

Lab5: Introduction to RMarkdown

QSSBA, Spring 2025

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HNC

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- 3 Getting started
- 4 Basic Syntax in RMarkdown
- 5 LaTeX: for document and presentation in PDF format
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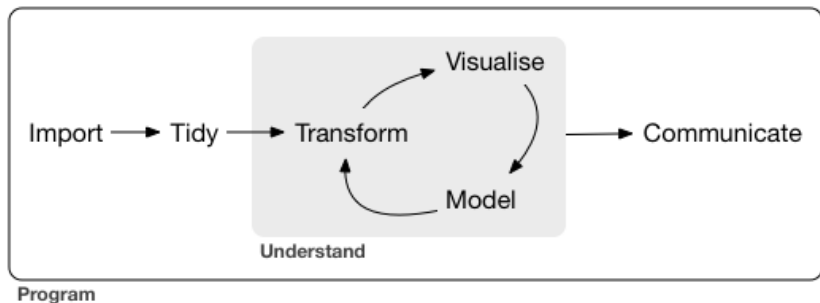
Section 1

Review previous lectures

What we have practiced so far

- Basic R syntax
- Data Management
 - Import and Export Data
 - Data Cleaning
 - Data Manipulation
 - Data Visualization
- Data Analysis (we will dive into it later)
 - Descriptive Statistics (we touched it a little bit)
 - Causal Inference
 - Predictive Modeling

The workflow of data analysis



What we are going to learn next

- How to **communicate** your results with audience if you finish your data analysis?
 - Write a report, paper even a book
 - Make a presentation
 - Build a website
- How to make your report or paper more beautiful and professional?
 - **RMarkdown**
 - **Quarto**(The next generation of RMarkdown)

Section 2

Why use RMarkdown?

What is Markdown?

- **Markdown:** 是一种轻量级的标记语言，它允许人们使用易读易写的纯文本格式编写文档，然后转换成有效的 XHTML（或者 HTML）文档。（维基百科）。
- 具有简介的语法、优美的格式以及多种软件的支持，因此是目前互联网上最流行的写作程式。
- 简单讲：容易学 + 兼容性强 + 功能强大

Word is far from perfect

- 先看我们最常用的但也无比糟糕的 **Word**
 - 体积臃肿，功能貌似强大，但很多其实都用不上。每次打开都费很久时间。
 - 最让人崩溃的是非常非常容易崩溃。
 - 版本和格式之间兼容性非常差。
 - 比如 MacOS 和 Win 之间。
 - 从网页上复制文字到 Word 里经常是乱的。
 - 与其他软件相结合能力差，无法单独生成动态文档。
 - 团队协作能力差。

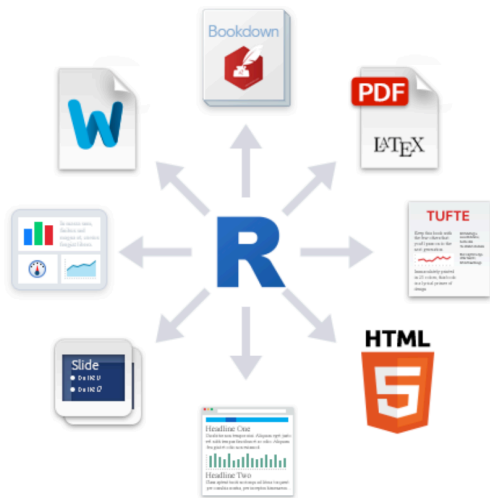
Markdown is more popular in scientific writing?

- 再看我们介绍的 **Markdown**

- 体积小，因为是纯文本文件，任意一个文本编辑器都可以打开。
- 即使文字内容很多，也不容易崩溃。
- 文档格式万能转换。（借助其他软件比如 `pandoc`）可以直接转化为 `pdf`、`docx`、`html`。
- 可以与统计软件相结合，生成动态文档。
- 与 `Github` 应用相结合，可以实现版本控制和程式化协作。（What is Github?）

What is RMarkdown?

