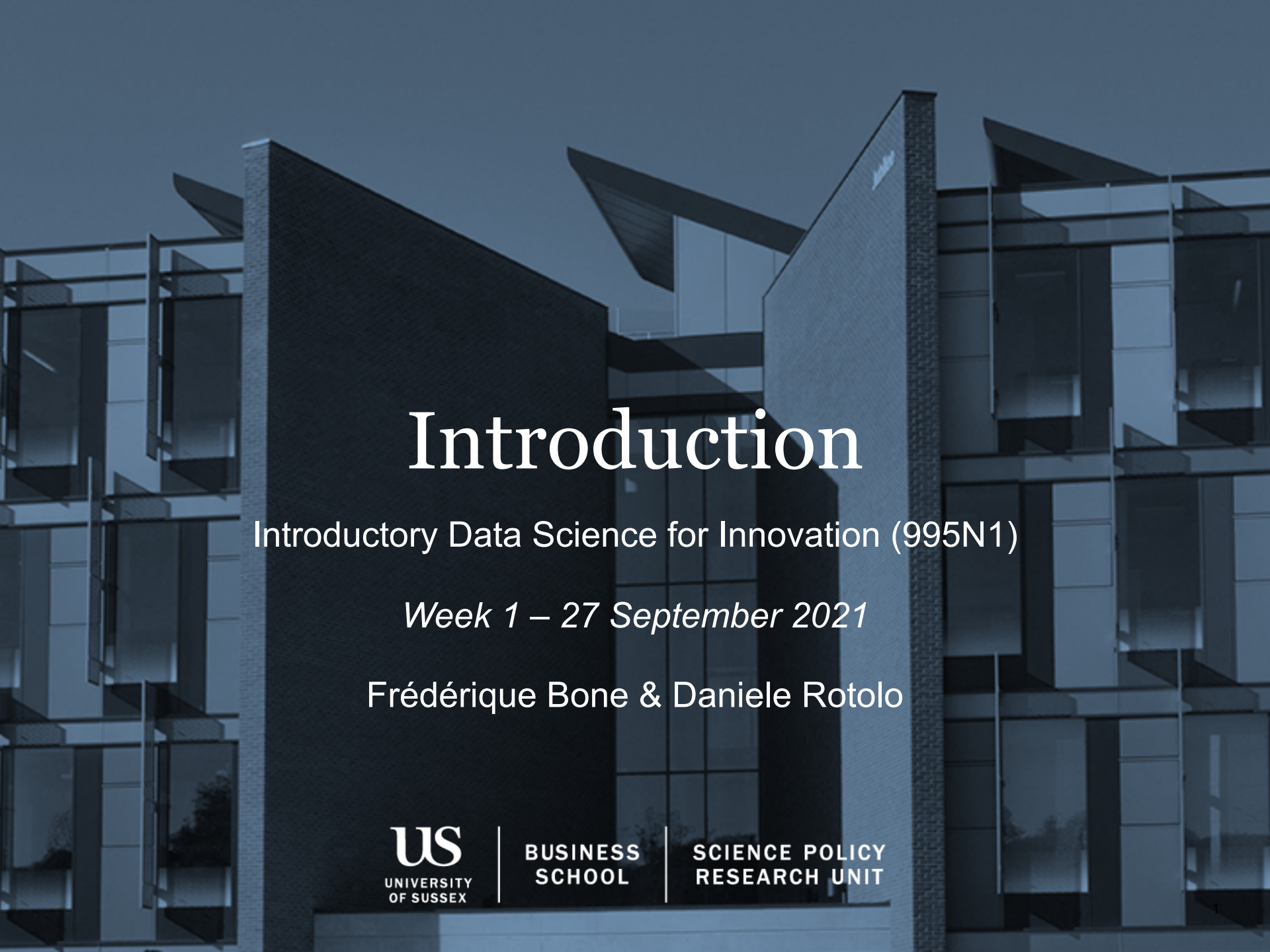

Introduction

Introductory Data Science for Innovation (995N1)

Week 1 – 27 September 2021

Frédérique Bone & Daniele Rotolo

UNIVERSITY OF SUSSEX | BUSINESS SCHOOL | SCIENCE POLICY RESEARCH UNIT

Did you get to install RStudio or connect to RStudio cloud?

Make sure you also downloaded the R script available in Canvas.

What do you expect to learn in this module?

What is Data Science?

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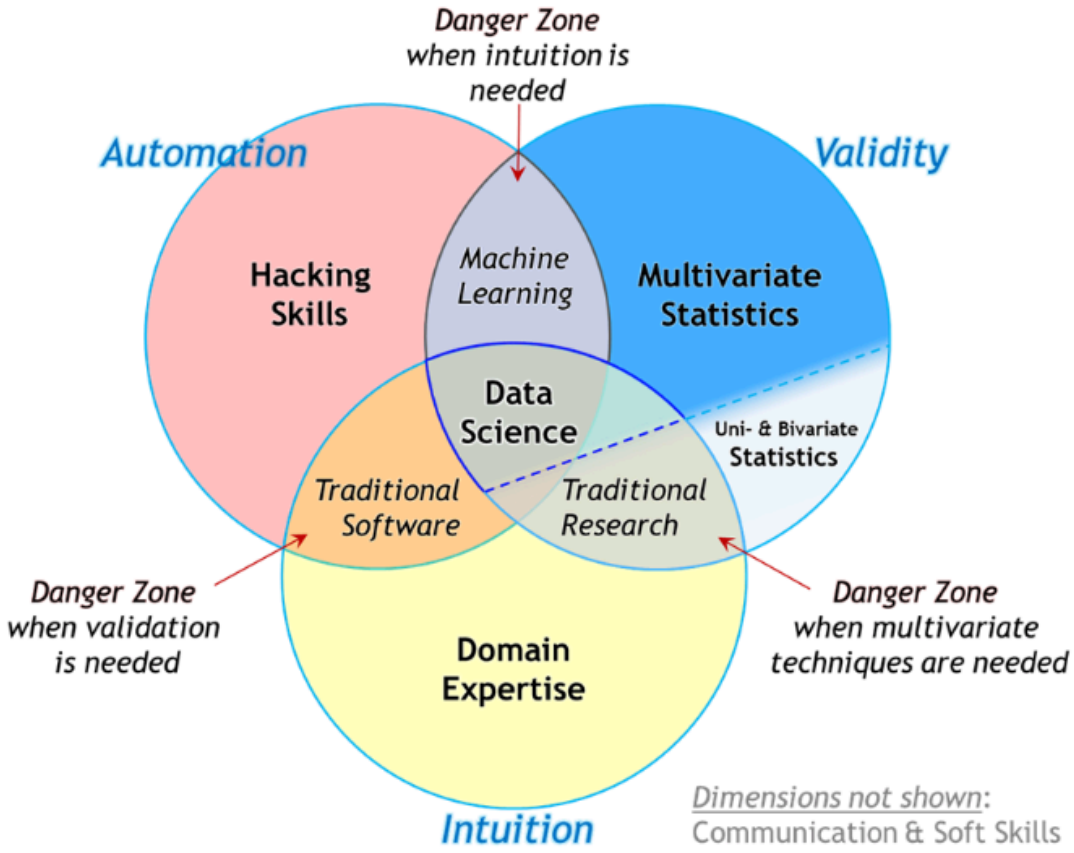
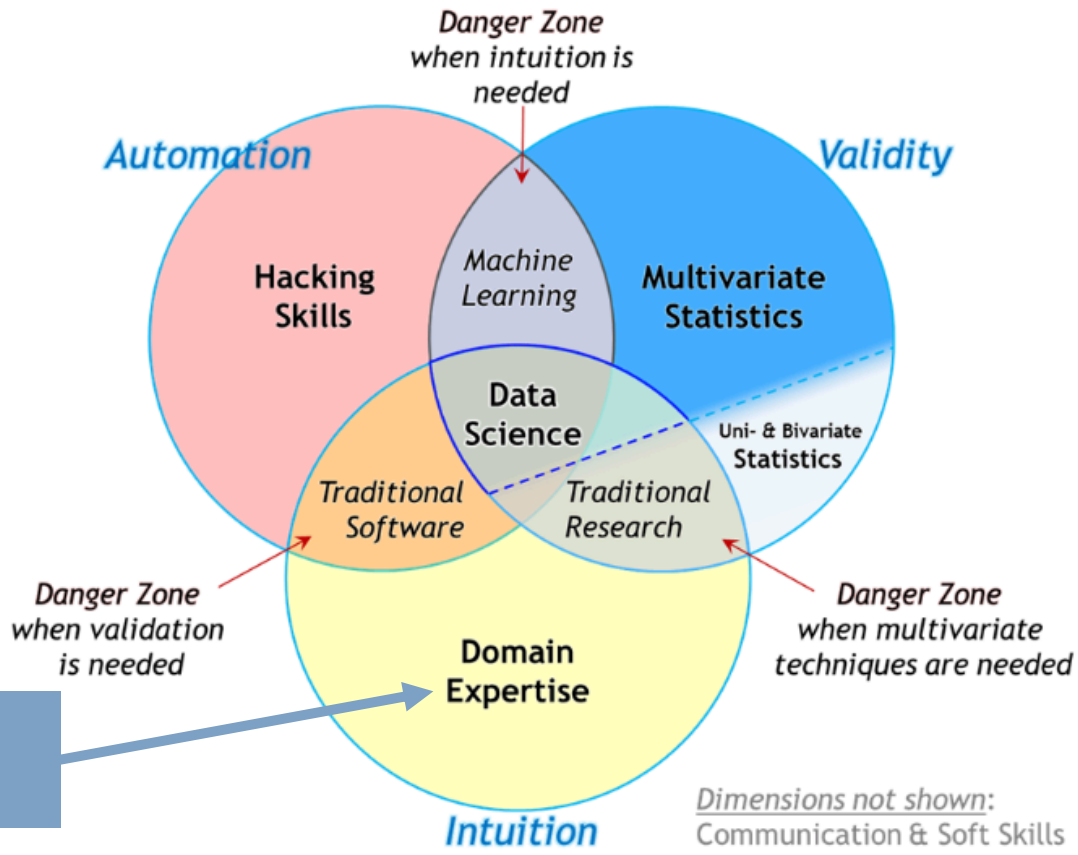
What is data science?



