

Introduction to R Markdown

STA237: Probability, Statistics and Data Analysis I

University of Toronto

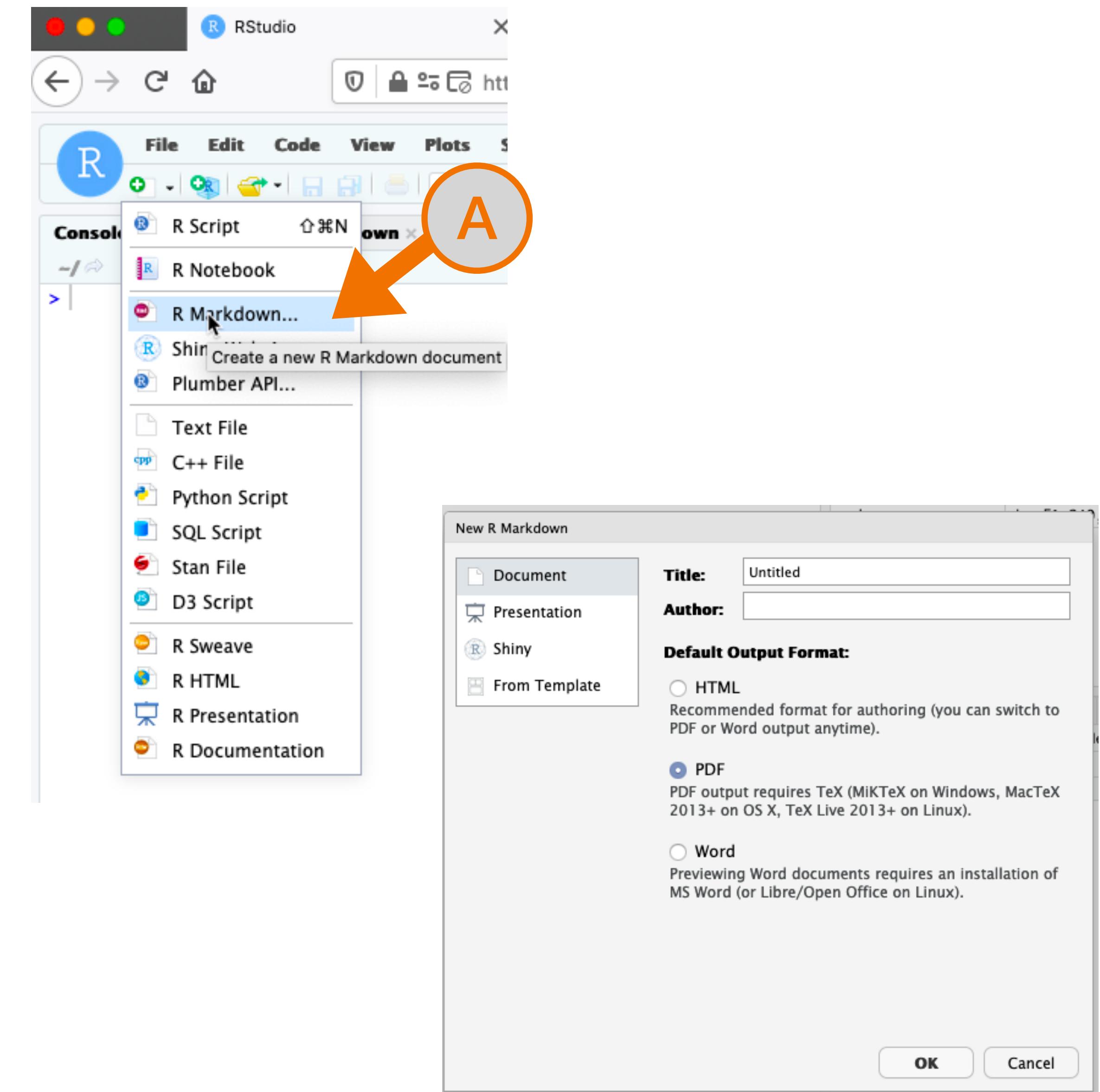
Summer 2021

Creating a PDF document using R Markdown

Create a New Document

Follow the steps to start new R Markdown document.