- 在 RStudio 中, 基于 Markdown 语法, 结合 R 的功能的文档处理套件。



Yihui Xie and knitr package

- Developed by a leading figure in R field: **Yihui Xie**(谢益辉)



- COS 访谈第 20 期：千秋邈矣独留我，百战归来再读书：谢益辉

Section 3

Getting started

Build a Project

- Recall: how to creat a project within RStudio
- Why?

Install and Library Packages

- (if necessary) install packages
 - **rmarkdown**
 - **knitr**

```
#install.packages("rmarkdown")  
#install.packages("knitr")  
#library("rmarkdown")  
#library("knitr")
```

Generate a document

- Static
 - Document: **Html, Word, LaTeX**
 - Presentation: **Html, Beamer in LaTeX, Powerpoint**
- Dynamic
 - Shiny App(you've use it)

Introduction to Rmarkdown

- .Rmd format
- Document:
 - Html
 - Word (requires you install MS Word)
 - PDF (requires you install LaTeX system)
- Presentation
 - Html: ioslides & Slidify
 - PDF: beamer of LaTeX system (requires you install LaTeX system)
 - Powerpoint: (requires you install MS Powerpoint)

Generate a html file(default)

- small size
- easy to compile
- can transfer to Word or PDF later

Section 4

Basic Syntax in RMarkdown

Introduction

- Let's try it by using a default template.
- Creat(open) a RMarkdown file

The screenshot shows the RStudio interface. The 'File' menu is open, and 'New File' > 'R Markdown' is selected. The console displays the following text:

```

R version 3.6.0 (2019-04-26)
Copyright (C) 2019 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu64
Type: x86_64-pc-linux-gnu64

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are free to redistribute it under certain conditions.
Type 'licence()' for distribution details.

Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

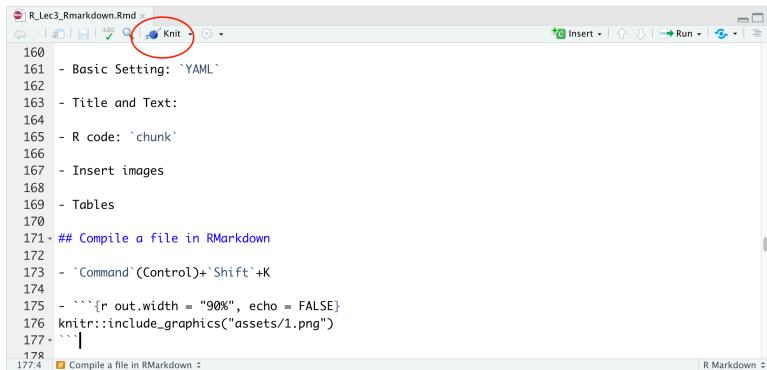
>
  
```

The Environment pane shows 'Global Environment' and 'Environment is empty'. The Packages pane shows a list of installed packages:

Name	Description	Version
System Library		
<input type="checkbox"/> abind	Combine Multidimensional Arrays	1.4-5
<input type="checkbox"/> aepack	ACE and AVAS for Selecting Multiple Regression Transformations	1.4.1
<input type="checkbox"/> AER	Applied Econometrics with R	1.2-5
<input type="checkbox"/> assertthat	Easy Pre and Post Assertions	0.2.0
<input type="checkbox"/> backports	Reimplementations of Functions Introduced Since R-3.0.0	1.1.2
<input type="checkbox"/> base64enc	Tools for base64 encoding	0.1-3
<input type="checkbox"/> benchr	High Precise Measurement of R Expressions Execution Time	0.2.2
<input type="checkbox"/> BH	Boost C++ Header Files	1.66.0-1
<input type="checkbox"/> bibtex	Bibtex Parser	0.4.2
<input type="checkbox"/> bindr	Parameterized Active Bindings	0.1.1
<input type="checkbox"/> bindrcpp	An 'Rcpp' Interface to Active Bindings	0.2.2
<input type="checkbox"/> bit	A Class for Vectors of 1-Bit Booleans	1.1-14
<input type="checkbox"/> bit64	A S3 Class for Vectors of 64bit Integers	0.9-7
<input type="checkbox"/> bitops	Bitwise Operations	1.0-6
<input type="checkbox"/> boot	Bootstrap Functions (Originally by Angelo Canty for S)	1.3-20
<input type="checkbox"/> brew	Templating Framework for Report Generation	1.0-6

