Introduction to Data Science (11372 & G 11516)

Semester 1 2021

UNIVERSITY OF CANBERRA

INTRODUCTION TO DATA SCIENCE

Lecture 1

Dr. Ibrahim Radwan

DISTINCTIVE BY DESIGN

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ACKNOWLEDGEMENT OF COUNTRY

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- I would like to acknowledge the Ngunnawal people who are the Traditional Custodians of the Land that we are on.
- I would also like to pay respect to the Elders both past and present of the Ngunnawal Nation and extend that respect to other Indigenous Australians who are present.

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UNIT OVERVIEW

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- This course is about **understanding** different concepts of Data Science
- Also, you will be **acquiring** practical skills of how to perform data analysis and modelling
- We will use **R language** in our practical work
- There is no specific Prerequisites or Co-requisites of this unit
- This is neither a machine learning unit nor a programming unit. However, both will be considered and touched, while going through the unit

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WHAT WILL BE COVERED IN IDS/IDS G?

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- What Data Science is
- The life cycle of a typical Data Science project
- Data Preparation and Wrangling
- Data Exploration and Visualization
- Basics of the statistical modelling
- Basics of supervised and unsupervised modelling
- How to present and document your final findings
- All the above with practices in R language, so basics of R language will be covered too

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WHO IS YOUR LECTURER?

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- Assistant Professor of Machine Learning and Artificial Intelligence
- Between 2017 – 2019, I had worked as a research fellow with the Australian National University.
- Between 2014 – 2016, I had worked as a computer vision and machine learning researcher in the Algorithm group, at Seeing Machines Ltd.
- I have done my PhD (2011 - 2014) at University of Canberra in Computer Vision
- Before that I got a Master and a Bachelor of Computer Science at Zagazig University, in Egypt
- I am a father of three kids

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UNIT OUTLINE

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- Very important document
- Represents the "contract" between you and us
- Describes what is being covered in this unit (*i.e. unit contents*)
- Describes how you will be assessed
  - Assignments
  - Quizzes
  - Assessment criteria
  - Minimum requirements to pass the unit
- Available on the unit website on UC Learn
  - https://unicanberra.instructure.com/courses/9040
  - Please read it carefully and let us know if anything is not clear

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LECTURES AND MATERIALS

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- Lecture notes and the recording of the lectures will be made available on the IDS UC Learn website (aka Canvas).
  - The lecture notes and slides will be posted before the lecture every week
- Additional reading
  - Recommended:
    - "R for Data Science" by *Garrett Grolemund* and *Hadley Wickham* (https://r4ds.had.co.nz/)
    - "Practical Data Science with R Second Edition" by Nina Zumel and John Mount (available as a hard copy at the UC library)
  - Supplementary:
    - "Modern Data Science with R" by Benjamin S. Baumer and Daniel T. Kaplan
    - "Introduction to Data Science, Data Analysis and Prediction Algorithms with R" by *Rafael A. Irizarry*, https://leanpub.com/datasciencebook

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LECTURES AND MATERIALS (2)

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- **USB Drives**: You are recommended to have two USB sticks / thumb drives / disks to store and to backup your work.

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HANDOUTS

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- There will be **no** handouts in this unit, only the lecture slides and the lab notes.
- Let's save some trees, everything will pretty much be available as a PDF on the UC Canvas site
- Download and print a copy from the UC Learn website, if you really need a hardcopy

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COURSE LOGISTICS AND TEAM

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- Unit Convener
  - Dr. Ibrahim Radwan
  - Rm: 6C45, Tel: (02) 6201 5538
  - ibrahim.radwan@canberra.edu.au
- Moderator
  - Dr. Shuangzhe Liu,
  - Rm: 6C34, Tel: (02) 6201 2513
  - Shuangzhe.Liu@canberra.edu.au
- Tutors
  - Dr. Karam Sallam
- Unit website:
  - https://unicanberra.instructure.com/courses/9811

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UC LEARN ONLINE (AKA CANVAS)

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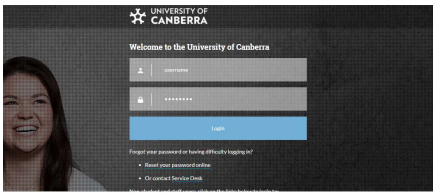
- https://unicanberra.instructure.com/courses/9811
- All material –lecture notes, lab notes and any other material –is available on the unit web site on UC Learn (via the MyUClogin)



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CHECKING YOUR PROGRESS

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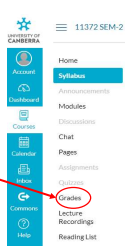
- As you complete assignments and tests, your test marks and assignment status are recorded on the IDS website on UC Learn. This is called ***Grades*** in Canvas.
- All of the information about your performance is recorded there, so please if you think that any of the information is incorrect, discuss it with:
  - Your tutor, in the first instance, or
  - Your lecturer, if the tutor was unable to help, as soon as possible.



