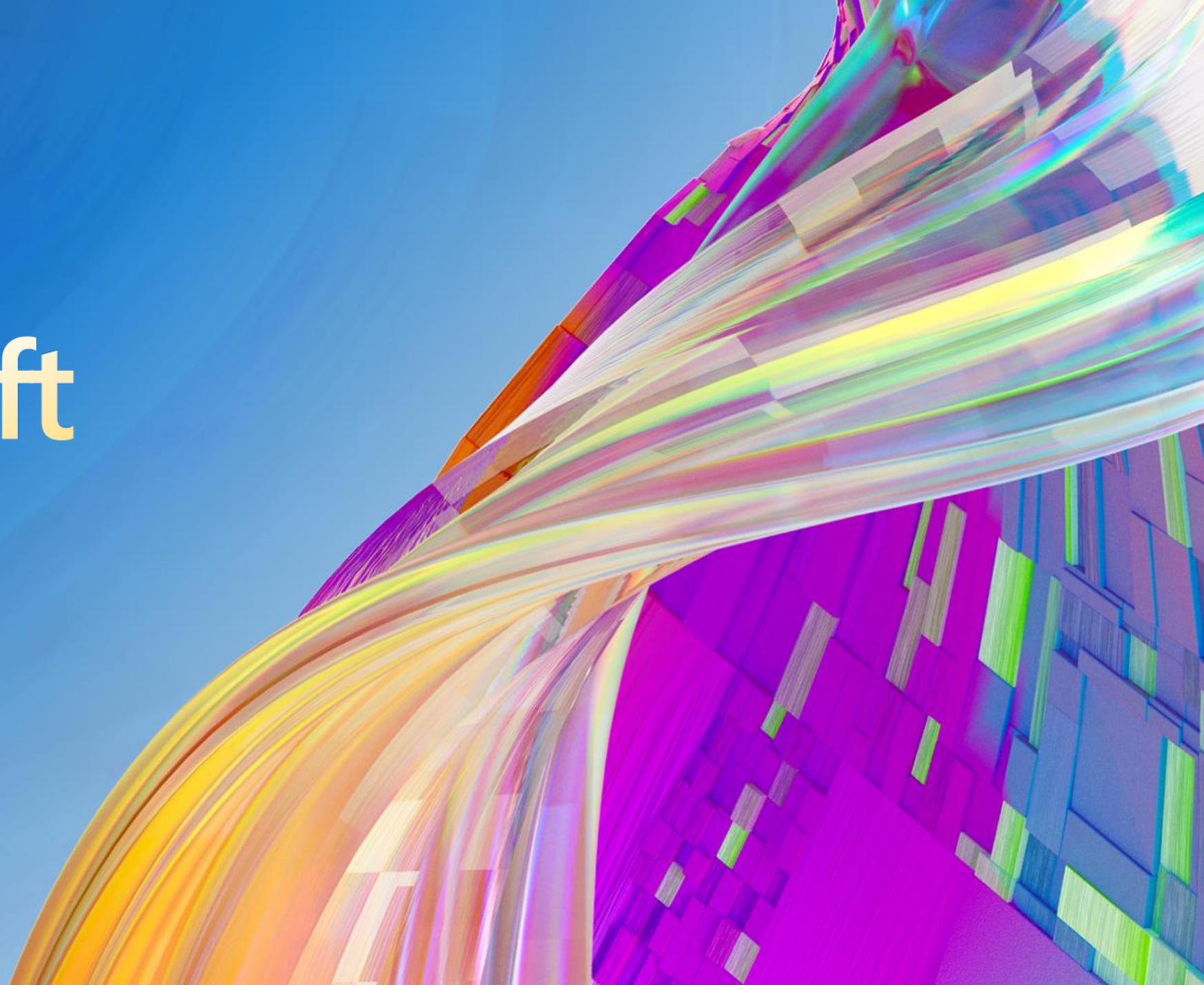




Microsoft Ignite



文档革命： 用R语言进行可重复性文档编写

张丹

微软MVP，北京青萌数海科技有限公司CTO

2022.11.12

博客：<http://fens.me>



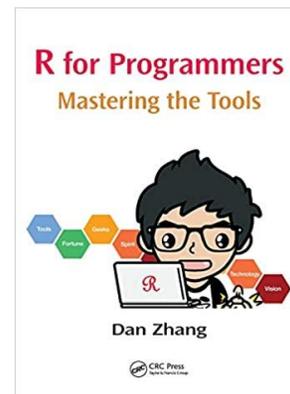
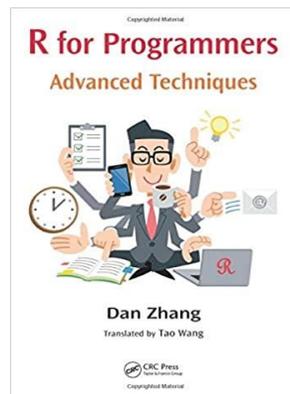
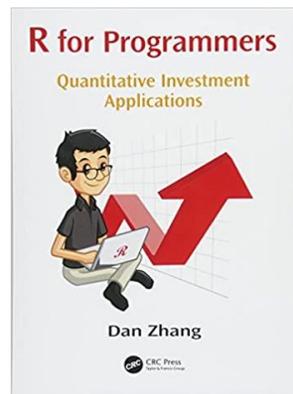
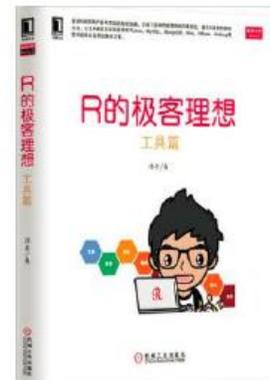
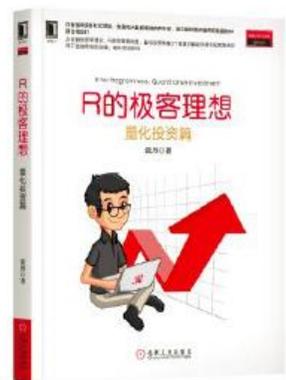
个人介绍

张丹， R语言实践者，北京青萌数海科技有限公司CTO，微软MVP。

10年以上互联网应用架构经验，在R、Java、NodeJS、大数据、数据挖掘等方面有深厚的积累。

精通量化投资交易策略，熟悉中国金融二级市场、交易规则和投研体系。熟悉数据学科方法论，在外汇、海关、区块链等领域均有落地的应用。

著有《R的极客理想：量化投资篇》、《R的极客理想：工具篇》、《R的极客理想：高级开发篇》，英文版图书被CRC出版集团引进，在美国发行。个人博客：<http://fens.me>。



前言

Markdown格式文档编写，已经从小众成为了一种主流的文档编写方式。R语言在可重复性文档编写领域中，有着重要的贡献，knitr和rmarkdown等包的支持，让文档编写有了非常舒服的使用体验。

基于rmarkdown的解决方案，不仅可以方便地实现Markdown所有功能，还支持嵌入R代码调用R语言本身计算功能，可嵌入动态表格，echarts图型，LaTeX数据公式，输出为HTML, WORD, PDF等多种格式。

几十行代码，就能方便地实现自动化文档系统。

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1. R语言可重复性文档解决方案
 2. 用R语言编写Markdown文档
 3. 嵌入R代码做模型计算和可视化
 4. 复杂数学公式LaTeX
 5. 动态表格flextable
 6. 动态图echarts4r
 7. 用pandoc输出Word, PDF, HTML
 8. 输出复杂的Word

可重复性研究

地质学家约翰·克拉伯特 (John Claerbout) 将「可重复研究」定义为“其他科学家复制 (论文) ”的可能性。

- 「纯复制」是指几乎完全复制手头研究的能力，主要用于验证。
- 「科学复制」是指在其他数据库上重复使用现有的研究材料，并将其视为稳健性测试或拓展原始研究工作。

对于许多研究项目来说，如果该项目的作者为所有其他研究人员提供了用以完全重现论文结果的所有资料 (数据和程序)，则该项目被认为是可重复的。

良好的写代码习惯： 自动化输出



可读性

易读性

可协作完善



计量软件到文字排版软件之间的无缝连接

节省了体力

减少编排导致的错误

R语言可重复性文档解决方案

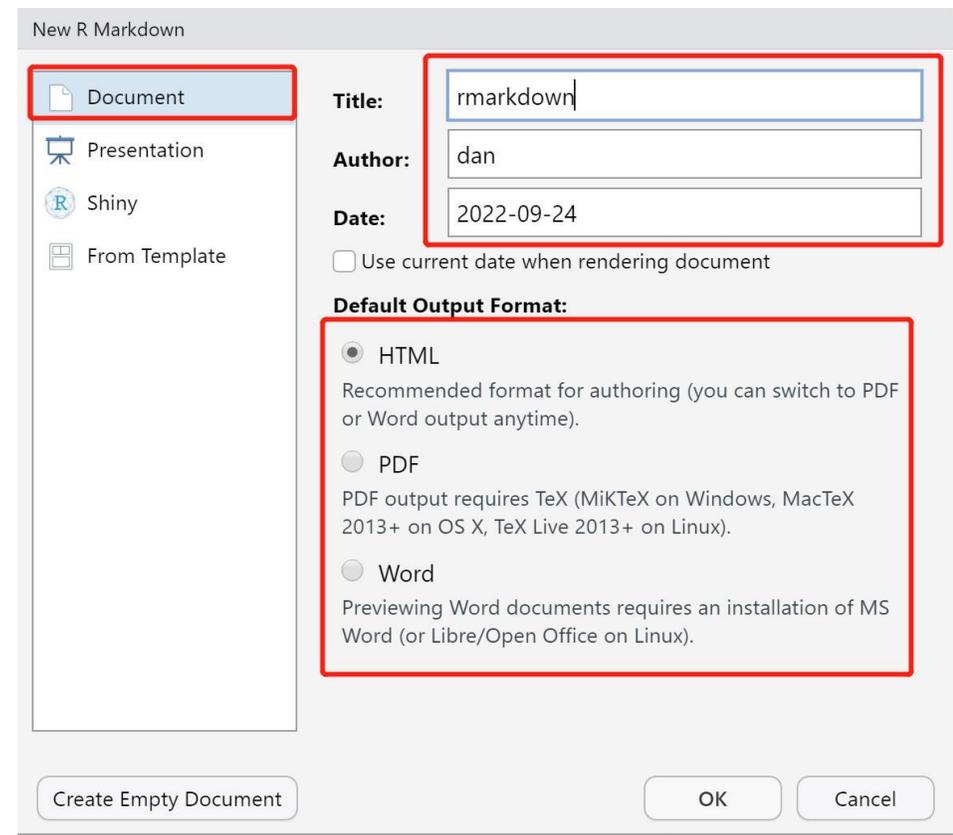
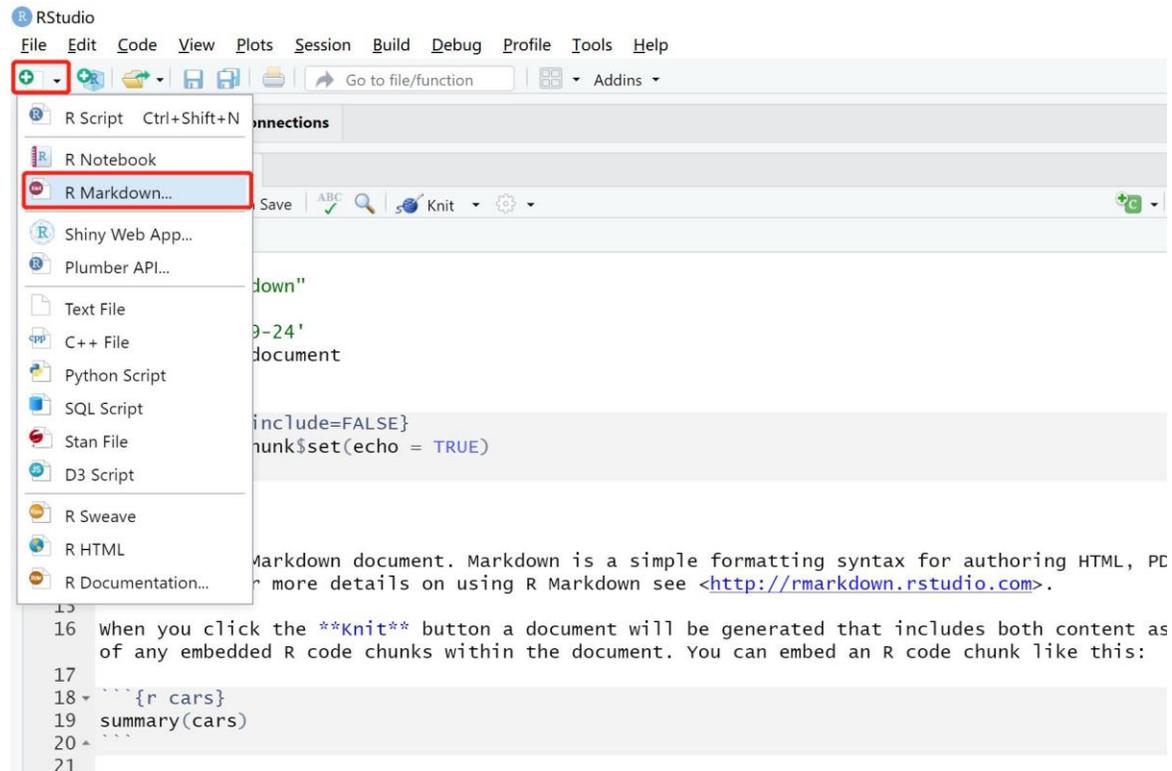