Compile a file in RMarkdown

- Command(Control)+Shift+K
- Or knit



```
R_Lec3_Rmarkdown.Rmd
160
161 - Basic Setting: `YAML`
162
163 - Title and Text:
164
165 - R code: `chunk`
166
167 - Insert images
168
169 - Tables
170
171 - ## Compile a file in RMarkdown
172
173 - `Command` (Control)+`Shift`+K
174
175 - ```{r out.width = "90%", echo = FALSE}
176 knitr::include_graphics("assets/1.png")
177 - ```
178
177.4 [Compile a file in RMarkdown]
```

The Structure of a rmarkdown template

- Basic Settings: `YAML`
- Titles and Texts:
- R codes: `chunk`
- Insert images
- Tables
- Math expressions
- For a quick review, please refer to
 - [RMarkodwn Reference Guide](<https://www.rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>)
 - [RMarkodwn Cheat Sheet](<https://www.rstudio.com/wp-content/uploads/2016/03/rmarkdown-cheatsheet-2.0.pdf>)

Other formats: for document and presentation

- Document:
 - Html
 - Word (requires you install word)
 - PDF (requires you install LaTeX system)

Generate a .docx file with Word

The screenshot displays the RStudio interface with the 'New R Markdown' dialog box open. The 'Word' option is selected under 'Default Output Format', which is circled in red. The dialog also shows the author's name as 'Frank Qu' and the title as 'Untitled'. Below the dialog, the console window shows the following output:

```
Output created: Rmarkdown_introduction.pdf
Warning message:
Package microtype Warning: One or more slots in the configuration
are unknown.
(microtype)                Make sure that no text commands are use
d.
(microtype)                See the documentation for details (the
note
(microtype)                on `xeCJK' in section 9: `Hints and cav
eats').
```

The right-hand side of the RStudio window shows the 'Environment' pane, which is currently empty, and the 'Files' pane, which shows the project structure.

Generate a .docx file with Word

```
1 ---
2 title: "Test"
3 author: "Frank Qu"
4 date: "4/8/2019"
5 output: word_document
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 ```
11
12 ## R Markdown
13
```

2:1 # Test ↕

R Markdown ↕

Generate a PDF report with LaTeX

New R Markdown

- Document
- Presentation
- Shiny
- From Template

Title: Test Report

Author: Zhaopeng QU

Default Output Format:

HTML

Recommended format for authoring (you can switch to PDF or Word output anytime).


PDF

PDF output requires TeX (MiKTeX on Windows, MacTeX 2013+ on OS X, TeX Live 2013+ on Linux).

Word

Previewing Word documents requires an installation of MS Word (or Libre/Open Office on Linux).

Generate a PDF report with LaTeX



```
1 ---
2 title: "Homework 1"
3 author: "Zhaopeng QU"
4 date: "9/23/2019"
5 output: pdf_document
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 ```
11
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word
15 documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.
16
17 When you click the Knit button a document will be generated that includes both content as well as the
18 output of any embedded R code chunks within the document. You can embed an R code chunk like this:
19
20 ```{r cars}
21 summary(cars)
22 ```
```