Source: Andrew Silver, https://towardsdatascience.com/the-essential-data-science-venn-diagram-35800c3bef40

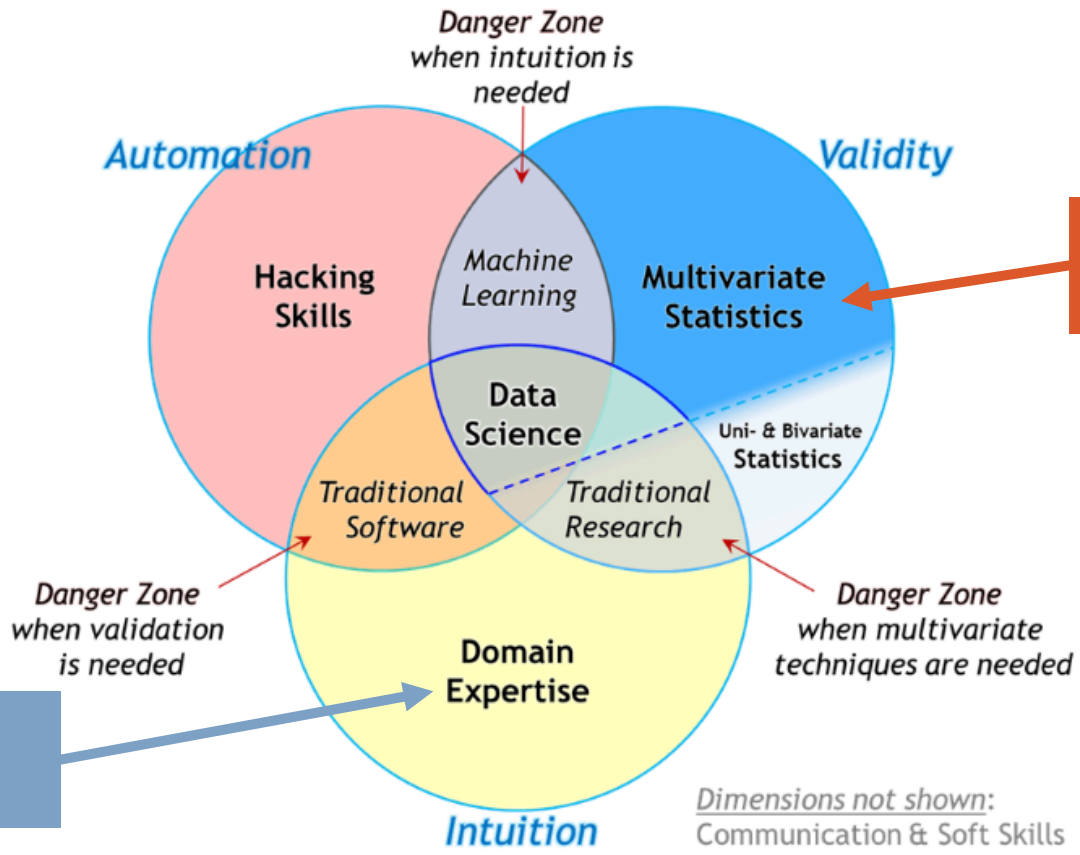
What is data science?



Semester 1 modules

Source: Andrew Silver, https://towardsdatascience.com/the-essential-data-science-venn-diagram-35800c3bef40

What is data science?



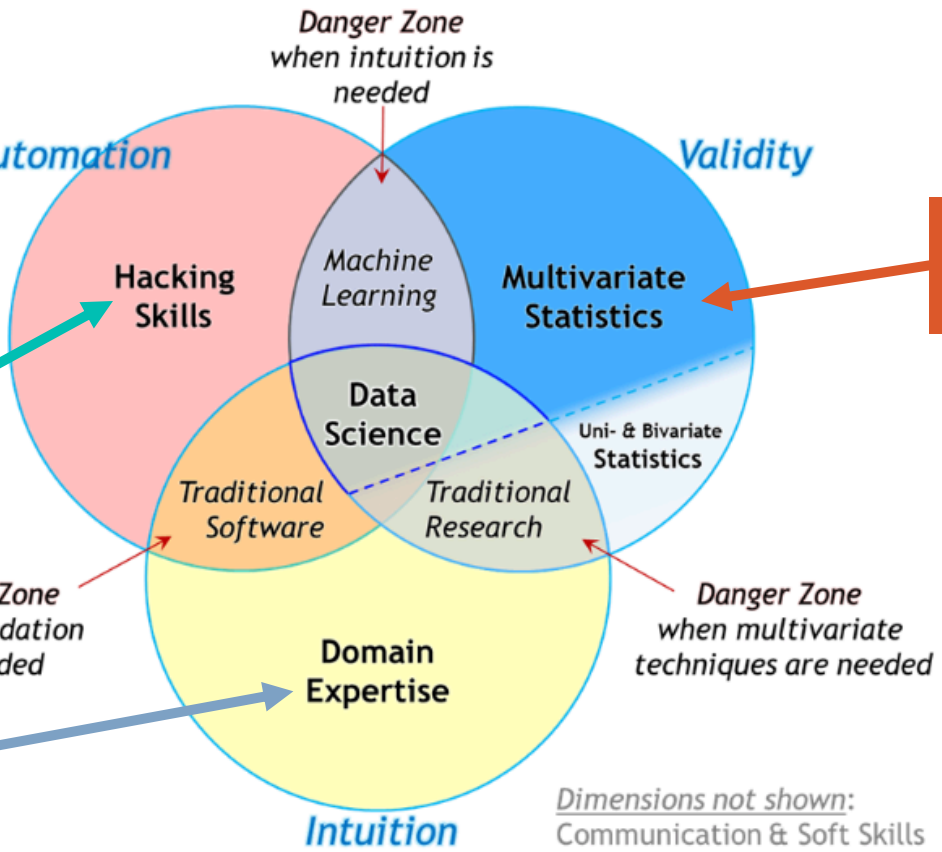
Semester 2 quant modules

Semester 1 modules

Source: Andrew Silver, https://towardsdatascience.com/the-essential-data-science-venn-diagram-35800c3bef40

What is data science?

Introduction to Data Science for Innovation
- Data processing
- Automation
- Intro to ML
- …



Semester 2 quant modules

Semester 1 modules

Source: Andrew Silver, https://towardsdatascience.com/the-essential-data-science-venn-diagram-35800c3bef40

What will you learn in this module?

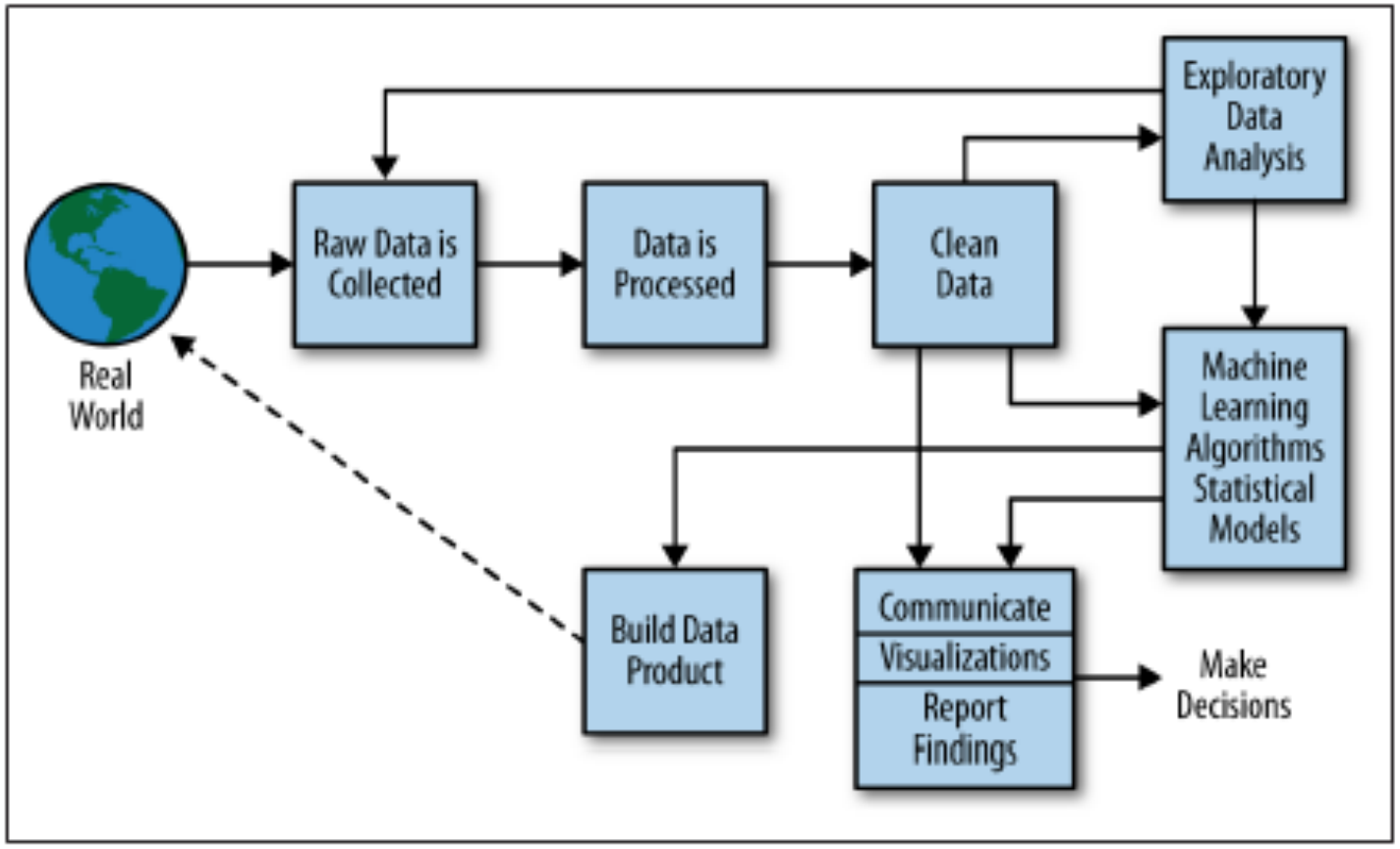
What you will learn on other Semester 1 modules?

You will develop an understanding of science and innovation policy with associated concepts and literature: together with your practical knowledge of science and technology policy, this provides you with '**domain expertise**'.