Pandoc



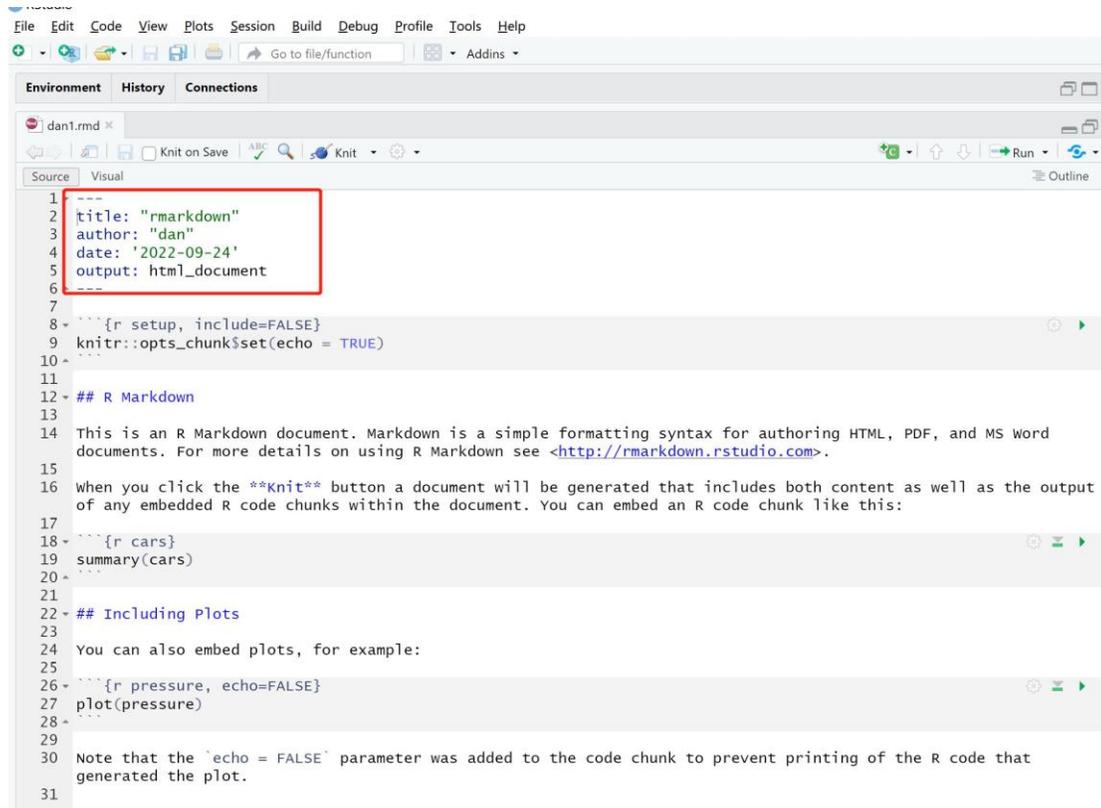
在RStudio中创建Markdown文档

在RStudio中，创建一个rmarkdown文档。



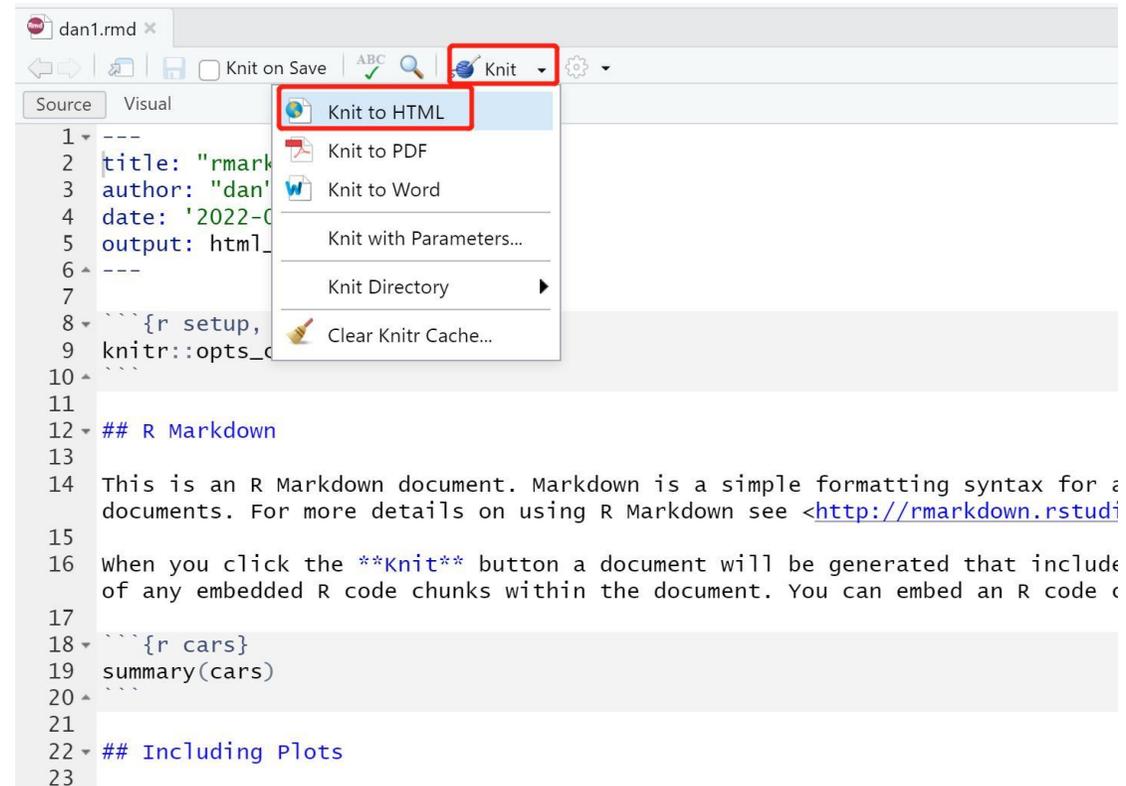
在RStudio中创建Markdown文档

打开新创建的文档，默认会是一个模板，以rmarkdown的格式进行展示，上面所输入的参数，在文档都的开头部分都有展示。然后保存一下文件。



The screenshot shows the RStudio interface with a new R Markdown document open. The top toolbar includes a 'Knit' button, which is highlighted with a red box. The source editor shows the following content:

```
1 ---
2 title: "rmarkdown"
3 author: "dan"
4 date: '2022-09-24'
5 output: html_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 output
18 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
23 ## Including Plots
24
25 You can also embed plots, for example:
26
27 {r pressure, echo=FALSE}
28 plot(pressure)
29
30 Note that the 'echo = FALSE' parameter was added to the code chunk to prevent printing of the R code that
31 generated the plot.
```



The screenshot shows the RStudio interface with the 'Knit' button highlighted by a red box. A dropdown menu is open, showing the following options:

- Knit to HTML
- Knit to PDF
- Knit to Word
- Knit with Parameters...
- Knit Directory
- Clear Knitr Cache...

The source editor shows the following content:

```
1 ---
2 title: "rmarkdown"
3 author: "dan"
4 date: '2022-09-24'
5 output: html_document
6 ---
7
8 {r setup,
9 knitr::opts_c
10
11
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple formatting syntax for a
15 documents. For more details on using R Markdown see <http://rmarkdown.rstudi
16
17 When you click the Knit button a document will be generated that include
18 of any embedded R code chunks within the document. You can embed an R code c
19
20 {r cars}
21 summary(cars)
22
23 ## Including Plots
```

Knit 输出Html和Word

运行Knit就会新打开一个窗口，看到HTML的网页输出，输出WORD。



rmarkdown

dan
2022-09-24

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>.

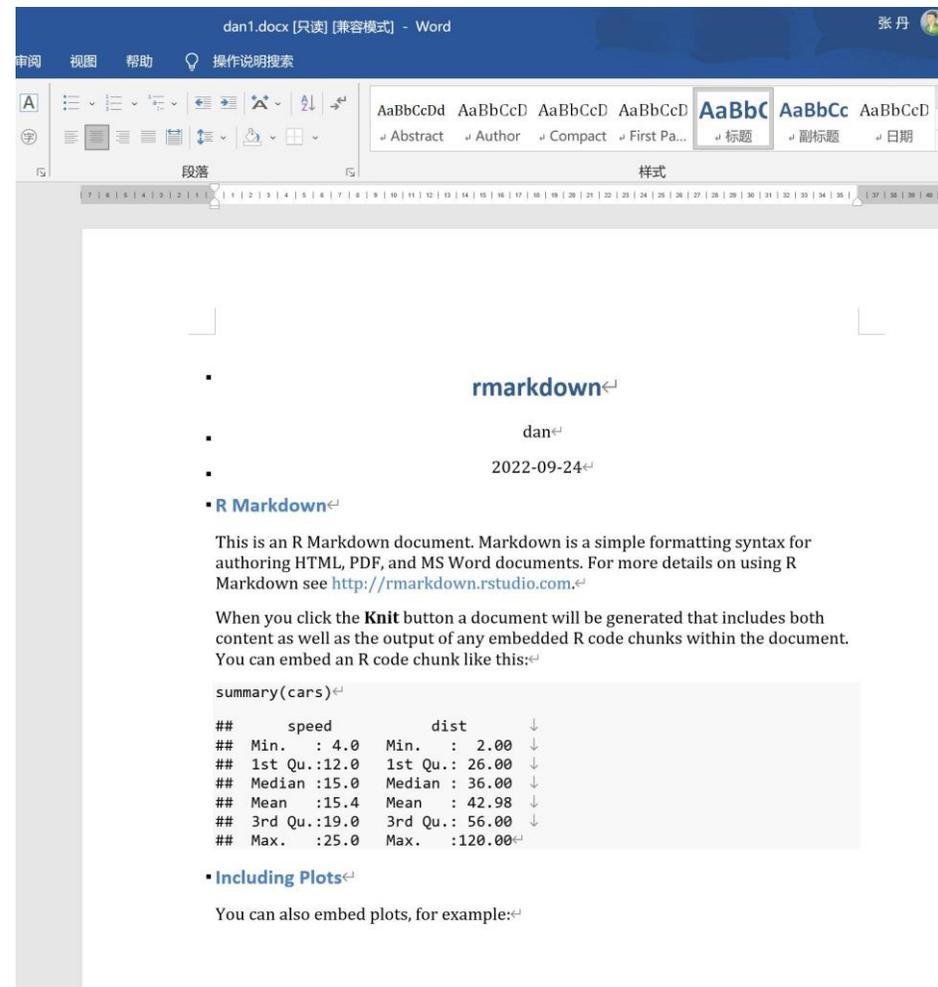
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
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
```

Including Plots

You can also embed plots, for example:



rmarkdown

dan
2022-09-24

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
```

Including Plots

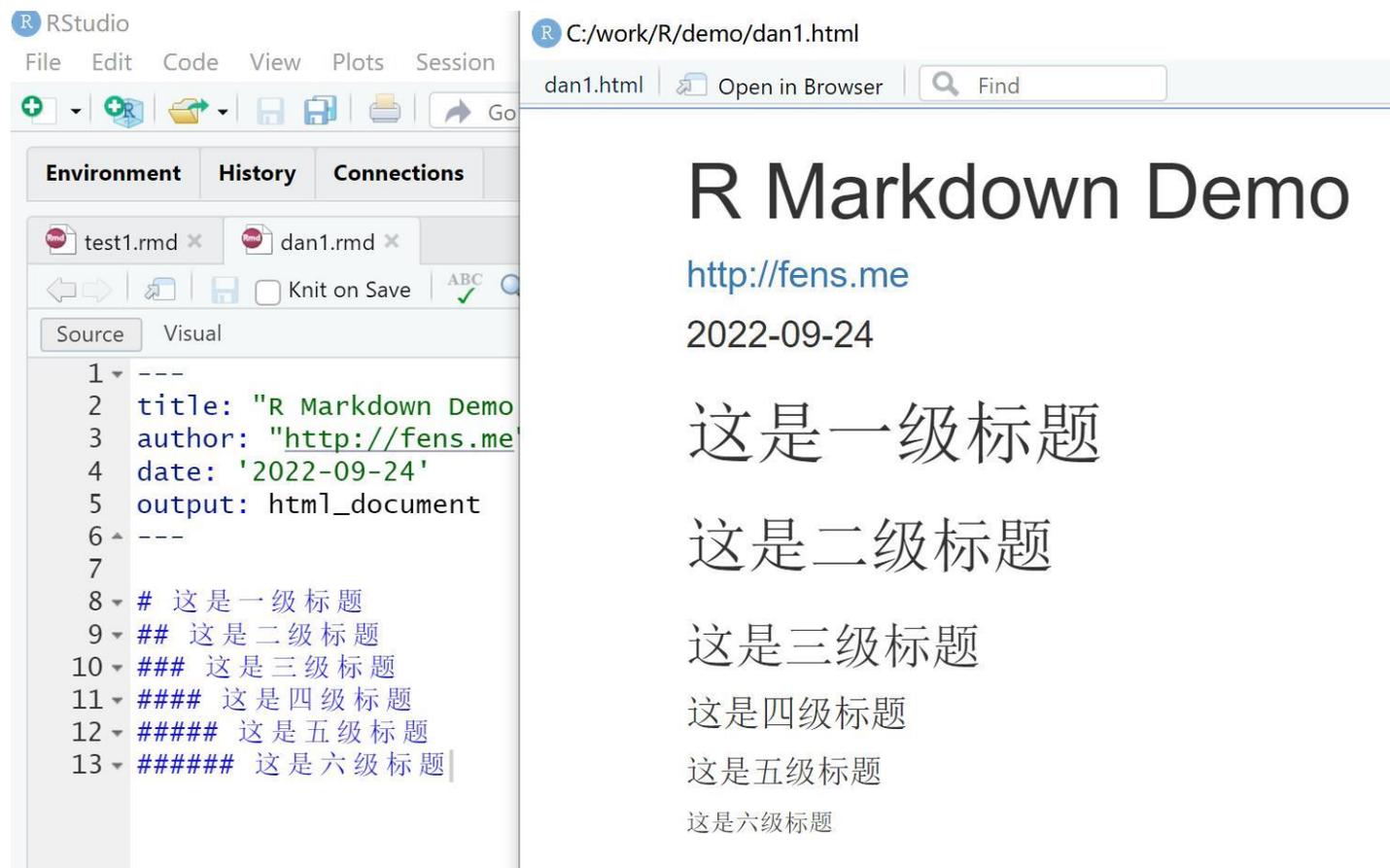
You can also embed plots, for example:

2. 用R语言编写Markdown文档

标题

在rmarkdown中嵌入markdown文本，是最基本的操作，在默认生成的文档中，就是一个带有markdown格式的文本。markdown格式的文本，包括10种主要的格式，分别是标题，字体，引用，分隔，图片，链接，列表，表格，代码。

标题：标题支持六级标题，用#做为开头，#的数量表示是几级标题。



The image shows a side-by-side comparison of R Markdown source code and its rendered HTML output. On the left, the RStudio source editor shows the following code:

```
1 ---
2 title: "R Markdown Demo"
3 author: "http://fens.me"
4 date: '2022-09-24'
5 output: html_document
6 ---
7
8 # 这是一级标题
9 ## 这是二级标题
10 ### 这是三级标题
11 #### 这是四级标题
12 ##### 这是五级标题
13 ##### 这是六级标题
```

On the right, the rendered HTML output is shown in a browser window. It displays the following content:

R Markdown Demo

<http://fens.me>

2022-09-24

这是一级标题

这是二级标题

这是三级标题

这是四级标题

这是五级标题

这是六级标题

字体

字体：字体格式设置有2种方法：

- 方法1：markdown默认支持的4种格式，加粗，斜体，斜体加粗，删除线。
- 方法2：使用html的标签来进行设置。

```
14
15
16 **这是加粗的文字**
17
18 *这是倾斜的文字*
19
20 ***这是斜体加粗的文字***
21
22 ~~这是加删除线的文字~~
23
24 <font face="宋体">宋体</font>
25
26 <font face="宋体" color=red>红色宋体</font>
27
28 <font face="宋体" color=red size=5>5号红色宋体</font>
29
30
31
```

这是加粗的文字
这是倾斜的文字
这是斜体加粗的文字
这是加删除线的文字
宋体
红色宋体
5号红色宋体

引用、分隔

引用：使用>用于表示引用外部的一段话，在引用中可以用\来进行换行。

```
29  
30  
31 > 我要引用一段文字\  
32 \  
33 R语言作为统计学一门语言，一直在小众领域闪耀着光芒。直到  
34 数据分析的利器。随着越来越多的工程背景的人的加入，R语言  
35 领域，教育，银行，电商，互联网...都在使用R语言。
```

我要引用一段文字

R语言作为统计学一门语言，一直在小众领域闪耀着光芒。直到大数据的爆发，数据分析的利器。随着越来越多的工程背景的人的加入，R语言的社区在迅速扩大领域，教育，银行，电商，互联网....都在使用R语言。

分隔：在markdown中，可以通过3个连续的-或*，来设置分隔符。

```
34  
35 -- 开始  
36  
37 -----  
38  
39 **开始|  
40  
41 *****  
42  
43 结束  
44
```

-开始

**开始

结束

图片、链接

图片：插入图片时，需要使用!`[文本说明]`(`链接`)语法。

```
45  
46 ![R的极客理想](http://fens.me/images/slider/img4.png)
```



链接：设置超级链接，有2种写法，一种就是`[显示文字]`(`链接`)，另一种是`<链接>`。

```
47  
48 [粉丝日志博客](fens.me)  
49  
50 <http://www.fens.me>
```

