

Hiroshi Suzuki

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AI

2019

2019 9

2020

Data Analysis for Researchers

20

PDF ePub

PDF ePub

- PDF
- ePub

Chapter 1

R python
dio IDE integrated development environment, R R Stu-
Cloud Reproducibility Posit
ming R Markdown Literate Program-
Bookdown R Markdown bookdown
R

APPENDIX ??

variable object

Appendix A

MOOCs

2019 9 17

A.1 YouTube

PDF

A.2

A.2.1

A.2.1.1

A.2.1.1.1

- 5 :2016 1 22 ¹
– <https://www8.cao.go.jp/cstp/kihonkeikaku/index5.html>
 - :2016 12 21 -
 1. ()
 - 2.
 3.
<https://www8.cao.go.jp/cstp/kihonkeikaku/index5.html>
-

¹ 1 2

- (6)
 - (D-DRIVE²)2017 ~
 - - 20 :2019 1 8
 - http://www.mext.go.jp/b_menu/shingi/chousa/koutou/095/gaiyoku/1412367.htm
 - : 2019 3 26
 - https://www.meti.go.jp/shingikai/economy/risukei_jinzai/20190326_report.html
 - ()
 - AI :2019 3 29 <https://www8.cao.go.jp/cstp/aigensoku.pdf>
 - AI 2019 AI 2019 6 11 <https://www.kantei.go.jp/jp/singi/tougou-innovation/pdf/aisenryaku2019.pdf>
1. 1: (50 /) AI [MOOC]
 2. 2: (100 /) AI
 3. 3: (AI)

A.2.1.2

<http://www.mi.u-tokyo.ac.jp/consortium/index.html>

-
-

A.2.1.3

- 2019

A.2.2

A.2.2.1 IR

IR IR

A.2.2.2

2019 3 MOOCs

²Doctoral program for Data-Related InnoVation Expert

A.2.2.3 : (Data Analysis for Researchers)

- () 3
- :Rotary Peace Fellow, The Project for Human Resource Development Scholarship (JDS) 4 10-25
- :
- :2 (70 × 2 × 10) 1 1
- : (R Markdown etc.)
- :2014-2015³, (2016), 2017

A.2.2.4

1. Introduction to R, Open Data and Free Software
2. Basic R Objects and Commands
2. Data Frame Manipulation
3. Linear Regression and Graphics
4. Dynamic Documents Using Rmarkdown
6. Statistical analysis with R II
5. Statistical analysis with R III
6. Statistical analysis with R IV
7. Guest Lecture and preparation for presentations
8. Final presentations

A.2.2.5

R Studio (PC) R R Markdown

- Base R
 - cars:
 - iris:
- package MASS
- WDI: World Bank Development indicators for R


```
library(WDI)
#GDP (current US$)
gdp <- WDI(country = c("US", "JP", "CN", "KR"),
  indicator = "NY.GDP.MKTP.CD",
  start = 1960, end = 2017)
```

 - wbstats
- Quandl package: <https://www.quandl.com/tools/r>
- Google Trends: <https://trends.google.co.jp/>
- Yahoo Finance: <https://finance.yahoo.com/quote/DATA/>

³2015

(Computing for Researchers)

A.2.3

A.2.3.1

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- ()

AI

A.2.3.1.1

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- ()

A.2.3.2 ()

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- ()

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— () ? ?
— () AI
— ()
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A.2.3.3

? Liberal Arts?

-
-
-
-

A.2.3.4**Teaching to Learning**

- *
 – - () Community of Inquiry (CoI), - Com-
 munication of Facts

A.2.3.5**Students with Various Backgrounds**

- :
- ()

A.2.3.6 Literacy**Expand your horizon!**

- :
 –
 – Q & A ()
 –
- :
 – I, II, A, B - :
 –
- :
 –
 –

A.2.3.7 Resources**IT / Cloud**

- (Open/Public Data)
- (Online/Cloud)
- (Free and online/cloud system)

A.2.3.8 :

- 1.
- 2.
3. http://www.soumu.go.jp/menu_seisaku/ictseisaku/ictriyou/ope
 ndata/

A.2.3.9 World Bank: Open Data Defined

The term “Open Data” has a very precise meaning. Data or content is open if anyone is free to use, re-use or redistribute it, subject at most to measures that

preserve provenance and openness.

1. The data must be **legally open**, which means they must be placed in the public domain or under liberal terms of use with minimal restrictions.
2. The data must be **technically open**, which means they must be published in electronic formats that are machine readable and non-proprietary, so that anyone can access and use the data using common, freely available software tools. Data must also be publicly available and accessible on a public server, without password or firewall restrictions. To make Open Data easier to find, most organizations create and manage Open Data catalogs.

A.2.3.10

List of Open Data Catalogue

- [:https://www.data.go.jp](https://www.data.go.jp)
- :
 - 1.
 - 2.
 - 3.
 - [:https://www.data.go.jp/list-of-database/](https://www.data.go.jp/list-of-database/)
 - [:https://www.jma.go.jp/jma/menu/menureport.html](https://www.jma.go.jp/jma/menu/menureport.html)
- U.S. Government's Open Data: <https://www.data.gov>
- EU Open Data Portal: <http://data.europa.eu/euodp/en/home>
- UK Open Data: <https://data.gov.uk>
- World Bank: New Ways of Looking at Poverty
 - Open Data: <https://data.worldbank.org>
 - World Development Indicators: <http://datatopics.worldbank.org/world-development-indicators/>
- UN Data: <http://data.un.org>
- WHO Data: <https://www.who.int/gho/en/>
- Google Public Data: :7 :136 <https://www.google.com/publicdata/directory>
- Open Knowledge Foundation: <https://okfn.org>
 - Global Open Data Index: <https://index.okfn.org>

A.2.3.10.1 Free Software, Online Access R

- R Project for Statistical Computing: <https://www.r-project.org>
- R Studio: <https://www.rstudio.com>
- R Studio Cloud: <https://rstudio.cloud>

A.2.3.10.2 Python

- Python: <https://www.python.org>
- Anaconda: <https://www.anaconda.com>
- Jupyter Notebook Cloud: Binder, Kaggle Kernels, Google Collaborate, CoCalc, PaizaCloud, etc.

A.2.3.10.3 Free Software

- Free Software, Free Society: Selected Essays of Richard M. Stallman: <https://www.gnu.org/philosophy/fsfs/rms-essays.pdf>
- Richard Stallman TEDxGeneva 2014: https://youtu.be/Ag1AKII_2GM

A.2.3.10.4 Online Learning Source**List of Online Help and Mini Courses**

- Online
 - TutorialPoint: <https://www.tutorialspoint.com/>
 - DataCamp: <https://www.datacamp.com/home>
 - Code Academy: <https://www.codecademy.com>
 - RStudio Premier: <https://rstudio.cloud/learn/primers>
- User Community

A.2.3.10.5 MOOCs

- OED: MOOC n. massive open online course, an educational course made available to a large number of people via the internet.
- First MOOC: 2008 by Dave Cormier, Connectivism and Connective Knowledge (CCK08)
- MIT OpenCourseWare 2002: ()OER Stanford U Model: UC Berkeley:
- MOOC : 2012 Stanford U. MIT

A.2.4 Massive Open Online Courses (MOOCs)**Moocs****A.2.4.1 MOOCs ****

-
-
-
- (datasets) () *

A.2.4.2 MOOCs

-
-
-
-

A.2.4.3 Moocs

A.2.4.3.1 Coursera Stanford U.