This course aims to provide you with practical skills:

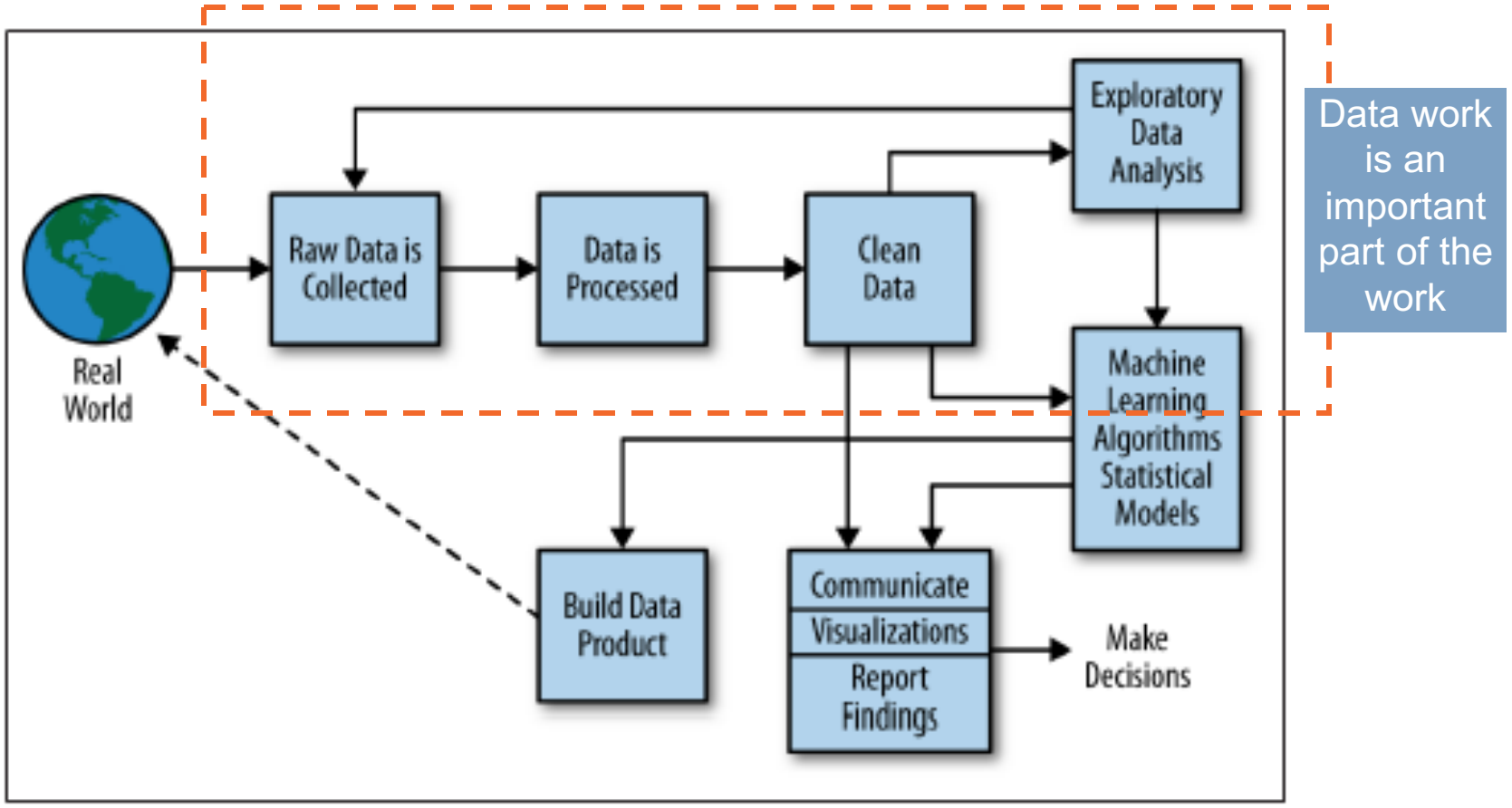
- To work with innovation related data ('into the wild')
- To clean and transform data in an efficient manner
- To generate analysis and visualisation for policy and decision making
- Through the use of computational tools (learning how to program)

What is data science?



Source: The Data Science Process, By Rachel Schutt & Cathy O'Neil, Doing Data Science, P. 41

What is data science?



Source: The Data Science Process, By Rachel Schutt & Cathy O'Neil, Doing Data Science, P. 41

What is data science?

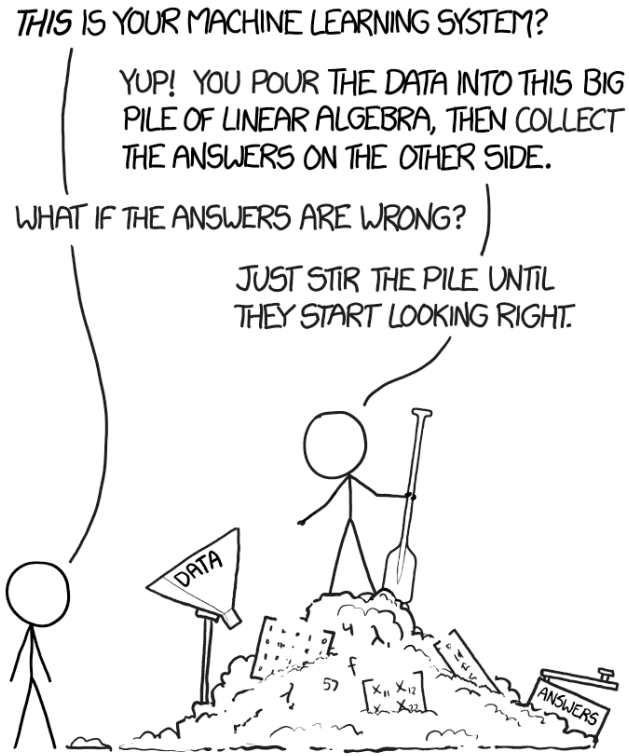
Data scientists, according to interviews and expert estimates, spend from 50 percent to 80 percent of their time mired in this more mundane labor of collecting and preparing unruly digital data, before it can be explored for useful nuggets.

Source: New York Times , 17 Aug. 2014
For Big-Data Scientists, 'Janitor Work' Is Key Hurdle to Insights

Garbage in → Garbage out

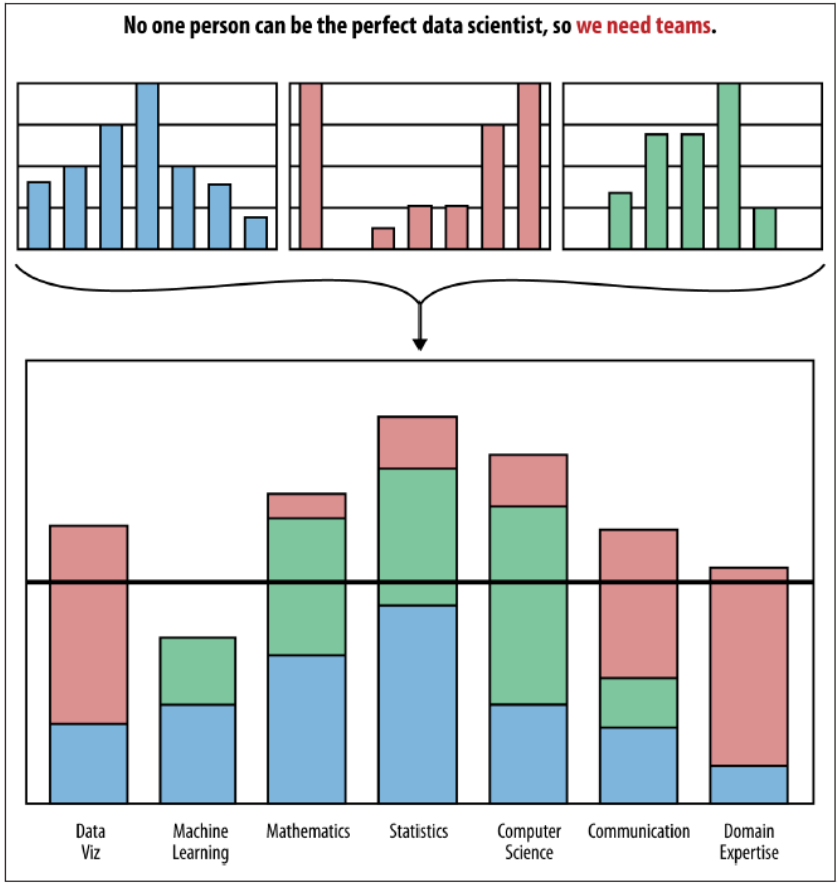
What is data science?

Garbage in → Garbage out



https://xkcd.com/1838/

What is data science?



Source: The Team profiles, By Rachel Schutt & Cathy O'Neil, Doing Data Science, P. 12

Introduction to Data Science for Innovation

You won't become computing/machine learning experts.

But you will gain knowledge on the workings of each part of the pipeline with practical cases of science and innovation data.

You will learn how to learn.

It's up to you to take your knowledge to the next level.

Why is it important?

Why learning data science?

Science and Innovation policy is evidence based

→ Example from Rebecca Endean,
Strategy Director of UK Research and Innovation
Presenting at the ResearchFish conference 2018.
(https://5ba0c32f-08ac-4ea4-84b2-3adc5e339103.filesusr.com/ugd/fc7e18_f53daa3096ed4822a6df0783bfbbfa51.pdf)

Why learning data science?