粉丝日志博客

<http://www.fens.me>

a

列表

列表：支持3种语法：

•**无序列表**，用 - + * 任何一种都可以，跟内容之间都要有一个空格。

•**有序列表**，用数字加点，跟内容之间都要有一个空格。

•**嵌套列表**，上一级和下一级之间有三个空格，跟内容之间都要有一个空格。

```
51  
52 无序列表  
53  
54 + 列表内容  
55 + 列表内容  
56 + 列表内容  
57  
58  
59 有序列表  
60  
61 1. 列表内容  
62 2. 列表内容  
63 3. 列表内容  
64  
65 无序列表嵌套  
66  
67 + 1 列表内容  
68   + 1.1 列表内容  
69   + 1.2 列表内容  
70 + 2 列表内容  
71 + 3 列表内容  
72  
73
```

```
无序列表  
  
• 列表内容  
• 列表内容  
• 列表内容  
  
有序列表  
  
1. 列表内容  
2. 列表内容  
3. 列表内容  
  
无序列表嵌套  
  
• 1 列表内容  
  ◦ 1.1 列表内容  
  ◦ 1.2 列表内容  
• 2 列表内容  
• 3 列表内容
```

表格

表格：

在嵌入表格时，需求包括表头行，分隔符行，表体行。表头行用|分隔，表体行也用|分隔，分隔符行需要用-|组合进行分隔。
当希望单元格整列对齐时，可以分隔符行加:来控制对齐，文字默认居左，两边加表示文字居中，右边加:表示文字居右。

74
75
76
77
78
79
80
81
82
83
84
85
86
87

```
表头|表头|表头  
---|:--:|---:  
内容|内容|内容  
内容|内容|内容  
  
表头|表头|表头  
--|--|--  
内容|内容|内容  
内容|内容|内容
```

表头	表头	表头
内容	内容	内容
内容	内容	内容
表头	表头	表头
内容	内容	内容
内容	内容	内容

代码

代码：代码的嵌入可以分为行内代码嵌入代码和代码块。

- **行内代码：**需要使用`”`包住代码，代码不可换行。
- **代码块：**需要用`“`“`”`来包住代码，代码可换行。

```
86  
87  
88 文字中内嵌了 `a="abc"` 代码|  
89  
90  
91 ```  
92 a="abc"  
93 a1=2  
94 a2=3  
95 a3=a1+a2  
96 ```  
97  
98  
99
```

文字中内嵌了 `a="abc"` 代码

```
a="abc"  
a1=2  
a2=3  
a3=a1+a2
```

3. 嵌入R代码做模型计算和可视化

嵌入R代码做模型计算和可视化

在插入R语言代码时，有2种语法，用`r`和``{r}``的。

•**行内代码段**：将公式插入到本行内，符号：`r 代码`，如：`r sum(1:10)`。

•**多行代码块**：将公式插入到新的一行内，并且居中，符号：``{r} 代码``。

```
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25
```

```
sum(1:10)=`r sum(1:10)`
```

```
``{r cars}  
summary(cars)  
```
```

```
sum(1:10)=55
```

```
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
```

# 嵌入R代码做模型计算和可视化

上面我们演示了在markdown中嵌入代码，那么对于R语言来说，如果我们希望嵌入R代码，需要代码块针对R代码做一些支持的时候，要怎么写呢。

```
100
101
102 {r}
103 a<-Sys.Date()
104 a
105
106 head(iris)
107 plot(iris)
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
```

```
a3=a1+a2

a<-Sys.Date()
a

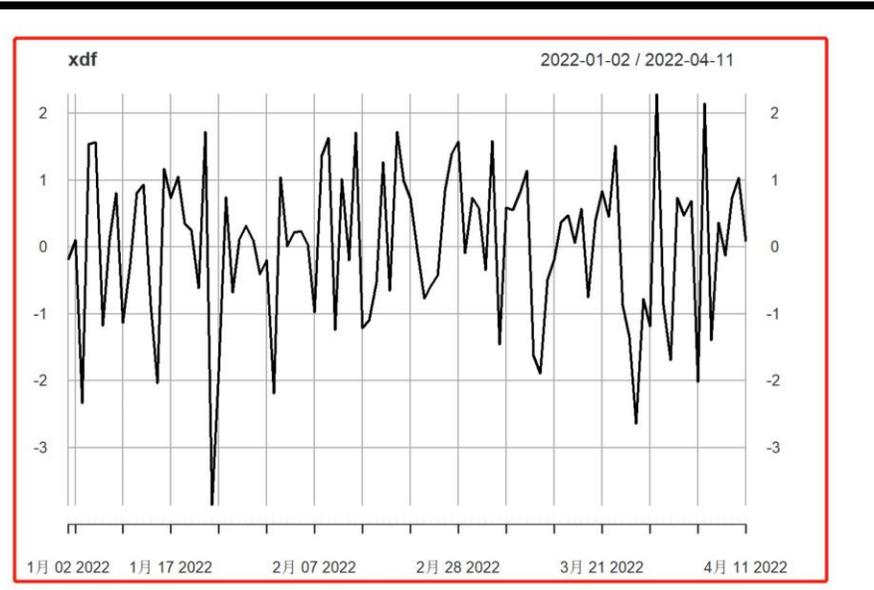
[1] "2022-09-24"

head(iris)

Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1 5.1 3.5 1.4 0.2 setosa
2 4.9 3.0 1.4 0.2 setosa
3 4.7 3.2 1.3 0.2 setosa
4 4.6 3.1 1.5 0.2 versicol
5 5.0 3.6 1.4 0.2 versicol
6 5.4 3.9 1.7 0.4 setosa

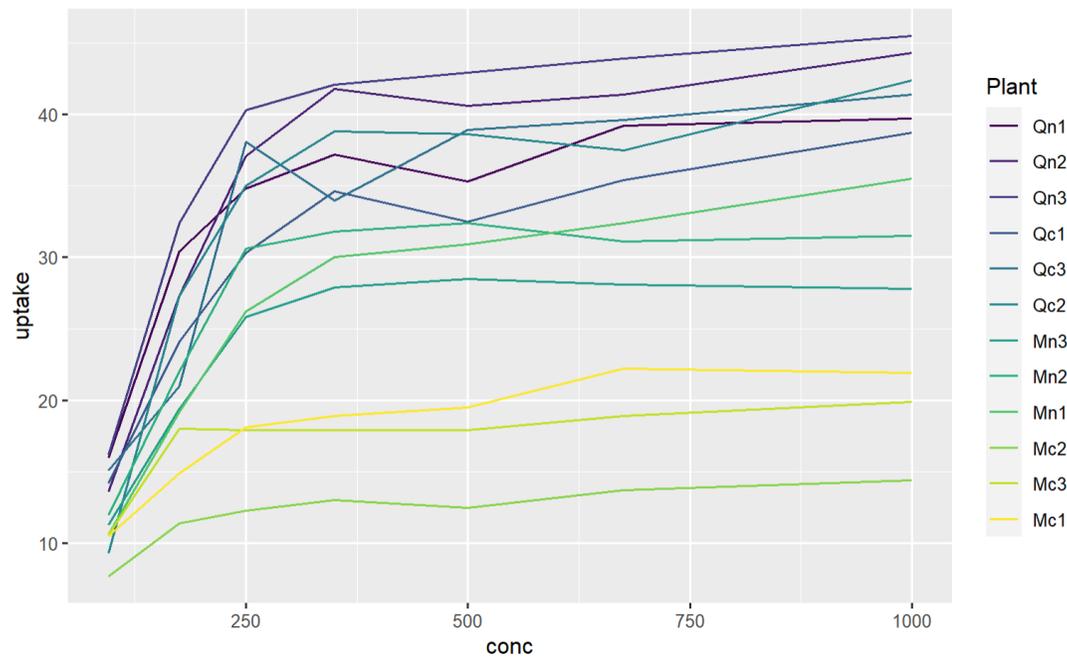
plot(iris)
```

```
117
118
119 {r echo=FALSE}
120 library(xts)
121 xdf<-xts(rnorm(100),order.by = as.Date('2022-01-01')+1:100)
122 plot(xdf)
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
```

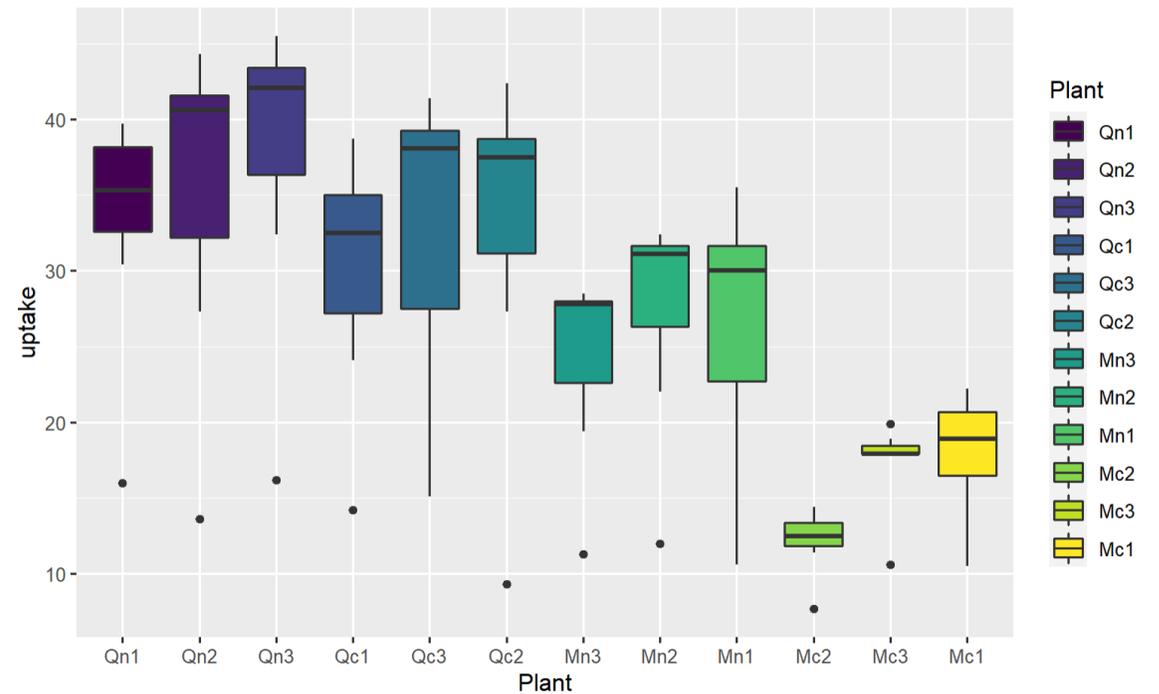


# 嵌入ggplot2静态图

```
{r}
library(ggplot2)
g<-ggplot(data=C02, aes(conc, uptake, color=Plant))
g<-g+geom_line()
g
}
```



```
{r}
ggplot(C02, aes(x=Plant, uptake)) +
 geom_boxplot(aes(fill=Plant))
}
```



# 嵌入DT动态表格

## 嵌入DT动态表格

```
124 {r}
125 {r}
126 library(DT)
127 datatable(iris)
128 {r}
```

Show 10 entries

|    | Sepal.Length | Sepal.Width | Petal.Length |
|----|--------------|-------------|--------------|
| 1  | 5.1          | 3.5         |              |
| 2  | 4.9          | 3           |              |
| 3  | 4.7          | 3.2         |              |
| 4  | 4.6          | 3.1         |              |
| 5  | 5            | 3.6         |              |
| 6  | 5.4          | 3.9         |              |
| 7  | 4.6          | 3.4         |              |
| 8  | 5            | 3.4         |              |
| 9  | 4.4          | 2.9         |              |
| 10 | 4.9          | 3.1         |              |

```
library(DT)
datatable(iris)
```

Show 10 entries

Search:

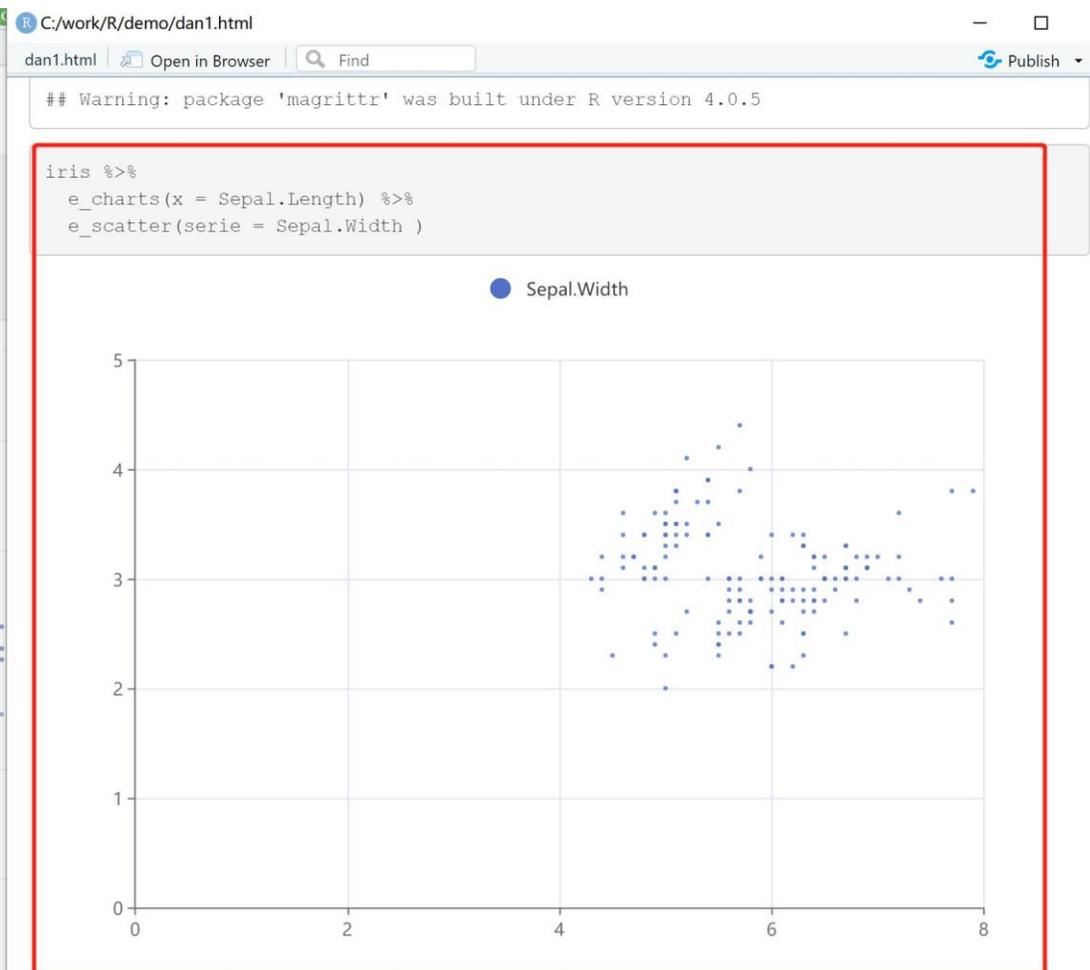
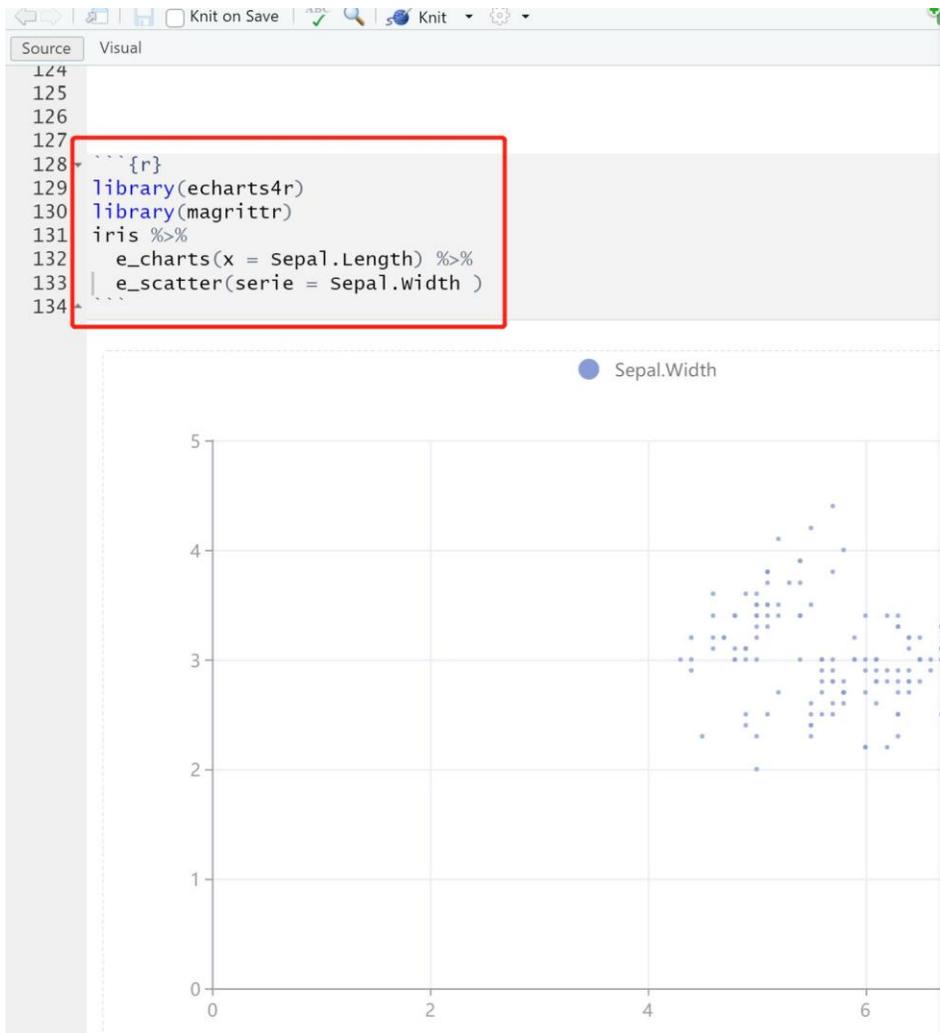
|    | Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|----|--------------|-------------|--------------|-------------|---------|
| 1  | 5.1          | 3.5         | 1.4          | 0.2         | setosa  |
| 2  | 4.9          | 3           | 1.4          | 0.2         | setosa  |
| 3  | 4.7          | 3.2         | 1.3          | 0.2         | setosa  |
| 4  | 4.6          | 3.1         | 1.5          | 0.2         | setosa  |
| 5  | 5            | 3.6         | 1.4          | 0.2         | setosa  |
| 6  | 5.4          | 3.9         | 1.7          | 0.4         | setosa  |
| 7  | 4.6          | 3.4         | 1.4          | 0.3         | setosa  |
| 8  | 5            | 3.4         | 1.5          | 0.2         | setosa  |
| 9  | 4.4          | 2.9         | 1.4          | 0.2         | setosa  |
| 10 | 4.9          | 3.1         | 1.5          | 0.1         | setosa  |

Showing 1 to 10 of 150 entries

Previous 1 2 3 4 5 ... 15 Next

# 嵌入echarts动态图

## 嵌入echarts动态图



# 数学公式

## 嵌入数学公式

