TDU.

INTRODUCTION TO R

Graphics and Automated Reports

Day 2

Public Health Agency of Canada
Agence de la santé publique du Canada

Canada

COURSE LEARNING OBJECTIVES FROM DAY 1

- By the end of this course, learners will be able to:

- Carry out data cleaning and processing, and descriptive epidemiological analyses (incl. commonly used data visualisations);
- Create automated data products (e.g., epidemiologic summaries);
- Design and carry out a data collation plan that is consistent with proposed analysis plan;
- Explain when it is most appropriate to program analyses and automate tasks using R;
- Find and appraise possible solutions to R programming challenges.

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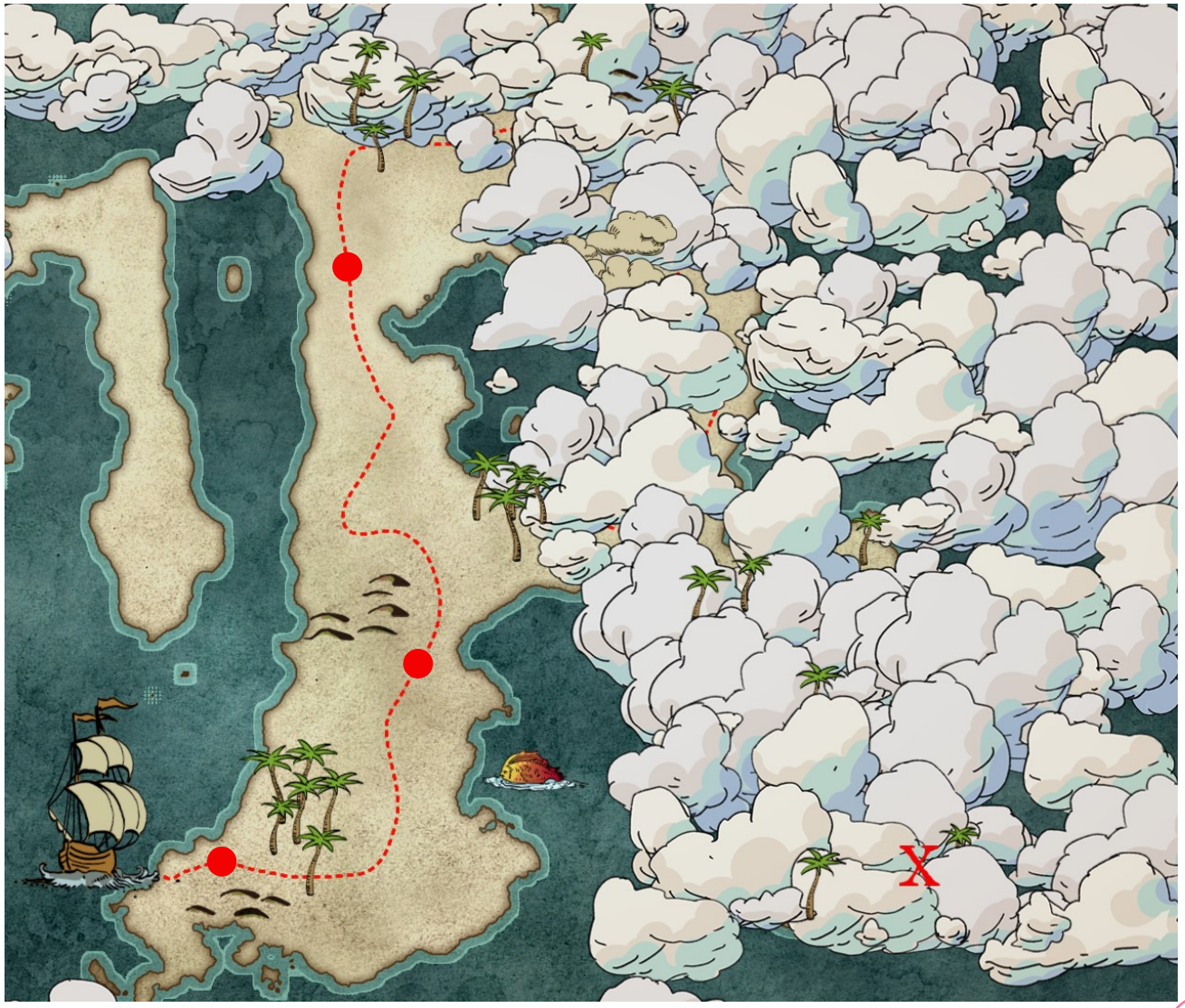
THE MAP

- In Day 1, we discovered:
  - “The coast of core-functions”;
  - “Syntax Sound”;
  - “Clean-Data Caves”

- In Day 2, we will continue our quest along
  - “Markdown Beach”;
  - “Automation Bay”;
  - “Visualization Valley”;
  - “Troubleshooting Trail”



DAY 2: PRE-COURSE LEARNING

Activity	Description
Context	TB 101
Foundational Concepts	Tidygraph
Foundational Concepts	Flextable
Refresher	Pre-Course Self-Study Module

SCAVENGER HUNT

Can you spot all instances of our piRate scout in this deck?

Note the slide number on which our friend appears and what important concept is being discussed on the associated slide. If you succeed in this task, you will unlock a special set of tools that can help you progress in your R quest.

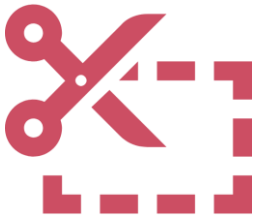
10 Considerations for Data Analysis

1. Read data into R

Consider (1) the type of data, (2) how they are stored, and (3) the size of the dataset.

2. Format the data

Long or wide format? Plan the analysis keeping in mind what your needs are.



3. Select data

Decide what data you'll need in advance from the dataset: subsets vs. filtered dataset. Consider pros and cons of the approach.

4. Modify data

Consider (1) what variables you will need, (2) calculations you will perform, and (3) algorithms needed to create the variables.

5. Link data

Assign a key variable(s) that you will link datasets on. Consider the join type you will need: inner, left, right, full, semi, or anti join.

6. Analyse data

Consider grouping data meaningfully in performing calculations and obtaining descriptive statistics. Evaluate outputs and interpret summaries.

7. Visualise data

Use tables or charts, and consider the best way to display the information.

8. Report findings

Communicate findings to those who need the information created from your work. Consider the audience you are communicating with.

9. Celebrate!

Preferably with cake!

10. Review

Review, revise, and re-do as needed. Often we can go back and simplify/optimise. This is important especially if the code will be used again.

WHAT WE HEARD

- More resources on **here()** package and R-Projects in the chat
  - If you run into issues, try running `here()` to have R tell you where your project is anchored!

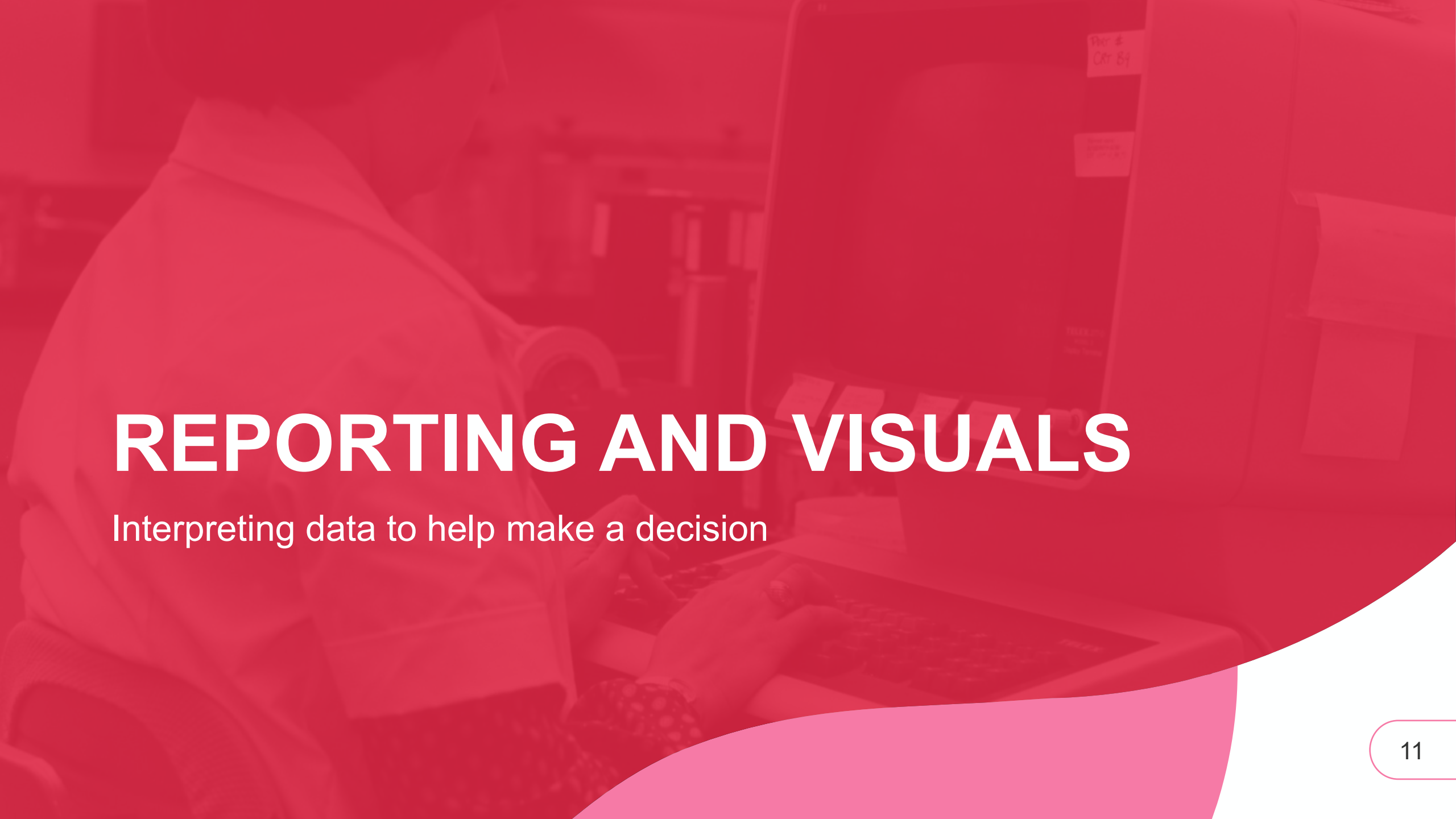
- pacman::p_load()

