Getting Started and R Markdown

STAT3022 Applied Linear Models Lecture 1

2020/02/24

THE UNIVERSITY OF SYDNEY

Today

1. Introduce yourself to someone you don't know.
2. Course structure and expectations.
3. Meet the toolkit - learn to use R Markdown.

Disability Services Support

You may not think of yourself as having a disability but the definition under the **Disability Discrimination Act (1992)** is broad and includes temporary or chronic medical conditions, physical or sensory disabilities, psychological conditions and learning disabilities.

Some types of disabilities we see include:
Anxiety // Arthritis // Asthma // Autism // ADHD
Bipolar disorder // Broken bones // Cancer
Cerebral palsy // Chronic fatigue syndrome
Crohn's disease // Cystic fibrosis // Depression
Diabetes // Dyslexia // Epilepsy // Hearing impairment // Learning disability // Mobility impairment // Multiple sclerosis // Post-traumatic stress // Schizophrenia // Vision impairment

Students needing assistance are advised to register with Disability Services as early as possible. Please contact us or review our website to find out more.

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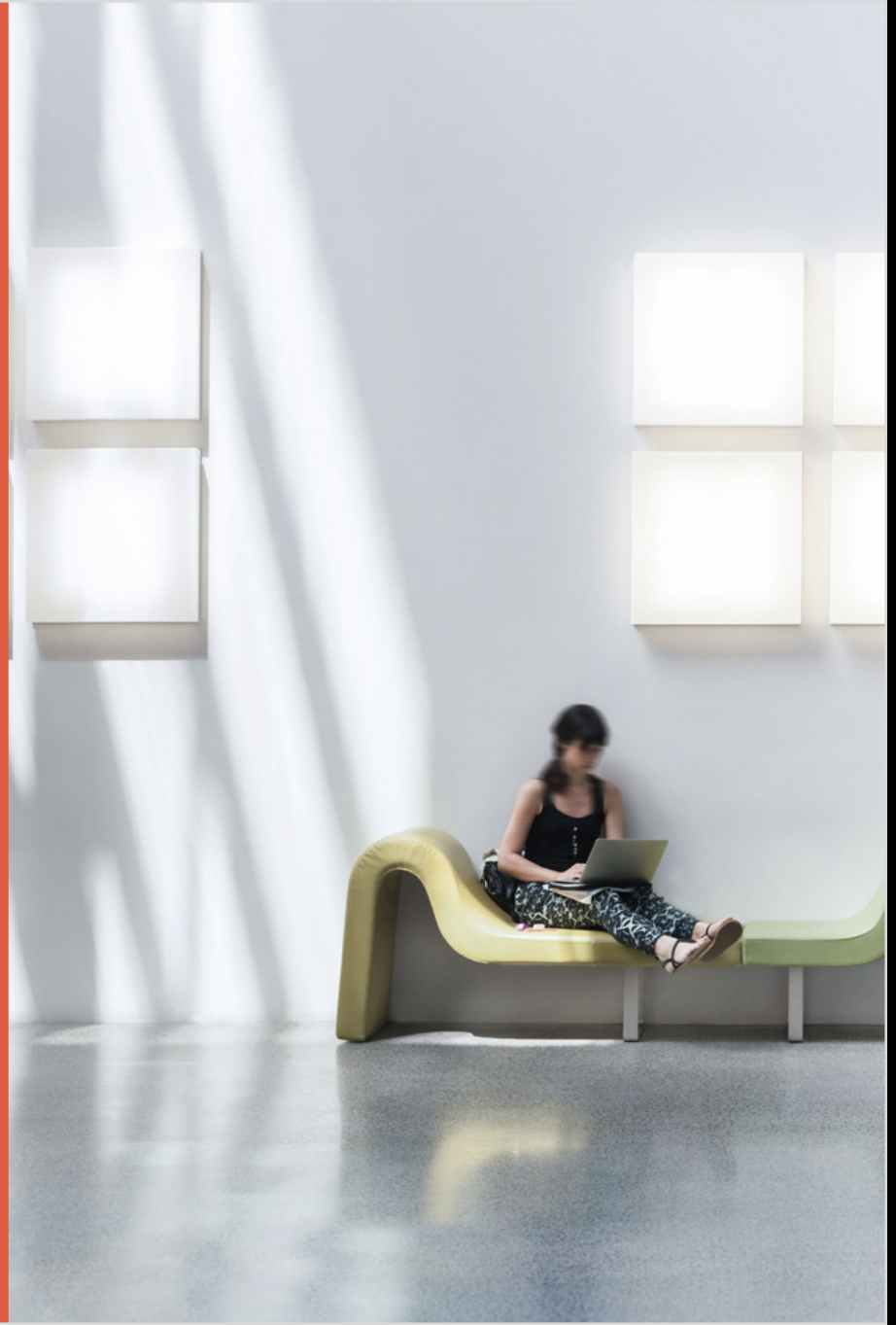
Disability Services Office
sydney.edu.au/disability
02 8627 8422