```
L41
L42
L43 $$
L44 \hat{\beta}_1=\frac{\sum\left(X_i-\overline{X}\right)Y_i}{\sum\left(X_i-\overline{X}\right)^2}
=\frac{\sum X_iY_i-\overline{X}\sum Y_i}{\sum X_i^2+\sum \overline{X}^2-2\overline{X}\sum X_i}
L45 =\frac{\sum X_iY_i-\overline{X}*N\overline{Y}}{\sum X_i^2+N\overline{X}^2-2\overline{X}*N\overline{X}}
L46 =\frac{\sum_{i=1}^N X_iY_i-N\overline{X}\overline{Y}}{\sum_{i=1}^N X_i^2-N\overline{X}^2}
L47 $$
```

$$\begin{aligned}\hat{\beta}_1 &= \frac{\sum (X_i - \bar{X}) Y_i}{\sum (X_i - \bar{X})^2} = \frac{\sum X_i Y_i - \bar{X} \sum Y_i}{\sum X_i^2 + \sum \bar{X}^2 - 2\bar{X} \sum X_i} \\ &= \frac{\sum X_i Y_i - \bar{X} * N\bar{Y}}{\sum X_i^2 + N\bar{X}^2 - 2\bar{X} * N\bar{X}} = \frac{\sum_{i=1}^N X_i Y_i - N\bar{X}\bar{Y}}{\sum_{i=1}^N X_i^2 - N\bar{X}^2}\end{aligned}$$

$$\begin{aligned}\hat{\beta}_1 &= \frac{\sum (X_i - \bar{X}) Y_i}{\sum (X_i - \bar{X})^2} = \frac{\sum X_i Y_i - \bar{X} \sum Y_i}{\sum X_i^2 + \sum \bar{X}^2 - 2\bar{X} \sum X_i} \\ &= \frac{\sum X_i Y_i - \bar{X} * N\bar{Y}}{\sum X_i^2 + N\bar{X}^2 - 2\bar{X} * N\bar{X}} = \frac{\sum_{i=1}^N X_i Y_i - N\bar{X}\bar{Y}}{\sum_{i=1}^N X_i^2 - N\bar{X}^2}\end{aligned}$$

## 4. 复杂数学公式LaTeX

---

# 嵌入复杂数学公式LaTeX

在插入数学公式时，有2种语法，用\$和\$\$的。

- 行内公式**：将公式插入到本行内，符号：\$公式内容\$，如：\$xyz\$，
- 多行公式**：将公式插入到新的一行内，并且居中，符号：\$\$公式内容\$\$。

内行插入一个公式  $5^2=3^2+4^2$

多行公式

```
$$
a^2=b^2+c^2 \\
a=5,b=4,c=3
$$
```

$$5^2 = 3^2 + 4^2$$

$$a^2 = b^2 + c^2$$
$$a = 5, b = 4, c = 3$$

# 希腊字母表

## 希腊字母表

| 名称      | 大写 | code    | 小写 | code     |
|---------|----|---------|----|----------|
| alpha   | A  | A       | α  | \alpha   |
| beta    | B  | B       | β  | \beta    |
| gamma   | Γ  | \Gamma  | γ  | \gamma   |
| delta   | Δ  | \Delta  | δ  | \delta   |
| epsilon | E  | E       | ε  | \epsilon |
| zeta    | Z  | Z       | ζ  | \zeta    |
| eta     | H  | H       | η  | \eta     |
| theta   | Θ  | \Theta  | θ  | \theta   |
| iota    | I  | I       | ι  | \iota    |
| kappa   | K  | K       | κ  | \kappa   |
| lambda  | Λ  | \Lambda | λ  | \lambda  |
| mu      | M  | M       | μ  | \mu      |
| nu      | N  | N       | ν  | \nu      |
| xi      | Ξ  | \Xi     | ξ  | \xi      |
| omicron | O  | O       | ο  | \omicron |
| pi      | Π  | \Pi     | π  | \pi      |
| rho     | P  | P       | ρ  | \rho     |
| sigma   | Σ  | \Sigma  | σ  | \sigma   |

```
22 $$
23 大写: A \ B \ \Gamma \ \Delta \ E \ Z \ \Theta \ I \ K \ \Lambda \ M \ N \ \Xi \ O \ \Pi \ P \ \Sigma
 \ T \ \Upsilon \ \Phi \ X \ \Psi \ \Omega
24 $$
 大写: Α Β Γ Δ Ε Ζ Θ Ι Κ Λ Μ Ν Ξ Ο Π Ρ Σ Τ Υ Φ Χ Ψ Ω
25
26 $$
27 小写: \alpha \ \beta \ \gamma \ \delta \ \epsilon \ \zeta \ \eta \ \theta \ \iota \ \kappa \ \lambda
 \ \mu \ \nu \ \xi \ \omicron \ \pi \ \rho \ \sigma \ \tau \ \upsilon \ \phi \ \chi \ \psi \ \omega
28 $$
 小写: α β γ δ ε ζ η θ ι κ λ μ ν ξ ο π ρ σ τ υ φ χ ψ ω
```

# 四则运算、括号、上下标

## 四则运算

```
基本运算: a+b,a-b,a*b,a \ast b, a/b\\
扩展基本运算: a\pm b, a \mp b, a \times b, a \cdot b,a \div b
```

基本运算:  $a + b, a - b, a * b, a \cdot b, a / b$   
扩展基本运算:  $a \pm b, a \mp b, a \times b, a \cdot b, a \div b$

## 上标、下标、顶部

```
x_i^2 \\
对比: 10^10 \ 和 10^{10} \\
对比: {x^5}^6 和 x^{5^6}
```

$x_i^2$   
对比:  $10^{10}$  和  $10^{10}$   
对比:  $x^{5^6}$  和  $x^{5^6}$

## 括号

```
小括号: (2+3) \\
方括号: [4+4] \\
大括号: \{a*b\} * \lbrace c+d \rbrace \\
尖括号: \langle x \rangle \\
上取整: \lceil x \rceil \\
下取整: \lfloor x \rfloor
```

小括号:  $(2 + 3)$   
方括号:  $[4 + 4]$   
大括号:  $\{a * b\} * \{c + d\}$   
尖括号:  $\langle x \rangle$   
上取整:  $\lceil x \rceil$   
下取整:  $\lfloor x \rfloor$

# 求和, 积分, 连乘, 分式, 根式

## 求和, 积分, 连乘, 交集并集, 最大最小, 自变量集

```
$$
求和: \sum_{i=1}^n {a+b} \\
积分: \int_{i=1}^{\infty} \\
多重积分: \iiint \ \iiint \ \iiiint \\
连乘: \prod_{i=1}^n {a+b} \\
交集和并集: \bigcup \ \bigcap \\
最大最小: \max_{x} \ \min_{x} \\
最大最小自变量集: \mathop {\operatorname{argmax}}_{c_k} \ \mathop {\operatorname{argmin}}_{c_k}
```

$$\text{求和: } \sum_{i=1}^n a + b$$

$$\text{积分: } \int_{i=1}^{\infty}$$

$$\text{多重积分: } \iiint \ \iiint \ \iiint$$

$$\text{连乘: } \prod_{i=1}^n a + b$$

$$\text{交集和并集: } \cup \cap$$

$$\text{最大最小: } \max_x \min_x$$

$$\text{最大最小自变量集: } \operatorname{argmax}_{c_k} \operatorname{argmin}_{c_k}$$

## 分式, 连分式, 根式

```
$$
分式1: \frac {a} {b} * \frac {a+b} {c+d} \\
分式2: {a+b\over c+d} \\
连分式: x=a_0 +
\frac {1^2} {\frac {a_1 +
\frac {2^2} {\frac {a_3 + |
\frac {4^2} {a_4 + ...}}}}} \\
x=a_0 +
\cfrac {1^2} {\frac {a_1 +
\cfrac {2^2} {\frac {a_3 +
\cfrac {3^2} {a_4 + ...}}}}} \\
根式: \sqrt{a+b} * \sqrt[4]{a+b}
```

$$\text{分式1: } \frac{a}{b} * \frac{a+b}{c+d}$$

$$\text{分式2: } \frac{a+b}{c+d}$$

$$\text{连分式: } x = a_0 + \frac{1^2}{a_1 + \frac{2^2}{a_2 + \frac{3^2}{a_3 + \frac{4^2}{a_4 + \dots}}}}$$

$$x = a_0 + \frac{1^2}{a_1 + \frac{2^2}{a_2 + \frac{3^2}{a_3 + \frac{4^2}{a_4 + \dots}}}}$$

$$\text{根式: } \sqrt{a+b} * \sqrt[4]{a+b}$$

# 三角函数、表达式、方程组

## 三角函数，反三角函数

```
三角函数：\sin x ,\ \cos x ,\ \tan x ,\ \cot x ,\ \sec x ,\csc x \\
反三角函数：\arcsin x ,\ \arccos x ,\ \arctan x \\
度：30^\circ
```

三角函数： $\sin x$ ,  $\cos x$ ,  $\tan x$ ,  $\cot x$ ,  $\sec x$ ,  $\csc x$   
反三角函数： $\arcsin x$ ,  $\arccos x$ ,  $\arctan x$   
度： $30^\circ$

## 分类表达式、多行表达式、方程组、占位符

```
分类表达式：
f(n)
\begin{cases}
\frac{n}{2}, & \text{if } n \text{ is even} \\
3n + 1, & \text{if } n \text{ is odd} \\\end{cases} \\
a+b, & \text{if } n=0 \\
\end{cases} \\

多行表达式：
\begin{equation}\begin{split}
a&=b+c-d \\
&\quad +e-f \\
&=g+h \\
&=i \\
\end{split}\end{equation} \\

方程组：
\left \{
\begin{array}{c}
a_1x+b_1y+c_1z=d_1 \\
a_2x+b_2y+c_2z=d_2 \\
a_3x+b_3y+c_3z=d_3 \\
\end{array}
\right. |
```

$$\text{分类表达式: } f(n) \begin{cases} \frac{n}{2}, & \text{if } n \text{ is even} \\ 3n + 1, & \text{if } n \text{ is odd} \\ a + b, & \text{if } n = 0 \end{cases}$$

$$\text{多行表达式: } \begin{aligned} a &= b + c - d \\ &\quad + e - f \\ &= g + h \\ &= i \end{aligned}$$

$$\text{方程组: } \begin{cases} a_1x + b_1y + c_1z = d_1 \\ a_2x + b_2y + c_2z = d_2 \\ a_3x + b_3y + c_3z = d_3 \end{cases}$$

# 运算符，排列组合，求模，特殊符号

## 运算符，排列组合，求模

```
$$
比较运算符: \lt ,\ gt ,\ \le ,\ \ge ,\ \ne ,\ \not\lt \\\
集合运算符: \cup,\ \cap,\ \setminus,\ \subset,\ \subseteq ,\ \supseteq ,\ \supsetneq ,\ \in ,\ \notin ,\ \emptyset ,\ \varnothing \\\
对数运算符: \log_2 ,\ \lg ,\ \ln \\\
排列组合: \binom{n+1}{2k} ,\ {n+1 \choose 2k} \\\
模运算: \pmod a , a \equiv b \pmod n \\\
$$
```

比较运算符:  $<$ ,  $>$ ,  $\leq$ ,  $\geq$ ,  $\neq$ ,  $\not<$ ,  $\not>$

集合运算符:  $\cup$ ,  $\cap$ ,  $\setminus$ ,  $\subset$ ,  $\subseteq$ ,  $\supseteq$ ,  $\supsetneq$ ,  $\in$ ,  $\notin$ ,  $\emptyset$ ,  $\varnothing$

对数运算符:  $\log_2$ ,  $\lg$ ,  $\ln$

排列组合:  $\binom{n+1}{2k}$ ,  $\begin{pmatrix} n+1 \\ 2k \end{pmatrix}$

模运算:  $(\pmod a)$ ,  $a \equiv b \pmod n$

## 特殊符号

