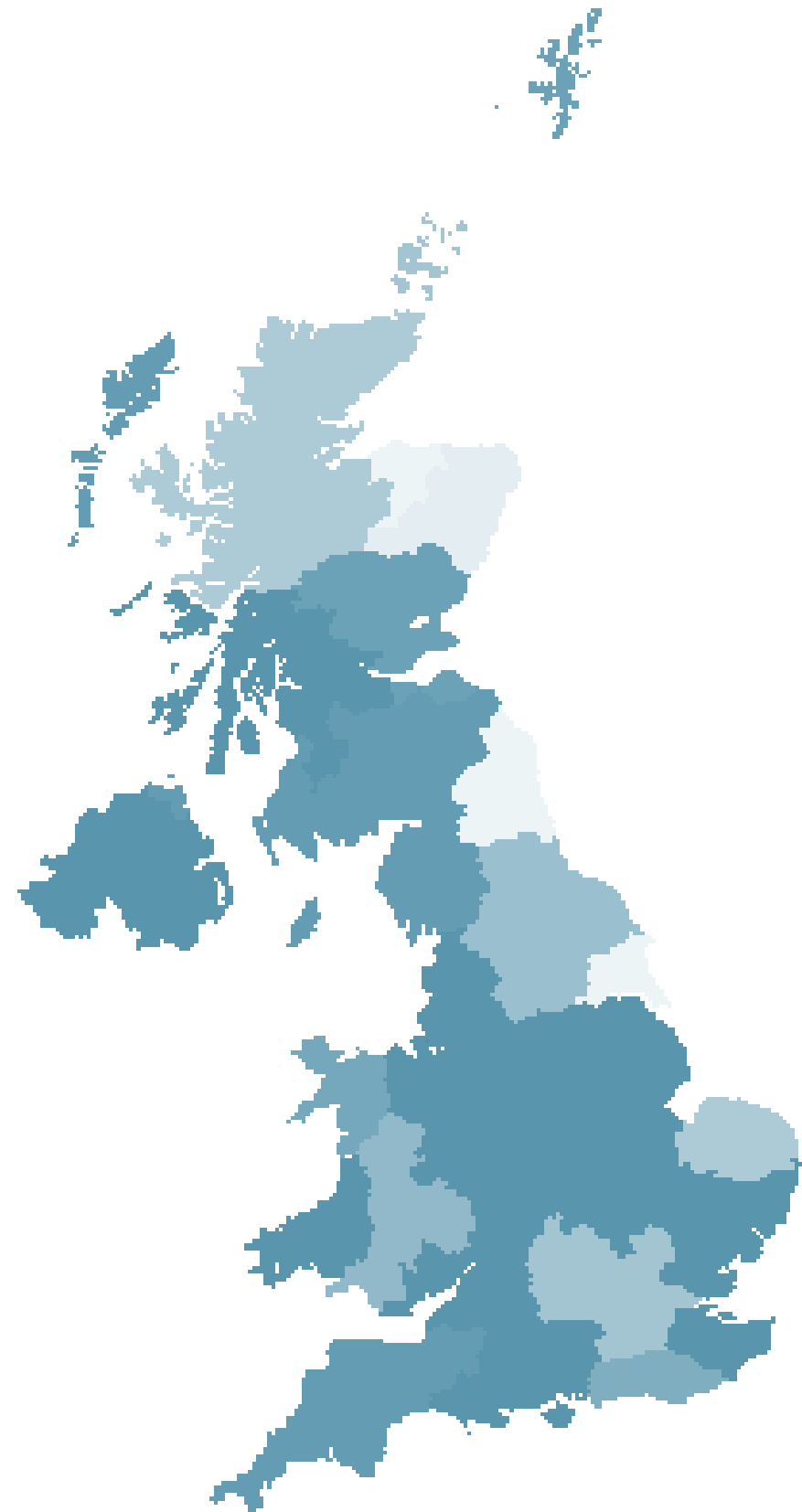
<code>ggplot2</code>	←	Make amazing graphs
<code>tibble</code>	←	Nice data frames
<code>tidyr</code>	←	Tidy your data
<code>readr</code>	←	Get data into R
<code>purrr</code>	←	Cool functional programming stuff
<code>dplyr</code>	←	Action verbs for manipulating data
<code>stringr</code>	←	Regular Expression tools for strings
<code>forcats</code>	←	Deal with factors

Into the [Tidyverse](#)!



streamlined data wrangling & visualization

Cloud Coverage on 1 Jan 2020



Source: Met Office

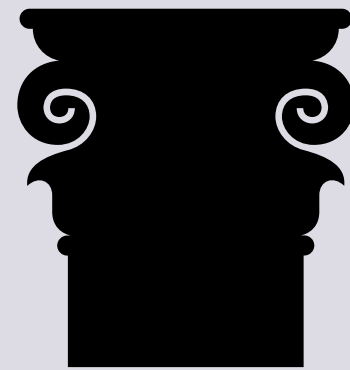
An animation example

An example of:

- the power of data visualization in R
- what HDS is building you towards

Animation (gganimate package) with maps (sf package) and Met Office data

R Syntax



There are 3 main different types of syntax you might come across:

- 1. base R (\$)**
- 2. tidy verse (%>%)**
- 3. formula (~)**



R Syntax Comparison :: CHEAT SHEET

Dollar sign syntax

goal(data\$x, data\$y)

SUMMARY STATISTICS:

one continuous variable:

```
mean(mtcars$mpg)
```

one categorical variable:

```
table(mtcars$cyl)
```

two categorical variables:

```
table(mtcars$cyl, mtcars$am)
```

one continuous, one categorical:

```
mean(mtcars$mpg[mtcars$cyl==4])
```

```
mean(mtcars$mpg[mtcars$cyl==6])
```

```
mean(mtcars$mpg[mtcars$cyl==8])
```

PLOTTING:

one continuous variable:

```
hist(mtcars$disp)
```

```
boxplot(mtcars$disp)
```

one categorical variable:

```
barplot(table(mtcars$cyl))
```

two continuous variables:

```
plot(mtcars$disp, mtcars$mpg)
```

two categorical variables:

```
mosaicplot(table(mtcars$am, mtcars$cyl))
```

one continuous, one categorical:

```
histogram(mtcars$disp[mtcars$cyl==4])
```

```
histogram(mtcars$disp[mtcars$cyl==6])
```

```
histogram(mtcars$disp[mtcars$cyl==8])
```

```
boxplot(mtcars$disp[mtcars$cyl==4])
```

```
boxplot(mtcars$disp[mtcars$cyl==6])
```

```
boxplot(mtcars$disp[mtcars$cyl==8])
```

WRANGLING:

subsetting:

```
mtcars[mtcars$mpg>30, ]
```

making a new variable:

```
mtcars$efficient[mtcars$mpg>30] <- TRUE
```

```
mtcars$efficient[mtcars$mpg<30] <- FALSE
```

Formula syntax

goal(y~x|z, data=data, group=w)

SUMMARY STATISTICS:

one continuous variable:

```
mosaic::mean(~mpg, data=mtcars)
```

one categorical variable:

```
mosaic::tally(~cyl, data=mtcars)
```

two categorical variables:

```
mosaic::tally(cyl~am, data=mtcars)
```

one continuous, one categorical:

```
mosaic::mean(mpg~cyl, data=mtcars)
```

tilde

PLOTTING:

one continuous variable:

```
lattice::histogram(~disp, data=mtcars)
```

```
lattice::bwplot(~disp, data=mtcars)
```

one categorical variable:

```
mosaic::bargraph(~cyl, data=mtcars)
```

two continuous variables:

```
lattice::xyplot(mpg~disp, data=mtcars)
```

two categorical variables:

```
mosaic::bargraph(~am, data=mtcars, group=cyl)
```

one continuous, one categorical:

```
lattice::histogram(~disp|cyl, data=mtcars)
```

```
lattice::bwplot(cyl~disp, data=mtcars)
```

The variety of R syntaxes give you many ways to “say” the same thing

read across the cheatsheet to see how different syntaxes approach the same problem

Tidyverse syntax

data %>% goal(x)

SUMMARY STATISTICS:

one continuous variable:

```
mtcars %>% dplyr::summarize(mean(mpg))
```

one categorical variable:

```
mtcars %>% dplyr::group_by(cyl) %>%
```

```
dplyr::summarize(n())
```

two categorical variables:

```
mtcars %>% dplyr::group_by(cyl, am) %>%
```

```
dplyr::summarize(n())
```

one continuous, one categorical:

```
mtcars %>% dplyr::group_by(cyl) %>%
```

```
dplyr::summarize(mean(mpg))
```

the pipe

PLOTTING:

one continuous variable:

```
ggplot2::qplot(x=mpg, data=mtcars, geom = "histogram")
```

```
ggplot2::qplot(y=disp, x=1, data=mtcars, geom="boxplot")
```

one categorical variable:

```
ggplot2::qplot(x=cyl, data=mtcars, geom="bar")
```

two continuous variables:

```
ggplot2::qplot(x=disp, y=mpg, data=mtcars, geom="point")
```

two categorical variables:

```
ggplot2::qplot(x=factor(cyl), data=mtcars, geom="bar") +  
facet_grid(~am)
```

one continuous, one categorical:

```
ggplot2::qplot(x=disp, data=mtcars, geom = "histogram") +  
facet_grid(~cyl)
```

```
ggplot2::qplot(y=disp, x=factor(cyl), data=mtcars,  
geom="boxplot")
```