Lecturers

- A/Prof. Jennifer Chan for STAT3022
  - jennifer.chan@sydney.edu.au
  - Carslaw 817
- Dr. Munir Hiabu for STAT3922
  - munir.hiabu@sydney.edu.au
  - Carslaw 827

STAT3022

What is this unit about?

The overall aim of this unit is to develop skills in the **statistical analysis** of data from **designed experiments** and **observational studies**.

The unit will be divided into five themes:

STAT3022 Course Structure

Structure

- 3 one hour lectures per week on Mon, Thu & Fri 9am from week 1 to 13
- 1 tutorial per week from week 2 to 13
- 1 computer lab per week from week 1 to 13 (replaced by lecture for STAT3922 students)

Assessments

- 2 assignments due Mon 6th April and Mon 25th May
  - each worth 7.5% of total mark for STAT3022 students
  - each worth 5% of total mark for STAT3922 students
- 1 quiz held 9am Thu 7th May
  - each worth 15% of total mark for STAT3022 students
  - each worth 12.5% of total mark for STAT3922 students
- final exam worth 55% of total mark during June exam period

Academic Integrity

Assignments

- You may make use of any online resources but you must explicitly cite where you obtained any information you directly use (or use as inspiration).
- Any recycled code that is discovered and is not explicitly cited will be treated as plagiarism.
- On assignments you may not directly share code with another student in this class.
- You are welcome to discuss the problems together and ask for advice, but you may not send or make use of code from another person.

Sourced from Data Science in a Box: https://datasciencebox.org/

? Help!

Where to get help

- Post your questions on edstem.
- Ask your tutor during tutorial or lab or lecturer during consultation hour: 10-11am Fridays.

Tips for asking questions

- *First search* existing resources and discussion for answers.
- Use proper formatting in edstem. E.g. if using code, use code formatting and LaTeX for mathematical equations.
- Give context and be precise in your description:
  - Good description: "For Tutorial 3 Q1 (k), the answer is given as $50.59165 \pm 1.812461 \times 4.567673$. Where does the value 1.812461 come from? Should this be $t_{10}^{1}(0.975) = 2.228$, which is the same as question 1 (j)?"
  - Bad description: "I don't get Tutorial 3 Q1 (k).

Expectations

Organisation

You are expected to:

- check the STAT3022 canvas website frequently;
- check and *contribute* to the STAT3022 edstem discussion board;
- complete the tutorial and computer lab questions in Week n by Week $n+1$;
- seek help from your tutor during tutorial and computer lab; and
- post your questions in edstem discussion board.

Technical skills

You are expected to:

- program in statistical programming language R; if you are not familiar with R, you are recommended to check the resources page in canvas and quickly catch up with the basics in R; and
- completed (STAT2x12 or DATA2x02) and MATH1x02 or equivalent courses.

What's your expectations out of this course?

Theme 2 Overview

Linear regression

- Model fit
  - Simple & Multiple linear regression
  - Polynomial regression
  - Robust regression
- Model diagnostics
  - Leverage points and outliers
  - Multi-collinearity
  - Goodness of fit measures: Multiple correlation coefficient, AIC, Cp and BIC
- Model selection
  - Forward, backwards, step-wise selection procedures
  - Inference: t-test and general F-test

Did someone say "Applied"?

Theme 1

Toolkits for analysis

R

+

RStudio

+

tidyverse ggplot2 dplyr rmarkdown ...

What's the difference between these?