- as.character()

Designed by Wayhomestudio - Freepik.com

ON TO THE NEXT QUEST IN OUR ADVENTURE

DEMO



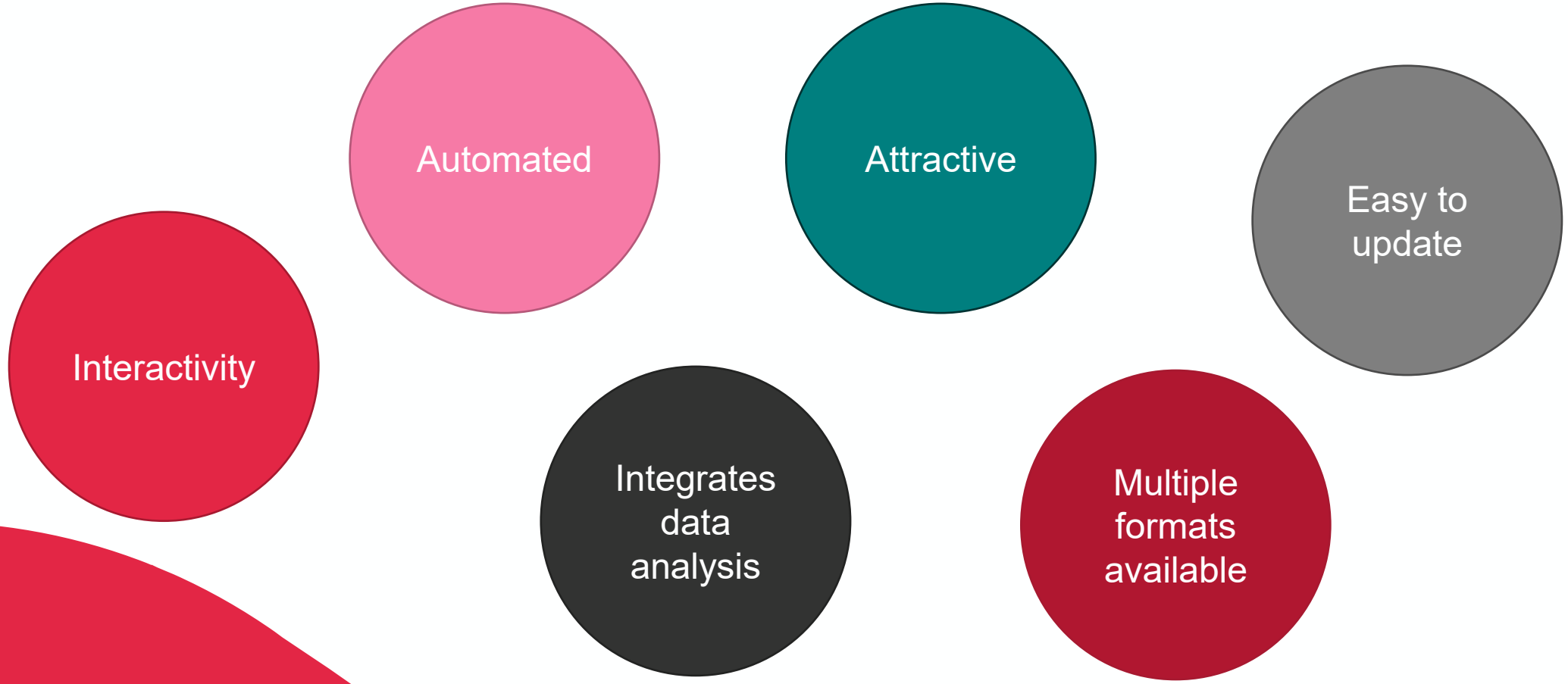
REPORTING AND VISUALS

Interpreting data to help make a decision

R MARKDOWN

REPORTING IN A ‘PERFECT-WORLD’

- Use the annotation tool to put a stamp on which of the following features of a reporting tool are important to you!



R MARKDOWN – WHAT IS IT?

- A tidyverse package: Rmarkdown

- An R markdown file (.Rmd) is a file format that creates documents (static or dynamic)

- Markdown is a formatting language that allows for documents to be written in plain text with formatting cues
  - “Chunks” of R code can be written directly in the markdown document or existing R scripts can be called or sourced using the source() function and specifying the file pathway
  - Narrative text can be added and formatted nicely
  - Use to create reports and other data products in various formats

R MARKDOWN

- Three main components of an R markdown file (.Rmd):
  - Metadata
    - YAML header
    - Written between “---”
  - Text
    - Markdown syntax
  - Code
    - R code chunks

Knit Insert Run

```
---
title: "This is my R markdown document"
author: "J. Stares"
date: "2021-01-25"
output: html_document
---

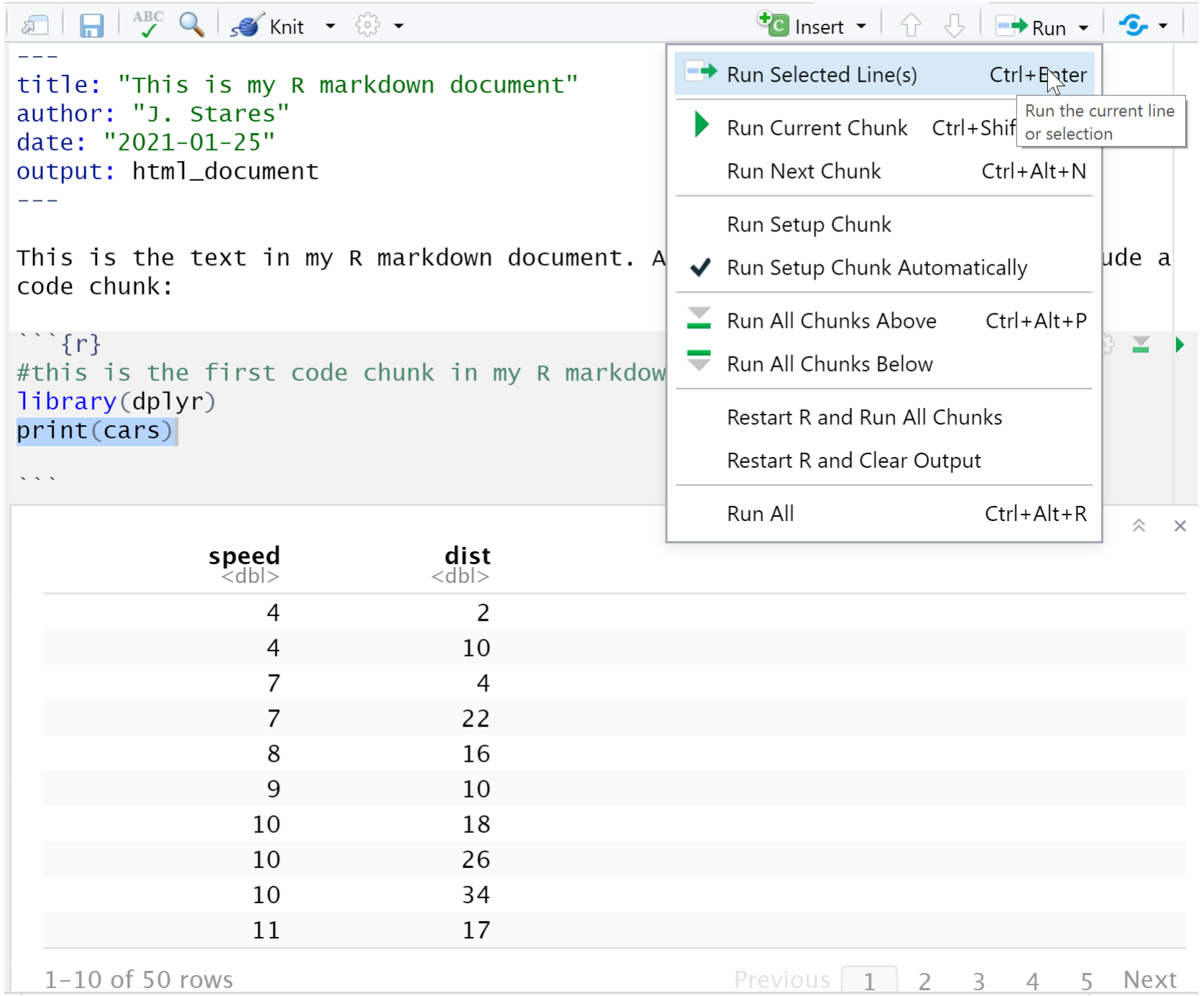
This is the text in my R markdown document. After this section, I will include a
code chunk:

```{r}
#this is the first code chunk in my R markdown document
library(dplyr)
print(cars)

```
```

speed <dbl>	dist <dbl>
4	2
4	10
7	4
7	22
8	16
9	10
10	18
10	26
10	34
11	17

1–10 of 50 rows Previous 1 2 3 4 5 Next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---
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This is the text in my R markdown document. A
ude a
code chunk:
```{r}
#this is the first code chunk in my R markdow
library(dplyr)
print(cars)
```
Run Selected Line(s) Ctrl+Enter
Run the current line or selection
Run Current Chunk Ctrl+Shif
Run Next Chunk Ctrl+Alt+N
Run Setup Chunk
Run Setup Chunk Automatically
Run All Chunks Above Ctrl+Alt+P
Run All Chunks Below
Restart R and Run All Chunks
Restart R and Clear Output
Run All Ctrl+Alt+R
speed <dbl> dist <dbl>
4 2
4 10
7 4
7 22
8 16
9 10
10 18
10 26
10 34
11 17
1–10 of 50 rows
Previous 1 2 3 4 5 Next

This is my R markdown document

J. Stares

2021-01-25

This is the text in my R markdown document. After this section, I will include a code chunk:

```
#this is the first code chunk in my R markdown document
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.0.3
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
print(cars)
```

```
##    speed dist
## 1      4    2
## 2      4   10
```