Generate a PDF report with LaTeX

Homework 1

Zhaopeng QU

9/23/2019

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

```
##      speed      dist
##  Min.   : 4.0    Min.    : 2.00
##  1st Qu.:12.0    1st Qu.: 26.00
##  Median :15.0    Median : 36.00
##  Mean   :15.4    Mean   : 42.98
##  3rd Qu.:19.0    3rd Qu.: 56.00
##  Max.   :25.0    Max.    :120.00
```

Section 5

LaTeX: for document and presentation in PDF format

Introduction to LaTeX

- LaTeX 是一种开源的文字编辑处理排版的软件，是科技写作的主要格式之一。
- 简单理解是相当于另一种 office 软件（集合了 Word 和 Powerpoint 的功能）。与 Word 的简单区别在于 LaTeX 不是“所见即所得”式的软件，即我们不能随意的在窗口里调整整个文档的格式，而是要通过各种函数、命令或者程序包的设定来确定文字版面的格式。
- LaTeX 的好处在于美观，这种美观性来自于格式的规范和准确。尤其是当在文中包含大量公式和图表等内容时，不会出现错位和乱码等问题。这方面使用过 Word 输入过公式和图表的同学都感受过“不能对齐”的痛苦。
- 想要使用 LaTeX 必须要学习：

LaTeX 语法，这其实是一整套的文字和排版编辑的语言，如果想要全部掌握，也没有那么容易。正如虽然几乎每天都使用 word，但 word 里的大部分功能我们都很少使用一样。学习 LaTeX 也可以先从最简单的方式开始，很多复杂的功能等到以后碰到问题需要时再学习应用。在本课程的内容中，大家只需要安装好即可。

Install LaTeX Packages or Full System

- Supported by LaTeX system you have to install it you have to install it at first.
 - install “tinytex” ” package within RStudio(recommended)
 - install full LaTeX system outside RStudio
 - Mac: MacTex
 - Win: MikeTex

```
system("pdflatex --version") # 检查一下版本
```

Install TinyTex

- TinyTex is a lightweight LaTeX distribution based on TeX Live.
- It is recommended to install TinyTex in RStudio.
- If you have already installed TeX Live, you can skip this step.

```
install.packages("tinytex")  
tinytex::install_tinytex()
```


Use Rmarkdown+LaTeX in RStudio

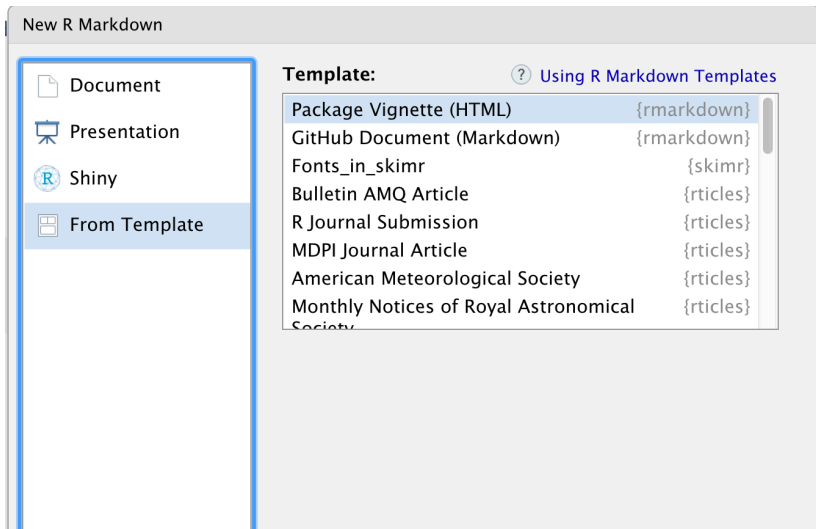
- You can use Rmarkdown+LaTeX in RStudio by clicking the Knit PDF button.
- You have to select the TeX engines in the YAML header or when knitting.
 - `pdflatex` is a common engine that works on both Windows and Mac, but has limited support for non-Latin characters.
 - `xelatex` is recommended for documents with non-Latin characters (like Chinese, Japanese, Korean, etc.) on both Windows and Mac, as it has better Unicode and font support.