- Stanford U.: Machine Learning <https://www.coursera.org/learn/machine-learning>
- (:2,513,476)
- Johns Hopkins U.: Data Science, 10 courses [, R] <https://www.coursera.org/specializations/jhu-data-science>
- U. of Michigan: Applied Data Science, 5 courses [, python] <https://www.coursera.org/specializations/data-science-python>
- 100% U. of Illinois, U. of Michigan, U. of Colorado,

A.2.4.3.2 edX MIT Harvard U.

- Harvard U.: Data Science, 9 courses [, R]
- MIT: Statistics and Data Science, 5 courses [Graduate Level]
- <https://www.edx.org/micromasters/mitx-statistics-and-data-science>
- Microsoft, IBM, UC SanDiego

A.2.4.4 Professional Certificate in Data Science

A.2.4.4.1 : HarvardX, through edX

- URL: <https://online-learning.harvard.edu/series/professional-certificate-data-science>
- Book: <https://rafalab.github.io/dsbook/> (R Markdown Document)

A.2.4.4.2 R Data Camp Assessment

1. Data Science: R Basics; R
2. Data Science: Visualization;
3. Data Science: Probability;
4. Data Science: Inference and Modeling;
5. Data Science: Productivity Tools; Unix, Git, GitHub, R Markdown

- 6. Data Science: Wrangling;
- 7. Data Science: Linear Regression;
- 8. Data Science: Machine Learning;
- 9. Data Science: Capstone

A.2.4.4.3 Professional Certificate in Data Science

8 weeks 8 weeks 8 weeks 8 weeks 8 weeks 8 weeks 8 weeks 8 weeks 2 weeks
 Required R Packages for Examples: tidyverse, dslabs: <https://cran.r-project.org/web/packages/dslabs/dslabs.pdf>

-
- 2010 FBI
- Gapminder: Almost nobody knows the basic global facts! (Gapminder Test)
 - TED (Hans Rosling) <https://www.gapminder.org>
 - Health and income outcomes for 184 countries from 1960 to 2016
 - Country, Year, Infant deaths per 1000, Life expectancy in years, Average of children per woman, Country population, GDP, Continent, Geographical region
- Brexit
- 2016
- UC Berkeley
-
-

A.2.4.4.4 JMOOC MOOC

(1)

- Week 1
 -
 - - gacco:
- Week 2
 -
 - :
- Week 3
 - Excel, R, Python
- Week 4
 -
 - -
 -

A.2.4.4.5 JMOOC: [https:// www. jmooc. jp](https://www.jmooc.jp) 10 8

- II: ()

A.2.5

A.2.5.1

-
-
-
-
-
-

A.2.5.2 R Markdown Or jupyter notebook for python

- Reproducible Research:
- Literate Programming: Code, Script * html, doc, presentation, pdf (using TeX)
-

A.2.5.3

-
-
-
- Empirical ([,])
-

Quote: On Listening to Lectures, by Plutarch The correct analogy for the mind is not a vessel that needs filling, but wood that needs igniting - no more - and then it motivates one towards originality and instills the desire for truth. (<https://quoteinvestigator.com/2013/03/28/mind-fire/>)

()

A.2.6

A.2.6.1

Quote: Apple co-founders Steve Jobs and Steve Wozniak didn't have degrees when they launched what has become one of the most valuable companies in the world. And now Apple CEO Tim Cook is

spreading the word that would-be programmers really don't need the endorsement of a university to be able to create something of commercial value, such as an app for the Apple App Store. <https://www.zdnet.com/article/apple-ceo-tim-cook-you-dont-need-a-degree-to-code-mobile-apps/>

A.2.6.2

AI

Appendix B

MOOCs

3 12 (II) covid-19

B.1

(AI [1] 2019 6 11 AI 2019 AI
2025
1. (50 /) AI [MOOC]
2. (100 /) AI
3. (AI)
6 25% 1500 AI (100
/) 1 6
AI [3] 2000 2 GP 3
2012 4 [4] STEAM
1, 3 (AI)
AI AI

¹5 20 22 11 IT EXPO
²22000.6 ()
³3
⁴42012.8

B.2

AI AI 2019 AI

AI AI (Artificial Intelligence()) AI

2019 AI AI AI

AI

([11])

Study) (,) () (Decision Science) (Empirical

AI

(Recommendation System) Google, Amazon, Netflix

5

AI AI

([12])

AI

eral Intelligence (AGI) AI AI Artificial Gen-

AI AI

B.3

B.3.1

5 ([7, 9])

(IoT,
Big Data)

(Public Data)

6

(R, Python)

edX, Coursera, JMOOC MOOCs

‘Skills and Self - ID Top Factors’

[13]

([8])

GAFA

B.3.2

TA

TA

2025 5

AI

()

R

Free

()

AI

Respect

B.3.3

()

()

1. Broad Band Internet Access
Broad Band Internet Access
2. RStudio (for R), Jupyter (for python) Data Science
Interactive Security
3. Team and Collaborative Teaching
4. MOOCs OCW
Interactive
5. Evidence Base AI Fact Base, Black Box
Fake News Hate Speech
Data Science

- A. Data Science: What? and Why?
 - Data Science ? AI ? Data Scientists?
 - Data Science ? -
- B. Business Data Science
- C. Data Science :Data Data
- D. Data Analysis

- [1] AI (AI) https://www.kantei.go.jp/jp/singi/ai_senryaku/index.html
- [2] AI 2019 AI 2019 6 11 <https://www.kantei.go.jp/jp/singi/tougou-innovation/pdf/aisenryaku2019.pdf>
- [3] AI https://www.kantei.go.jp/jp/singi/ai_senryaku/suuri_datascience_ai/dai1/sankou3.pdf
- [4] <https://www.mhlw.go.jp/toukei/learning/index.html>
- [5]
- [6] ~ Moocs (:)
- [7] AUTOMATE THIS: how algorithm came to rule our world by Christopher Steiner

- [8] Doing Data Science by Rachel Schutt and Cathy O’Neil
- [9] Weapon’s of Math Destruction by Cathy O’Neil AI
- [10] edX Professional Certificate in Data Science: <https://online-learning.harvard.edu/series/professional-certificate-data-science> edX Data Science Ethics: <https://www.edx.org/course/data-science-ethics>
- [11] Factfulness by Hans Rosling, et. al.
- [12] How I learned to understand the world by Hans Rosling with Fanny Haerges-tam
- [13] Analyzing the Analyzers (O’Reilly) by Harlan Harris, Sean Murphy, and Marck Vais- man

Appendix C

1
2020 3 2020 6

C.1 ? AI?

(Data Science) 10
AI(Artificial Intelligence)
(Decision Making Science)
2 7 (Training Data, 2 7)
2 7 () ()
Google, Amazon (Recommendation Sys-
tem)
([1, 2])
AI Buzz Word AI
AI () AI
AI
(Ex-
poratory Data Analysis)
(Data Visualization)
AI AI
([1],[4]²)

¹2019 3 31 ()College of Liberal Arts, International Christian University 2019
⁴ ¹
² “Weapons of Math Destruction” . (Weapons of Mass Destruction))

([8])

C.2

– 10 [5] ? Gapminder
 (<https://www.gapminder.org>) 13 10
 (bias) TED ([9]) Gapminder
 2017 Google Google Pub-
 lic Data (https://www.google.com/publicdata/directory?hl=en_US&5B
 Gapminder]) ([6])
 () e-Stat (<https://www.e-stat.go.jp>)³

C.3 ?