UKRI's approach to assessing impact is based around recognising key differences in its activities and focusing on *relevant* impacts

---

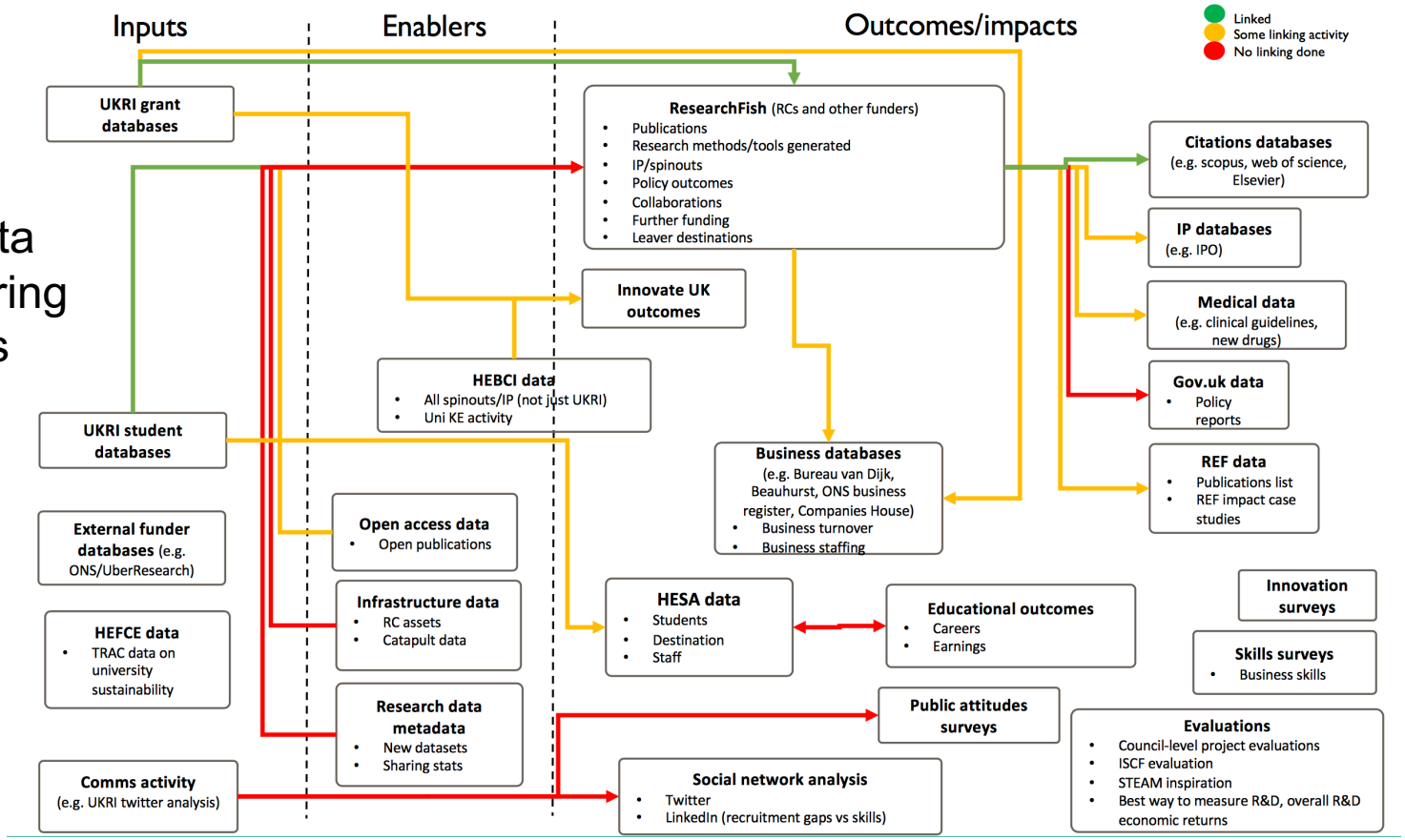
There is no *one-size-fits-all* approach to evaluating research and innovation programmes. UKRI is developing an overarching evaluation strategy which:

- Is systematic, evidence-based and dynamic;
- Assesses impact beyond counting citations;
- Does not privilege one discipline over another because its outputs are more tangible and/or immediate;
- Understands that there is a lag between funding and realisation of impact;
- Understands that impact may not be in the form of a product or tool, but contributing towards a web of knowledge which allows for further understanding/work to be done; and
- Makes a convincing and robust case for impact, utilising effective tools and methods for assessing impact.

Rebecca Endean, UKRI, 2018

Why learning data science?

UKRI
From data
To measuring
impacts



Rebecca Endean, UKRI, 2018

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Outline of the course

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Outline

Introduction to programming and data manipulation:

- Week 1: Introduction
- Week 2: Data structure
- Week 3: Data Collection and Transformation

Lecture outline

Data in the wild:

- Week 4: Data sources and innovation indicators innovation 1

- Week 5: Data sources and innovation indicators innovation 2 (Guest lecture – ResearchFish TBC)

Lecture outline

Analysing innovation data:

- Week 6: Textual data and text-mining (P1)
- Week 7: Textual data and text-mining (P2)
- Week 8: Data visualisation
- Week 9: Introduction to machine learning

Lecture outline

Wrapping up:

- Week 10: Revisions

- Week 11: Data Science, Policy and Practice (Guest lecture –TBC)

Assessments

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Assessments

Learning outcome	Assessment mode
•Identify data sources to address research questions and the main ethical concerns associated with data usage	REP
•Identify the most appropriate approaches to read, process and transform data	REP, GPN
•Describe and apply major text-mining techniques to generate intelligence for decision making	GPN
•Employ data analysis techniques to produce effective visualisations	REP, GPN

Assessments

Coursework, (GPN):

Group presentation (30% of the final mark)
A small text mining project.

Timeline:
Week 1-3: creation of groups (2-3 students)
Week 3-10: project development (including supervision)
Week 11: project submission
Week 11: group presentation

Submit your presentation to f.bone@sussex.ac.uk and d.rotolo@sussex.ac.uk by Week 11.

Assessments

Assessment (REP):

Report – 3000 words (70% of the final mark)

- The report will need to examine a topic or a phenomenon related to Science & Technology Policy using the analytical and visualisation techniques introduced in the module
- The analysis should rely on a working script in R to be included as part of the report.
- The report should draw on the content of other modules that you have attended to produce a critical interpretation of the results of your analysis.
- Further details will communicated.

Learning to program

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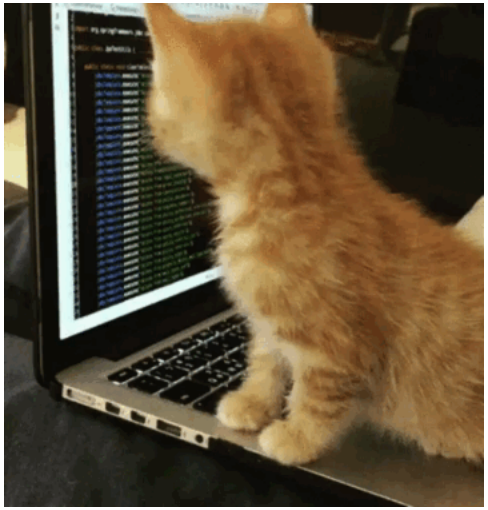
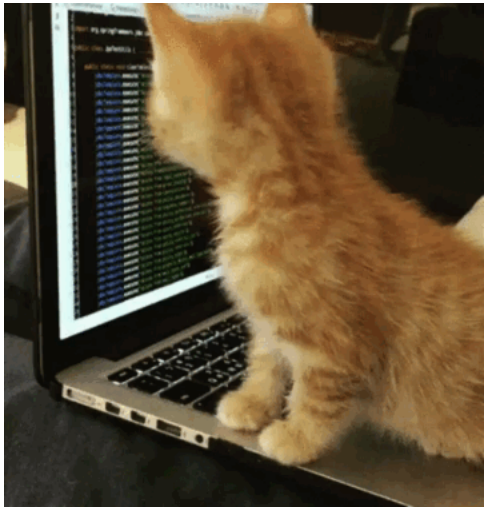
Learning to program

Do you have any programming experience?



Learning to program

Do you have any programming experience?



Don’t worry we’ll teach you the basics …

Learning to program

What language should I learn?

We will learn R!

- R is an easy to use language
- It started as a language for statistics
- But becomes increasingly popular for data science projects

It includes many packages for:

- importing data
- data wrangling
- data visualisation

Comes with a good environment/user interface

Learning to program

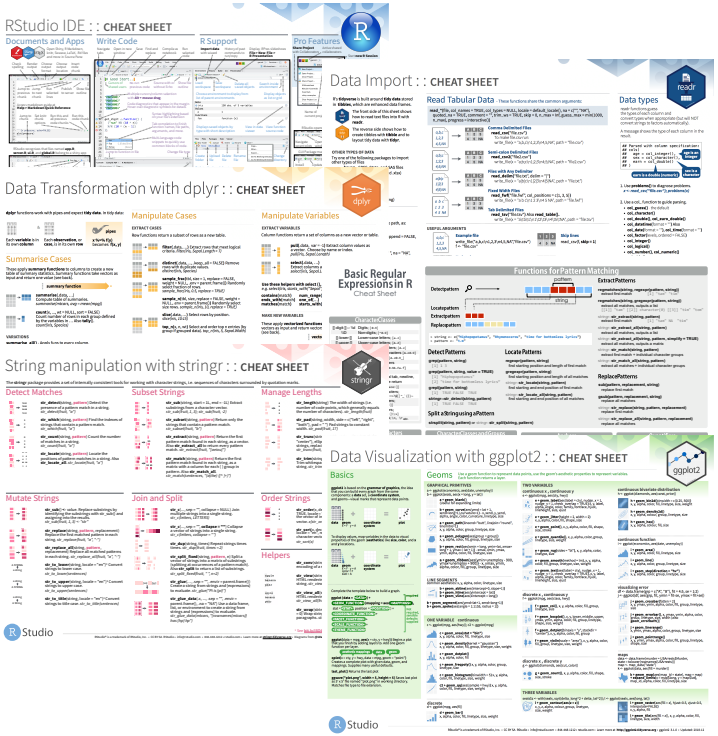
The **workshops** will give you hands-on exercises to learn how to use R

- Introduce the RStudio environment.
- Getting data and handling them in R
- Using programming logic to solve problems
- Working with text data
- Introduce machine learning
- Visualise the data to take decisions

Learning to program

There is a lot of useful functions in all the packages available (maybe too many to remember):

Use Cheat Sheets



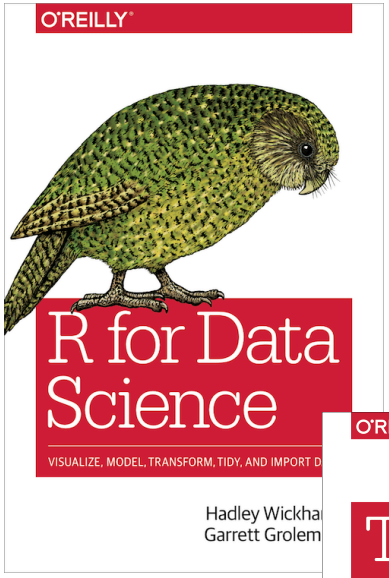
https://rstudio.com/resources/cheatsheets/

Learning to program

Many suggested readings will include chapters from the ‘R for Data Science’ book. (https://r4ds.had.co.nz/index.html)

For text mining, the book ‘Text Mining with R’ is also a reference. (https://www.tidytextmining.com)

They are both available online for free.