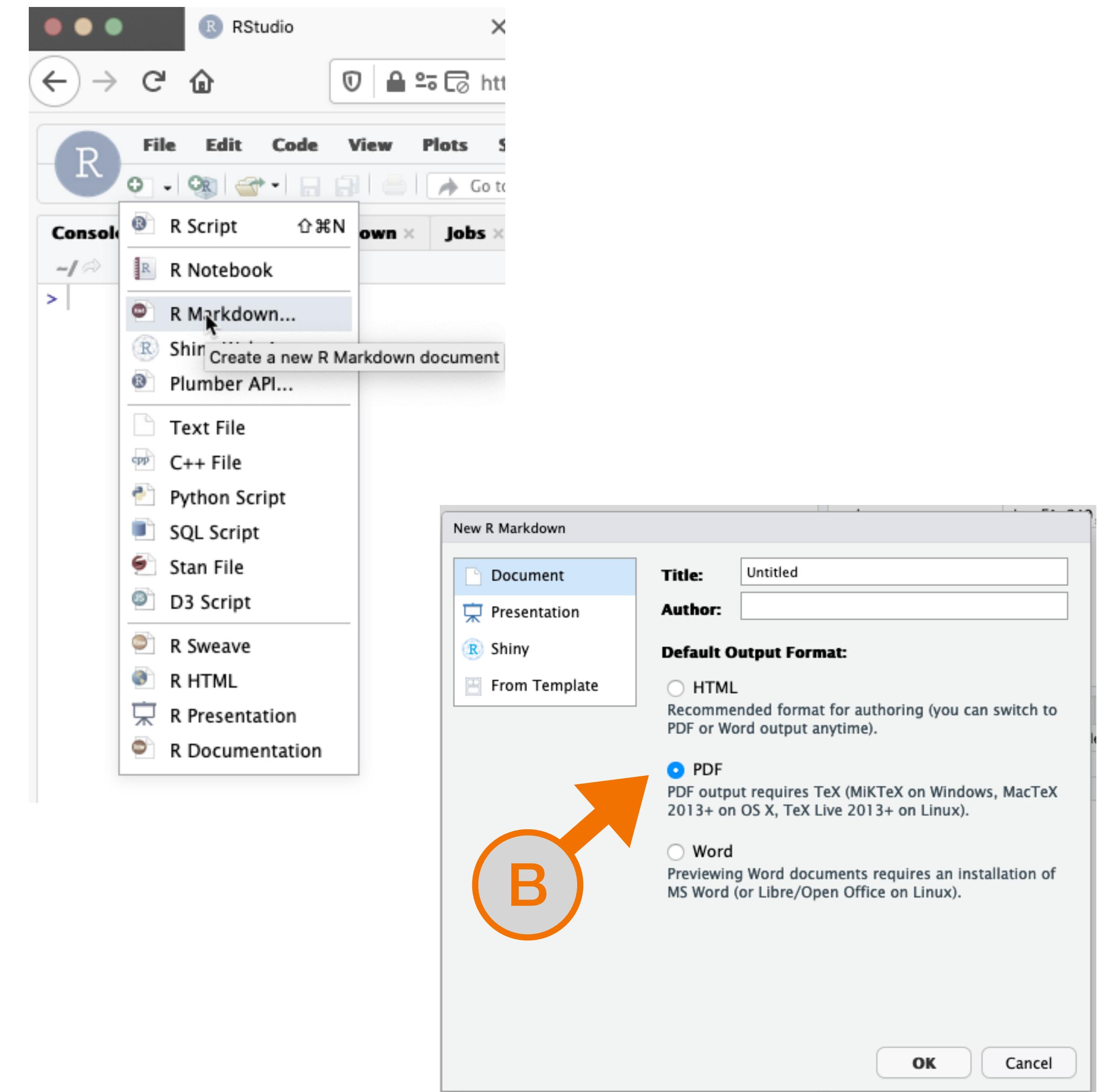
1. Select *R Markdown...* (A) from the New File dropdown menu



Create a New Document

Follow the steps to start new R Markdown document.

1. Select *R Markdown...* (A) from the New File dropdown menu
2. Fill in *Title* and *Author*, and select *PDF* (B) as the output format