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LECTURES

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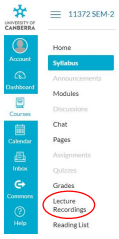
- Will cover the theory and code examples using R language
- Lectures will be recorded, you can access the recordings via 'Lecture Recordings' on the UC Learn site (after the lecture's time)
  - Tue (15:30–17:20) in (virtual room)
  - Start in Week 1, 9th of February
- If you foresee any problem in being able to watch the lectures and/or having any problem to access the recordings, please send me an email
  - The later you leave it, the less likely it is that a satisfactory solution can be found, so in your own interest, discuss it early!



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TUTORIALS AND COMPUTER LABS

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- Practical work, hands-on training
- Working on problems using R language
- A combined 2 hours (1h tutorial & computer lab + 1h unsupervised activities)
- Start in week 2
- UG groups
  - Wed (15:30 - 16:30) in (1C33)
  - Fri (10:30 - 11:30) in (virtual room)
- G groups:
  - Wed (11:30 - 12:30) in (6B4)
  - Fri (15:30 - 16:30) in (virtual room)

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PRACTICAL WORK

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- To be performed using R-Studio as a user interface for R language on your own PC/laptop
  - R is a programing language that can be used to data analytics and statistical computing.
  - R-studio is an open-source and a cross-platform tool
  - R-Studio is an IDE that can be used for writing and running R programs
  - R and R-Studio can be installed on Windows, Linux and Mac-OS
  - You may use alternative IDE on your laptop, such as PyCharm or Spyder

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PRACTICAL WORK (2)

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- Students are encouraged to use USBs to backup their work
- You will use your student ID to access any computer in the university's campus
- Access to the buildings after 6.30 pm may require swipe card access

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PLAGIARISM (CHEATING)

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- Handing in work that is not your own, or very similar to another student's work
- Treated very seriously by university (*Student Conduct), i.e.* can result in Fail
  - https://www.canberra.edu.au/current-students/queensland-students/student-conduct
- Won't help as won't prepare you for final assessment
- Lecturer / Tutor can orally question students on their submitted work
- Avoid this by starting early and seeking help
- Seek help from tutor, student resource centre, lecturer, etc.

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ASSESSMENT DETAILS

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- **Unit Readiness Test**:
  - This test is an early assessment item, which you will be required to complete several associated tasks and a short quiz.
  - **Due Date:** 23:59 Sunday, Week 4
  - **Weighting Percentage:** 10%
- **Assignment 1**:
  - In this assignment you will be developing and changing programs in R language toward the learned skills of data collection, data wrangling and data exploration.
  - You will be given a template for the assignment and you need to submit a working version of this template as well as output of the visualization part/s as a single ZIP file
  - **Due Date:** 23:59, Sunday, Week 10
  - **Weighting Percentage:** 30%

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ASSESSMENT DETAILS (2)

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- **Week 9 online test**
  - 1-hour test via UC learn online site
  - **Due Date:** 23:55, Sunday, Week 9
  - **Weighting Percentage:** 20%
- **Final Assignment** :
  - In this assignment you will be developing and changing programs in R language toward the learned skills through the whole unit.
  - **Due Date:** Week 14-15
  - **Weighting Percentage:** 40%

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ASSESSMENT DETAILS (3)

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- All assessment items will receive a numerical mark. The final grade will be a weighted average of the individual assessment items
- You need to achieve a minimum 25% of the marks in first assignment and a minimum 50% in the final assignment to pass this unit
- A delay in submitting any of the assessment items will be penalised with 5% every for 24 hours, until 7 days, unless you have an approved extension request.

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ASSESSMENT DETAILS (4)

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- **To be awarded a particular grade in IDS/IDS G, you must meet both the assignment requirements as in the table below:**

- Minimum 25% of marks in the first assignment (Data Wrangling and Exploration Assignment), **and**
- Minimum 50% in the final assignment.