Learning to program

The other main language for data science is ‘Python’.

Python is a language used by engineers, computer scientists.

It is more likely that that the latest machine learning algorithms are first available on python.

Both R & Python have their strength for data science (see this blog) .
If you ever wanted to start using python and still working with R, you can use reticulate.


Let’s practice with R!
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Overview of RStudio

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Objectives

1) Guided tour of RStudio

2) Basic operations in R

Through 4 small exercises:
1. Do simple computations in R
2. Use variables in cumulative steps
3. Glimpse a dataset
4. Work with R packages (to use specific functions developed by others)

To do the exercises, download the R sheet on canvas.

Rstudio

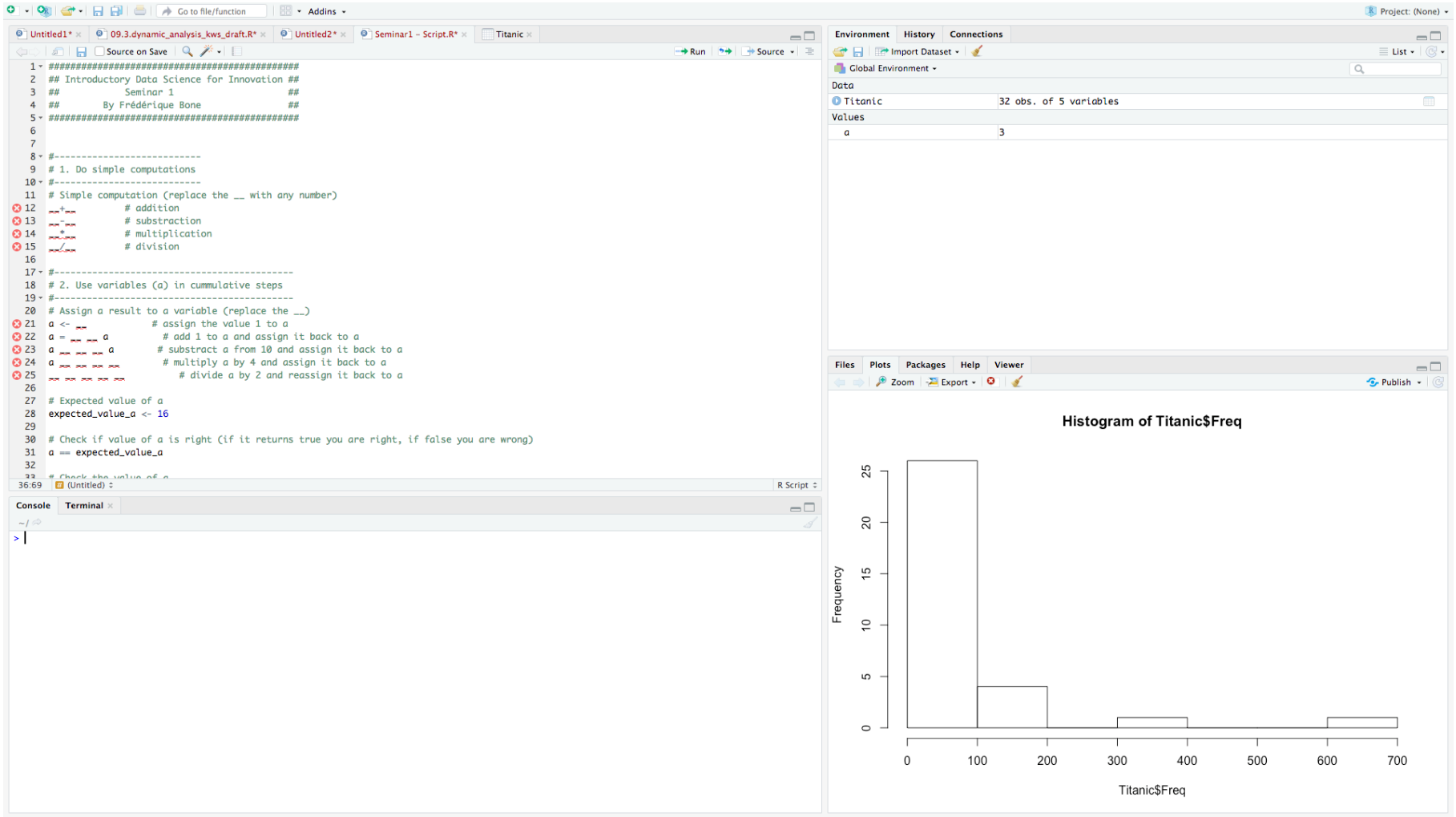
We are going to work with the RStudio environment.

Use either your own copy of Rstudio (see canvas for installation guide)

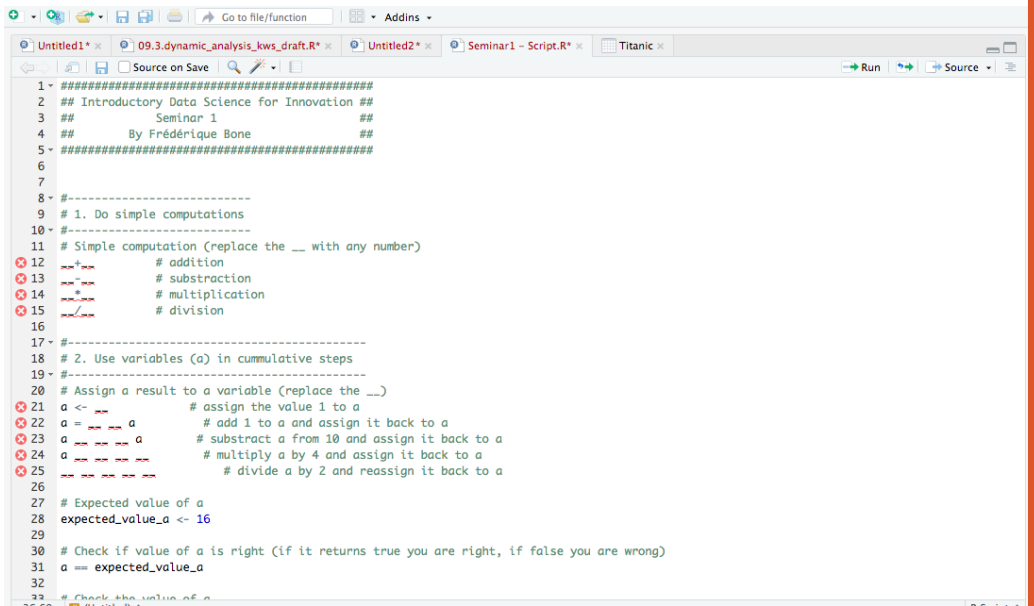
Or go to the Sussex server (on campus only):