AI
 4
 5 Free-Open-Online⁶
 (Empirical)
 Excel R python⁷ (Reproducible)
 (Literate Programming)
 python R
 R RStudio IDE⁸
 RStudio.cloud
 RStudio.cloud <http://RStudio.cloud> Sign Up Google
 Project New Project RStudio
 Tools Install Packages ... swirl Console library(swirl)
 Enter() swirl() Enter R
<https://foods4all.github.io>
 RStudio.cloud Learn Cheat Sheets() Learn
 Primer() The Basic() RStudio.cloud Log
 Out

³ (specialized agencies)

⁴Gapminder Tools World Bank <https://data.worldbank.org>

⁵ AI : <https://dashboard.e-stat.go.jp>

⁶

⁷

⁷ Free Software Foundation <https://www.fsf.org/about/>

⁸Integrated Development Environment /

2 1 R ([3]) tidyverse
 R
 2 ([2])
 MOOCs (Massive Open Online Courses) JMOOC(<https://www.jmooc.jp>)
 HarvardX Data Science [7]
 9 2 9 (Audit) R
 (Script) Google
 MOOCs
<https://foods4all.github.io> Free-Open-Online

C.4

10

()

- [1] Christopher Steiner 2013.
- [2] Rachel Schutt, Cathy O’Neil 2014.
- [3] R Hadley Wickham 2017. “R for Data Science” (<https://r4ds.had.co.nz>) Jeffrey B. Arnold (<https://jrnold.github.io/r4ds-exercise-solutions/>)
- [4] AI Cathy O’Neil 2018 .
- [5] Factfulness()– 10 Hans Rosling BP 2019.
- [6] Hans Rosling 2019.
- [7] :edX Professional Certificate in Data Science: <https://online-learning.harvard.edu/series/professional-certificate-data-science>
- [8] :edX Data Science Ethics: <https://www.edx.org/course/data-science-ethics>
- [9] Hans Rosling TED Talk(): https://www.ted.com/talks/hans_rosling_the_best_stats_you_ve_ever_seen?language=ja

⁹Data Science: R Basics, Visualization
¹⁰ 2

Appendix D

Data Analysis for Researchers

D.1

International Christian University QALL401
2020

D.2

| | | | | |
|----------|------------|------|------|-------|
| 2021 | Bookdown | 2022 | 2021 | Book- |
| down | | | | |
| bookdown | R Markdown | R | | |
| | 2022 | 2023 | | 12 |

- Data Analysis for Researchers 2021
- Data Analysis for Researchers 2022

Appendix E

Introduction to R

E.1 70 x2

Data Analysis for Researchers D 2022 11 2 R
R 12 Data Analysis for Researchers

Data Analysis for Researchers Introduction

E.2

RMarkdown RNotebook [Code] RMarkdown
RStudio
• RNotebook

Appendix F

F.1

| | | | | | |
|---------------------------------|---------------|----------|----------|-------------------|--------------|
| Data Analysis for Researchers D | | | | 2023 2 20 22 24 | 70 |
| R | | | | Web | Google Colab |
| Windows | R | R Studio | | Google Colab | R |
| Public Data | | | | World Development | Indicator |
| Template | | | | | |
| | Windows | R | R Studio | | Posit |
| Cloud | RStudio Cloud | 20 | PC | Posit Cloud | |

F.2

- R Studio R Slide + Video
- R Markdown
- R RNotebook
- RNotebook
- WDI
-

Appendix G

Data Science for All

searchers D F Data Analysis for Re-

G.1

- - Data Science for All -
- Let's enjoy data science together!
 - 2019 2020

Appendix H

Chat GPT

Chat GPT

DeepL

- First Chat
- Digital Health
-
- Big Mac Index

H.1 First Chat -

[HS] Explain the difference between equality and fairness by an example story

Chat GPT Equality refers to the idea that everyone should be treated the same, regardless of their personal characteristics or circumstances. Fairness, on the other hand, refers to the idea that people should be treated justly and in a way that is reasonable and appropriate given the specific situation.

Here is an example story that illustrates the difference between equality and fairness:

There are two children, Anna and Billy, who are both competing in a race at school. Anna is a fast runner, while Billy is slower. The teacher decides to give both children a head start in the race, with Anna starting 10 meters ahead of the starting line and Billy starting 5 meters ahead.

In this situation, equality would dictate that both children should start at the same point, regardless of their running abilities. However, fairness would dictate that the teacher's decision to give each child a different head start is appropriate, as it takes into account the fact that Anna is a faster runner and gives Billy a chance to catch up.

While equality aims to treat everyone the same, fairness recognizes that different people may have different needs or abilities and seeks to treat them in a way

that is fair and just.

[HS] What is the difference between a differentiable function and a continuous function in reals

Chat GPT A function is said to be differentiable at a point if it is possible to define a derivative of the function at that point. The derivative of a function at a point is a measure of how the function is changing at that point. A function is differentiable if it is possible to define a derivative at every point in its domain.

On the other hand, a function is continuous at a point if it is possible to draw the graph of the function without lifting your pencil from the paper. This means that there are no sudden jumps or breaks in the graph of the function at that point. A function is continuous if it is continuous at every point in its domain.

So, in summary, a differentiable function is one for which the derivative can be defined at every point, while a continuous function is one that does not have any breaks or jumps in its graph.

Both differentiability and continuity are important concepts in calculus and are often used to describe the behavior of functions. However, they are not the same thing and a function can be either one or both. For example, a function can be differentiable but not continuous, or continuous but not differentiable.

[HS] what is the difference between data science and statistical analysis? explain by examples

Chat GPT Data science and statistical analysis are related fields that involve the collection, processing, and analysis of data. However, they have some important differences.

Data science is a broad field that encompasses a wide range of techniques and methods for working with data. It includes statistical analysis, but it also includes other methods such as machine learning, data visualization, and data engineering. Data scientists use a variety of tools and techniques to analyze data, with the goal of extracting insights, making predictions, and solving problems.

For example, a data scientist might use machine learning algorithms to analyze a large dataset in order to predict customer behavior, or they might use data visualization techniques to create interactive graphics that help to communicate the results of an analysis.

Statistical analysis, on the other hand, is a more specific field that focuses on the use of statistical methods to analyze data. Statistical analysts use statistical techniques such as regression analysis, hypothesis testing, and analysis of variance (ANOVA) to understand relationships between variables and make predictions.

For example, a statistical analyst might use regression analysis to understand the relationship between a company's sales and its advertising budget, or they might

use hypothesis testing to determine whether there is a significant difference between the means of two groups.

In summary, data science is a broad field that encompasses a wide range of techniques and methods for working with data, while statistical analysis is a more specific field that focuses on the use of statistical methods to analyze data.

[HS] Write a short essay on the FIFA World Cup 2022 like Makuranosoushi of Seishonagon in Japanese

Chat GPT The FIFA World Cup 2022 is a highly anticipated international soccer tournament that will be held in Qatar. This will be the first time that the World Cup has been held in the Middle East, and it is expected to be a memorable and exciting event.

The tournament will feature 32 teams from around the world, who will compete in a series of matches to determine the ultimate champion. The teams will be divided into eight groups, with the top two teams from each group advancing to the knockout round.