```
$$
箭头: \to ,\ \rightarrow ,\ \leftarrow ,\ \Rightarrow ,\ \Leftarrow ,\ \mapsto ,\ \uparrow ,\ \downarrow ,\ \Uparrow ,\ \Downarrow \\\
逻辑运算符: \land ,\ \lor ,\ \lnot ,\ \forall ,\ \exists ,\ \top ,\ \bot ,\ \vdash ,\ \dashv \\\
符号: \star ,\ \ast ,\ \oplus ,\ \circ ,\ \bullet \\\
等于: \approx ,\ \sim ,\ \cong ,\ \equiv ,\ \simeq \\\
范围: \infty ,\ \aleph_0 ,\ \nabla ,\ \partial ,\ \mathbb{I} ,\ \mathbb{R} \\\
点: \dots ,\ \cdots ,\ \cdot \\\
顶部: \hat{x} ,\ \widehat{xy} ,\ \check{x} ,\ \breve{x} ,\ \overline{x} ,\ \vec{x} ,\ \overrightarrow{x} ,\ \dot{x} ,\ \ddot{x} \\\
连线: \overline{a+b+c+d} ,\ \underline{a+b+c+d} ,\ \overbrace{a+b+c+d}^{2.0} ,\ \underbrace{a+b+c+d}_{1.0} \\\
$$
```

箭头:  $\rightarrow$ ,  $\leftarrow$ ,  $\Rightarrow$ ,  $\Leftarrow$ ,  $\mapsto$ ,  $\uparrow$ ,  $\downarrow$ ,  $\Uparrow$ ,  $\Downarrow$

逻辑运算符:  $\wedge$ ,  $\vee$ ,  $\neg$ ,  $\forall$ ,  $\exists$ ,  $\top$ ,  $\perp$ ,  $\vdash$ ,  $\dashv$

符号:  $\star$ ,  $\ast$ ,  $\oplus$ ,  $\circ$ ,  $\bullet$

等于:  $\approx$ ,  $\sim$ ,  $\cong$ ,  $\equiv$ ,  $\simeq$

范围:  $\infty$ ,  $\aleph_0$ ,  $\nabla$ ,  $\partial$ ,  $\mathbb{I}$ ,  $\mathbb{R}$

点:  $\dots$ ,  $\cdots$ ,  $\cdot$

顶部:  $\hat{x}$ ,  $\widehat{xy}$ ,  $\check{x}$ ,  $\breve{x}$ ,  $\overline{x}$ ,  $\vec{x}$ ,  $\overrightarrow{x}$ ,  $\dot{x}$ ,  $\ddot{x}$

连线:  $\overline{a+b+c+d}$ ,  $\underline{a+b+c+d}$ ,  $\overbrace{a+b+c+d}^{2.0}$ ,  $\underbrace{a+b+c+d}_{1.0}$

# 颜色、字体

## 颜色

```
$$
\color{black}{text}, \color{gray}{text},
\color{silver}{text}, \color{white}{text},
\color{maroon}{text}, \color{red}{text},
\color{yellow}{text}, \color{lime}{text}, \\
\color{olive}{text}, \color{green}{text},
\color{teal}{text}, \color{aqua}{text},
\color{blue}{text}, \color{navy}{text},
\color{purple}{text}, \color{fuchsia}{text}
```

\$\$

*text, text, text, , text, text, text, text,*  
*text, text, text, text, text, text, text, text*

## 字体

```
$$
\mathbb ABCDEabcde \\
\Bbb ABCDEabcde \\
\mathbf ABCDEabcde \\
\mathtt ABCDEabcde \\
\mathrm ABCDEabcde \\
\mathscr ABCDEabcde \\
\mathfrak ABCDEabcde \\
\rm ABCDEabcde \\
\it ABCDEabcde \\
\bf ABCDEabcde \\
\cal ABCDEabcde \\
\sf ABCDEabcde \\
\mit ABCDEabcde \\
\tt ABCDEabcde \\
$$
```

$\mathbb{A}BCDEabcde$   
 $\mathbb{B}BCDEabcde$   
 $\mathbf{A}BCDEabcde$   
 $\mathtt{A}BCDEabcde$   
 $\mathrm{A}BCDEabcde$   
 $\mathscr{A}BCDEabcde$   
 $\mathfrak{A}BCDEabcde$   
 $\mathrm{A}BCDEabcde$   
 $\mathit{A}BCDEabcde$   
 $\mathbf{A}BCDEabcde$   
 $\mathit{A}BCDEabcde$   
 $\mathbf{A}BCDEabcde$   
 $\mathit{A}BCDEabcde$   
 $\mathbf{A}BCDEabcde$   
 $\mathit{A}BCDEabcde$   
 $\mathbf{A}BCDEabcde$

# 复杂的公式

```


$$\hat{\beta}_1 = \frac{\sum (X_i - \bar{X}) Y_i}{\sum (X_i - \bar{X})^2} = \frac{\sum X_i Y_i - \bar{X} \sum Y_i}{\sum X_i^2 + \sum \bar{X}^2 - 2\bar{X} \sum X_i}$$

$$= \frac{\sum X_i Y_i - \bar{X} * N\bar{Y}}{\sum X_i^2 + N\bar{X}^2 - 2\bar{X} * N\bar{X}} = \frac{\sum_{i=1}^N X_i Y_i - N\bar{X}\bar{Y}}{\sum_{i=1}^N X_i^2 - N\bar{X}^2}$$


```

$$\hat{\beta}_1 = \frac{\sum (X_i - \bar{X}) Y_i}{\sum (X_i - \bar{X})^2} = \frac{\sum X_i Y_i - \bar{X} \sum Y_i}{\sum X_i^2 + \sum \bar{X}^2 - 2\bar{X} \sum X_i}$$

$$= \frac{\sum X_i Y_i - \bar{X} * N\bar{Y}}{\sum X_i^2 + N\bar{X}^2 - 2\bar{X} * N\bar{X}} = \frac{\sum_{i=1}^N X_i Y_i - N\bar{X}\bar{Y}}{\sum_{i=1}^N X_i^2 - N\bar{X}^2}$$

```


$$SSR = \sum_{i=1}^N \hat{E}_i^2 = \sum (Y_i - \hat{\beta}_1 X_i)^2$$

$$FOC: \frac{\partial SSR}{\partial X_i} = -2 \sum (Y_i - \hat{\beta}_1 X_i) \hat{\beta}_1 = -2\hat{\beta}_1 \sum (Y_i - \hat{\beta}_1 X_i) = 0$$

$$\Rightarrow \sum_{i=1}^N \hat{E}_i = \sum (Y_i - \hat{\beta}_1 X_i) = 0$$

$$\frac{\partial SSR}{\partial \beta_1} = -2 \sum (Y_i - \hat{\beta}_1 X_i) X_i = 0$$

$$\Rightarrow \sum_{i=1}^N X_i \hat{E}_i = \sum X_i (Y_i - \hat{\beta}_1 X_i) = 0$$


```

$$SSR = \sum_{i=1}^N \hat{E}_i^2 = \sum (Y_i - \hat{\beta}_1 X_i)^2$$

$$FOC: \frac{\partial SSR}{\partial X_i} = -2 \sum (Y_i - \hat{\beta}_1 X_i) \hat{\beta}_1 = -2\hat{\beta}_1 \sum (Y_i - \hat{\beta}_1 X_i) = 0$$

$$\Rightarrow \sum_{i=1}^N \hat{E}_i = \sum (Y_i - \hat{\beta}_1 X_i) = 0$$

$$\frac{\partial SSR}{\partial \beta_1} = -2 \sum (Y_i - \hat{\beta}_1 X_i) X_i = 0$$

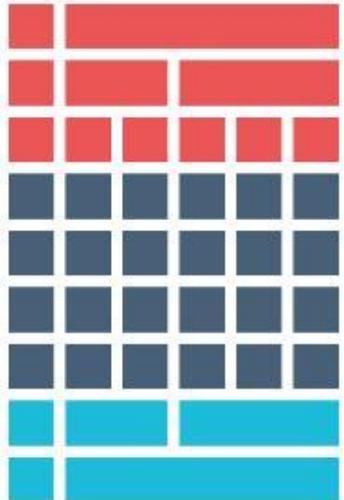
$$\Rightarrow \sum_{i=1}^N X_i \hat{E}_i = \sum X_i (Y_i - \hat{\beta}_1 X_i) = 0$$

# 动态表格flexible

---

# flextable设计原理

flextable表的是以组件化的方式进行建构，按格子会被划分成几个不同的区域，每个不同的区域会有不同的API支持，实现不同的数据操作。



**Merge cells**

```
merge_at() merge_h()
merge_v()
```

**Widths and heights**

```
set_table_properties(
 layout = "autofit")
autofit() width()
height() hrule()
fit_to_width()
```

**Themes**

```
theme_booktabs()
theme_vanilla()
theme_box()
theme_tron()
theme_tron_legacy()
```

**Supported output**

```
R Markdown: HTML, PDF, Word
and PowerPoint
Word and PowerPoint with officer
plot with plot()
images with save_as_images()
```

**Header**

```
add_header_row()
add_header_lines()
add_header()
set_header_labels()
set_header_df()
```

**Footer**

```
add_footer_row()
add_footer_lines()
add_footer()
set_footer_labels()
set_footer_df()
```

**Style**

```
style(): general style function
align(): set text alignment
bg(): set background color
font(): set font
fontsize(): set font size
italic(): set italic font
bold(): set bold font
color(): set font color
padding(): set paragraph paddings
rotate(): rotate cell text
valign(): vertical alignment
highlight(): text highlight color
set_flextable_defaults(): default values
```

**Format content**

```
colformat_char() colformat_int()
colformat_lgl() colformat_num()
compose(as_paragraph(...))
footnote(as_paragraph(...))
```

**Utilities**

```
as_flextable() for tests,
glm, lm, gam, xtable
as_grouped_data()
proc_freq()
```

**Borders**

```
border_outer() border_inner_h()
border_inner_v() hline()
hline_top() hline_bottom()
vline() vline_left()
vline_right()
```

# 基本表格

给这个表格增长各种不同的属性，包括默认样式，表数据，表标题，表头，表体，页脚等样式设置。

```
```{r}
set_flextable_defaults(
  font.size = 10, theme_fun = theme_vanilla,
  padding.left = 6, padding.right = 6,
  background.color = "#EFEFEF")
ft <- flextable(head(mtcars))
ft <- add_header_row(ft,
  colwidths = c(4,2,5),
  values = c("AAA", "BBB", "CCC"))
)
ft <- align(ft, i = 1, part = "header", align = "center")
ft <- color(ft, ~ wt > 3, ~ wt, color = "red")
ft <- bold(ft, ~ hp > 100, ~ hp, bold = TRUE)
ft <- add_footer_lines(ft, "The data was extracted from the 1974 Motor Trend US magazine, and
comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles
(1973-74 models).")
ft <- color(ft, part = "footer", color = "#666666")
ft <- set_caption(ft, caption = "TABLE 1: Motor Trend Car Road Tests")
ft
```
```

TABLE 1: Motor Trend Car Road Tests

| AAA |     |      | BBB        |      |     | CCC  |    |    |      |      |
|-----|-----|------|------------|------|-----|------|----|----|------|------|
| mpg | cyl | disp | hp         | drat | wt  | qsec | vs | am | gear | carb |
| 21  | 6   | 160  | <b>110</b> | 3.9  | 2.6 | 16   | 0  | 1  | 4    | 4    |
| 21  | 6   | 160  | <b>110</b> | 3.9  | 2.9 | 17   | 0  | 1  | 4    | 4    |
| 23  | 4   | 108  | 93         | 3.8  | 2.3 | 19   | 1  | 1  | 4    | 1    |
| 21  | 6   | 258  | <b>110</b> | 3.1  | 3.2 | 19   | 1  | 0  | 3    | 1    |
| 19  | 8   | 360  | <b>175</b> | 3.1  | 3.4 | 17   | 0  | 0  | 3    | 2    |
| 18  | 6   | 225  | <b>105</b> | 2.8  | 3.5 | 20   | 1  | 0  | 3    | 1    |

The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models).

# 表格样式

字体、大小、颜色、编距、背景、对齐、过滤

```
set_flextable_defaults(
 font.size = 10, font.family = "Helvetica",
 font.color = "#1ba555",
 table.layout = "fixed",
 border.color = "blue",
 padding.top = 3, padding.bottom = 3,
 padding.left = 4, padding.right = 4)
```

```
ft<-flextable(mtcars[1:6,1:4])
ft
```

```
ft<-style(ft,i = 1,
 pr_t = fp_text_default(
 italic = TRUE,
 color = "red")) %>%
 style(i = 2, j = 3:4,
 pr_t = fp_text_default(
 shading.color = "yellow"),
 pr_p = fp_par(
 text.align = "center", padding = 1))
ft
```

```
ft<-fontsize(ft,i = ~ cyl %in% "6", size = 10) %>%
 font(part = "all", fontname = "Courier") %>%
 color(part = "header", color = "#e22323", j = c("mpg", "hp", "disp")) %>%
 bold(part = "header", j = c("mpg", "hp")) %>%
 italic(part = "all", j = "cyl") %>%
 highlight(i = ~ disp < 200, color = "wheat", j = c("mpg", "hp"))
ft
```

| mpg  | cyl | disp | hp  |
|------|-----|------|-----|
| 21.0 | 6   | 160  | 110 |
| 21.0 | 6   | 160  | 110 |
| 22.8 | 4   | 108  | 93  |
| 21.4 | 6   | 258  | 110 |
| 18.7 | 8   | 360  | 175 |
| 18.1 | 6   | 225  | 105 |

| mpg         | cyl      | disp       | hp         |
|-------------|----------|------------|------------|
| <i>21.0</i> | <i>6</i> | <i>160</i> | <i>110</i> |
| 21.0        | 6        | 160        | 110        |
| 22.8        | 4        | 108        | 93         |
| 21.4        | 6        | 258        | 110        |
| 18.7        | 8        | 360        | 175        |
| 18.1        | 6        | 225        | 105        |

| <i>mpg</i>  | <i>cyl</i> | <i>disp</i> | <i>hp</i>  |
|-------------|------------|-------------|------------|
| <i>21.0</i> | <i>6</i>   | <i>160</i>  | <i>110</i> |
| <i>21.0</i> | 6          | 160         | 110        |
| <i>22.8</i> | 4          | 108         | 93         |
| 21.4        | 6          | 258         | 110        |
| 18.7        | 8          | 360         | 175        |
| 18.1        | 6          | 225         | 105        |

# 表格内容

## 边框、颜色、合并单元格

```
...{r}
myft <- as.data.frame(matrix(runif(5*5), ncol = 5)) %>%
 flextable() %>%
 colformat_double() %>% autofit() %>%
 align(align = "center", part = "all") %>%
 bg(bg = "black", part = "header") %>%
 color(color = "white", part = "all") %>%
 bg(bg = scales::col_numeric(palette = "viridis", domain = c(0, 1)))
myft
```

```
big_border = fp_border(color="red", width = 2)
small_border = fp_border(color="yellow", width = 1)
myft <- border_inner_h(myft, part="all", border = big_border)
myft <- border_inner_v(myft, part="all", border = small_border)
myft
```

```
myft<- merge_at(myft,i = 1:2, j = 1)
myft<- merge_h_range(myft, i = ~ V5 < 0.5,j1="V4",j2="V5")
myft
```

| V1  | V2  | V3  | V4  | V5  |
|-----|-----|-----|-----|-----|
| 0.6 | 0.1 | 0.0 | 0.9 | 0.9 |
| 0.3 | 0.6 | 0.7 | 0.0 | 0.7 |
| 0.7 | 0.8 | 0.3 | 0.3 | 0.7 |
| 0.5 | 0.4 | 0.9 | 0.3 | 0.2 |
| 0.2 | 0.2 | 0.1 | 0.9 | 0.7 |

| V1  | V2  | V3  | V4  | V5  |
|-----|-----|-----|-----|-----|
| 0.6 | 0.1 | 0.0 | 0.9 | 0.9 |
| 0.3 | 0.6 | 0.7 | 0.0 | 0.7 |
| 0.7 | 0.8 | 0.3 | 0.3 | 0.7 |
| 0.5 | 0.4 | 0.9 | 0.3 | 0.2 |
| 0.2 | 0.2 | 0.1 | 0.9 | 0.7 |

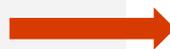
| V1  | V2  | V3  | V4  | V5  |
|-----|-----|-----|-----|-----|
| 0.6 | 0.1 | 0.0 | 0.9 | 0.9 |
|     | 0.6 | 0.7 | 0.0 | 0.7 |
| 0.7 | 0.8 | 0.3 | 0.3 | 0.7 |
| 0.5 | 0.4 | 0.9 | 0.3 |     |
| 0.2 | 0.2 | 0.1 | 0.9 | 0.7 |

# 表格叠加图

## 表格中嵌入图形