Generate a PDF report with LaTeX: 中文支持

- LaTeX 的中文支持需要加载特殊的字体包才能使用。
 - 使用谢益辉开发的 `rticles packages` 的模版
 - 直接在 `YAML` 里添加 LaTeX 中文包





Generate a PDF report with LaTeX: 中文支持

```
#installed.packages("rticles")
```



Generate a PDF report with LaTeX: 中文支持

New R Markdown

-  Document
-  Presentation
-  Shiny
-  From Template

Template:

 [Using R Markdown Templates](#)

PLOS Journal Article	{rticles}
Sage Journals Article Template	{rticles}
Taylor & Francis Journal Article	{rticles}
CTeX Documents	{rticles}
ASA Journal Article	{rticles}
Royal Society Open Science Journal Article	{rticles}
American Geophysical Union (AGU) Article Template	{rticles}
Association for Computing Machinery	{rticles}

Generate a PDF report with LaTeX: 中文支持

```

1 | ---
2 | title: "在R Markdown文档中使用中文"
3 | author:
4 |   - 谢益辉
5 |   - 邱怡轩
6 |   - 于淼
7 | documentclass: ctexart
8 | output:
9 |   rarticles::ctex:
10 |     fig_caption: yes
11 |     number_sections: yes
12 |     toc: yes
13 | classoption: "hyperref,"
14 | ---
15 |
16 | # 引言
17 |
18 | 中文LaTeX文档并非难题。当然这句话得站在巨人 [CTeX](http://ctex.org) 的肩膀上才能说，它让我们只需要一句
19 |
20 | ```latex
21 | \documentclass{ctexart} % 或者ctexrep/ctexbook
22 | ```
23 |
24 | 1:1 在R Markdown文档中使用中文
  
```

Generate a PDF report with LaTeX: 中文支持

- 在 YAML 里添加 LaTeX 中文包

```

1- ---
2- title: "作业1"
3- author: "曲兆鹏"
4- date: "9/23/2019"
5- output:
6-   pdf_document:
7-     latex_engine: xelatex
8- header-includes:
9-   \usepackage{xeCJK}
10- ---
11-
12- ```{r setup, include=FALSE}
13- knitr::opts_chunk$set(echo = TRUE)
14- ```
15-
16- ## R Markdown
17-
18- This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and
19- MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>

```

Generate a PDF report with LaTeX: 中文支持

- 在 YAML 里添加 LaTeX 中文包

作业 1

曲光鹏

9/23/2019

R Markdown

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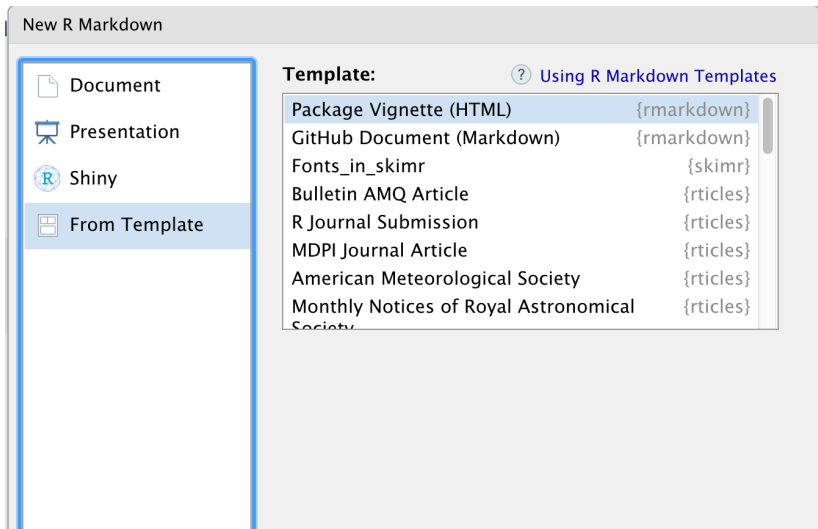
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

```
##           speed           dist
## Min.   : 4.0   Min.   : 2.00
## 1st Qu.:12.0   1st Qu.: 26.00
## Median :15.0   Median : 36.00
## Mean   :15.4   Mean   : 42.98
## 3rd Qu.:19.0   3rd Qu.: 56.00
## Max.   :25.0   Max.   :120.00
```