The World Cup 2022 is sure to be filled with drama and excitement, as the world's best soccer players come together to compete on the biggest stage. The tournament will feature many talented and skilled players, including stars such as Lionel Messi, Cristiano Ronaldo, and Neymar Jr.

The World Cup 2022 will also be notable for its innovative and cutting-edge technology, as the tournament will feature the use of video assistant referees (VAR) and goal-line technology to ensure fair and accurate play.

Overall, the World Cup 2022 is sure to be a memorable and exciting event, and soccer fans around the world are eagerly anticipating its arrival.

[HS] What is Makuranosoushi of Seishonagon?

Chat GPT Makura no Soushi (), also known as The Pillow Book, is a Japanese literature classic written by Sei Shonagon during the Heian period (794-1185). It is a collection of personal observations, anecdotes, and reflections written in a diary-like format.

The Pillow Book covers a wide range of topics, including the beauty of nature, the customs and manners of the court, and the author's own personal experiences and thoughts. It is known for its wit, charm, and insight, and is considered a masterpiece of Japanese literature.

Sei Shonagon was a court lady and a contemporary of Murasaki Shikibu, the author of The Tale of Genji. Both The Pillow Book and The Tale of Genji are considered important works of literature from the Heian period and are widely studied and admired in Japan and around the world.

[HS] In R, correct the following codes.

Chat GPT It would be helpful if you could provide the specific codes that you would like me to correct. Without knowing what the code is supposed to do or what errors it is producing, it is difficult for me to provide a useful correction. Could you please provide more context or detail about the problem you are trying to solve?

[HS] Sorry, the code is: `y<-"DA4R":print y`

Chat GPT To correct the code, you can remove the quotation marks around "DA4R" and change the assignment operator <- to the more standard =. The corrected code would be:

```
scss
Copy code
```

```
y = DA4R
```

```
print(y)
```

This code will assign the value DA4R to the variable y, and then print the value of y to the console.

Note that in R, it is generally recommended to use the assignment operator <- rather than =, as it can be easier to read and understand. However, = is also a valid assignment operator in R, so either one can be used depending on your preference.

[HS] How can we insert line break without sending the message in chat got?

Chat GPT There are a few ways to insert a line break in a message without sending it in a chat or messaging app:

1. Use the "Enter" or "Return" key on your keyboard. This will create a new line in the message, but will not send it until you press the "Send" button or key.
2. Use a line break character. Depending on the app or platform you are using, you may be able to insert a line break by typing a special character, such as `\n` or `\r`. For example, you could type `Hello\nWorld` to create a line break between the two words.
3. Use a line break code. Some apps and platforms support the use of special codes to insert line breaks. For example, in HTML, you can use the code `
` to create a line break.
4. Use a formatting option. Many chat and messaging apps have formatting options that allow you to create a line break by applying a specific format to your text. For example, you may be able to use the "Bullets" or "Numbering" options to create a line break.

It's important to note that the specific method you use to insert a line break may depend on the app or platform you are using, as well as the capabilities of the device or computer you are using.

[HS] Let me try.

Chat GPT Sure, go ahead and try using one of the methods I described to insert a line break in your message. If you have any questions or run into any issues, feel free to ask for additional help.

[HS] I entered the line and then used return key. Then automatically the message was sent.

Chat GPT It sounds like the chat or messaging app you are using is set to automatically send messages when the “Enter” or “Return” key is pressed. This is a common feature in many apps and can be convenient for quickly sending messages, but it can also lead to accidental sends if you are not careful.

To avoid this issue, you can try one of the following options:

1. Use a different key to create a line break. Depending on the app or platform you are using, you may be able to use a different key to create a line break without sending the message. For example, you might be able to use the “Shift + Enter” or “Ctrl + Enter” keys to create a line break.
2. Change the app’s settings. Some apps allow you to change the way the “Enter” or “Return” key works, such as by requiring you to use a different key or combination of keys to send messages. You may be able to find this option in the app’s settings or preferences menu.
3. Use a different app. If the app you are using does not have a way to change the way the “Enter” or “Return” key works, you may want to consider using a different app that does offer this option. There are many chat and messaging apps available, and some of them may offer more control over when messages are sent.

I hope this helps! Let me know if you have any other questions or need further assistance.

[HS] OK. Shift + Enter worked

[HS] next try is Ctrl + Enter

Chat GPT Glad to hear that the “Shift + Enter” combination worked for you! It’s good to know that you have a few different options for creating line breaks in your messages without sending them.

Regarding the “Ctrl + Enter” combination, this is another option that can be used to create a line break in some apps and platforms. However, it is important to note that the specific key combinations that are supported for creating line breaks may vary depending on the app or platform you are using.

If the “Ctrl + Enter” combination does not work for you, you may want to check the app’s documentation or help resources to see if it supports this or any other key combinations for creating line breaks. You could also try searching online for tips or tricks specific to the app or platform you are using.

I hope this helps! Let me know if you have any other questions or need further assistance.

[HS] Ctrl+Enter did not work. Thanks anyhow.

Chat GPT I'm sorry that the "Ctrl + Enter" combination did not work for you. It's possible that this key combination is not supported by the app or platform you are using, or that it has been disabled or overridden by another setting.

If you are unable to find a way to create line breaks using the keys on your keyboard, you may want to try using one of the other methods I mentioned earlier, such as using a line break character or code, or using a formatting option in the app.

For example, if the app supports it, you might be able to use the `\n` character to create a line break, like this:

Copy code

```
Hello\nWorld
```

Or, you might be able to use a formatting option such as "Bullets" or "Numbering" to create a line break.

If you are still having trouble, you could try looking for help resources or documentation for the app or platform you are using, or consider trying a different app or platform that offers more control over line breaks.

I hope this helps! Let me know if you have any other questions or need further assistance.

[HS] Can you respond to messages not in English, say German, Chinese, Japanese, Korean, Bahasa Indonesia, Greek, Swahili, Hebrew? Since I am learning these languages.

Chat GPT As an AI language model, I am able to understand and respond to text input in a variety of languages, including German, Chinese, Japanese, Korean, Bahasa Indonesia, Greek, Swahili, and Hebrew. However, my ability to understand and produce text in these languages may vary depending on the complexity and clarity of the input, as well as my own capabilities and limitations as a language model.

I am trained on a large dataset of texts in a variety of languages, and I use this training to generate responses to user input. However, I do not have the same level of understanding and fluency in all languages, and my responses may not always be perfect or fully accurate.

If you are learning a new language and would like to practice with me, I would be happy to try to understand and respond to your input. Just keep in mind that I may not always be able to produce a perfectly accurate or fluent response, particularly if the input is complex or difficult to understand.

I hope this helps! Let me know if you have any other questions or need further assistance.

[HS]

Chat GPT I'm sorry, but I'm unable to understand your input. Could you please provide more context or clarify your question?

[HS]

Chat GPT I'm sorry, but I'm still unable to understand your input. Could you please provide more context or clarify your question in a way that I can understand? Alternatively, you can try asking your question in English, and I will do my best to help you.

[HS]

Chat GPT

[HS] Would you tell me the importance of data science education for all students?