```
library(ggplot2)
gg_bars <- function(z) {
 z <- scale(z)
 z <- na.omit(z)
 z <- data.frame(x = seq_along(z), z = z, w = z < 0)
 ggplot(z, aes(x = x, y = z, fill = w)) +
 geom_col(show.legend = FALSE) +
 theme_void()
}

dat <- as.data.table(mtcars)
z <- dat[,
 lapply(.SD, function(x) list(gg_bars(x))),
 by = c("vs", "am"), .SDcols = c("mpg", "disp", "drat")]
ft <- flextable(z)
ft <- compose(ft,
 j = c("mpg", "disp", "drat"),
 value = as_paragraph(gg_chunk(value = ., height = .15, width = 1)),
 use_dot = TRUE
)
ft
```



|  | vs | am | mpg | disp | drat |
|--|----|----|-----|------|------|
|  | 0  | 1  |     |      |      |
|  | 1  | 1  |     |      |      |
|  | 1  | 0  |     |      |      |
|  | 0  | 0  |     |      |      |

# 表格扩展

## crosstable:

```

{r}
library(crosstable)
head(ggplot2::mpg)
crosstable(ggplot2::mpg, cols = c("class", "displ"), by = drv) %>%
 crosstable::as_flextable()

```

```

> ggplot2::mpg
A tibble: 234 x 11
 manufacturer model displ year cyl trans drv cty hwy fl class
 <chr> <chr> <dbl> <int> <int> <chr> <chr> <int> <int> <chr> <chr>
1 audi a4 1.8 1999 4 auto(l5) f 18 29 p compact
2 audi a4 1.8 1999 4 manual(m5) f 21 29 p compact
3 audi a4 2 2008 4 manual(m6) f 20 31 p compact
4 audi a4 2 2008 4 auto(av) f 21 30 p compact
5 audi a4 2.8 1999 6 auto(l5) f 16 26 p compact
6 audi a4 2.8 1999 6 manual(m5) f 18 26 p compact
7 audi a4 3.1 2008 6 auto(av) f 18 27 p compact
8 audi a4 quattro 1.8 1999 4 manual(m5) 4 18 26 p compact
9 audi a4 quattro 1.8 1999 4 auto(l5) 4 16 25 p compact
10 audi a4 quattro 2 2008 4 manual(m6) 4 20 28 p compact

```

| label | variable   | drv           |               |               |
|-------|------------|---------------|---------------|---------------|
|       |            | 4             | f             | r             |
|       | 2seater    | 0 (0%)        | 0 (0%)        | 5 (100.00%)   |
|       | compact    | 12 (25.53%)   | 35 (74.47%)   | 0 (0%)        |
|       | midsize    | 3 (7.32%)     | 38 (92.68%)   | 0 (0%)        |
| class | minivan    | 0 (0%)        | 11 (100.00%)  | 0 (0%)        |
|       | pickup     | 33 (100.00%)  | 0 (0%)        | 0 (0%)        |
|       | subcompact | 4 (11.43%)    | 22 (62.86%)   | 9 (25.71%)    |
|       | suv        | 51 (82.26%)   | 0 (0%)        | 11 (17.74%)   |
|       | Min / Max  | 1.8 / 6.5     | 1.6 / 5.3     | 3.8 / 7.0     |
| displ | Med [IQR]  | 4.0 [2.9;4.7] | 2.4 [2.0;3.0] | 5.4 [4.6;5.7] |
|       | Mean (std) | 4.0 (1.1)     | 2.6 (0.7)     | 5.2 (0.8)     |
|       | N (NA)     | 103 (0)       | 106 (0)       | 25 (0)        |

## ftExtra:

```

{r}
library(ftExtra)
library(flextable)

data.frame(
 x = c("***bold**", "*italic*"),
 y = c("^superscript^", "~subscript~"),
 z = c("***^ft^~Extra~** is*", "*Cool*")
) %>%
 flextable() %>%
 colformat_md()

```

| x             | y                      | z                                   |
|---------------|------------------------|-------------------------------------|
| <b>bold</b>   | <sup>superscript</sup> | <i>ft</i><br><i>Extra</i> <i>is</i> |
| <i>italic</i> | <sub>subscript</sub>   | <i>Cool</i>                         |

# 动态图echarts4r

---

## Apache ECharts

一个基于 JavaScript 的开源可视化图表库

快速入门

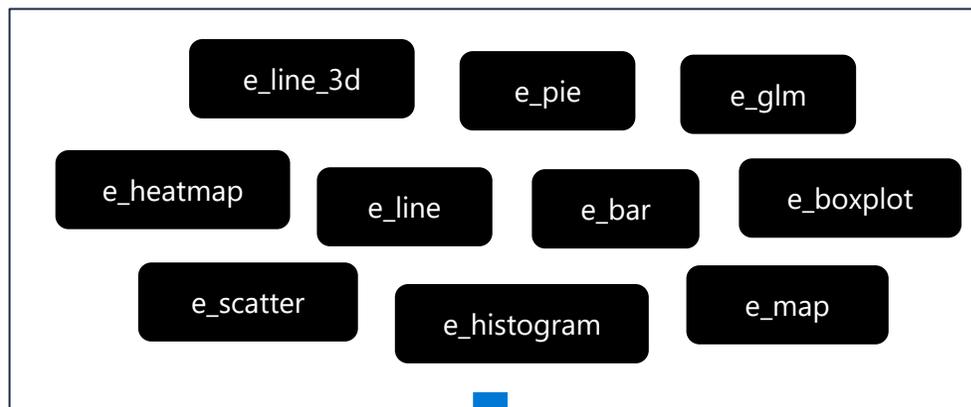
所有示例



<https://echarts.apache.org/zh/index.html>

# echarts4r设计原理

echarts4r 包的语法非常简洁，很容易上手，很多时候我们只需要从官网复制一个例子的代码就能画出图来。



- **基本语法**：横纵轴、多个变量
- **组件**：格式化文本、标题、图例、数据标签
- **坐标系**：直角坐标系、极坐标系
- **主题**：选择主题、背景颜色、线的属性



# 基本使用

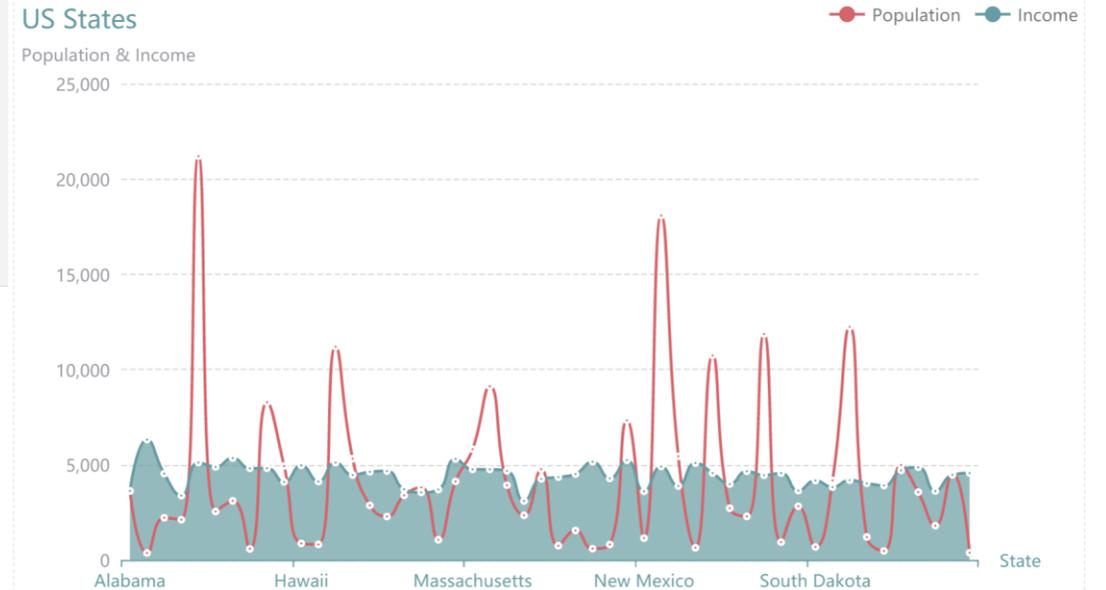
```
{r}
library(echarts4r)
library(magrittr)

df <- state.x77 %>%
 as.data.frame() %>%
 tibble::rownames_to_column("State")
df
df %>%
 e_charts(State) %>% # initialise and set x
 e_line(Population, smooth = TRUE) %>% # add a line
 e_area(Income, smooth = TRUE) %>% # add area
 e_axis_labels(x = "State") %>% # axis labels
 e_title("US States", "Population & Income") %>% # Add title & subtitle
 e_theme("infographic") %>% # theme
 e_legend(right = 0) %>% # move legend to the bottom
 e_tooltip(trigger = "axis") # tooltip
```

| State<br><chr> | Population<br><dbl> | Income<br><dbl> | Illiteracy<br><dbl> | Life Exp<br><dbl> | Murder<br><dbl> | HS Grad<br><dbl> | Frost<br><dbl> |
|----------------|---------------------|-----------------|---------------------|-------------------|-----------------|------------------|----------------|
| Alabama        | 3615                | 3624            | 2.1                 | 69.05             | 15.1            | 41.3             | 20             |
| Alaska         | 365                 | 6315            | 1.5                 | 69.31             | 11.3            | 66.7             | 152            |
| Arizona        | 2212                | 4530            | 1.8                 | 70.55             | 7.8             | 58.1             | 15             |
| Arkansas       | 2110                | 3378            | 1.9                 | 70.66             | 10.1            | 39.9             | 65             |
| California     | 21198               | 5114            | 1.1                 | 71.71             | 10.3            | 62.6             | 20             |
| Colorado       | 2541                | 4884            | 0.7                 | 72.06             | 6.8             | 63.9             | 166            |
| Connecticut    | 3100                | 5348            | 1.1                 | 72.48             | 3.1             | 56.0             | 139            |
| Delaware       | 579                 | 4809            | 0.9                 | 70.06             | 6.2             | 54.6             | 103            |
| Florida        | 8277                | 4815            | 1.3                 | 70.66             | 10.7            | 52.6             | 11             |
| Georgia        | 4931                | 4091            | 2.0                 | 68.54             | 13.9            | 40.6             | 60             |

1-10 of 50 rows | 1-8 of 9 columns

Previous 1 2 3 4 5 Next

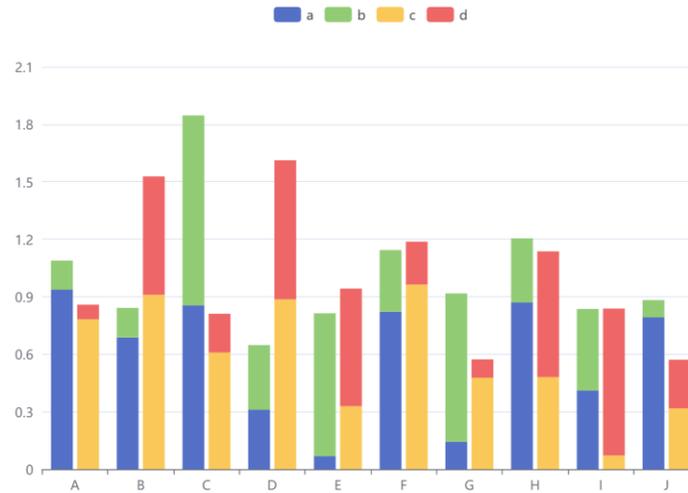


# 基本使用

## 柱状图

```
{r}
df <- data.frame(
 x = LETTERS[1:10],
 a = runif(10),
 b = runif(10),
 c = runif(10),
 d = runif(10)
)

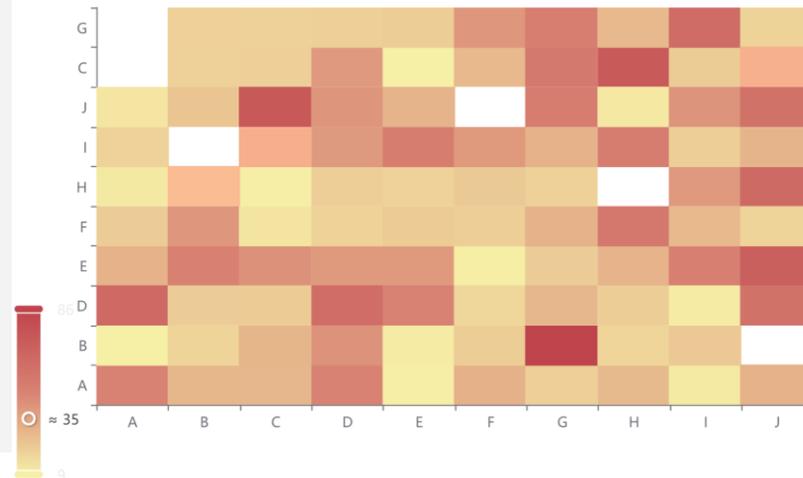
df %>%
 e_charts(x) %>%
 e_bar(a, stack = "grp") %>%
 e_bar(b, stack = "grp") %>%
 e_bar(c, stack = "grp2") %>%
 e_bar(d, stack = "grp2")
```



## 热力图

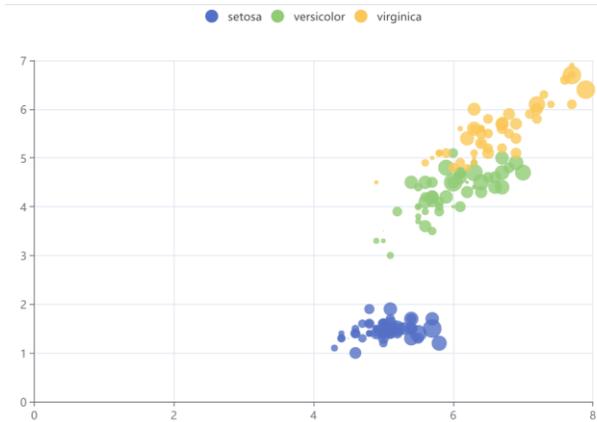
```
{r}
v <- LETTERS[1:10]
matrix <- data.frame(
 x = sample(v, 300, replace = TRUE),
 y = sample(v, 300, replace = TRUE),
 z = rnorm(300, 10, 1),
 stringsAsFactors = FALSE
) %>%
 dplyr::group_by(x, y) %>%
 dplyr::summarise(z = sum(z)) %>%
 dplyr::ungroup()

matrix %>%
 e_charts(x) %>%
 e_heatmap(y, z) %>%
 e_visual_map(z)
```



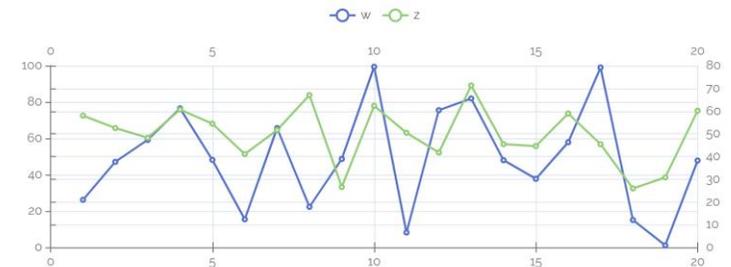
## 散点图