WRANGLING:

subsetting:

```
mtcars %>% dplyr::filter(mpg>30)
```

making a new variable:

```
mtcars <- mtcars %>%
```

```
dplyr::mutate(efficient = if_else(mpg>30, TRUE, FALSE))
```

- last updated 2018, needs some updating

- credit to Amelia McNamara

- [Full cheat sheet here](#)

Bar chart demonstration in R using health care data



Tips to start out with R

- **Add comments to your code if using script**
 - Use a # at the beginning of the line or at the end of the line
- **You can also add sections to your script code**
 - At the end of a section add 4 dashes - or 4 hashes #
- **Avoid dots and spaces in variable names**
 - instead used capital letters or underscore
- **Check Cheatsheets, especially when using a new package**
 - Top menu *Help* > *Cheatsheets* or <https://rstudio.com/resources/cheatsheets/>
- **If you are unsure of what something does,**

type into the console a question mark followed by the function or package

- >?function
- for common functions, check the [introverse package](#) documentation
- **General introduction to R as a programming language: [A Succinct Intro to R](#)**
- **Always load packages at the start of a script**
- **Make sure everything is spelled correctly! and capitalization is consistent when loading in data**
- **Practice makes perfect. Build familiarity with the system and don't be afraid to make mistakes**
- **When in doubt, Google it!!**

Have you looked for R help online?
If so, was it effective?
What did you type in?

How to effectively search for help online:

- when in doubt, copy and paste an error into google
- include the package name or “in R” in your search
- built-in R help function `>?function`
- [StackOverflow](#)
- [RStudio Community](#)
- Be willing and ready to adapt code to your context
- Holly has a lovely document with more details

Questions?

Some helpful definitions...

Working Directory

- After installing R & RStudio, you need to set the working directory
 - This is the location on your computer where any data files to imported can be found, and where any R scripts (the files that save your code) will be saved
- In R studio, you can set the working directory with the menus (*Session >> Set Working Directory >> Choose Directory*) or with a line of code that gives the path of the folder on your computer:
 - `>setwd("Drive:/Folder1/Folder2")`
- If you have made a new R Project from an existing Directory as shown in the live demo, working directory will be set this way
- can always check working directory with the function:
 - `>getwd()`

Some vocabulary

- **Function** = how you get stuff done in R (chapters in metaphor)
- **Argument** = specifications of functions (specific pages in metaphor)
- **Packages** = are a collection of R functions, complied code and sample data. By default a set of packages are installed during installation. They are stored under a directory called "library" in the R environment (books in metaphor)
- **Documentation** = the explanations of functions and arguments for different packages written by the authors (glossary in metaphor)
- **"run" or "running code"** = enter command into the R console to make it happen
- **Script** = a text file containing (almost) the same commands that you would enter on the command line of R
- **Data frame** = a *special type of list* where every element of the list has same length (i.e. data frame is a "rectangular" list); *de facto* data structure for most tabular data and what we use for statistics.
 - **Tibble** = tidyverse style dataframe
- **Indexing** = selecting a subset of the elements in order to use them in further analysis or possibly change them. Style depends on syntax (see slide 13 + cheat sheets)

Variable Types in R

- **character:** "a", "SWC"
- **numeric:** 2, 15.5
 - "continuous" variable in other software
- **integer** is similar, use numeric in practice (less limitations)
- **double** is similar, but is a numeric value with decimal places
- **logical:** TRUE, FALSE
- **complex:** 1+4i (complex numbers with real and imaginary parts)
- **factor:** used to describe items that can have a finite number of values (gender, social class, etc.).
 - A factor has a `levels` attribute and class "factor"
 - Optionally, it may also contain a `contrasts` attribute which controls the parametrization used when the factor is used in a modeling functions.
 - "categorical" variable in other software. Tell R that a variable is **nominal** by making it a factor. An ordered factor is used to represent an **ordinal variable**.

Data Structures in R

- **Vectors** = most common and basic structure in R; a collection of elements that are most commonly of mode `character`, `logical`, `integer` or `numeric`.
- **Atomic vector** = vector where elements must be the same data type; default vector type
- **List** = a special type of vector. Each element can be a different type.
- **Matrix** = an extension of the numeric or character vectors. They are not a separate type of object but simply an atomic vector with dimensions; the number of rows and columns. As with atomic vectors, the elements of a matrix must be of the same data type.
- **Array** = similar to matrices but can have more than two dimensions
- **Data frame** = a *special type of list* where every element of the list has same length (i.e. data frame is a “rectangular” list); *de facto* data structure for most tabular data and what we use for statistics