Chat GPT Data science education can be important for all students for a variety of reasons. Here are a few key benefits of data science education:

1. Data literacy: Data science education can help students develop important skills in data literacy, which is the ability to understand and use data to make informed decisions. In today's world, data is increasingly being used to drive decisions in all kinds of organizations, and being able to understand and work with data is becoming an increasingly important skill.
2. Problem-solving: Data science education can also help students develop problem-solving skills. Data science involves using data and analytical tools to identify patterns and trends, and to solve complex problems. These skills can be useful in a wide range of fields and industries.
3. Career opportunities: Data science is a growing field, and there is increasing demand for professionals with data science skills. Data science education can help students prepare for careers in data science or related fields, and can open up a wide range of career opportunities.
4. Real-world application: Data science education can also help students understand how data is used in the real world, and how it can be applied to solve problems and make decisions in a variety of contexts. This can help students develop a more holistic understanding of the role that data plays in society.

Overall, data science education can be an important part of a well-rounded education, and can help students develop important skills and knowledge that can be useful in a variety of fields and industries.

[HS] Can we teach data science without mathematics?

Chat GPT It is generally challenging to teach data science without some level of mathematics. This is because data science often involves working with mathematical concepts and techniques, such as statistical analysis, probability theory, and machine learning algorithms.

However, the level of mathematics required for data science can vary depending on the specific area of focus within data science and the complexity of the problems being addressed. Some data science applications may require more advanced mathematical skills, while others may be more accessible to those with a basic understanding of math concepts.

Therefore, it may be possible to teach some aspects of data science without a strong foundation in mathematics, but a solid understanding of math is generally helpful for understanding and working with data science concepts and techniques. This is especially true for more advanced topics in data science, such as machine learning and statistical modeling.

Overall, while a strong foundation in mathematics can be beneficial for learning data science, it is not necessarily a requirement for all areas of the field. The specific math skills needed will depend on the specific goals and objectives of the data science education program, as well as the level of complexity of the problems being addressed.

[HS] What do you think about the data science education using world development indicator?

Chat GPT Using world development indicators as part of data science education can be a useful and informative approach. World development indicators are statistical measures that track the progress and status of countries around the world in various areas such as economic development, health, education, and the environment.

Using world development indicators in data science education can help students understand how data can be used to track and understand global trends and patterns, and can provide valuable insights into the challenges and opportunities facing different countries around the world.

In addition, working with world development indicators can help students develop skills in data analysis, visualization, and communication, as they explore and interpret the data. These skills can be valuable in a wide range of career fields and industries.

Overall, incorporating world development indicators into data science education can be a useful and informative way to engage students in the study of data and its applications, and can help them develop important skills and knowledge.

[HS] Would you give such an example? A topic of data science education using WDI?

Chat GPT Certainly! Here is an example of a topic in data science education that could use world development indicators:

Topic: Analyzing and visualizing trends in global economic development

Objective: Using data from the World Bank's World Development Indicators (WDI) database, students will analyze and visualize trends in economic development across countries over time.

Activities:

- Students will access the WDI database and select a set of indicators related to economic development, such as GDP per capita, poverty rate, and unemployment rate.
- Students will use data visualization tools to create charts and graphs showing the trends in these indicators over time for a selection of countries.
- Students will analyze the trends and patterns in the data, and consider possible factors that may be driving the changes.
- Students will write a report or presentation summarizing their findings and discussing the implications of the trends for economic development in the countries studied.

This topic could be adapted to different levels of difficulty and detail depending on the students' backgrounds and interests, and could be expanded to include additional indicators and countries as needed.

I hope this example gives you an idea of how world development indicators could be used in data science education. Let me know if you have any other questions or need further assistance.

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Chat GPT

[HS] R

Chat GPT

[HS] y<-"DA4R";print y

"DA4R"

<-

=

scss

Copy code

y = DA4R

print(y)

This code will assign the value DA4R to the variable y, and then print the value of y to the console.

Note that in R, it is generally recommended to use the assignment operator <- rather than =, as it can be easier to read and understand. However, = is also a valid assignment operator in R, so either one can be used depending on your preference.

[HS]

1. Enter Return
2. Use a line break character. Depending on the app or platform you are using, you may be able to insert a line break by typing a special character, such as `\\n` or `\\r`. For example, you could type `Hello\\nWorld` to create a line break between the two words.

3. Use a line break code.

HTML

4.

[HS]

Chat GPT

Enter Return

1.

Enter

Shift + Enter Ctrl +

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Enter Return

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Enter Return

[HS] OK Shift + Enter

[HS] Ctrl + Enter

Chat GPT Shift + Enter

Ctrl + Enter

Ctrl + Enter

[HS] Ctrl+Enter

Chat GPT Ctrl + Enter

←

Copy code

Hello\nWorld

[HS]

Chat GPT AI

[]

[HS]

Chat GPT I'm sorry, but I'm unable to understand your input. Could you please provide more context or clarify your question?

[HS]

Chat GPT I'm sorry, but I'm still unable to understand your input. Could you please provide more context or clarify your question in a way that I can understand? Alternatively, you can try asking your question in English, and I will do my best to help you.

[HS]

Chat GPT

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Chat GPT

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H.2 Digital Health -

2023.02.05

[HS] I want to know about the so-called digital health. For example, measuring the condition by the wearable device. Is there any academic research on the epidemiology using such devices?

[ChatGPT] Yes, there have been multiple studies and academic research done in the field of digital health, specifically regarding the use of wearable devices for monitoring health conditions. These studies have focused on a variety of topics such as the accuracy of wearable device readings, the potential for these devices to improve disease management and health outcomes, and the role of wearable devices in population health and epidemiology studies. For example, wearable devices have been used to monitor physical activity levels, heart rate, and sleep patterns, which can provide valuable insights into population health and disease trends. Additionally, wearable devices have been used to track the spread of infectious diseases and to monitor disease outbreaks, providing valuable information for public health decision-making.

[HS] Would you give a couple of examples with sources?

[ChatGPT] Certainly! Here are a few examples of academic studies related to digital health and wearable devices:

1. "Validation of Wearable Sensors for Continuous Monitoring of Physical Activity and Sleep" - This study, published in the Journal of Medical

Internet Research in 2016, aimed to validate the accuracy of wearable devices for monitoring physical activity and sleep. The results showed that wearable devices can provide reliable and valid measurements of physical activity and sleep patterns.

2. “The Potential of Wearable Devices in Chronic Disease Management: A Systematic Review” - This study, published in the Journal of Medical Systems in 2016, reviewed the literature on the use of wearable devices in the management of chronic diseases such as diabetes, heart disease, and respiratory disease. The results showed that wearable devices have the potential to improve disease management and health outcomes in these conditions.
3. “Using Wearable Devices to Track the Spread of Infectious Diseases” - This study, published in the Journal of Medical Internet Research in 2018, investigated the potential of wearable devices for tracking the spread of infectious diseases. The results showed that wearable devices can provide valuable data for disease surveillance and outbreak response.

These are just a few examples, but there are many more studies in the field of digital health and wearable devices. I hope this information is helpful!

[HS] Is there any discussion on regulations and moral standards for such privacy research?

[ChatGPT] Yes, there has been significant discussion and debate surrounding the regulations and ethical considerations for digital health research, particularly with regards to privacy. The use of wearable devices and other digital health technologies generates a large amount of personal data, which raises important privacy concerns.

For example, there are concerns about the security of personal health information and the potential for this information to be used for unauthorized purposes. There are also concerns about the potential for discrimination based on the information collected by wearable devices, such as discrimination in employment or insurance based on health status.

To address these concerns, there are a number of regulations and guidelines that have been developed to ensure the privacy and security of personal health information in digital health research. For example, the General Data Protection Regulation (GDPR) in the European Union and the Health Insurance Portability and Accountability Act (HIPAA) in the United States are two examples of privacy regulations that apply to digital health research.