```
{r}
iris %>%
 group_by(Species) %>%
 e_charts(Sepal.Length) %>%
 e_scatter(Petal.Length, Sepal.Width)
```



## 双轴图

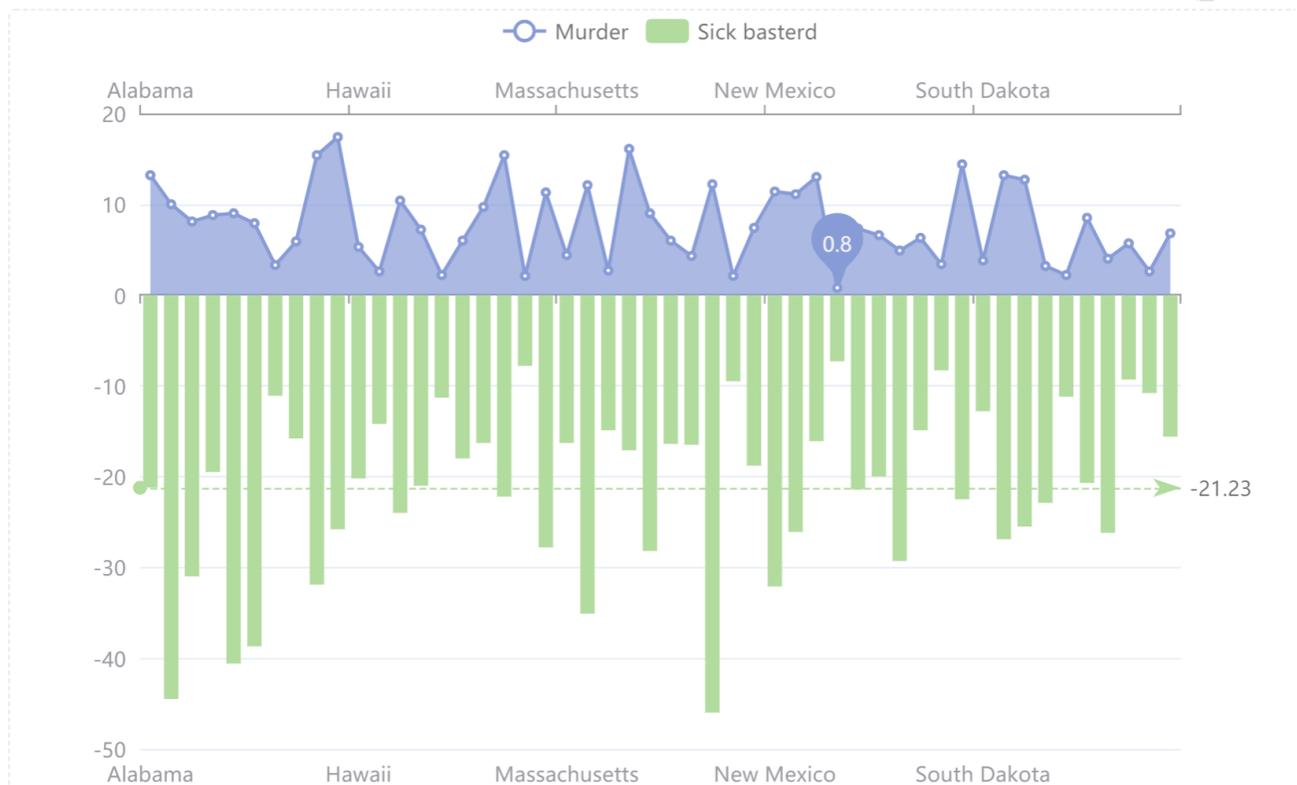
```
df |>
 e_charts(x) |>
 e_line(w) |>
 e_line(z, x_index = 1, y_index = 1) |>
 e_grid(height = "35%") |> # two grids of 35% height
 e_grid(height = "35%", top = "50%") # this grid is 50% from the top
```



# 基本使用

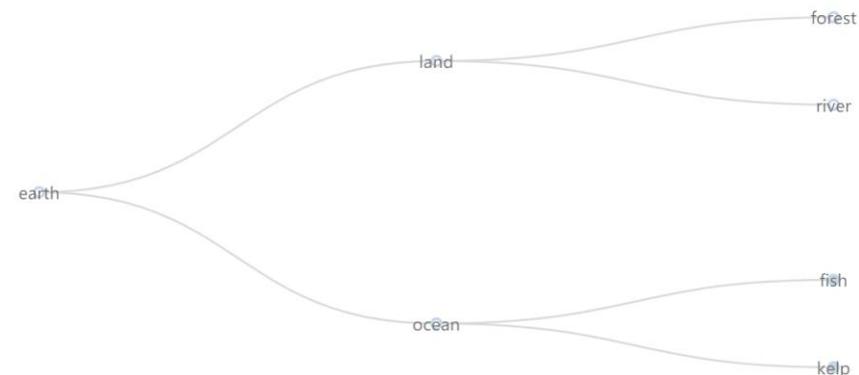
## 点线图

```
{r}
USArrests %>%
 tibble::rownames_to_column("State")%>%
 dplyr::mutate(
 Rape = -Rape
) %>%
 e_charts(State) %>%
 e_area(Murder)%>%
 e_bar(Rape, name = "Sick basterd", x_index = 1) %>% # second y axis
 e_mark_line("Sick basterd", data = list(type = "average")) %>%
 e_mark_point("Murder", data = list(type = "min"))
```



## 树型图

```
{r}
library(dplyr)
df <- tibble(
 name = "earth", # 1st level
 children = list(
 tibble(name = c("land", "ocean"), # 2nd level
 children = list(
 tibble(name = c("forest", "river"), # 3rd level
 children = list(
 tibble(name = c("shark", "tuna"), # 4th level
 NULL # kelp
)
)
)
)
)
)
df %>%
 e_charts() %>%
 e_tree()
```



用pandoc输出Word, PDF, HTML

---

# pandoc的基本使用

Pandoc是使用Haskell语言编写的一款跨平台、自由开源及命令行界面的标记语言转换工具，可实现不同标记语言间的格式转换。

## PDF

```
pandoc example.md -o example.pdf --template eisvogel --highlight-style pygments
```

原文档

输出

主题

样式

## Word

```
pandoc -s m.md -S --reference-docx reference.docx -o m.docx
```

原文档

样式表

输出

## LaTeX

```
pandoc example.md -o example.tex --template eisvogel
```

原文档

输出

主题

# pandoc的基本使用

---

**输入类型:** `pandoc --list-input-formats`

commonmark, creole, **csv**, docbook, **docx**,  
dokuwiki, **epub**, fb2, gfm, haddock, **html**,  
ipynb, jats, jira, **json**, **latex**, man, **markdown**,  
markdown\_github, markdown\_mmd,  
markdown\_phpextra, markdown\_strict,  
mediawiki, muse, native, odt, opml, org, rst,  
t2t, textile, tikiwiki, twiki, vimwiki

**输出类型:** `pandoc --list-output-formats`

asciidoc, asciidoctor, beamer, commonmark,  
context, docbook, docbook4, docbook5, **docx**,  
dokuwiki, dzslides, **epub**, epub2, epub3, , fb2,  
gfm, haddock, **html**, html4, html5, icml, **ipynb**,  
jats, jats\_archiving, jats\_articleauthoring,  
jats\_publishing, jira, **json**, **latex**, man, **markdown**,  
markdown\_github, markdown\_mmd,  
markdown\_phpextra, markdown\_strict, mediawiki,  
ms, muse, native, odt, opendocument, opml,  
org, **pdf**, **plain**, **pptx**, revealjs, rst, rtf, s5,  
slideous, slidy, tei, texinfo, textile, xwiki, zimwiki

# 输出复杂的Word

---

word\_document, officedown, bookdown

# word\_document

使用模型的rmarkdown的word\_document模式输出word文件。

```

title: "文档革命：用flextable生成报告中的表格"
output:
 word_document:
 toc: yes

{r_setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
setwd("C:/work/new_document")

\newpage
文档革命：用flextable生成报告中的表格

R的极客理想系列文章，涵盖了R的思想，使用，工具，创新等的一系列要点，以我的强大。

R语言作为统计学一门语言，一直在小众领域闪耀着光芒。直到大数据的爆发，R语言分析的利器。随着越来越多的工程背景的人的加入，R语言的社区在迅速扩大成长，教育，银行，电商，互联网...都在使用R语言。

要成为有理想的极客，我们不能停留在语法上，要掌握牢固的数学，概率，统计知识把R语言发挥到各个领域。让我们一起动起来吧，开始R的极客理想。

转载请注明出处：
<http://blog.fens.me/r-table-flextable/>

前言
```

## 文档革命：用 flextable 生成报告中的表格

|                           |   |
|---------------------------|---|
| 文档革命：用 flextable 生成报告中的表格 | 2 |
| 转载请注明出处：                  | 2 |
| 前言                        | 2 |
| 目录                        | 2 |
| 1. flextable 包介绍          | 3 |

### 文档革命：用 flextable 生成报告中的表格

R的极客理想系列文章，涵盖了R的思想，使用，工具，创新等的一系列要点，以我个人的学习和体验去诠释R的强大。

R语言作为统计学一门语言，一直在小众领域闪耀着光芒。直到大数据的爆发，R语言变成了一项炙手可热的数据分析的利器。随着越来越多的工程背景的人的加入，R语言的社区在迅速扩大成长。现在已不仅仅是统计领域，教育，银行，电商，互联网...都在使用R语言。

要成为有理想的极客，我们不能停留在语法上，要掌握牢固的数学，概率，统计知识，同时还要有创新精神，把R语言发挥到各个领域。让我们一起动起来吧，开始R的极客理想。

### 转载请注明出处：

<http://blog.fens.me/r-table-flextable/>

### 前言

flextable包，为我们提供了强大的表格处理功能。

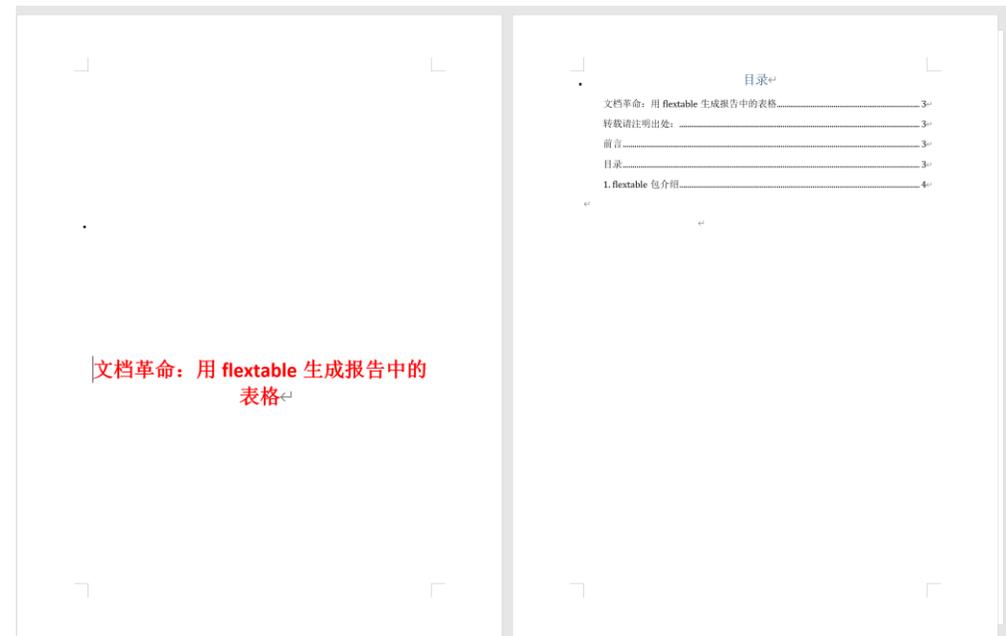
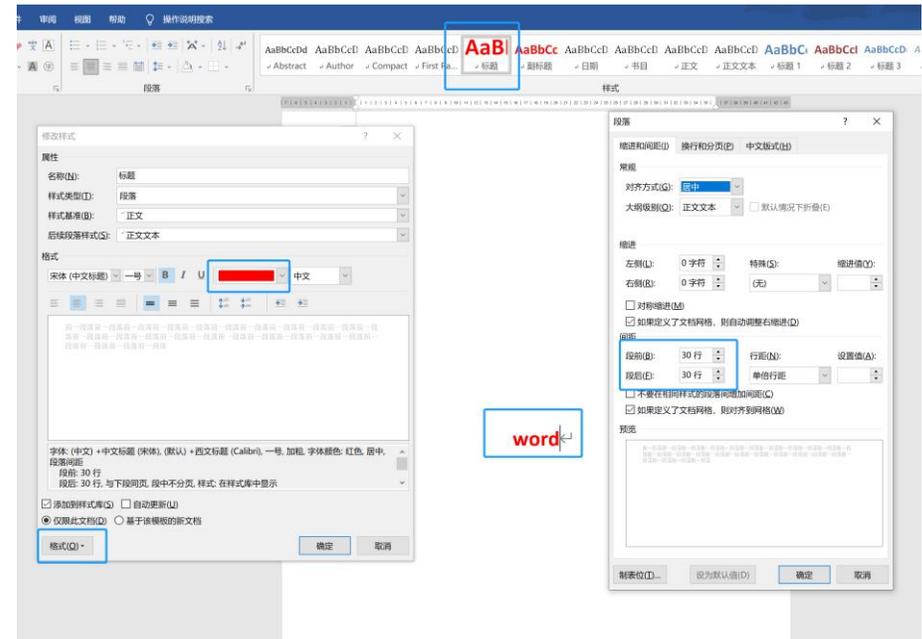
### 目录

- flextable包介绍
- 创建一个基本表格
- 表头，表体，表尾
- 表体内容样式
- 表格合并
- 表格扩展

# word样式表

可以使用一种独立的docx做为样式表。

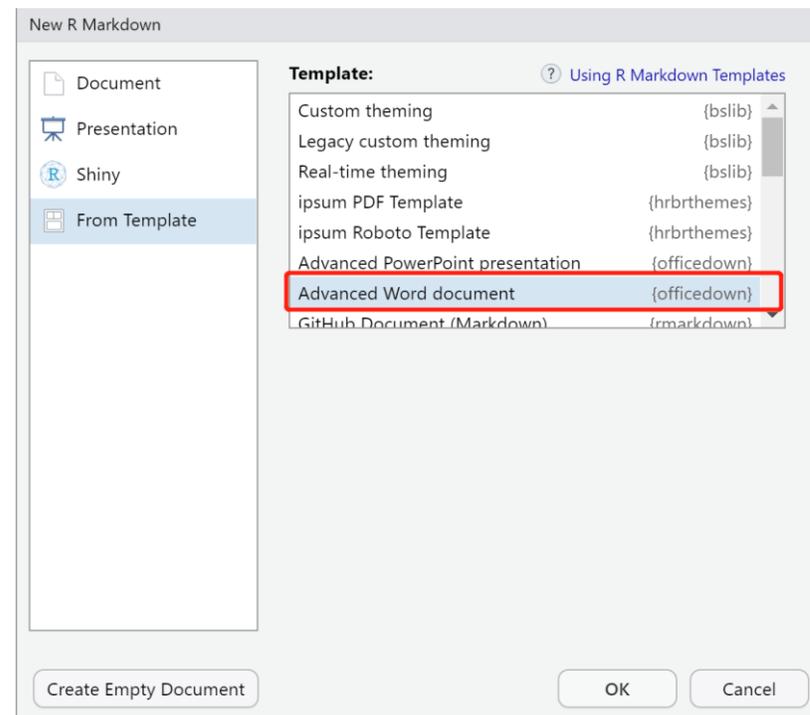
```
1 ---
2 title: "文档革命：用flextable生成报告中的表格"
3 output:
4 word_document:
5 reference_docx: "C://work//new_document//word-template.docx"
6 fig_caption: TRUE
7 toc: yes
8 toc-title: "目录"
9 ---
10
11
12 {r_setup, include=FALSE}
13 knitr::opts_chunk$set(echo = TRUE)
14 setwd("C://work/new_document")
15
16
17 \newpage
18 |
19 ## 文档革命：用flextable生成报告中的表格
20
21 R的极客理想系列文章，涵盖了R的思想，使用，工具，创新等的一系列要点，以我个人
22 的强大。
23
24 R语言作为统计学一门语言，一直在小众领域闪耀着光芒。直到大数据的爆发，R语言变
25 据分析的利器。随着越来越多的工程背景的人的加入，R语言的社区在迅速扩大成长。现
26 域，教育，银行，电商，互联网...都在使用R语言。
27
28 要成为有理想的极客，我们不能停留在语法上，要掌握牢固的数学，概率，统计知识，
29 把R语言发挥到各个领域。让我们一起动起来，开始R的极客理想。
30
31 ## 转载请注明出处：
32 <http://blog.fens.me/r-table-flexible/>
```



# officedown

officedown用来调整使用R语言生成的Word中的格式。结合了Rmarkdown和officer的很多优点。

- 插入一段格式复杂的段落
- 把内容分成不同的区块
- 使用模板格式化图表
- 交叉引用和小标题等
- 此包还擅长用rmarkdown是做PPT，可在幻灯片中自由插入矢量图形！



# 基本排版