R essentials

A short list:

- Functions are (most often) verbs, followed by what they will be applied to in parantheses:

```
do_this(to_this)
do_that(to_this, to_that, with_those)
```

- Columns (variables) in data frames are accessed with `$`:

```
dataframe$var_name
```

- Packages are installed with the install.packages function and loaded with the library function, once per session:

```
install.packages("package_name")
library(package_name)
```

Sourced from Data Science in a Box: https://datasciencebox.org/

Literate Programming

In literature programming, you interweave code, output and narrative in one place.

Reproducibility checklist

What does it mean for a data analysis to be "reproducible"?

Near-term goals:

- Are the tables and figures reproducible from the code and data?
- Does the code actually do what you think it does?
- In addition to what was done, is it clear why it was done? (e.g., how were parameter settings chosen?)

Long-term goals:

- Can the code be used for other data?
- Can you extend the code to do other things?

Side note: Literate Programming by Donald Knuth is the seminal book on literate programming.

Sourced from Data Science in a Box: https://datasciencebox.org/

Markdown Syntax

- You will achieve literate programming by using R Markdown in this course.
- Let's start with simple markdown syntax for text.

Emphasis

```
*italic*   **bold**

_italic_   __bold__
```

Headers

```
# Header 1

## Header 2

### Header 3
```

Lists

Unordered List

```
* Item 1
* Item 2
    + Item 2a
    + Item 2b
```

Ordered List

```
1. Item 1
2. Item 2
3. Item 3
    + Item 3a
    + Item 3b
```

Manual Line Breaks

End a line with two or more spaces:

```
Roses are red,
Violets are blue.
```

Links

Use a plain http address or add a link to a phrase:

```
http://example.com

[linked phrase](http://example.com)
```

Images

Images on the web or local files in the same directory:

```
![alt text](http://example.com/logo.png)

![alt text](figures/img.png)
```

Blockquotes

```
A friend once said:

> It's always better to give
> than to receive.
```

Markdown Example

Look here

See also RStudio >

Help >

Cheatsheet >

R Markdown Reference Guide

Code

Headers

```
# First level header
## Second level header
### Third level header
```

Emphasis

```
*This text will be italic*
**This text will be bold**
*You **can** combine them*
```

Images

```
![](images/kunoichi.svg)
```

Output

First level header

Second level header

Third level header

This text will be italic

This text will be bold

*You **can** combine them*

An R Markdown document

File extension should be `.Rmd`

```
---
title: "A Simple Regression"
author: "Yihui Xie"
output: html_document
---
We built a linear regression model.
```{r}
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```

The *slope* of the regression is **`r b[2]`**.
```

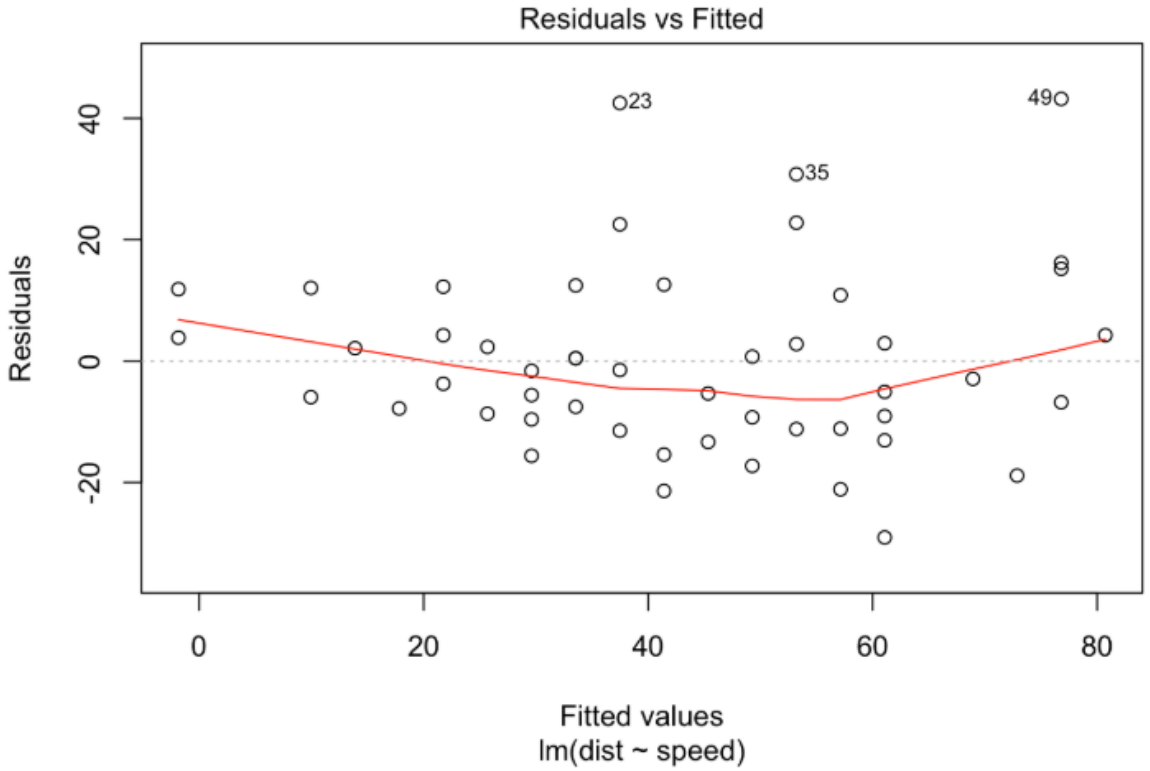
Now it's now time to start knitting 

A Simple Regression

Yihui Xie

We built a linear regression model.