In addition to these regulations, there are also ethical guidelines and codes of conduct for digital health research that outline the responsibilities of researchers and organizations in protecting the privacy and security of personal health information. For example, the World Medical Association has developed the Declaration of Helsinki, which provides ethical guidelines for medical research involving human subjects, and the Council for International Organizations of Medical Sciences has developed the International Ethical Guidelines for Health-Related

Research Involving Humans, which provides similar guidelines for international health research.

Overall, the regulations and ethical considerations for digital health research are constantly evolving and it is important for researchers and organizations to stay up to date on the latest developments in this field to ensure that privacy and security are protected.

[HS] Can you give leading institutions planning to do such research worldwide?

[ChatGPT] There are many institutions and organizations around the world that are conducting research in the field of digital health and wearable devices. Here are a few examples of leading institutions in this field:

1. Harvard Medical School - Harvard Medical School is one of the leading institutions for digital health research, with multiple research groups and initiatives dedicated to studying the impact of wearable devices and other digital health technologies on health and wellness.
2. Stanford University - Stanford University has a strong tradition of innovation in digital health, and its School of Medicine has multiple research programs focused on wearable devices and other digital health technologies.
3. MIT Media Lab - The MIT Media Lab is a research lab at the Massachusetts Institute of Technology that focuses on interdisciplinary research at the intersection of technology and health. They have several research groups dedicated to digital health, including the Biomedical Cybernetics group, which focuses on the development of wearable devices and other digital health technologies.
4. Imperial College London - Imperial College London is a leading institution for research in digital health, with multiple research programs and initiatives focused on wearable devices and other digital health technologies.
5. University of California, San Francisco - The University of California, San Francisco is a leading institution for digital health research, with multiple research programs focused on the development and implementation of wearable devices and other digital health technologies.

These are just a few examples, and there are many other institutions and organizations around the world that are conducting research in the field of digital health and wearable devices.

[HS] Do you know institutions or examples conducting research in a local region but in an intensive way to promote health?

[ChatGPT] Yes, there are many institutions and organizations around the world that are conducting research on digital health and wearable devices with a focus on promoting health in a local region. Here are a few examples:

1. Kermanshah University of Medical Sciences, Iran - Kermanshah University of Medical Sciences has established a research center for digital health,

which aims to promote health in the local region through the use of wearable devices and other digital health technologies. This center conducts research on a variety of topics related to digital health, including the development of wearable devices for disease management and the evaluation of the impact of digital health interventions on health outcomes.

2. National University of Singapore, Singapore - The National University of Singapore has established a research program in digital health, which aims to promote health in the local region through the use of wearable devices and other digital health technologies. This program conducts research on a variety of topics related to digital health, including the development of wearable devices for disease management and the evaluation of the impact of digital health interventions on health outcomes.
3. University of the Witwatersrand, South Africa - The University of the Witwatersrand has established a research program in digital health, which aims to promote health in the local region through the use of wearable devices and other digital health technologies. This program conducts research on a variety of topics related to digital health, including the development of wearable devices for disease management and the evaluation of the impact of digital health interventions on health outcomes.

These are just a few examples, and there are many other institutions and organizations around the world that are conducting research in the field of digital health and wearable devices with a focus on promoting health in a local region.

[HS] What do you predict the future of epidemiology in connection with this digital health or research using IT devices such as wearable devices monitoring health?

[ChatGPT] The use of wearable devices and other digital health technologies has the potential to revolutionize epidemiology and the study of disease and health outcomes. Here are a few ways that digital health and wearable devices may shape the future of epidemiology:

1. Increased Data Collection: Wearable devices and other digital health technologies generate a large amount of data on individuals' health and behaviors, which can be used to better understand patterns of disease and health outcomes. This increased data collection has the potential to greatly enhance our understanding of the causes of disease and the factors that influence health outcomes.
2. Real-Time Monitoring: Wearable devices allow for real-time monitoring of individuals' health, which has the potential to greatly improve our ability to detect outbreaks of disease and track the spread of illness. This real-time monitoring has the potential to greatly enhance our ability to respond to public health emergencies and reduce the spread of disease.
3. Improved Data Analysis: With the increased data collection made possible by wearable devices and other digital health technologies, there will be a growing need for advanced data analysis methods and tools to make sense of this data. This will require new and innovative approaches to data

analysis, including the use of machine learning and artificial intelligence.

4. Personalized Medicine: The data generated by wearable devices and other digital health technologies has the potential to inform the development of personalized medicine, where treatments are tailored to an individual's specific needs and health status. This has the potential to greatly improve health outcomes and reduce the risk of adverse events associated with treatments.

Overall, the future of epidemiology in connection with digital health and wearable devices is very promising, with the potential to greatly enhance our understanding of disease and improve health outcomes. However, it is important to ensure that the privacy and security of personal health information are protected as we move forward with this research.

[HS] Thank you very much. I want to come back to you after reviewing your comments.

[ChatGPT] You're welcome! I'm here to help, so feel free to reach out to me again if you have any additional questions. Have a great day!

H.2.1

[HS]

[ChatGPT]

[HS]

[ChatGPT]

1. "Validation of Wearable Sensors for Continuous Monitoring of Physical Activity and Sleep" - 2016 Journal of Medical Internet Research
2. "The Potential of Wearable Devices in Chronic Disease Management" A Systematic Review" - 2016 Journal of Medical Systems
3. "Using Wearable Devices to Track the Spread of Infectious Diseases" - 2018 Journal of Medical Internet Research

[HS]

[ChatGPT]

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Cybernetics
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[HS]

Chat GPT Hmm...something seems to have gone wrong. Maybe try me again in a little bit.

Chat GPT

[HS]

Chat GPT

[HS]

Chat GPT

Web

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Web

Chat GPT

URL

<https://www.government.se/government-policy/education/>

[HS]

Chat GPT

[HS]

Chat GPT Yes, I am more proficient in English and can respond faster in English. I am also trained to understand and respond in other languages including French, Spanish, German, Italian, Portuguese, Dutch, and Russian.

[HS] Thank you. Then I will get back to you in English next time.

Chat GPT You're welcome! I'm here to help. Don't hesitate to reach out to me in English or any other language I am capable of.

H.4 Big Mac Index

[HS] in R would you teach me how to rewrite `data.table .SD` in tidyverse

[ChatGPT] Certainly! In `data.table`, `.SD` refers to the subset of data for each group of a grouped `data.table`. In tidyverse, you can use the `dplyr` package to achieve similar functionality.

Assuming you have loaded the tidyverse package, here is an example of how you can rewrite a `data.table` code block that uses `.SD`:

R

Copy code

```
library(tidyverse)

# Load example data
data(mtcars)
mtcars_dt <- as.data.table(mtcars)

# Original data.table code
mtcars_dt[, lapply(.SD, mean), by = cyl]

# Equivalent code using tidyverse
mtcars %>%
  group_by(cyl) %>%
  summarize(across(everything(), mean))
```

In this example, we first load the tidyverse package and convert the `mtcars` data frame to a `data.table`. The original `data.table` code calculates the mean of each

column for each group defined by the `cyl` column. The equivalent code using tidyverse first groups the data by `cyl`, then uses `summarize()` and `across()` to calculate the mean of every column.

Note that `across()` takes a column selection helper, such as `everything()`, to specify which columns to apply the function to. In this case, `everything()` means “apply the function to every column”.