R Markdown Reference Guide

Learn more about R Markdown at rmarkdown.rstudio.com
Learn more about Interactive Docs at shiny.rstudio.com/articles

Contents:

1. **Markdown Syntax**
2. Knitr chunk options
3. Pandoc options

Syntax

```
Plain text

End a line with two spaces
to start a new paragraph.

*italics* and _italics_

**bold** and __bold__

superscript^2^

~~strikethrough~~

[link](www.rstudio.com)

# Header 1

## Header 2

### Header 3

#### Header 4

##### Header 5

###### Header 6

endash: --

emdash: ---

ellipsis: ...

inline equation: $A = \pi*r^{2}$

image: ![](path/to/smallorb.png)
```

Becomes

Plain text

End a line with two spaces to start a new paragraph.

italics and *italics*

bold and **bold**

superscript^2

~~strikethrough~~

link

Header 1

Header 2

Header 3

Header 4

Header 5

Header 6

endash: –

emdash: —

ellipsis: …

inline equation: $A = \pi * r^2$

image: 

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Syntax

```
***

> block quote

* unordered list
* item 2
    + sub-item 1
    + sub-item 2

1. ordered list
2. item 2
    + sub-item 1
    + sub-item 2

Table Header   | Second Header
-------------- | -------------
Table Cell     | Cell 2
Cell 3         | Cell 4
```

Becomes

> block quote

- unordered list
- item 2
  - sub-item 1
  - sub-item 2

1. ordered list
2. item 2
   - sub-item 1
   - sub-item 2

Table Header	Second Header
Table Cell	Cell 2
Cell 3	Cell 4

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3. Pandoc options

Syntax	Becomes
Make a code chunk with three back ticks followed by an r in braces. End the chunk with three back ticks: ```{r} paste("Hello", "World!") ```	Make a code chunk with three back ticks followed by an r in braces. End the chunk with three back ticks: `paste("Hello", "World!")` `## [1] "Hello World!"`
Place code inline with a single back ticks. The first back tick must be followed by an R, like this `r paste("Hello", "World!")`.	Place code inline with a single back ticks. The first back tick must be followed by an R, like this Hello World!.
Add chunk options within braces. For example, `echo=FALSE` will prevent source code from being displayed: ```{r eval=TRUE, echo=FALSE} paste("Hello", "World!") ```	Add chunk options within braces. For example, `echo=FALSE` will prevent source code from being displayed: `## [1] "Hello World!"`

Learn more about chunk options at http://yihui.name/knitr/options

Chunk options

option	default value	description
Code evaluation		
child	NULL	A character vector of filenames. Knitr will knit the files and place them into the main document.
code	NULL	Set to R code. Knitr will replace the code in the chunk with the code in the code option.
engine	'R'	Knitr will evaluate the chunk in the named language, e.g. **engine = 'python'**. Run **names(knitr::knit_engines$get())** to see supported languages.
eval	TRUE	If **FALSE**, knitr will not run the code in the code chunk.
include	TRUE	If **FALSE**, knitr will run the chunk but not include the chunk in the final document.
purl	TRUE	If **FALSE**, knitr will not include the chunk when running **purl()** to extract the source code.
Results		
collapse	FALSE	If **TRUE**, knitr will collapse all the source and output blocks created by the chunk into a single block.
echo	TRUE	If **FALSE**, knitr will not display the code in the code chunk above it's results in the final document.
results	'markup'	If **'hide'**, knitr will not display the code's results in the final document. If **'hold'**, knitr will delay displaying all output pieces until the end of the chunk. If **'asis'**, knitr will pass through results without reformatting them (useful if results return raw HTML, etc.)
error	TRUE	If **FALSE**, knitr will not display any error messages generated by the code.
message	TRUE	If **FALSE**, knitr will not display any messages generated by the code.
warning	TRUE	If **FALSE**, knitr will not display any warning messages generated by the code.
Code Decoration		
comment	'##'	A character string. Knitr will append the string to the start of each line of results in the final document.
highlight	TRUE	If **TRUE**, knitr will highlight the source code in the final output.
prompt	FALSE	If **TRUE**, knitr will add > to the start of each line of code displayed in the final document.
strip.white	TRUE	If **TRUE**, knitr will remove white spaces that appear at the beginning or end of a code chunk.
tidy	FALSE	If **TRUE**, knitr will tidy code chunks for display with the **tidy_source()** function in the **formatR** package.

R MARKDOWN – LET'S REVIEW

- What sorts of documents can be created using R markdown?
  - Pdf, word, html, ppt, dashboard, webpages and more

- Is the # needed to add narrative text to your R markdown file?
  - No, the # isn't needed to add narrative text – it is used for formatting
  - Note # still required to comment R code within code "chunks"

- Why would you use R markdown?
  - Reproduce your work at the click of a button, export results as a report or link to dashboard, create a transparent record of your work, etc.

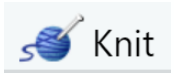
R MARKDOWN – LET'S REVIEW

- What is the header used to open a chunk of R code in a markdown file?
  - ```{r}

- How do you supress printing of R code in your rendered file?
  - In the code chunk header: echo=FALSE