```
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```



The *slope* of the regression is **3.9324088**.

An R Markdown document

File extension should be `.Rmd`

```
---
title: "A Simple Regression"
author: "Yihui Xie"
output: pdf_document
---
We built a linear regression model.
```{r}
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```

The *slope* of the regression is **`r b[2]`**.
```

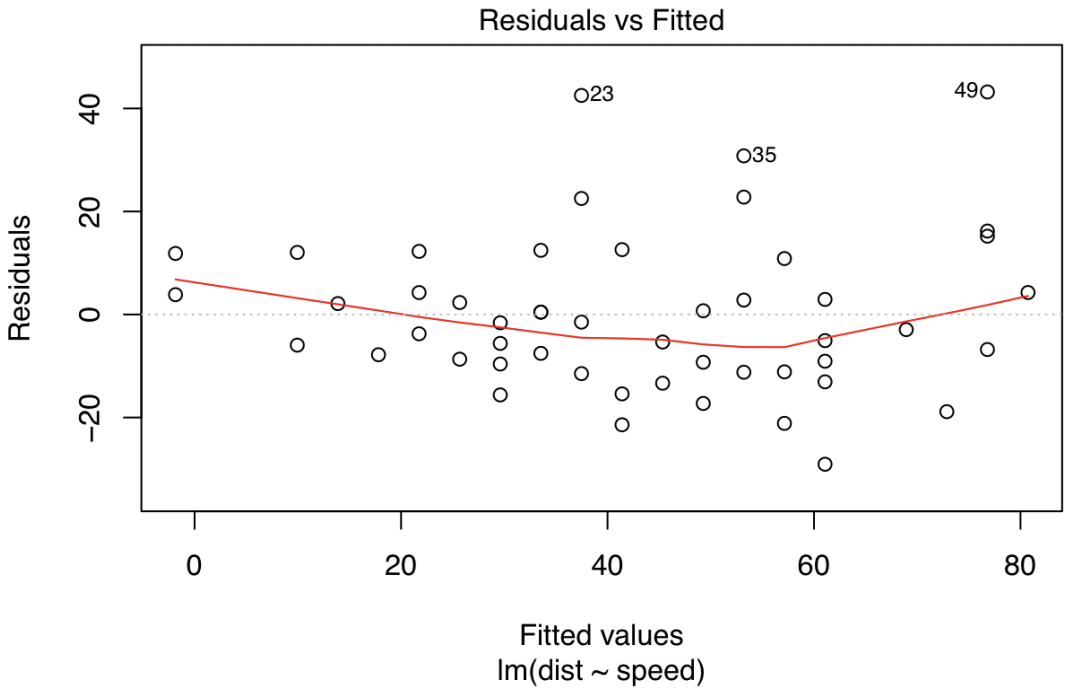
- The output of your document is now a **pdf** file.
- You will need to have LaTeX installed for this to work!
- You can get LaTeX also through tinytex R-package.

A Simple Regression

Yihui Xie

We built a linear regression model.