Grade	Assignments + Exam
Pass	Minimum 50% of combined weighted marks of all assessment items
Credit	Minimum 65% of combined weighted marks of all assessment items
Distinction	Minimum 75% of combined weighted marks of all assessment items
High Distinction	Minimum 85% of combined weighted marks of all assessment items

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OPPORTUNITIES FOR LEARNING

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- **Lectures**
  - Pay attention
  - Annotate your notes
  - Ask questions
- **Tutorials and Labs**
  - Come prepared – read the tutorial work before the tutorial and attempt any practical work. The tutorial and lab classes are for discussion and to resolve difficulties. Actively participate!
  - Do the R exercises in the tutorial and computer lab notes
  - If you expect to magically pick up the 'crumbs of wisdom' from just attending the classes, be warned that this will not be sufficient to pass the unit

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OPPORTUNITIES FOR LEARNING (2)

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- **Assignments**
  - Start early
  - Do your own work
  - Seek help and do so early
- **Textbooks**
  - We have recommended readings every lecture

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CONSULTATION TIME

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- Tue (12:30 – 13:30) in (6C45 and/or remotely through virtual room)
- Other times by prior appointment only!
  - Best, arrange a time with me by email
  - Ibrahim.Radwan@Canberra.edu.au
- Make use of the **online discussion forum** on the UC Canvas site!
  - It's a much faster way of getting in contact and also has the benefit of other students, who might have a similar questions, being able to see the answer as well

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WHAT IS DATA SCIENCE?

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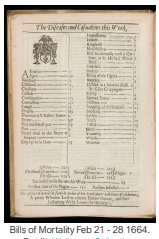
- Is Data Science new?
  - No, people used to use different methods to extract information from data, (e.g. "bills of mortality" in 1592). These bills were weekly statistical summary of the mortalities in London.
- … so, is Data Science when you deal with large amount of data "*Big Data*"?
  - No, Data Science can deal with small and large data.
- Does Data Science only exist coupled with Machine Learning?
  - No, there is also statistical and mathematical modelling.
- … so, what is Data science?



Bills of Mortality Feb 21 - 28 1664.
Credit: Wellcome Collection.

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WHAT IS DATA SCIENCE? (2)

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- Before we jump into the definition of the Data Science, let us understand the difference between:
- "**Data**": is a raw, unstructured pieces or records that are needed to be processed to have a meaning,
- and, "**Information**" is where these data are processed and presented in a given context so as to make it useful.

- Data Science is the science that encapsulates set of components that can be used to turn raw data into actionable insights.

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WHAT IS DATA SCIENCE? (3)

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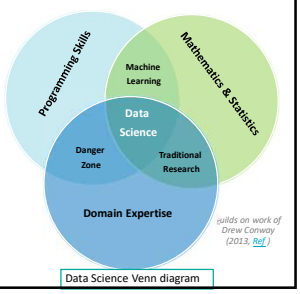
- What is the Data Science?
- Data Science Venn diagram
- Why is Data Science so important?

Data → Information



builds on work of Drew Conway (2013, Ref)

Data Science Venn diagram

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WHAT IS DATA SCIENCE? (4)

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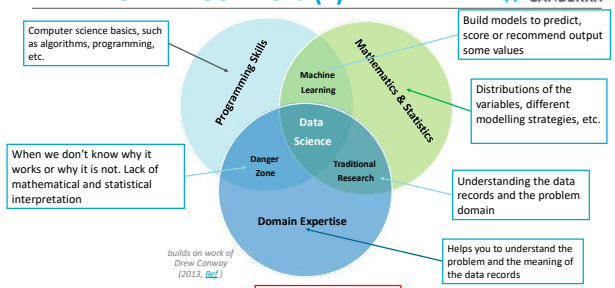

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Data Science Venn diagram

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WHY DATA SCIENCE?