```{r, echo=FALSE}
```

- How do you create an ordered list in a markdown document?
  - Just number the text:
    1. Item 1
    2. Item 2, etc.

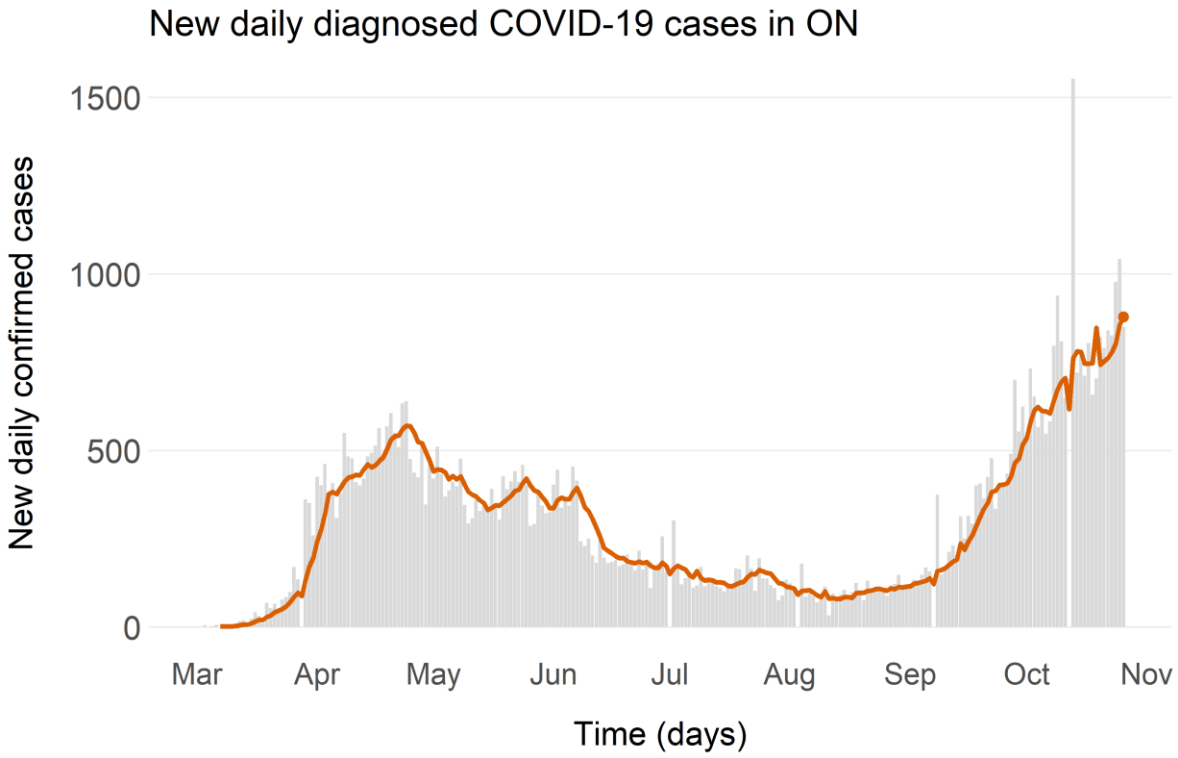
- How do you render and export your document?
  - Knit the document: 

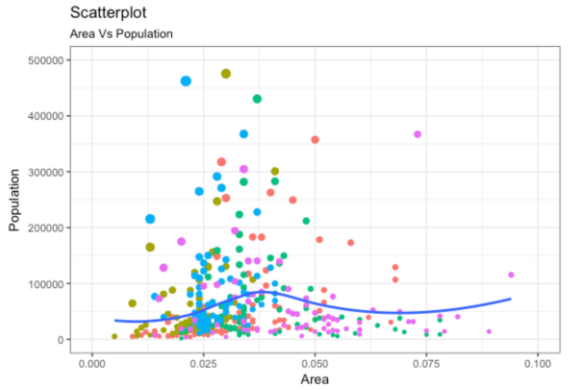
DATA VISUALIZATION

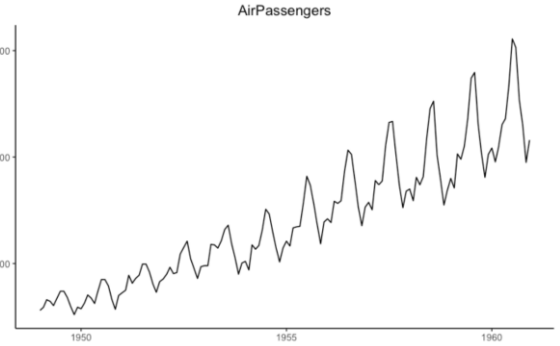
Very, very, very briefly

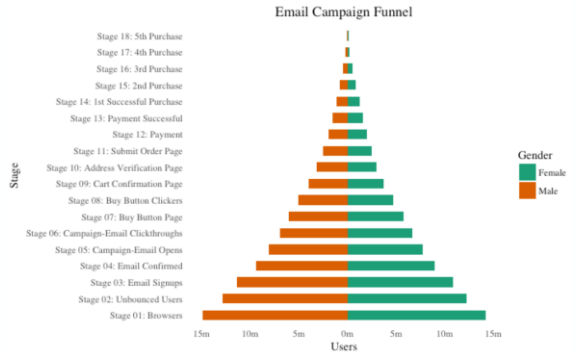
DATA VISUALISATION

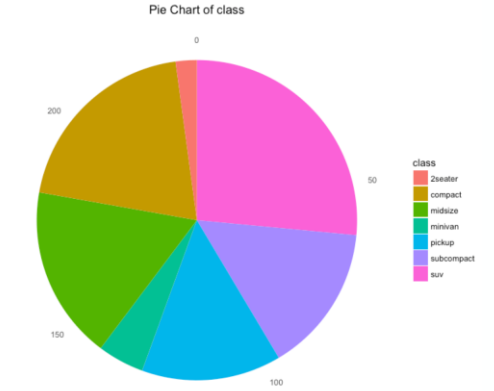
- Recall Exercise 1 – ggplot2:
  - Bar chart: geom_bar()
  - Line graph: geom_line()
  - Point: geom_point()
    - New cases (smoothed) for the maximum date in the dataset

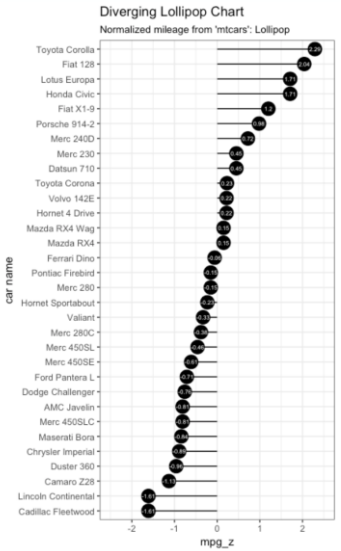


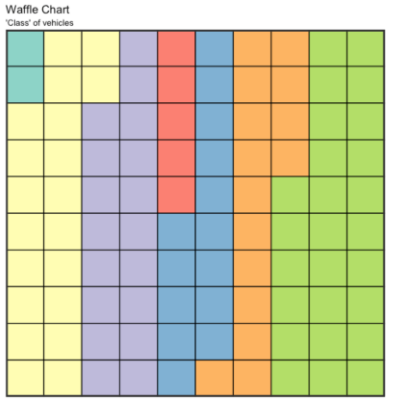


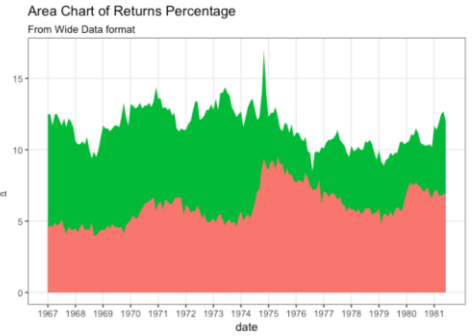


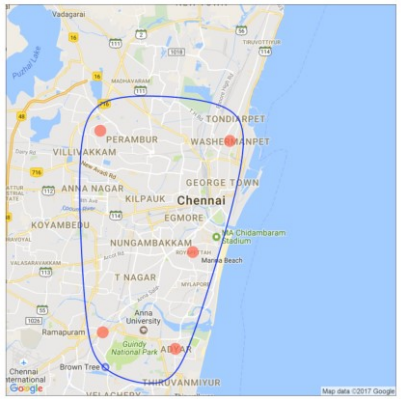


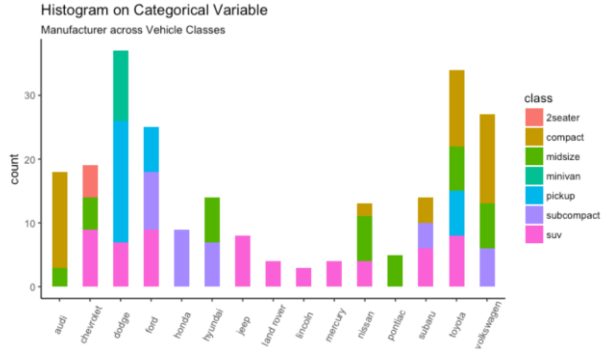


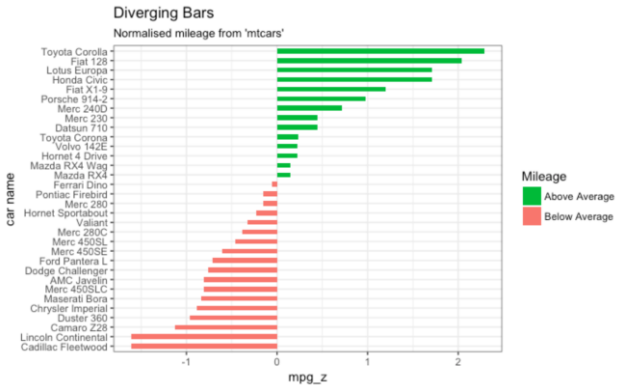


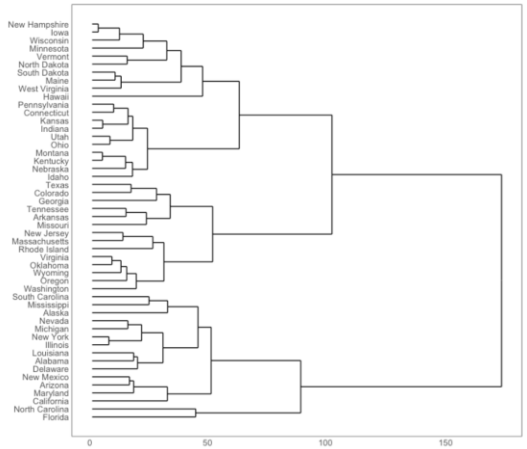


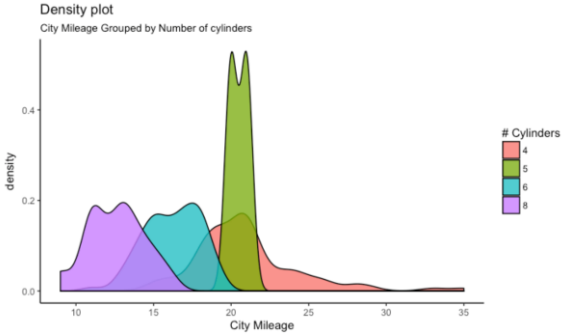


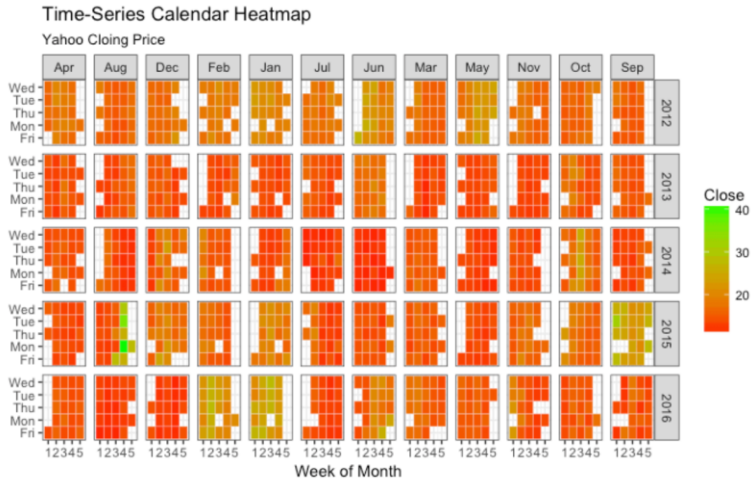








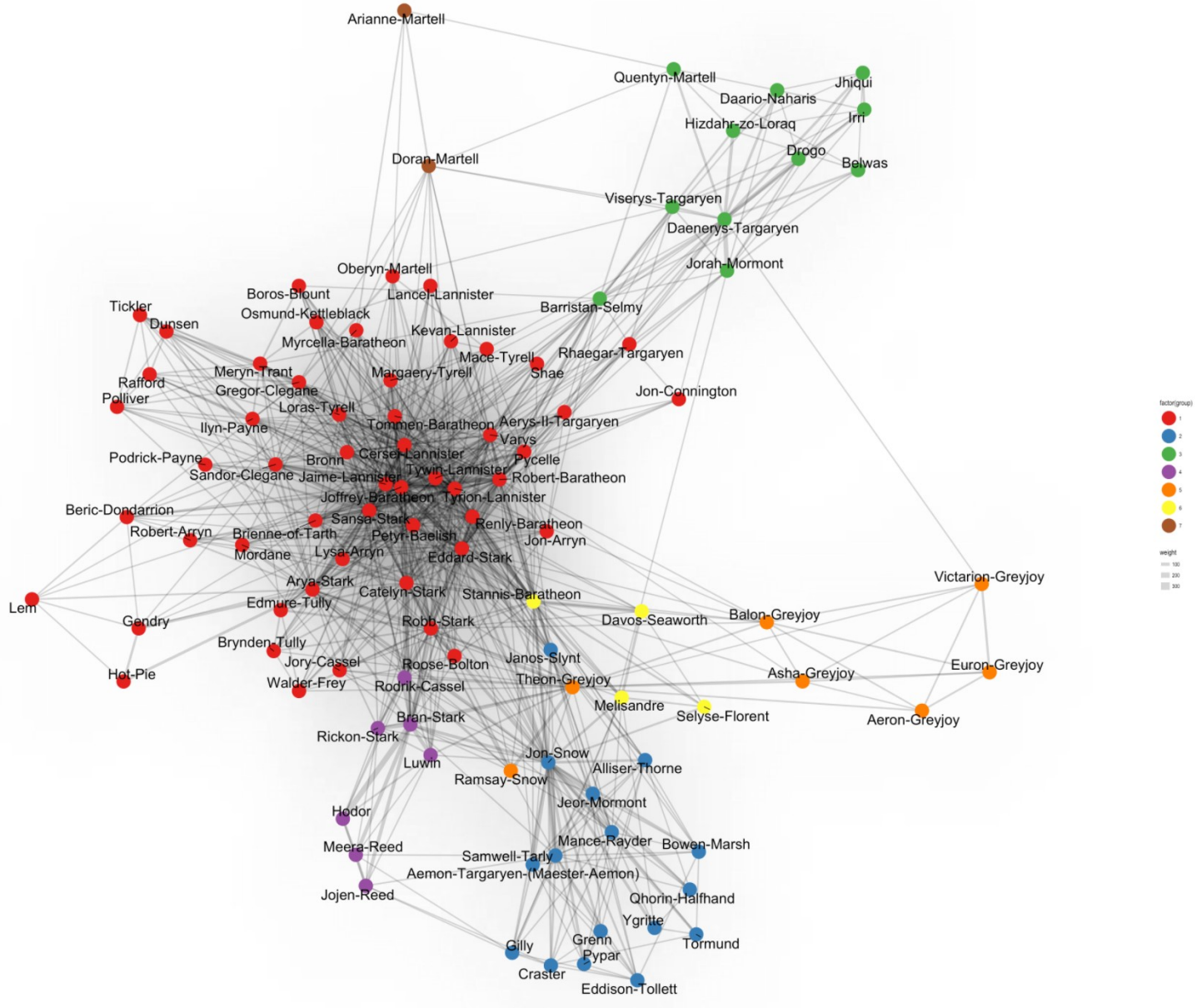




Code for all these and more: http://r-statistics.co/Top50-Ggplot2-Visualizations-MasterList-R-Code.html#Hierarchical%20Dendrogram

DATA VISUALISATION – SOCIAL NETWORK DIAGRAM

- Use in person-to-person outbreaks
  - Social network diagram
  - Epidemic curve
  - Other?



https://www.shirin-glander.de/2018/03/got_network/

LET'S REVIEW SOME SNA TERMINOLOGY

Term	Definition
A. Node	1. A group in which all of the actors are connected by a link.
B. Degree	2. A network where the direction of the relationship between actors is known and represented.
C. Edge	3. Also called an agent, a point, a vertex, or an actor.
D. Contacts	4. The number of connections that an actor has to other actors.
E. Component	5. Also called a tie, a link, or an arc.
F. Directed	6. During outbreak investigations SNA is often used to represent the relationship between cases and their _____.