Generate a PDF report with LaTeX: 中文支持

```
#installed.packages("rticles")
```



Generate a PDF report with LaTeX: 中文支持

New R Markdown

-  Document
-  Presentation
-  Shiny
-  From Template

Template:

 [Using R Markdown Templates](#)

PLOS Journal Article	{rticles}
Sage Journals Article Template	{rticles}
Taylor & Francis Journal Article	{rticles}
CTeX Documents	{rticles}
ASA Journal Article	{rticles}
Royal Society Open Science Journal Article	{rticles}
American Geophysical Union (AGU) Article Template	{rticles}
Association for Computing Machinery	{rticles}

Generate a PDF report with LaTeX: 中文支持

```

1 | ---
2 | title: "在R Markdown文档中使用中文"
3 | author:
4 |   - 谢益辉
5 |   - 邱怡轩
6 |   - 于淼
7 | documentclass: ctexart
8 | output:
9 |   rarticles::ctex:
10 |     fig_caption: yes
11 |     number_sections: yes
12 |     toc: yes
13 | classoption: "hyperref,"
14 | ---
15 |
16 | # 引言
17 |
18 | 中文LaTeX文档并非难题。当然这句话得站在巨人 [CTeX](http://ctex.org) 的肩膀上才能说，它让我们只需要一句
19 |
20 | ```latex
21 | \documentclass{ctexart} % 或者ctexrep/ctexbook
22 | ```
23 |
24 | 1:1 在R Markdown文档中使用中文
  
```

Generate a PDF report with LaTeX: 中文支持

- 在 YAML 里添加 LaTeX 中文包

```

1- ---
2- title: "作业1"
3- author: "曲兆鹏"
4- date: "9/23/2019"
5- output:
6-   pdf_document:
7-     latex_engine: xelatex
8- header-includes:
9-   \usepackage{xeCJK}
10- ---
11-
12- ```{r setup, include=FALSE}
13- knitr::opts_chunk$set(echo = TRUE)
14- ```
15-
16- ## R Markdown
17-
18- This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and
19- MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>
20-
21- 8:1 作业1
  
```

Generate a PDF report with LaTeX: 中文支持

- 在 YAML 里添加 LaTeX 中文包

作业 1

曲光鹏

9/23/2019

R Markdown

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## Mean   :15.4   Mean   : 42.98
## 3rd Qu.:19.0   3rd Qu.: 56.00
## Max.   :25.0   Max.   :120.00
```

Section 6

RMarkdown for Presentations

Presentation forms

- Html: ioslides & Slidify
- PDF: beamer of LaTeX system (requires you install LaTeX system)
- Powerpoint: (requires you install Powerpoint)

Basic Forms

- very similar to documents
- try it by yourself

Introduction to Quarto

- Quarto is a modern publishing system that combines the best features of **R Markdown** and **Jupyter Notebooks**.
- It is a **new generation of R Markdown**, which is more powerful and flexible.
 - It can be use for R, Python, Julia, etc.
- The information of Quarto is available at [\[here\]\(https://quarto.org/\)](https://quarto.org/)
- The syntax of Quarto is **similar to that of R Markdown**.
- You can also try using **Quarto** to write your report and presentation.

Section 7

Resources and References

Some useful online resources

- RStudio, R Markdown from RStudio
- Cosma Shalizi, (2016), Using R Markdown for Class Reports
- Quarto, Quarto