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- A simple answer could be:
  - We have lots of data and what is really needed is the information,
  - because there is more data available than ever before, more data than we could understand.
  - Therefore, we need data science to give us the ability to extract the insights and the important information from these unstructured data
- Is not the statistics or the machine learning enough?
  - Statistics or machine learning are quite useful in building models on the data, but firstly, you need to understand that data
  - Combining the statistics and machine learning with understanding of the problem and data results in Data Science
- Video about what and why data science

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BEING A DATA SCIENTIST

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- What does it mean to be a data scientist?
  - For every new problem, you may go into a new field to try to understand how it works, to massage the data until you understand them, to try to acquire all the knowledge of the field without being a specialist. (a detective job? ☺)
  - Be updated all the time with the new tools, methods and workflows, as it is rapidly evolving, you do not need to fall behind
  - As a data scientist, you need to try different ideas using scientific methods to achieve critical tasks
  - Being ready to understand, analyse and process messy data structures and build efficient models out of these data to predict valuable information, is not it exciting? ☺

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PROGRAMMING IN R

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- R is a programming language and a free software environment for statistical computing and graphics.
- R compiles and runs on a wide variety of UNIX platforms, Windows and MacOS
- https://www.r-project.org/
- A bit about the history of it and the connection with S

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OVERVIEW & HISTORY OF R

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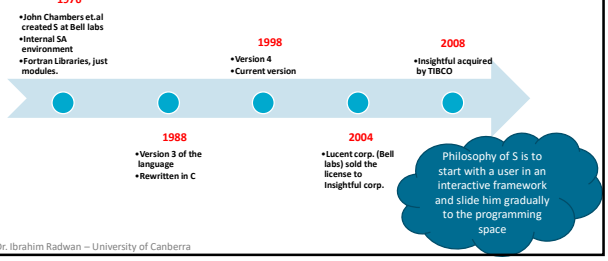
- R is dialect of S language, so what is "S"?



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OVERVIEW & HISTORY OF R (2)

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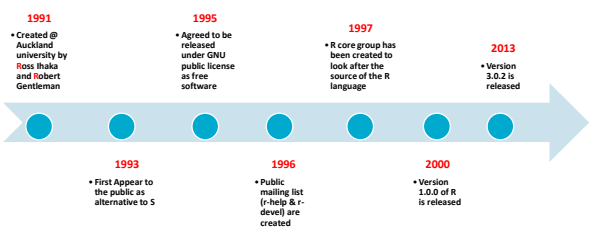

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SETUP YOUR ENVIRONMENT

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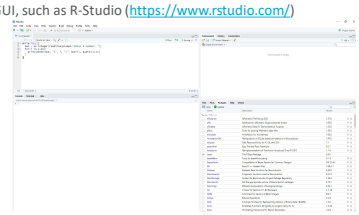
- Two main components
  - R (https://cran.r-project.org/mirrors.html)
  - Graphical user interface, GUI, such as R-Studio (https://www.rstudio.com/)



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SETUP YOUR ENVIRONMENT (2)

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- **To Install R**
  - Open an internet browser and search for CRAN (**C**omprehensive **R** **A**rchive **N**etwork) and go to the https://cran.r-project.org
  - Select the Download link that is suitable for your operating system
  - Click on the file containing the latest version of R
  - Save the .pkg file (MAC OS) or .exe file (Windows OS)
  - Double-click it to open, and follow the installation instructions
  - Now that R is installed, you need to download and install RStudio

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SETUP YOUR ENVIRONMENT (3)

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- **To Install RStudio**
  - Go to www.rstudio.com and click on the "Download RStudio" button.
  - Click on "Download RStudio Desktop"
  - Click on the version recommended for your operating system, or the latest for Mac OS or Windows OS,
  - For MAC OS,
    - save the .dmg file on your computer, double-click it to open, and then drag and drop it to your applications folder.
  - For Windows OS,
    - save the executable file. Run the .exe file and follow the installation instructions.
    - leave all default settings in the installation options.

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KEY TAKEAWAYS

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- Data Science encapsulates different discipline to extract insights from messy data
- A data science project involves going back and forth between different stages until reaching successful results
- Data science is not just statistics, it is more about understanding the interests and the needs of the stakeholders
- As a data scientist you need to be equipped with the passion to understand different problems from different domains
- Before jumping into solving a problem or an issue, you need to ensure that you have a clear and quantifiable goals
- Data science is quite exciting if you are passionate about discovering root causes of the issues and ready to solve them

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RECOMMENDED READINGS

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- Chapter 1 from "Practical Data Science with R Second Edition" by Nina Zumel and John Mount. A hard copy of the book exists in the library
  - https://livebook.manning.com/book/practical-data-science-with-r-second-edition/chapter-1/
- Warm-up with R and R-Studio:
  - How to install R and R-Studio?
  - Navigating the R-Studio Environment?

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