LET'S REVIEW SOME SNA TERMINOLOGY

Term	Definition
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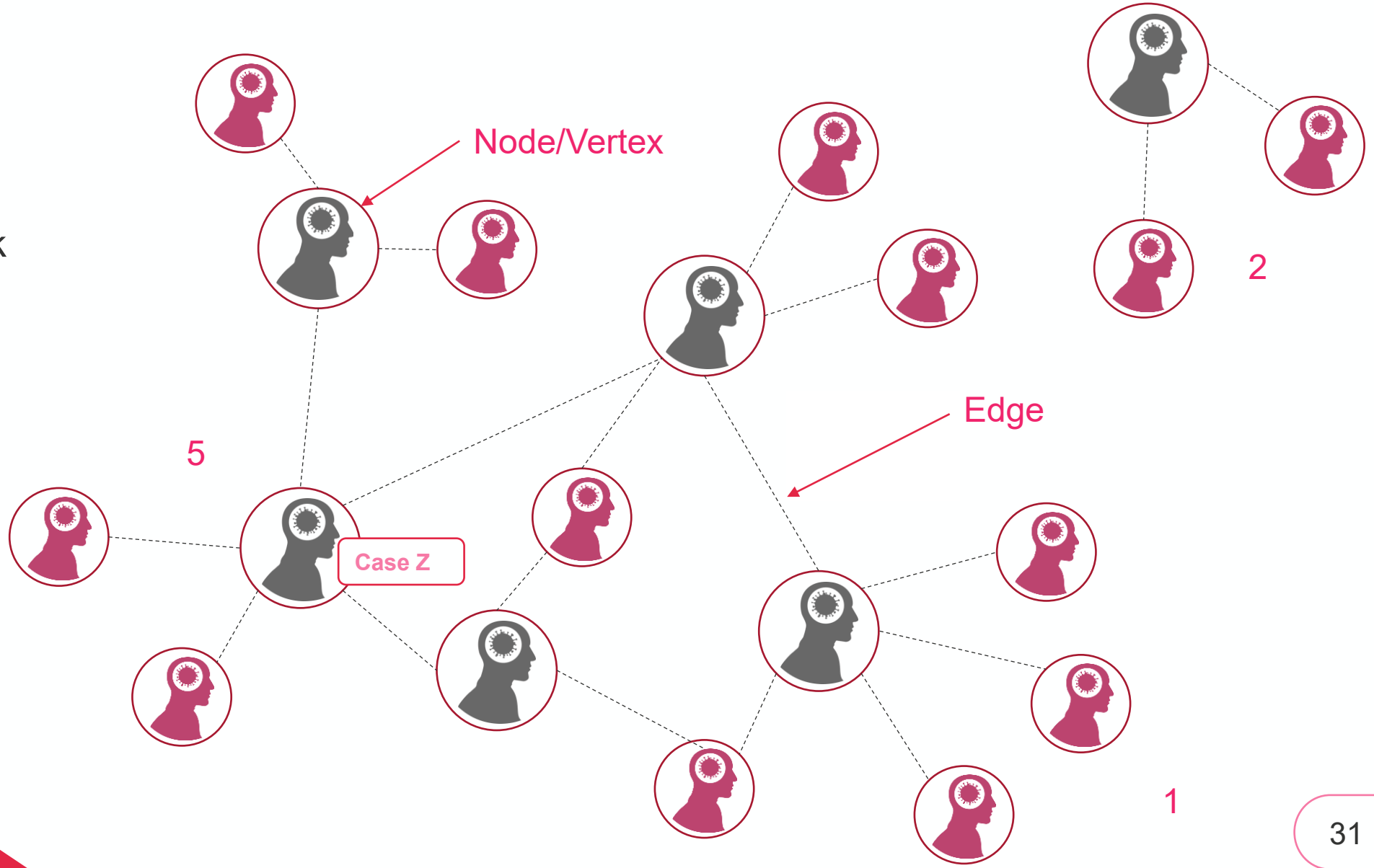
E. Component	1. A group in which all of the actors are connected by a link.
F. Directed	2. A network where the direction of the relationship between actors is known and represented.

DATA VISUALISATION – SOCIAL NETWORK DIAGRAM

- Key parts:
  - Node/Vertex
  - Edge/Tie/Link
  - Component
  - Degree



TIDYGRAPH

- Package that uses the social network analytics capabilities of another package (igraph) but allows use of tidyverse language and structure
  - Can use igraph itself, as well as other packages including epicontacts

- Need two different data elements:
  1.
  2.

SOCIAL NETWORK DIAGRAM - TIDYGRAPH

- In an outbreak situation, what would the nodes represent?
  - Cases and contacts
  - As a dataframe also include demographic information and case classification
    - 1 row per person

- What would the edges represent?
  - Relationships between cases and contacts
  - As a dataframe also include characterisations of that relationship (e.g., household, workplace, etc.)
    - 1 row per person

SOCIAL NETWORK DIAGRAM - TIDYGRAPH

- After processing your case and contact data to obtain edge and node dataframes
- Using ***tidygraph***:
  - Apply the *tbl_graph()* function to combine node and edge dataframes into a tidygraph object.

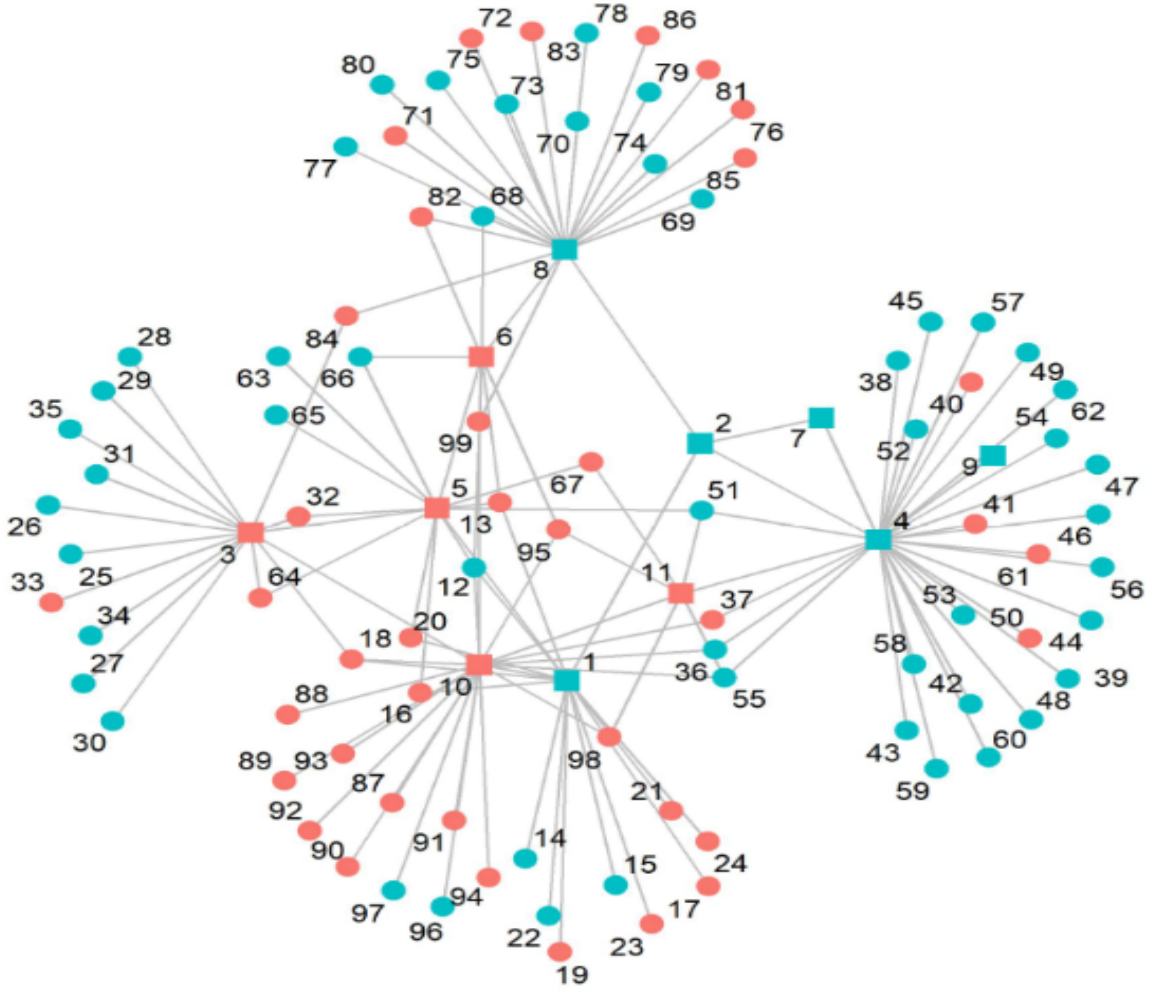
```
network_full <- tbl_graph(nodes = nodes_full,
                          edges = edges_full, directed = FALSE)
```

SOCIAL NETWORK DIAGRAM - TIDYGRAPH

- After combining edge and node dataframes
- Using ***tidygraph***:
  - Create network plot object using ***ggraph***
    - Note the similarity in format / structure to ***ggplot2***.
    - Format node & edge shape, colour, size according to various attributes.
    - Apply themes that have already been created.