```
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```



The *slope* of the regression is **3.9324088**.

An R Markdown document

File extension should be `.Rmd`

```
---
title: "A Simple Regression"
author: "Yihui Xie"
output: word_document
---
We built a linear regression model.
```{r}
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```

The *slope* of the regression is **`r b[2]`**.
```

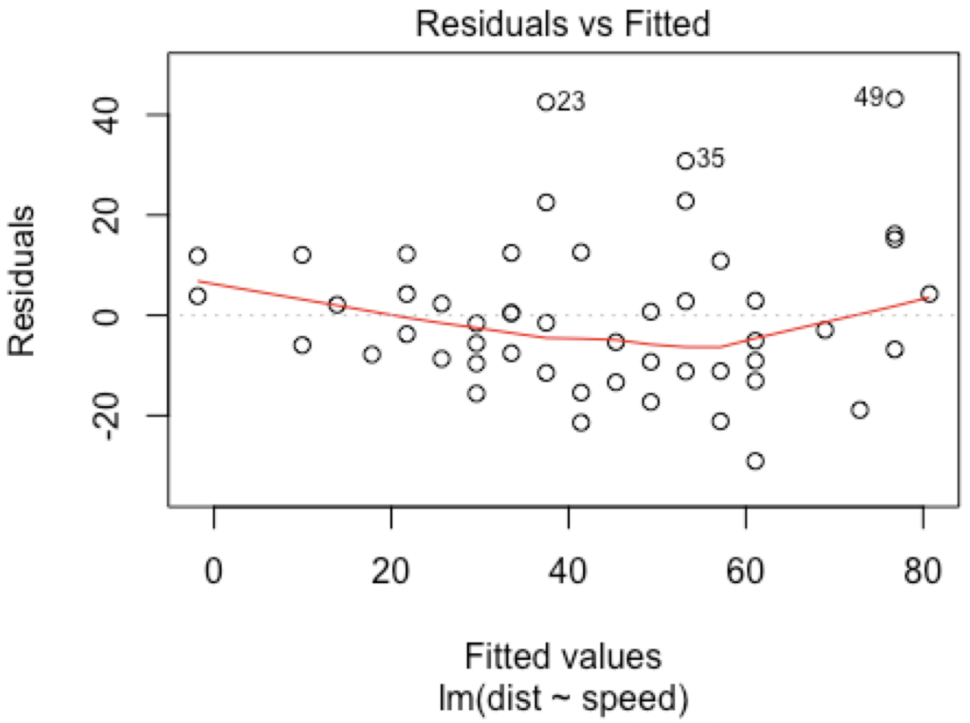
The output of your document is now a **word** file.

A Simple Regression

Yihui Xie

We built a linear regression model.

```r
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```



The *slope* of the regression is **3.9324088**.

Don't want your code chunks to appear in the report?

```{r, echo=F}
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```

Don't want your code chunks to be evaluated (but appear) in the report?

```{r, eval=F}
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```

Want your code chunks to be evaluated but hide code and output?

```{r, include=F}
fit <- lm(dist ~ speed, data = cars)
b   <- coef(fit)
plot(fit, 1)
```

You can find other code chunk options here.

R Markdown

- Fully reproducible reports -- each time you knit the analysis is ran from the beginning.

What is the difference between Markdown and R Markdown?

```
summary(cars$dist)
```

```
    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
    2.00   26.00   36.00   42.98   56.00  120.00
```

```
summary(cars$speed)
```

```
    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
     4.0    12.0    15.0    15.4    19.0    25.0
```

R Code Blocks

R code will be evaluated and printed

```
```{r}
summary(cars$dist)
summary(cars$speed)
```
```

Inline R Code

```
There were `r nrow(cars)` cars studied
```

Excuse me, do you have time to talk about your future?

Summary

- Carefully read the expectations.
- Be sure to schedule and plan well (important graduates attributes!)
- Get your toolkit ready - study them on your own time if you are not familiar with them.
- Remember your BIG goal - mastery of the theory and applications broadly is helpful than you knowing how to answer specific questions.
- Use R Markdown for reproducible reports.
- Learn to use R Markdown in this week's computer lab (needed for assignments).

Next lesson

- Data wrangling and visualisation in R

To do

- Download and install toolkits