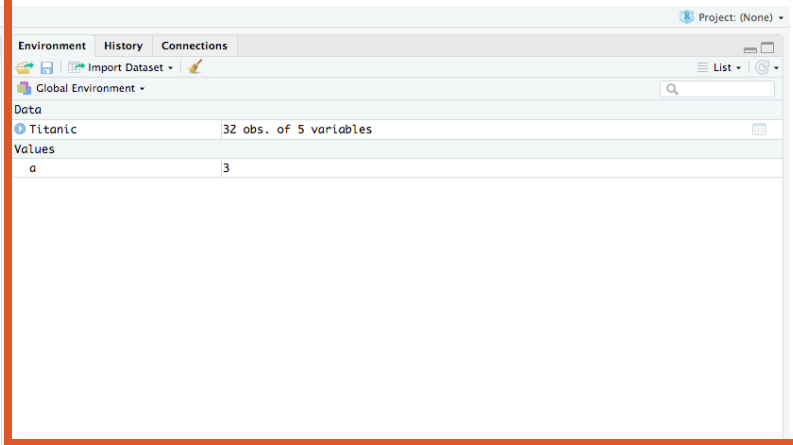
http://rstudio.uscs.susx.ac.uk/

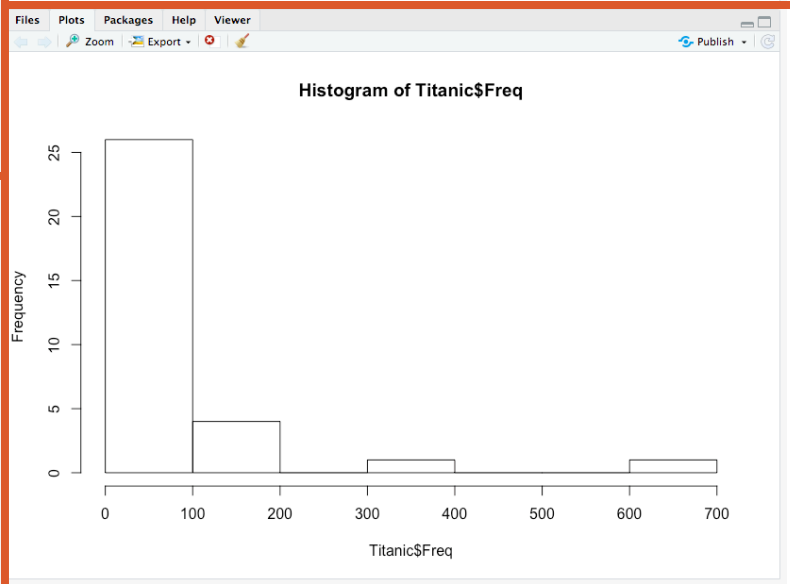
View of RStudio



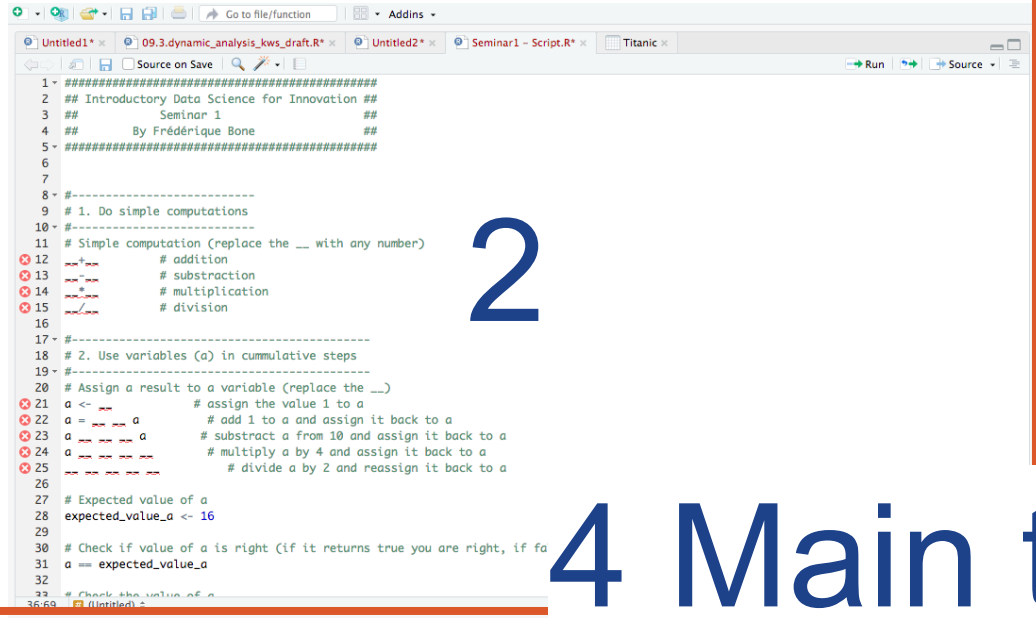
View of RStudio







View of RStudio



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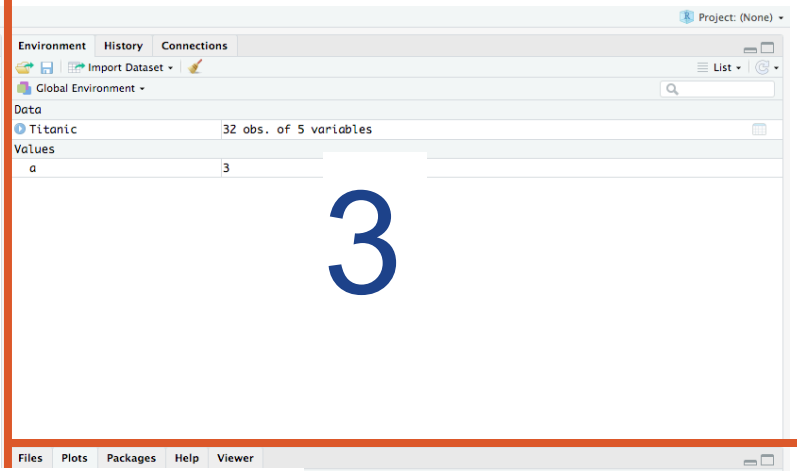

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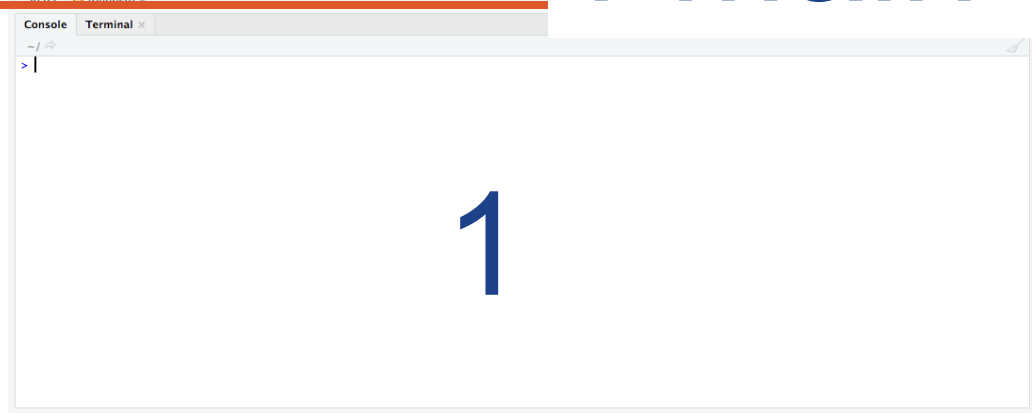
4 Main tabs



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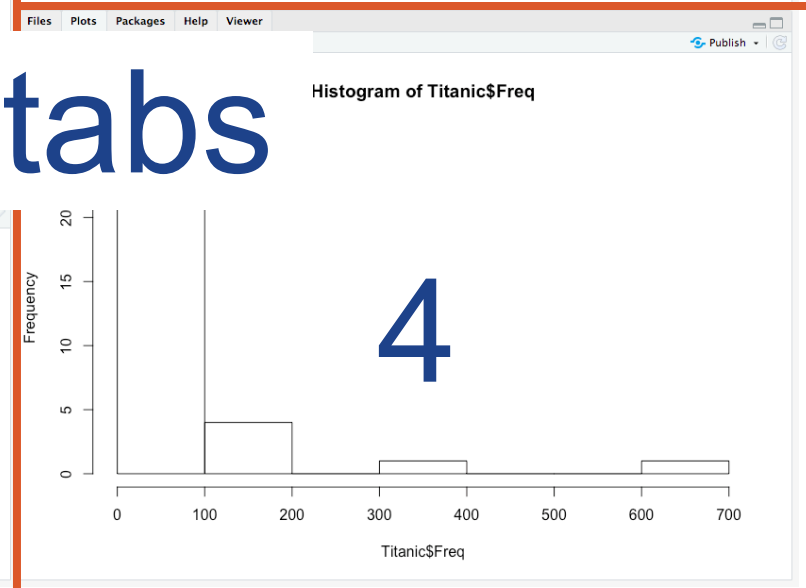

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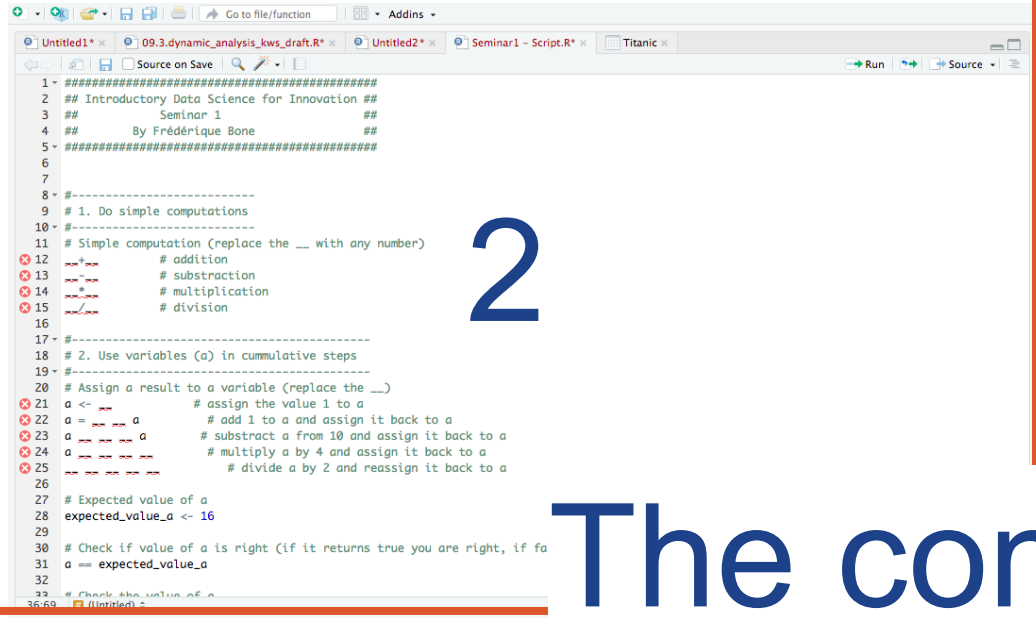
View of RStudio



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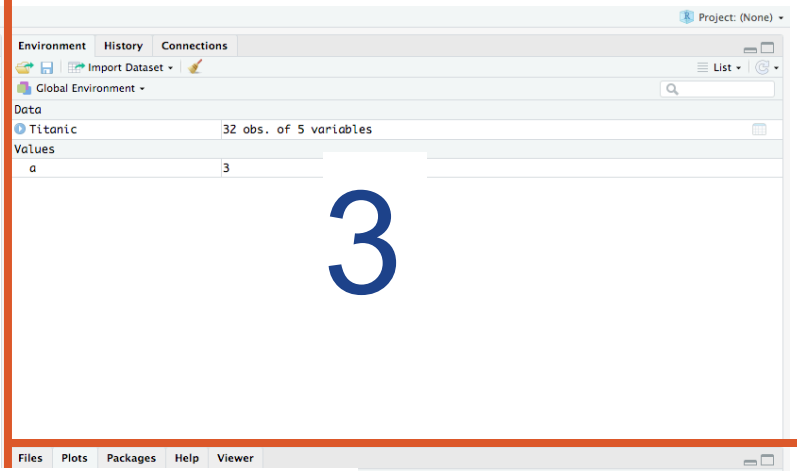

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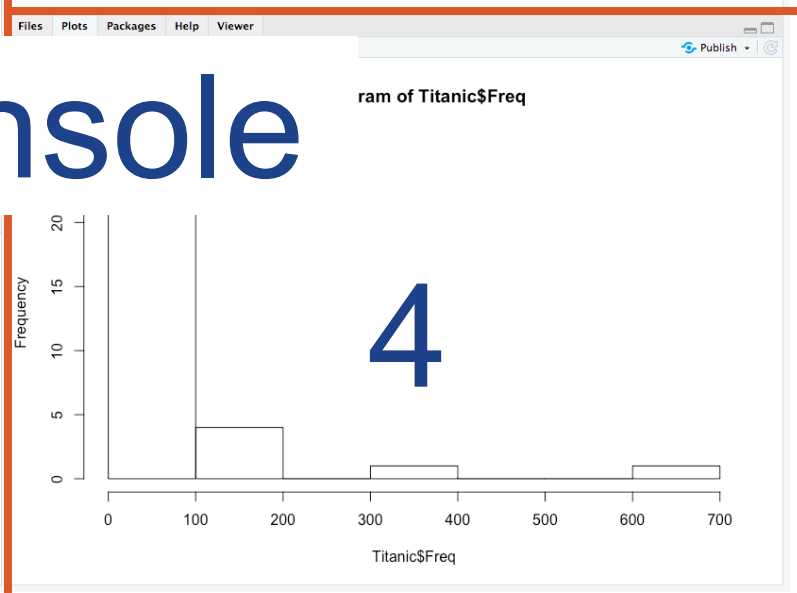
The console