```
network_full %>%
  ggraph() +
  geom_edge_link0(color = "#bdbdbd") +
  geom_node_point(aes(colour = Location, shape = Classification),
                  alpha = 1,
                  size = 4) +
  scale_fill_brewer(type = "qual",
                    palette = 5) +
  geom_node_text(label = label_full,
                 repel = TRUE,
                 point.padding = 0.1,
                 segment.color = NA) +
  theme(panel.background = element_blank(),
        plot.title = element_text(size = 20),
        legend.position = "bottom") +
  scale_shape_manual(values = c(15,16))
```

SOCIAL NETWORK DIAGRAM - TIDYGRAPH



BREAK-TRIVIA: KNOW YOUR KNOTS!

A 

B 

C 

D 

E 

F 

1. Sheepshank
2. Cat's Paw
3. Overhand
4. Half-hitch
5. Slipknot
6. Fisherman's Bend

TABLES, SOURCING CODE, AND TROUBLESHOOTING

Ways to catch wind in your sails so that you reach your destination quickly and safely

TABLES FOR DESCRIPTIVE EPIDEMIOLOGY

- Descriptive epidemiology: tables
- The flextable package provides a way to easily create nicely formatted tables of report and publication quality
- Embed tables in R markdown documents or render as graphic files
- Workhorse function: flextable()
  - Use dataframe containing the data as the object

FLEXTABLE

- Formatting the table
  - Default
  - Prebuilt themes
    - e.g., theme_vanilla() or theme_vader()
  - Custom design of themes

			measures		time
Ozone	Solar.R	Wind	Temp	Month	Day
41	190	7.4	67	5	1
36	118	8.0	72	5	2
12	149	12.6	74	5	3
18	313	11.5	62	5	4
		14.3	56	5	5
28		14.9	66	5	6

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FLEXTABLE

- Other useful functions:
  - font() → specify font
  - fontsize() → specify font size
  - bold() → bold face text
  - italic() → italic face text
  - bg() → background colour of table/table section
  - colour() → font colour
  - align() → text alignment (e.g., centre)
  - autofit() → automatically adjusts table size to fit the size of table contents
  - rotate() → rotate text (i.e., display vertically)
  - set_header_labels() → Specify labels in table header (default is column name)
  - add_header_row() and add_footer_row()→ add a single row of labels to display among one or more columns
  - fix_border_issues() → fixes rendered borders when cells are merged
  - set_caption() → specify a title for your table
  - footnote() → add footnote to table

FLEXTABLE - EXAMPLE