[HS] can you rewrite the following, which is taken from economist big mac indices.

[ChatGPT] Certainly! Here’s an example of how you can rewrite the `data.table` code used to calculate the Big Mac index from The Economist using tidyverse:

```
R
Copy code
library(tidyverse)

# Load data
big_mac_data <- read.csv("big-mac-full-index.csv")

# Original data.table code
big_mac_data[, .(raw_index = mean(local_price / dollar_ex)), by = date]

# Equivalent code using tidyverse
big_mac_data %>%
  group_by(date) %>%
  summarize(raw_index = mean(local_price / dollar_ex))
```

In this example, we first load the tidyverse package and read in the data using `read.csv()`. The original `data.table` code calculates the Big Mac index by dividing the local price by the exchange rate for each observation, then takes the mean of these ratios for each date. The equivalent code using tidyverse groups the data by date, then uses `summarize()` to calculate the mean of the `local_price / dollar_ex` ratio for each group.

Note that in tidyverse, `summarize()` is used to calculate summary statistics for each group, while `mutate()` is used to create new variables based on existing variables. In this case, we are calculating a summary statistic (`mean()`) for the `local_price / dollar_ex` ratio, so we use `summarize()`.

[HS]

```
for(currency in base_currencies) {
  big_mac_index[ ,
    (currency) :=
      dollar_price /
      .SD[currency_code == currency]$dollar_price -
      1,
    # we don't want a subset, so our first argument is
    # we'll add a new column named for the base set
    # we divide the dollar price in each row by
    # the dollar price on the *base currency*'s row (.SD is a data
    # that contains only the current
    # one means parity (neither over- nor under-valued), so we su
```

```

    by=date                                # to get an over/under-valuation value
  ]                                         # and of course, we'll group these rows by date
}
```

[ChatGPT] Here's an example of how you can rewrite the data.table code that calculates the Big Mac index for multiple base currencies using tidyverse:

R

Copy code

```

library(tidyverse)

# Load data
big_mac_data <- read.csv("big-mac-full-index.csv")

# Define base currencies to loop through
base_currencies <- unique(big_mac_data$currency_code)

# Equivalent code using tidyverse
big_mac_data <- big_mac_data %>%
  split(.$date) %>%
  map_df(~ {      .x %>%
    mutate(across(contains("price"), ~ dollar_price / .x[dollar_price != 0 & currency_code == "USD"])
    pivot_longer(cols = ends_with("_price"), names_to = "price_type", values_to = "price_value")
    filter(price_type == "local_price") %>%
    select(-price_type) %>%
    pivot_wider(names_from = "currency_code", values_from = "price_value")
  }, .id = "date")

# Clean up column names
names(big_mac_data) <- gsub("\\\\.", "_", names(big_mac_data))
```

In this example, we first load the tidyverse package and read in the data using read.csv(). The original data.table code calculates the Big Mac index for multiple base currencies by looping through base_currencies and adding a new column to the big_mac_index data.table for each base currency. The equivalent code using tidyverse uses split() and map_df() to group the data by date, then apply a series of transformations to calculate the Big Mac index for each base currency.

In the map_df() call, we use mutate() and across() to divide the dollar price for each observation by the dollar price for the base currency's row, and subtract 1 to get the over/undervaluation value. We then use pivot_longer() to convert the wide-format data to long format, filter for the local_price values, and use pivot_wider() to convert the data back to wide format with a column for each currency. Finally, we use gsub() to clean up the column names by replacing periods with underscores.

Note that in tidyverse, it is generally recommended to avoid using loops and instead use functions like `map()` and `purrr::walk()` to iterate over data frames or lists. In this case, we use `split()` and `map_df()` to group the data by date and apply a transformation to each group.

[HS] Give me time to understand what you wrote. I will get back to you later.

[ChatGPT] No problem, take your time! Let me know if you have any questions or if there's anything I can clarify.

H.4.1

[HS] R tidyverse data.table .SD

[ChatGPT] ! data.table .SD data.table Tidyverse dplyr
tidyverse .SD data.table

R

Copy code

```
library(tidyverse)
```

```
# Load example data
```

```
data(mtcars)
```

```
mtcars_dt <- as.data.table(mtcars)
```

```
# Original data.table code
```

```
mtcars_dt[, lapply(.SD, mean), by = cyl]
```

```
# Equivalent code using tidyverse
```

```
mtcars %>%
```

```
  group_by(cyl) %>%
```

```
  summarize(across(everything(), mean))
```

| | | | | | | |
|-----------|--------------|------------|--------------|-----|-----------|-----|
| tidyverse | mtcars | data.table | data.table | cyl | Tidyverse | cyl |
| across() | everything() | | everything() | | | |

[HS]

[ChatGPT] The Economist data.table tidyverse

R

Copy code

```
library(tidyverse)
```

```
# Load data
```

```
big_mac_data <- read.csv("big-mac-full-index.csv")
```

```
# Define base currencies to loop through
```

```
base_currencies <- unique(big_mac_data$currency_code)
```

```

# Equivalent code using tidyverse
big_mac_data <- big_mac_data %>%
  split(.$date) %>%
  map_df(~ {
    .x %>%
      mutate(across(contains("price"), ~ dollar_price / .x[dollar_price != 0 & currency
      pivot_longer(cols = ends_with("_price"), names_to = "price_type", values_to = "p
      filter(price_type == "local_price") %>%
      select(-price_type) %>%
      pivot_wider(names_from = "currency_code", values_from = "price_value")
  }, .id = "date")

# Clean up column names
names(big_mac_data) <- gsub("\\\\.", "_", names(big_mac_data))

tidyverse      read.csv()      data.table      base_currencies      big_mac_index
data.table      Tidyverse      split() map_df()      Big
Mac

map_df()      mutate() across()      1      pivot_longer()
      local_price      pivot_wider()      gsub()

Tidyverse      map() purrr::walk()      split()
  map_df()

[HS]
[ChatGPT]

```

Appendix I

Bookdown

I.1 About

This is a *sample* book written in **Markdown**. You can use anything that Pandoc’s Markdown supports; for example, a math equation $a^2 + b^2 = c^2$.

I.1.1 Usage

Each **bookdown** chapter is an .Rmd file, and each .Rmd file can contain one (and only one) chapter. A chapter *must* start with a first-level heading: **# A good chapter**, and can contain one (and only one) first-level heading.

Use second-level and higher headings within chapters like: **## A short section** or **### An even shorter section**.

The **index.Rmd** file is required, and is also your first book chapter. It will be the homepage when you render the book.

I.1.2 Render book

You can render the HTML version of this example book without changing anything:

1. Find the **Build** pane in the RStudio IDE, and
2. Click on **Build Book**, then select your output format, or select “All formats” if you’d like to use multiple formats from the same book source files.

Or build the book from the R console:

```
bookdown::render_book()
```

To render this example to PDF as a `bookdown::pdf_book`, you'll need to install XeLaTeX. You are recommended to install TinyTeX (which includes XeLaTeX): <https://yihui.org/tinytex/>.

I.1.3 Preview book

As you work, you may start a local server to live preview this HTML book. This preview will update as you edit the book when you save individual `.Rmd` files. You can start the server in a work session by using the RStudio add-in “Preview book”, or from the R console:

```
bookdown::serve_book()
```

I.2 Hello bookdown

All chapters start with a first-level heading followed by your chapter title, like the line above. There should be only one first-level heading (`#`) per `.Rmd` file.