1

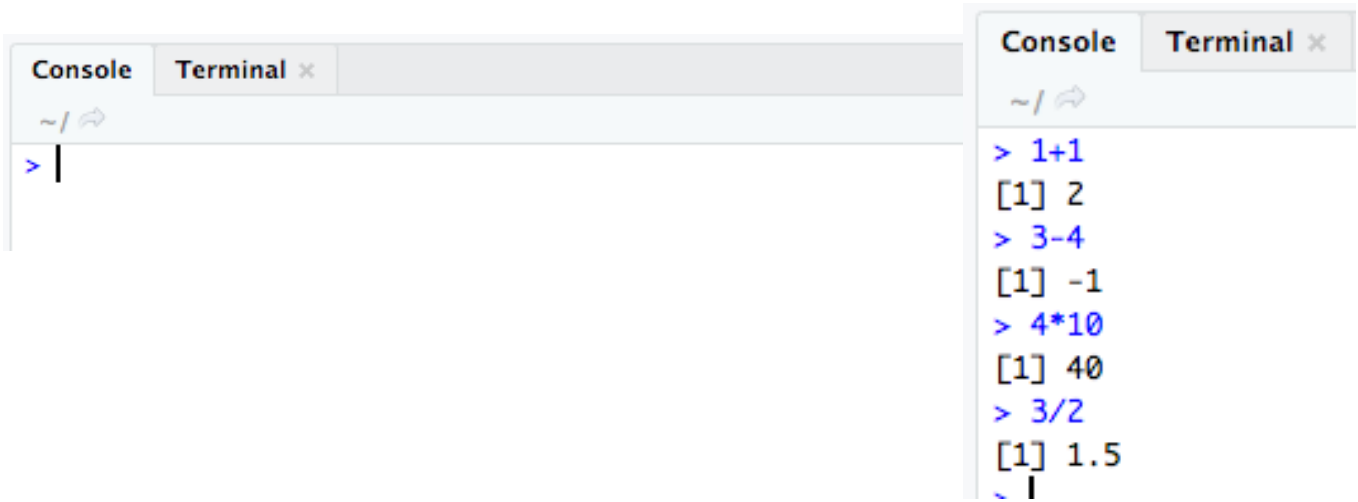


4

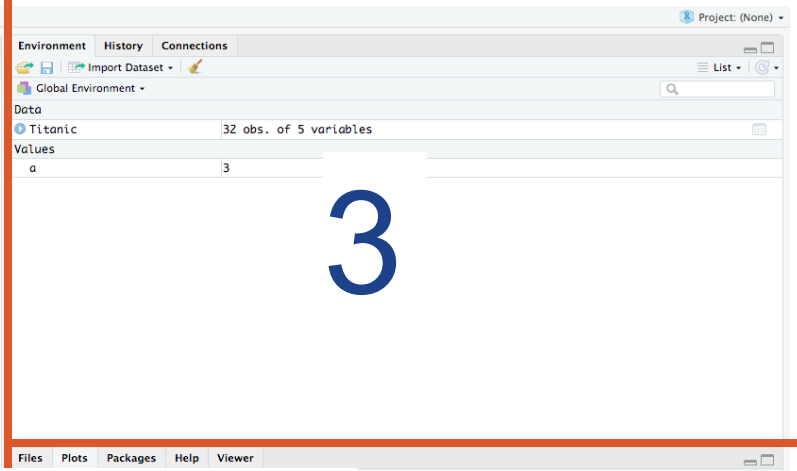
The console

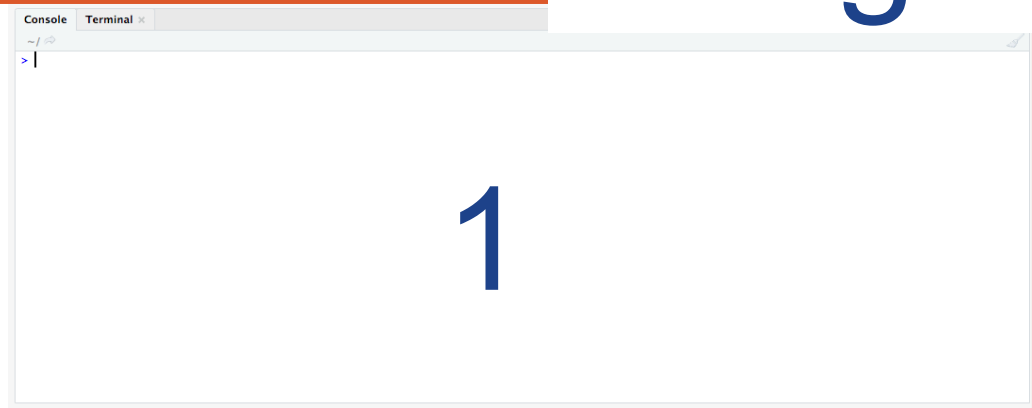
The console :
where you give your instructions for some action to be done.

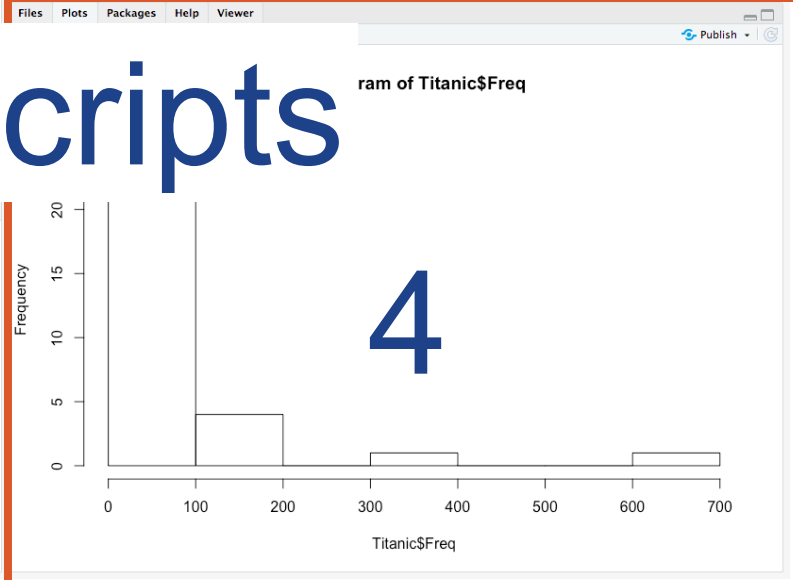
Try typing some basic operations, and press enter



View of RStudio







2

3

Using scripts

1

4

Using scripts

Scripts:

When you want to write something beyond one operation, it may be useful to create a script.

A script enables you to write all your code in a single document.
→ Better organisation
→ Run the same code at a later stage

Let's upload the exercise script and start section 1

Replace _ _ by the correct value

Using scripts

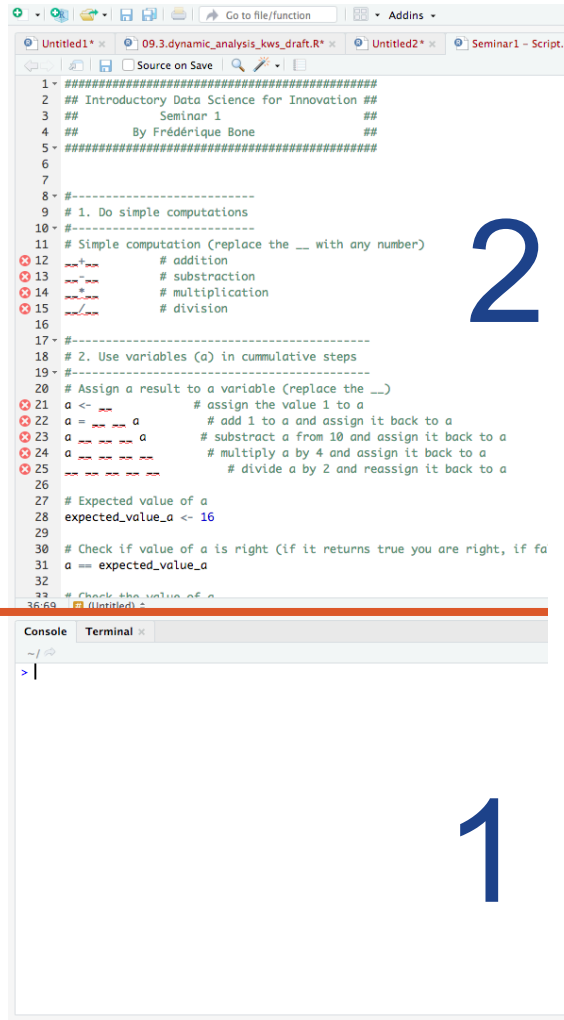
Move to exercise 2.

Using the same operators than in exercise 1 use different steps to change the value of **a**

Using scripts

Now change the first value of **a**
Rerun that part of the code.

View of RStudio



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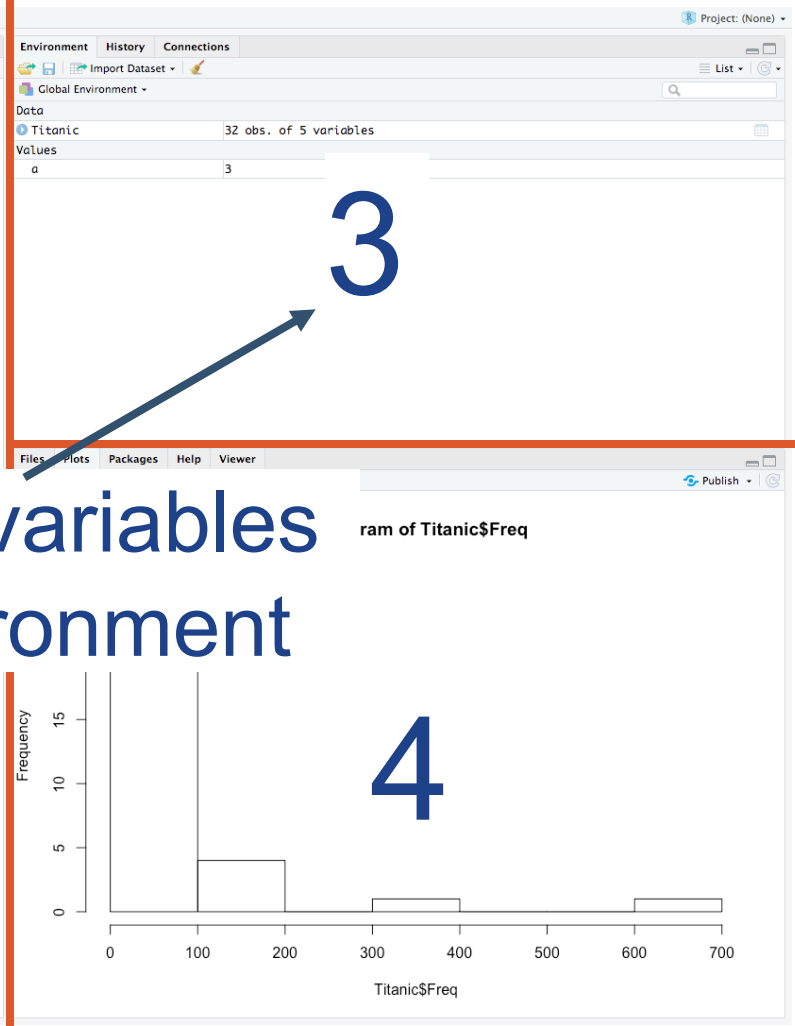