```
tab_case_site_infection <- flextable(case_site_infection) %>%
  bg(bg = "#E6E6E6", part = "header") %>%
  bold(part = "header") %>%
  fontsize(size = 10, part = "all") %>%
  font(part = "all", fontname = "Arial") %>%
  align(align = "center", part = "all") %>%
  set_header_labels(Site_infection = "Site of infection" ) %>%
  align(j=c("Site_infection"), align = "left") %>%
  bold( i = 6,  bold = TRUE, part = "body") %>%
  width(j = 1, width = 1.5) %>%
  set_caption(" Site of TB infection", style = "Table Caption")

tab_case_site_infection
```

Site of TB infection

Site of infection	Count
Abdominal	1
Meningeal	1
Miliary	1
Pleural	4
Pulmonary TB	4
Total	11

FLEXTABLE - EXAMPLE

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Total	11

SOURCING CODE

Programming for larger projects

SOURCING CODE

- The source() function: calls and runs code from another script
- Useful for setting up complex projects (i.e., long, segmented code)
- Aides in debugging when re-running script
- Final version of scripts

SOURCING CODE

```
source(here("scripts", "01_define_paths.R"))
source(here("scripts", "02_load_libraries.R"))
source(here("scripts", "03_import_data.R"))
source(here("scripts", "04_clean_data.R"))
source(here("scripts", "05_summarise_data.R"))
source(here("scripts", "06_visualize_data.R"))
source(here("scripts", "07_eat_cake.R"))
```

SOURCING CODE: GROUP DISCUSSION

ADVANTAGES

- Can you think of any advantages to setting up a project by creating several smaller scripts and then calling them/sourcing them in another?

DISADVANTAGES

- Can you think of any disadvantages to setting up a project by creating several smaller scripts and then calling them/sourcing them in another?

Advantages

Disadvantages

SOURCING CODE

ADVANTAGES

- Organised workflow for complex projects
- Aides in debugging
  - i.e., easy to see what section is broken
- Aides in replication of work

DISADVANTAGES

- Requires time to go back and optimise your code
- Extra time to ensure that code is aligned and runs smoothly when compiled
- Requires extra effort in ensuring that details regarding your system are communicated in an accessible way

BREAK

- Take a few minutes for yourself
  - Too many scraps of paper on your desk?
  - Need a mindfulness activity suggestion?
  - Build yourself a flotilla of paper ships!

TROUBLESHOOTING

Common errors, tips, and tricks

TROUBLESHOOTING - ERRORS

- RStudio helps to identify basic problems in your code:

```
34
35  =install.packages("readr")
36  install.packages("readxl")
```

TROUBLESHOOTING - ERRORS

1. Error in library(X) : there is no package called ‘X’
2. Error in X() : could not find function “X”
3. Error in function(X) : object ‘X’ not found
4. Error : unexpected ‘X’ in [line of code]
5. Error : ‘X’ does not exist in current working directory [pathway]

A. X is an error in a line of code - revisit that line to see what the issue is
B. X is a package that has not been installed – install the package or check for typos
C. X is a file that is not located where your line of code said that it would be – ensure that the file pathway is correct and check for typos
D. X is an object (e.g., a dataframe) that doesn’t exist – check for typos or order in which you’ve run your code (e.g., did you clear your workspace?)
E. X is a function – check to make sure the right packages have been installed and loaded for this session and check for typos

TROUBLESHOOTING - ERRORS

- Error in library(X) : there is no package called ‘X’
  - X is a package that has not been installed – install the package or check for typos
- Error in X() : could not find function “X”
  - X is a function – check to make sure the right packages have been installed and loaded for this session and check for typos
- Error in function(X) : object ‘X’ not found
  - X is an object (e.g., a dataframe) that doesn’t exist – check for typos or order in which you’ve run your code (e.g., did you clear your workspace?)
- Error : unexpected ‘X’ in [line of code]
  - X is an error in a line of code - revisit that line to see what the issue is
- Error : ‘X’ does not exist in current working directory [pathway]
  - X is a file that is not located where your line of code said that it would be – ensure that the file pathway is correct and check for typos

TROUBLESHOOTING - ERRORS

- Error in [line of code] : undefined columns selected
  - Confirm that your reference to a particular variable in your code is correct, whether you are indexing or calling by name

- Error in [line of code] : replacement has [x] rows, data has [y]
  - Depends on what you are doing: confirm that the steps of what you are doing are reflected accurately in the code (E.g., did you create the variable you are trying to assign values to)

- Error in [line of code] : all arguments must have the same length
  - Depends on what you're doing: try addressing NA's specifically in function options

TROUBLESHOOTING - APPROACH

- Start writing code in short pieces – one line does one thing

- Make note of changes to the data as you process it to ensure that the code is doing what it is expected to do (e.g., counts of records and variables, cross tabulations)
  - length(), count(), table(), str(), etc.

- Once your simple code works, consider:
  - Chaining statements together %>%
  - Recycling for similar tasks
  - Advanced: building functions, loops

TROUBLESHOOTING - TIPS

- Check spelling
  - Note: R is case sensitive
- Check correct referencing of variables and datasets
- Confirm that variables (and other objects) are being treated according to their type
  - Did your numeric data load as character for some reason?
  - Are you working with functions for dataframes, but your data are currently stored as a list?
  - Are there trailing whitespaces or non printable characters that came along with it?

TROUBLESHOOTING - TIPS

- Become comfortable translating code to your preferred spoken language through practice - what the functions do, what precisely is happening in relation to objects and data
  - Then you will be in a position to adapt code that is shared with you or that you find

- Start your search statement with the software name
  - Incl. version, package, function, etc. as applicable

- Follow-up with question, function, or error message
  - In relation to error messages, they are sometimes long and in such cases it may be most useful to take the more generic portions of the returned message

TROUBLESHOOTING - RESOURCES

- https://stackoverflow.com/
- https://www.rdocumentation.org
- https://www.tidyverse.org/
- https://www.dummies.com/programming/r/r-for-dummies-cheat-sheet/
- http://www.cookbook-r.com/
- https://www.reconlearn.org/

TROUBLESHOOTING - TIPS

- Identify and make note of sources/websites that keep popping up that have useful information
- Don’t hesitate to ask for help if you cannot find or think of a solution to your problem
- Practice, be patient with yourself as you learn, and be open to experimentation - troubleshooting skills are acquired over time

R Markdown Refer

Learn more about R Markdown at rmarkdown
Learn more about Interactive Docs at shiny.rstudio

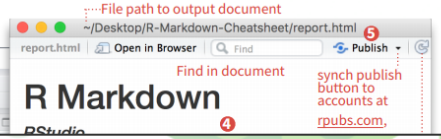
Syntax

Plain text

R Markdown : : CHEAT SHEET

What is R Markdown?

.Rmd files · An R Markdown



.rmd Structure

YAML Header
Optional section of render (e.g. pandoc)

rmarkdown

Data Visualization with ggplot2 : : CHEAT SHEET

ggplot2

Basics

Geoms

Use a geom function to represent data points, use the geom's aesthetic properties to represent variables.
Each function returns a layer.

continuous bivariate distribution
h <- ggplot(diamonds, aes(carat, price))

h + geom_bin2d(binwidth = c(0.25, 500)**)**
x, y, alpha, color, fill, linetype, size, weight

h + geom_density2d()
x, y, alpha, colour, group, linetype, size

h + geom_hex()
x, y, alpha, colour, fill, size

continuous function
i <- ggplot(economics, aes(date, unemploy))

i + geom_area()
x, y, alpha, color, fill, linetype, size

i + geom_line()
x, y, alpha, color, group, linetype, size

i + geom_step(direction = "hv")
x, y, alpha, color, group, linetype, size

visualizing error
df <- data.frame(grp = c("A", "B"), fit = 4:5, se = 1:2)
j <- ggplot(df, aes(grp, fit, ymin = fit-se, ymax = fit+se))

j + geom_crossbar(fatten = 2**)**
x, y, ymax, ymin, alpha, color, fill, group, linetype, size

j + geom_errorbar(), x, ymax, ymin, alpha, color, group, linetype, size, width (also

Data Transformation with dplyr : : CHEAT SHEET

dplyr

dplyr functions work with pipes and expect **tidy data**. In tidy data:

Each **variable** is in its own **column** & Each **observation**, or **case**, is in its own **row**

pipes
x %>% f(y) becomes **f(x, y)**

Summarise Cases

These apply **summary functions** to columns to create a new table of summary statistics. Summary functions take vectors as input and return one value (see back).

summary function

summarise(.data, …)
Compute table of summaries.
summarise(mtcars, avg = mean(mpg))

count(x, ..., wt = NULL, sort = FALSE)
Count number of rows in each group defined by the variables in … Also **tally**().
count(iris, Species)

VARIATIONS

summarise_all() - Apply funs to every column.
summarise_at() - Apply funs to specific columns.
summarise_if() - Apply funs to all cols of one type.

Group Cases

Manipulate Cases

EXTRACT CASES

Row functions return a subset of rows as a new table.

filter(.data, …) Extract rows that meet logical criteria. *filter(iris, Sepal.Length > 7)*

distinct(.data, ..., .keep_all = FALSE) Remove rows with duplicate values.
distinct(iris, Species)

sample_frac(tbl, size = 1, replace = FALSE, weight = NULL, .env = parent.frame()) Randomly select fraction of rows.
sample_frac(iris, 0.5, replace = TRUE)

sample_n(tbl, size, replace = FALSE, weight = NULL, .env = parent.frame()) Randomly select size rows. *sample_n(iris, 10, replace = TRUE)*

slice(.data, …) Select rows by position.
slice(iris, 10:15)

top_n(x, n, wt) Select and order top n entries (by group if grouped data). *top_n(iris, 5, Sepal.Width)*

Logical and boolean operators to use with filter()

<	<=	is.na()	%in%	|	xor()
>	>=	!is.na()	!	&	

See **?base::Logic** and **?Comparison** for help.

Manipulate Variables

EXTRACT VARIABLES

Column functions return a set of columns as a new vector or table.

pull(.data, var = -1) Extract column values as a vector. Choose by name or index.
pull(iris, Sepal.Length)

select(.data, …)
Extract columns as a table. Also **select_if()**.
select(iris, Sepal.Length, Species)

Use these helpers with select (),
e.g. select(iris, starts_with("Sepal"))

contains(match) **num_range**(prefix, range) **:**, e.g. mpg:cyl
ends_with(match) **one_of**(…) **-**, e.g, -Species
matches(match) **starts_with**(match)

MAKE NEW VARIABLES

These apply **vectorized functions** to columns. Vectorized funs take vectors as input and return vectors of the same length as output (see back).

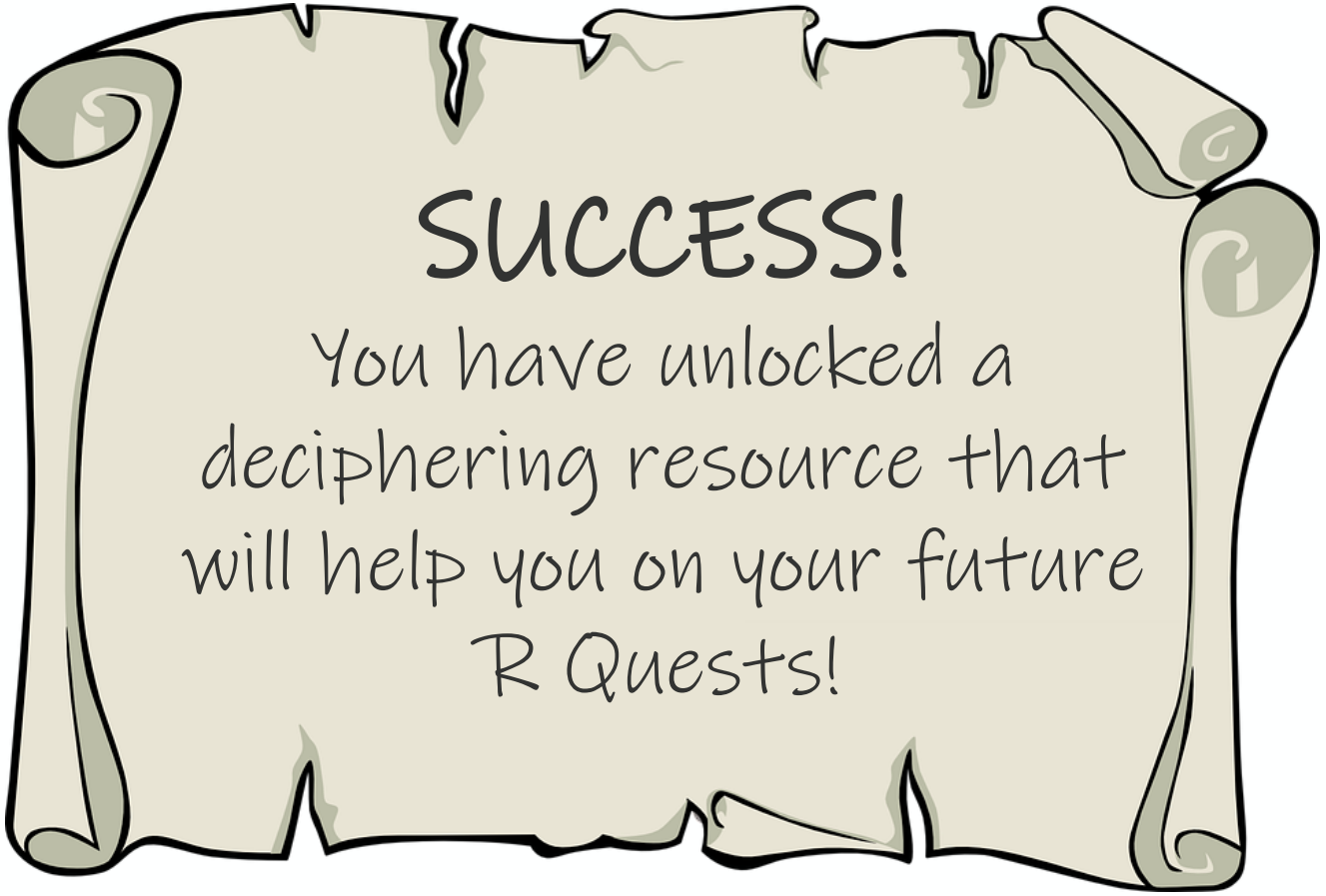
vectorized function

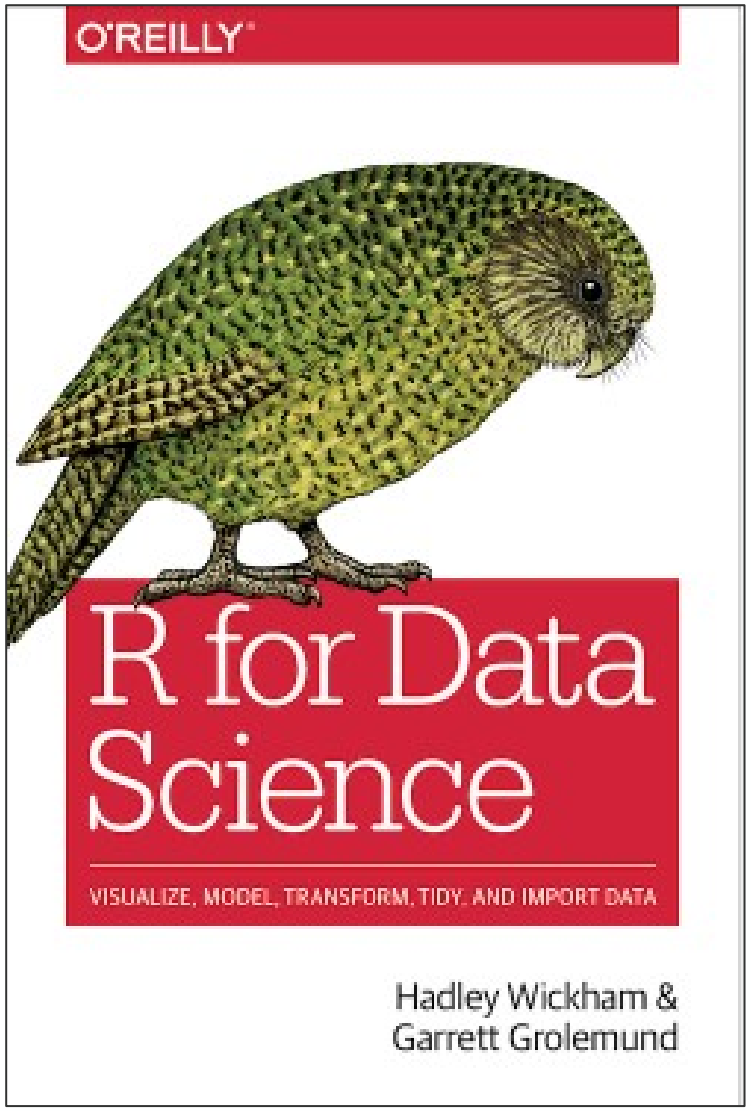
mutate(.data, …)
Compute new column(s).
mutate(mtcars, gpm = 1/mpg)

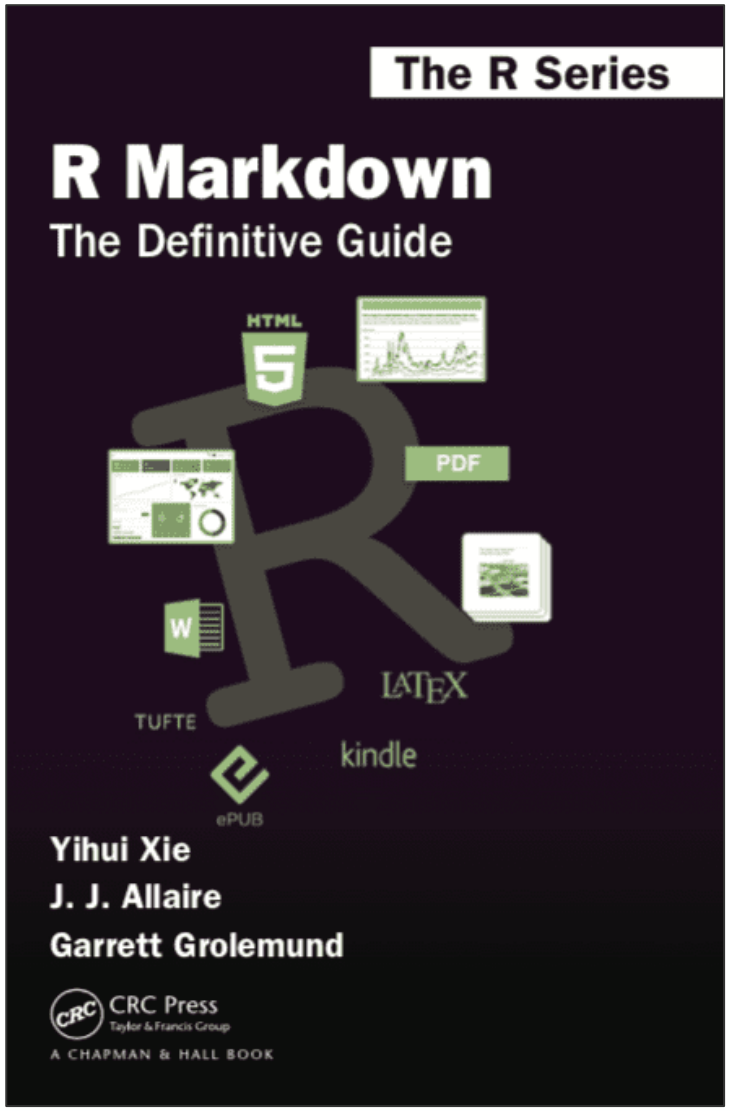
transmute(.data, …)
Compute new column(s), drop others

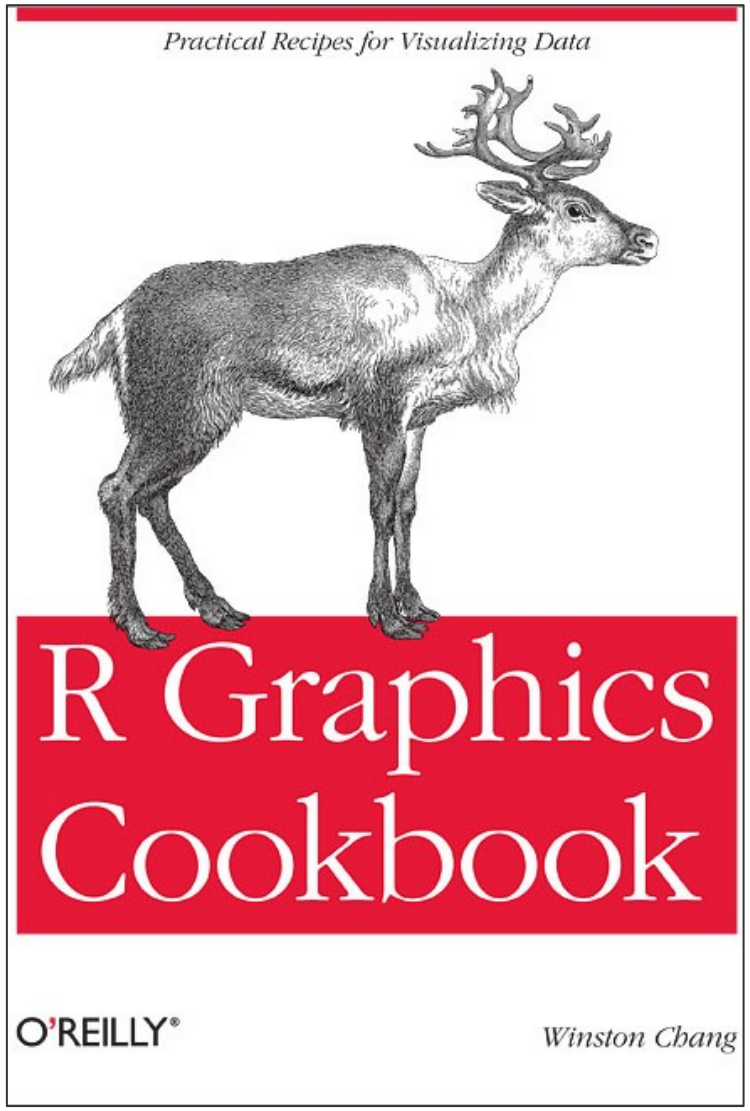
https://rstudio.com/resources/cheatsheets/

SCAVENGER HUNT




O'REILLY
R for Data Science
VISUALIZE, MODEL, TRANSFORM, TIDY, AND IMPORT DATA
Hadley Wickham &
Garrett Grolemund


The R Series
R Markdown
The Definitive Guide
HTML
PDF
LATEX
TUFTE
kindle
ePUB
Yihui Xie
J. J. Allaire
Garrett Grolemund
CRC Press
Taylor & Francis Group
A CHAPMAN & HALL BOOK


Practical Recipes for Visualizing Data
R Graphics Cookbook
O'REILLY
Winston Chang

DECODE THE MESSAGE

DECODE THE MESSAGE

What is R markdown?

What does the mutate() function do?

What is the function used following ggplot() to specify a bar chart?

Can you run RStudio on your computer without installing R?

Are packages developed by the R Epidemics Consortium (RECON) part of the tidyverse?


BREAK: BEACH PARTY!
Using the annotation tool – draw something you'd bring with you to a deserted island beach!

WRAP UP

DAY 2 - EXERCISE

CONCEPTUAL

- You will get some data on TB cases and contacts, and clean and explore it.
- You can source/adapt existing code from day 1, write brand new code, or a combination, to create descriptive epi figures and tables relevant to the investigation.
- You will create a social network diagram
- Build an automated report in R markdown (or part of one) containing all the figures you created and any text notes or interpretation you make, and export the report document for your site.

TECHNICAL

- You will try out ggplot2 themes to change the look/format of figures.
- Create nice-looking tables flextable for reports.
- Details on structuring data for SNA with tidygraph package.
- You will source your code in an R markdown file to output a document based on your script.

PRE-LEARNING FOR DAY 3

- Details can be found in the Participant Guide

- Webpage: Canadian Chronic Disease Indicators

- From pre-course self-study module:
  - Video: Data Manipulation Tools and Dplyr (20 mins)
  - Video: R Markdown (7 mins)

Questions?

NEED HELP OR CLARIFICATION?

Remember: Slack channel for this training session

- Phacrusers.slack.com -> intro_r_oct2023cohort

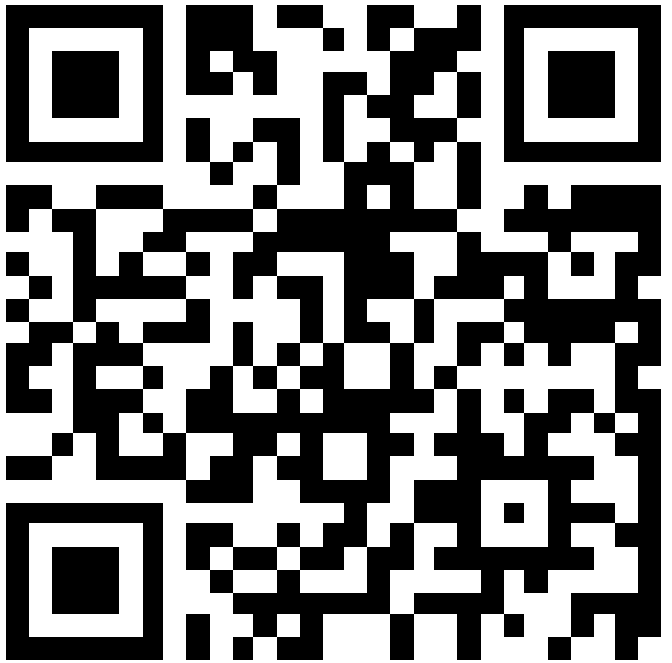
- **Use the Slack channel to:**
  - Connect with your peers
  - Find materials shared throughout the course
  - Ask questions about the materials/exercises to your peers, facilitators and subject matter experts
  - Help others who have questions if you know the answer!

FEEDBACK FROM DAY 2

- Please answer a few questions to provide us some feedback from Day 2

https://www.slido.com/

#ROct2023



EXERCISE DEMO

Getting Started