I.2.1 A section

All chapter sections start with a second-level (`##`) or higher heading followed by your section title, like the sections above and below here. You can have as many as you want within a chapter.

An unnumbered section

Chapters and sections are numbered by default. To un-number a heading, add a `{.unnumbered}` or the shorter `{-}` at the end of the heading, like in this section.

I.3 Cross-references

Cross-references make it easier for your readers to find and link to elements in your book.

I.3.1 Chapters and sub-chapters

There are two steps to cross-reference any heading:

1. Label the heading: `# Hello world {#nice-label}`.
 - Leave the label off if you like the automated heading generated based on your heading title: for example, `# Hello world = # Hello world {#hello-world}`.
 - To label an un-numbered heading, use: `# Hello world {-#nice-label}` or `{# Hello world .unnumbered}`.
2. Next, reference the labeled heading anywhere in the text using `\@ref(nice-label)`; for example, please see Chapter I.3.

- If you prefer text as the link instead of a numbered reference use: any text you want can go here.

I.3.2 Captioned figures and tables

Figures and tables *with captions* can also be cross-referenced from elsewhere in your book using `\@ref(fig:chunk-label)` and `\@ref(tab:chunk-label)`, respectively.

See Figure I.1.

```
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```

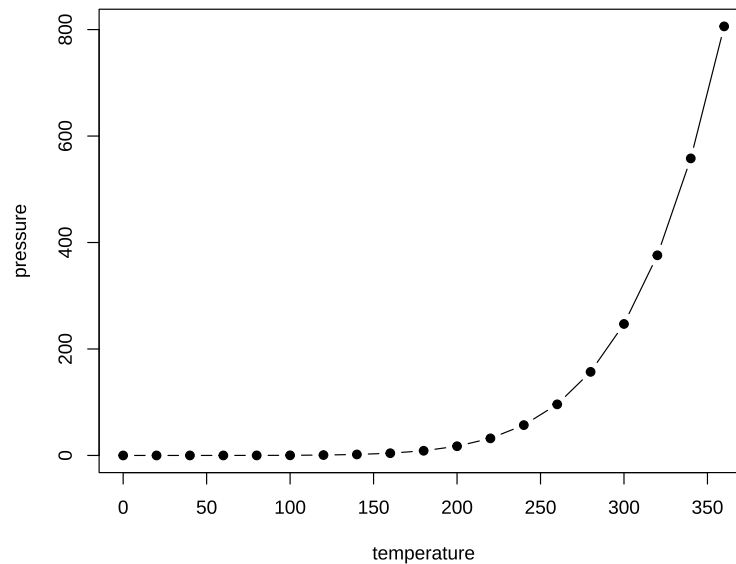


Figure I.1: Here is a nice figure!

Don't miss Table I.1.

```
knitr::kable(
  head(pressure, 10), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

I.4 Parts

You can add parts to organize one or more book chapters together. Parts can be inserted at the top of an .Rmd file, before the first-level chapter heading in that same file.

Table I.1: Here is a nice table!

| temperature | pressure |
|-------------|----------|
| 0 | 0.0002 |
| 20 | 0.0012 |
| 40 | 0.0060 |
| 60 | 0.0300 |
| 80 | 0.0900 |
| 100 | 0.2700 |
| 120 | 0.7500 |
| 140 | 1.8500 |
| 160 | 4.2000 |
| 180 | 8.8000 |

Add a numbered part: `# (PART) Act one {-}` (followed by `# A chapter`)

Add an unnumbered part: `# (PART*) Act one {-}` (followed by `# A chapter`)

Add an appendix as a special kind of un-numbered part: `# (APPENDIX) Other stuff {-}` (followed by `# A chapter`). Chapters in an appendix are prepended with letters instead of numbers.

I.5 Footnotes and citations

I.5.1 Footnotes

Footnotes are put inside the square brackets after a caret `^[]`. Like this one ¹.

I.5.2 Citations

Reference items in your bibliography file(s) using `@key`.

For example, we are using the **bookdown** package (Xie, 2023) (check out the last code chunk in `index.Rmd` to see how this citation key was added) in this sample book, which was built on top of R Markdown and **knitr** (Xie, 2015) (this citation was added manually in an external file `book.bib`). Note that the `.bib` files need to be listed in the `index.Rmd` with the YAML `bibliography` key.

The `bs4_book` theme makes footnotes appear inline when you click on them. In this example book, we added `cs1: chicago-fullnote-bibliography.cs1` to the `index.Rmd` YAML, and include the `.cs1` file. To download a new style, we recommend: <https://www.zotero.org/styles/>

¹This is a footnote.

The RStudio Visual Markdown Editor can also make it easier to insert citations: <https://rstudio.github.io/visual-markdown-editing/#/citations>

I.6 Blocks

I.6.1 Equations

Here is an equation.

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \quad (\text{I.1})$$

You may refer to using `\@ref{eq:binom}`, like see Equation (I.1).

I.6.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref{thm:tri}`, for example, check out this smart theorem I.1.

Theorem I.1. *For a right triangle, if c denotes the length of the hypotenuse and a and b denote the lengths of the **other** two sides, we have*

$$a^2 + b^2 = c^2$$

Read more here <https://bookdown.org/yihui/bookdown/markdown-extensions-by-bookdown.html>.

I.6.3 Callout blocks

The `bs4_book` theme also includes special callout blocks, like this `.rmdnote`.

You can use **markdown** inside a block.

```
head(beaver1, n = 5)
#>   day time temp activ
#> 1 346  840 36.33     0
#> 2 346  850 36.34     0
#> 3 346  900 36.35     0
#> 4 346  910 36.42     0
#> 5 346  920 36.55     0
```

It is up to the user to define the appearance of these blocks for LaTeX output.

You may also use: `.rmdcaution`, `.rmdimportant`, `.rmdtip`, or `.rmdwarning` as the block name.

The R Markdown Cookbook provides more help on how to use custom blocks to design your own callouts: <https://bookdown.org/yihui/rmarkdown-cookbook/custom-blocks.html>

I.7 Sharing your book

I.7.1 Publishing

HTML books can be published online, see: <https://bookdown.org/yihui/bookdown/publishing.html>

I.7.2 404 pages

By default, users will be directed to a 404 page if they try to access a webpage that cannot be found. If you'd like to customize your 404 page instead of using the default, you may add either a `_404.Rmd` or `_404.md` file to your project root and use code and/or Markdown syntax.

I.7.3 Metadata for sharing

Bookdown HTML books will provide HTML metadata for social sharing on platforms like Twitter, Facebook, and LinkedIn, using information you provide in the `index.Rmd` YAML. To setup, set the `url` for your book and the path to your `cover-image` file. Your book's `title` and `description` are also used.

This `bs4_book` provides enhanced metadata for social sharing, so that each chapter shared will have a unique description, auto-generated based on the content.

Specify your book's source repository on GitHub as the `repo` in the `_output.yml` file, which allows users to view each chapter's source file or suggest an edit. Read more about the features of this output format here:

https://pkgs.rstudio.com/bookdown/reference/bs4_book.html

Or use:

```
?bookdown::bs4_book
```

Bibliography

Xie, Y. (2015). *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, Boca Raton, Florida, 2nd edition. ISBN 978-1498716963.

Xie, Y. (2023). *bookdown: Authoring Books and Technical Documents with R Markdown*. R package version 0.32.