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4

Looking at variables in the environment

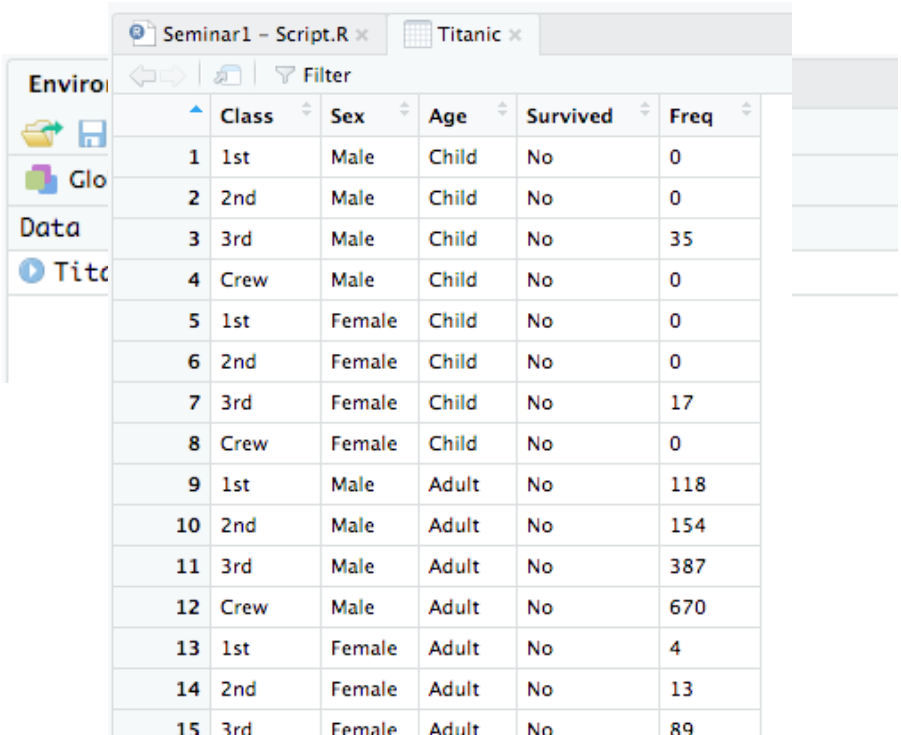
1

Exploring datasets

Move to exercise 3.
We are going to explore a dataset.

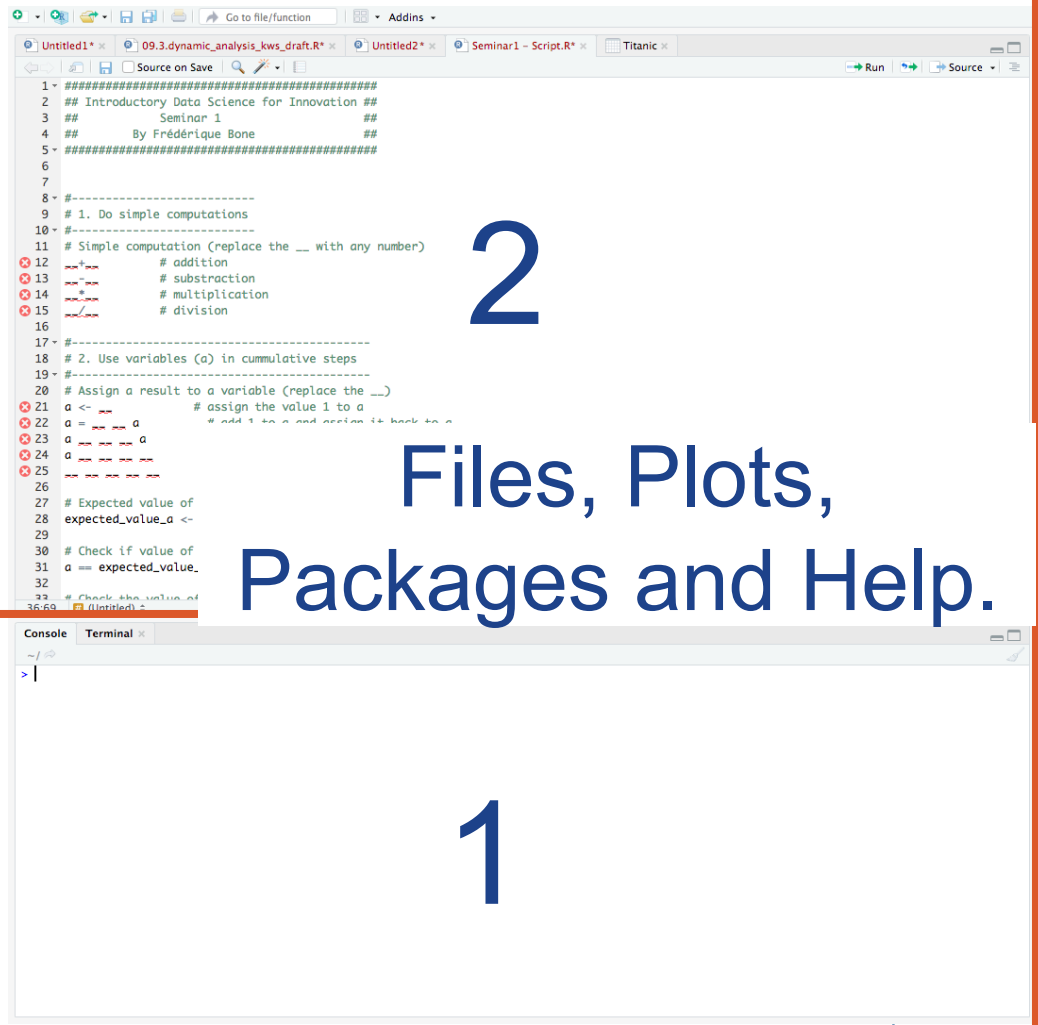
Using scripts

What is the size of the dataset?
What are the main variables of the dataset?



	Class	Sex	Age	Survived	Freq
1	1st	Male	Child	No	0
2	2nd	Male	Child	No	0
3	3rd	Male	Child	No	35
4	Crew	Male	Child	No	0
5	1st	Female	Child	No	0
6	2nd	Female	Child	No	0
7	3rd	Female	Child	No	17
8	Crew	Female	Child	No	0
9	1st	Male	Adult	No	118
10	2nd	Male	Adult	No	154
11	3rd	Male	Adult	No	387
12	Crew	Male	Adult	No	670
13	1st	Female	Adult	No	4
14	2nd	Female	Adult	No	13
15	3rd	Female	Adult	No	89

View of RStudio



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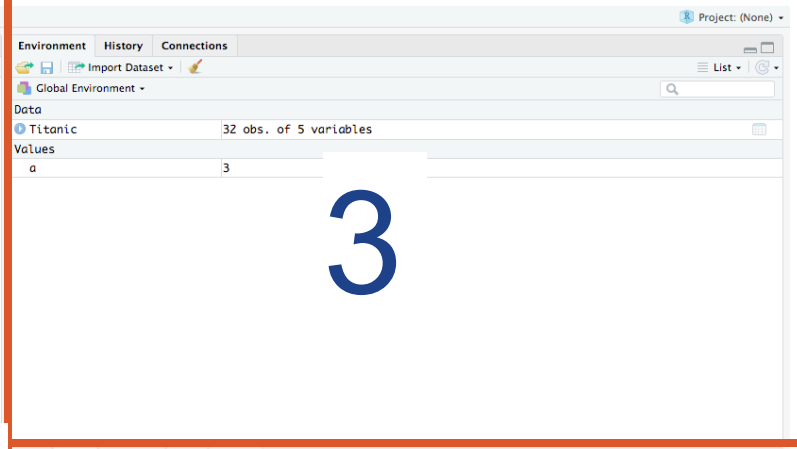
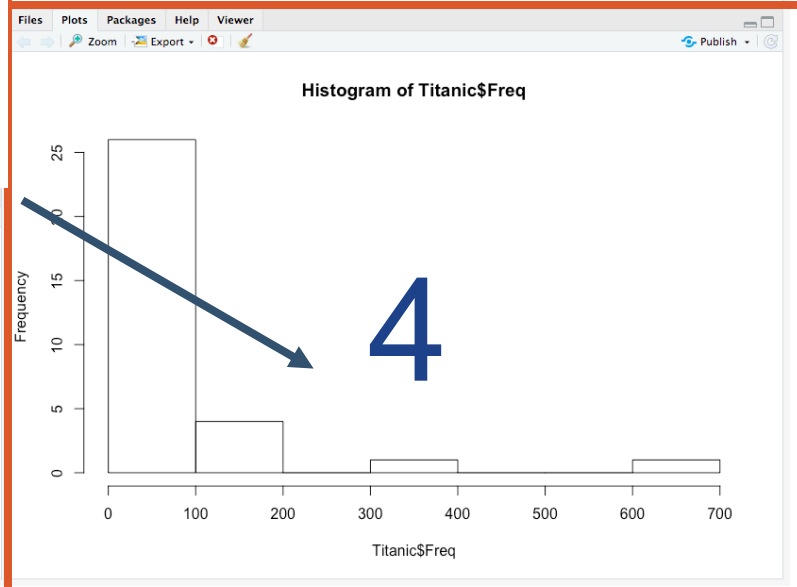


3

Files, Plots, Packages and Help.



4

1

Installing packages

Move to exercise 4 to install packages.

Thank you.

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