```
1 ----
2 date: "`r Sys.Date()`"
3 author: "Your Name"
4 title: "officetdown template"
5 output:
6 officetdown::rdocx_document:
7 mapstyles:
8 Normal: ['First Paragraph']
9 ----
```

```
11 ```{r setup, include=FALSE}
12 knitr::opts_chunk$set(echo = TRUE, fig.cap = TRUE)
13 library(officetdown)
14 library(officer)
15
16 fp <- fp_par(
17 text.align = "center",
18 padding.bottom = 20, padding.top = 120,
19 border.bottom = fp_border()
20)
21 ft <- fp_text(shading.color='#EFEFEF', bold = TRUE)
22 ```
```

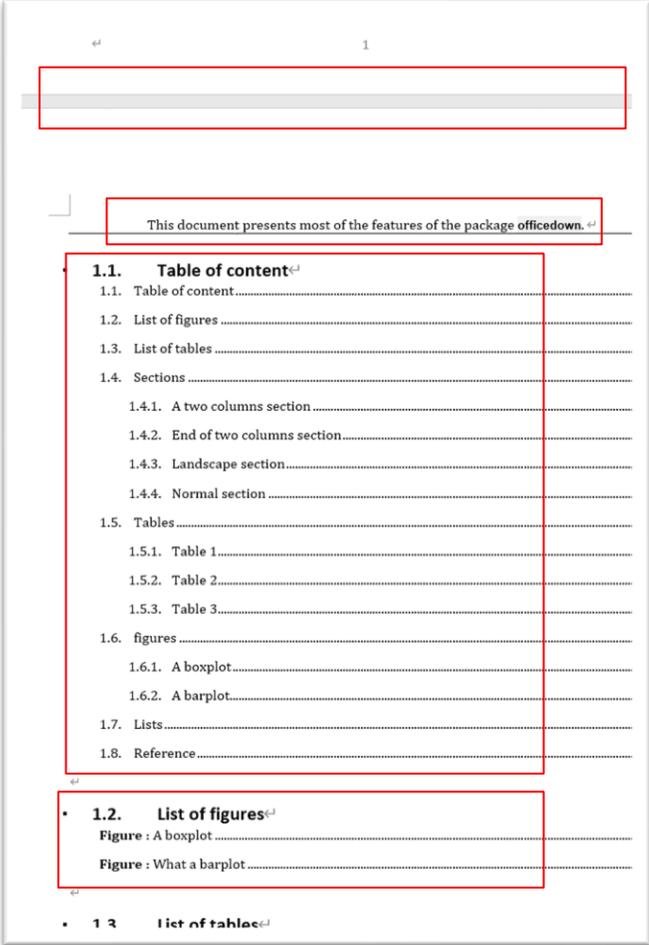
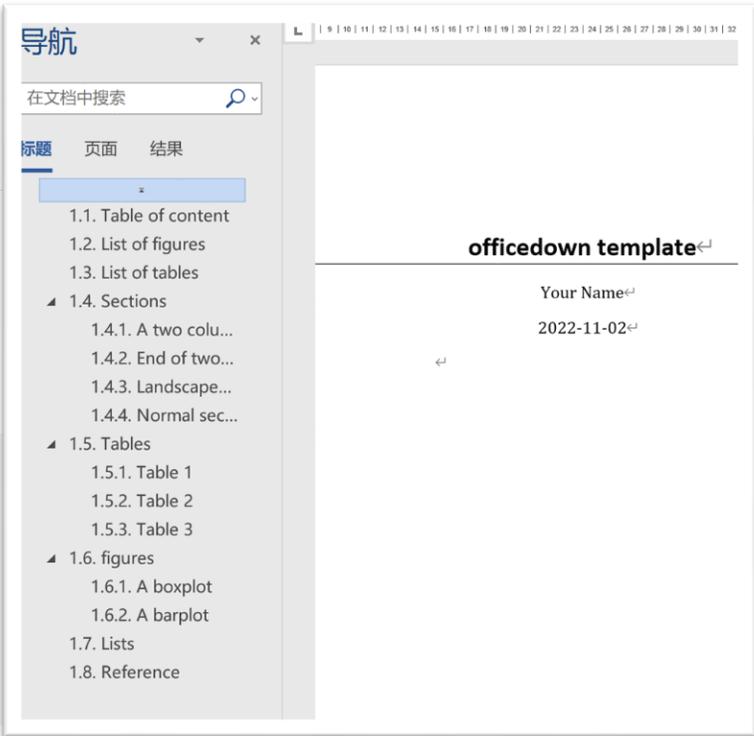
```
24 \newpage
```

```
27 This document presents most of the features of the package `r ftext("officetdown", ft)`.
28 `r fp`
```

```
30 ## Table of content
31
32 <!---BLOCK_TOC-->
```

```
34 ## List of figures
35
36 <!---BLOCK_TOC{seq_id: 'fig'}-->
```

```
38 ## List of tables
39
40 <!---BLOCK_TOC{seq_id: 'tab'}-->
```



# 重排2列

\newpage

▼ ## Sections

▼ ### A two columns section

```
<!--BLOCK_MULTICOL_START-->
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nulla eu pulv dui. In at cursus ante. Vestibulum non sagittis lacus. Duis vitae iacu nibh ut pretium tempus, enim lorem dignissim quam, at euismod massa ma facilisis dapibus diam nec volutpat. Maecenas facilisis dapibus egesta pharetra pulvinar. Nunc bibendum elit sed cursus congue.

```
`r run_columnbreak()`Curabitur ligula quam, iaculis faucibus orci quis lectus. Suspendisse fringilla nisl pulvinar, laoreet tellus sed, solli consequat congue erat in iaculis. Curabitur luctus tellus ut turpis ia scelerisque.
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nulla eu pulv dui. In at cursus ante. Vestibulum non sagittis lacus. Duis vitae iacu nibh ut pretium tempus, enim lorem dignissim quam, at euismod massa ma facilisis dapibus diam nec volutpat. Maecenas facilisis dapibus egesta pharetra pulvinar. Nunc bibendum elit sed cursus congue. Curabitur lig faucibus orci quis, vestibulum lobortis lectus. Suspendisse fringilla tellus sed, sollicitudin tortor. Donec consequat congue erat in iaculi tellus ut turpis iaculis, nec laoreet ligula scelerisque.

```
<!--BLOCK_MULTICOL_STOP{widths: [3,3], space: 0.2, sep: true}-->
```

▼ ### End of two columns section



## 1.4. Sections

### 1.4.1. A two columns section

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nulla eu pulvinar arcu, quis aliquam dui. In at cursus ante. Vestibulum non sagittis lacus. Duis vitae iaculis dui. Vivamus tempor, nibh ut pretium tempus, enim lorem dignissim quam, at euismod massa magna at magna. Sed facilisis dapibus diam nec volutpat. Maecenas facilisis dapibus egestas. Curabitur dignissim pharetra pulvinar. Nunc bibendum elit sed cursus congue.

Curabitur ligula quam, iaculis faucibus orci quis, vestibulum lobortis lectus. Suspendisse fringilla nisl pulvinar, laoreet tellus sed, sollicitudin tortor. Donec consequat congue erat in iaculis. Curabitur luctus tellus ut turpis iaculis, nec laoreet ligula scelerisque.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nulla eu pulvinar arcu, quis aliquam dui. In at cursus ante. Vestibulum non sagittis lacus. Duis vitae iaculis dui. Vivamus tempor, nibh ut pretium tempus, enim lorem dignissim quam, at euismod massa magna at magna. Sed facilisis dapibus diam nec volutpat. Maecenas facilisis dapibus egestas. Curabitur dignissim pharetra pulvinar. Nunc bibendum elit sed cursus congue. Curabitur ligula quam, iaculis faucibus orci quis, vestibulum lobortis lectus. Suspendisse fringilla nisl pulvinar, laoreet tellus sed, sollicitudin tortor. Donec consequat congue erat in iaculis. Curabitur luctus tellus ut turpis iaculis, nec laoreet ligula scelerisque.

# 表格和列表

```
85 > ## Tables
86
87 > ### Table 1
88
89 > ```{r tab.cap="caption 1", tab.id="mtcars"}
90 > head(mtcars)
91 > ```
92
93
94 > ### Table 2
95
96 > ```{r tab.cap="iris"}
97 > head(iris)
98 > ```
99
100 > ### Table 3
101
102 > ```{r tab.cap="cars", tab.id="cars"}
103 > head(cars)
104 > ```
105
106 > ## Lists
107
108 > Amet nunc eros curabitur tellus massa, eros maximus porttitor sociosqu, pellentesque.
109
110 > * Erat mauris egestas finibus tincidunt sed in rhoncus a tellus etiam.
111 > - A adipiscing per ultricies justo tellus lorem.
112 > - Imperdiet ut dui primis, sed gravida, at sed nulla.
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114 > - Urna sed dui, ornare, eu turpis mus pellentesque amet amet bibendum.
115 > * Himenaeos tincidunt, auctor dapibus scelerisque, montes nunc faucibus
116 > sodales malesuada ridiculus sed cubilia ligula.
117
118
119 > 1. Erat mauris egestas finibus tincidunt sed in rhoncus a tellus etiam.
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124 > 2. Himenaeos tincidunt, auctor dapibus scelerisque, montes nunc faucibus
125 > sodales malesuada ridiculus sed cubilia ligula.
126
```

## 1.5. Tables

### 1.5.1. Table 1

head(mtcars)

Table 1: caption 1

| mpg  | cyl | disp | hp  | drat | wt    | qsec  | vs | am | gear | carb |
|------|-----|------|-----|------|-------|-------|----|----|------|------|
| 21.0 | 6   | 160  | 110 | 3.90 | 2.620 | 16.46 | 0  | 1  | 4    | 4    |
| 21.0 | 6   | 160  | 110 | 3.90 | 2.875 | 17.02 | 0  | 1  | 4    | 4    |
| 22.8 | 4   | 108  | 93  | 3.85 | 2.320 | 18.61 | 1  | 1  | 4    | 1    |
| 21.4 | 6   | 258  | 110 | 3.08 | 3.215 | 19.44 | 1  | 0  | 3    | 1    |
| 18.7 | 8   | 360  | 175 | 3.15 | 3.440 | 17.02 | 0  | 0  | 3    | 2    |
| 18.1 | 6   | 225  | 105 | 2.76 | 3.460 | 20.22 | 1  | 0  | 3    | 1    |

### 1.5.2. Table 2

head(iris)

Table 2: iris

| Sepal.Length | Sepal.Width | Petal.Length | Petal.Width | Species |
|--------------|-------------|--------------|-------------|---------|
| 5.1          | 3.5         | 1.4          | 0.2         | setosa  |
| 4.9          | 3.0         | 1.4          | 0.2         | setosa  |
| 4.7          | 3.2         |              |             |         |
| 4.6          | 3.1         |              |             |         |
| 5.0          | 3.6         |              |             |         |
| 5.4          | 3.9         |              |             |         |

## 1.7. Lists

Amet nunc eros curabitur tellus massa, eros maximus porttitor sociosqu, pellentesque.

- Erat mauris egestas finibus tincidunt sed in rhoncus a tellus etiam.
  - A adipiscing per ultricies justo tellus lorem.
    - Imperdiet ut dui primis, sed gravida, at sed nulla.
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Lorem dolor interdum orci eros pellentesque semper tristique, sodales, et sed ut! Porta mattis natoque et. Ac facilisi ipsum viverra elementum vestibulum ligula amet enim magnis luctus ullamcorper. Rhoncus rhoncus elit in at nisl. Tincidunt habitant sit.

- Aptent conubia quam montes id sagittis.
  - Mattis nisi nascetur, aliquam dui ex, tristique.
    - Imperdiet ut dui primis, sed gravida, at sed nulla.
    - Donec ligula nulla ac. Nisl ac at accumsan sagittis eros felis lobortis amet nec phasellus urna bibendum sapien.
  - Eu dui ac id, dictum proin consectetur convallis.
- Facilisi eu lectus mauris lorem. Et sed sapien pellentesque sed etiam vehicula.
- In porttitor id lorem eu efficitur, nisl dis!

# 表格和列表

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Lorem dolor interdum orci eros pellentesque semper tristique, sodales, et sed ut! Porta mattis natoque et. Ac facilisi ipsum viverra elementum vestibulum ligula amet enim magnis luctus ullamcorper. Rhoncus rhoncus elit in at nisl. Tincidunt habitant sit.

- Aptent conubia quam montes id sagittis.
  - Mattis nisi nascetur, aliquam dui ex, tristique.
    - Imperdiet ut dui primis, sed gravida, at sed nulla.
    - Donec ligula nulla ac. Nisl ac at accumsan sagittis eros felis lobortis amet nec phasellus urna bibendum sapien.
  - Eu dui ac id, dictum proin consectetur convallis.
- Facilisi eu lectus mauris lorem. Et sed sapien pellentesque sed etiam vehicula.
- In porttitor id lorem eu efficitur, nisl dis!

# bookdown

用bookdown来管理你的书，所有的文本文件都要使用UTF-8编码。

例子：

```
dir <- system.file(package = "officedown",
"examples", "bookdown")
file.copy(dir, getwd(), recursive = TRUE, overwrite
= TRUE)
fs::dir_tree("bookdown", recurse = TRUE)
rmarkdown::render_site("bookdown")
```

<https://bookdown.org/>



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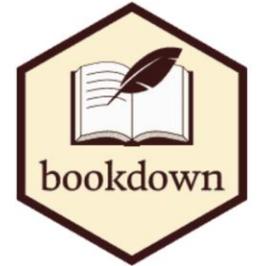


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### R Graphics Cookbook, 2nd edition

by Winston Chang

2022-10-26

Star



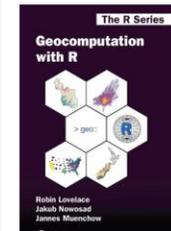
This cookbook contains more than 150 recipes to help scientists, engineers, programmers, and data analysts generate high-quality graphs quickly—without having to comb through all the details of R’s graphing systems. Each recipe tackles a specific problem with a solution you can apply to your own project and includes a discussion of how and why the recipe works

### Geocomputation with R

by Robin Lovelace, Jakub Nowosad, Jannes Muenchow

2022-10-23

Star



Welcome | Geocomputation with R is for people who want to analyze, visualize and model geographic data with open source software. It is based on R, a statistical programming language that has powerful data processing, visualization, and geospatial capabilities. The book equips you with the knowledge and skills to tackle a wide range of

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