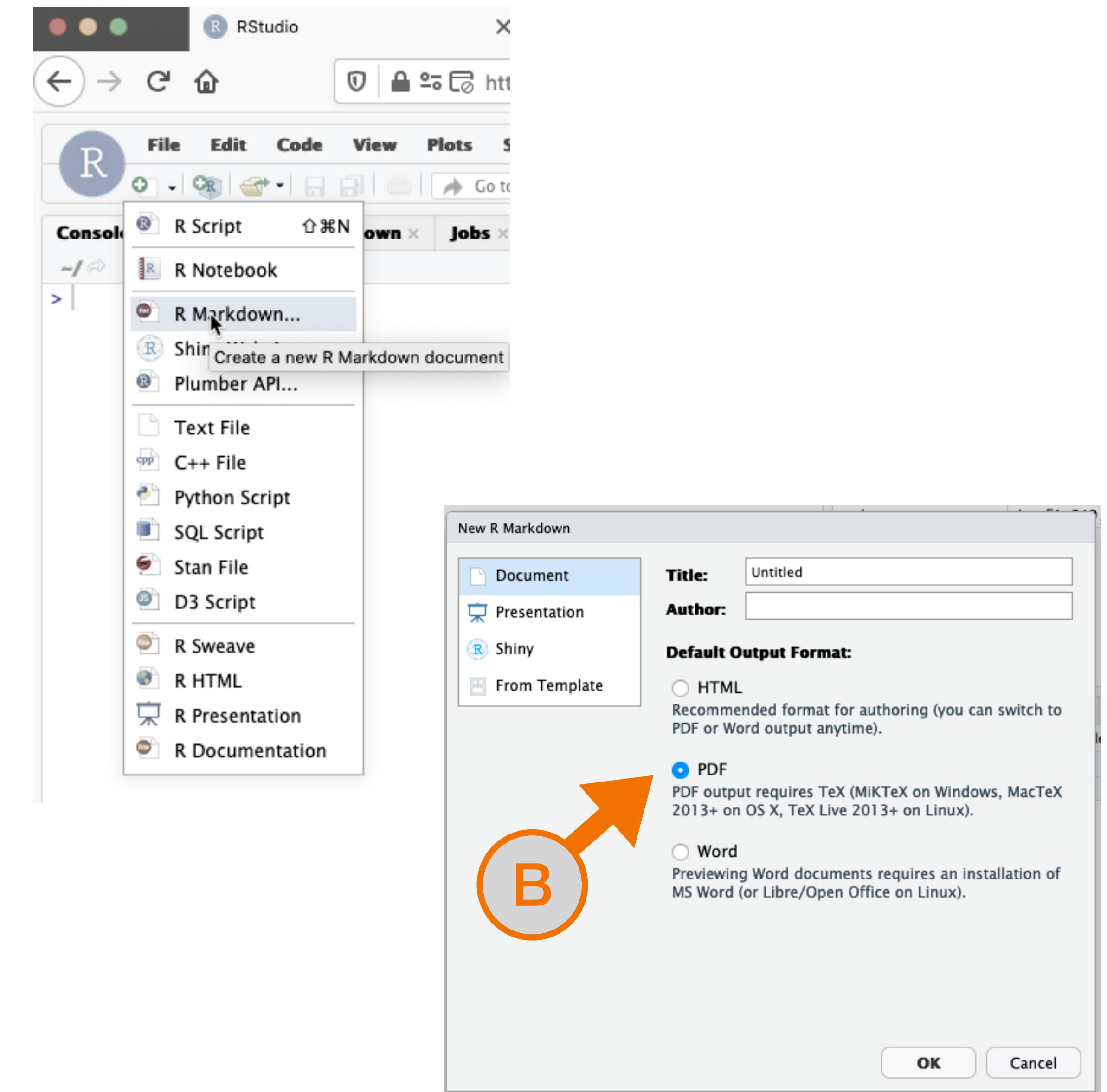
Create a New Document

Follow the steps to start new R Markdown document.

1. Select *R Markdown...* (A) from the New File dropdown menu
2. Fill in *Title* and *Author*, and select *PDF* (B) as the output format

You can also render other document types such as HTML and Word from R Markdown.

This tutorial will focus on rendering PDF documents.



A R Markdown Document

You will now see a new R Markdown document with the default texts populated.

The screenshot shows the RStudio interface with a browser tab at the top displaying a Jupyter notebook URL. The main workspace contains an R Markdown document titled "Untitled1". The code editor shows the following content:

```
1 ---  
2 title: "STA313 Tutorial"  
3 author: "STA313 TA"  
4 date: '2021-01-04'  
5 output: pdf_document  
6 ---  
7  
8 ```{r setup, include=FALSE}  
9 knitr::opts_chunk$set(echo = TRUE)  
10 ```  
11  
12 ```{r example, echo=FALSE, include=TRUE, eval=TRUE}  
13 summary(cars)  
14 ```  
15  
16 ## Inline Code  
17  
18 The inline code `r round(pi, 4)` renders 3.1416.  
19  
20 ## R Markdown  
18:49 # Inline Code
```

The "Environment" pane shows "Environment is empty". The "Files" pane shows a single file named ".Rhistory" with a size of 0 B and a modified date of Jan 4, 2021, 1:.

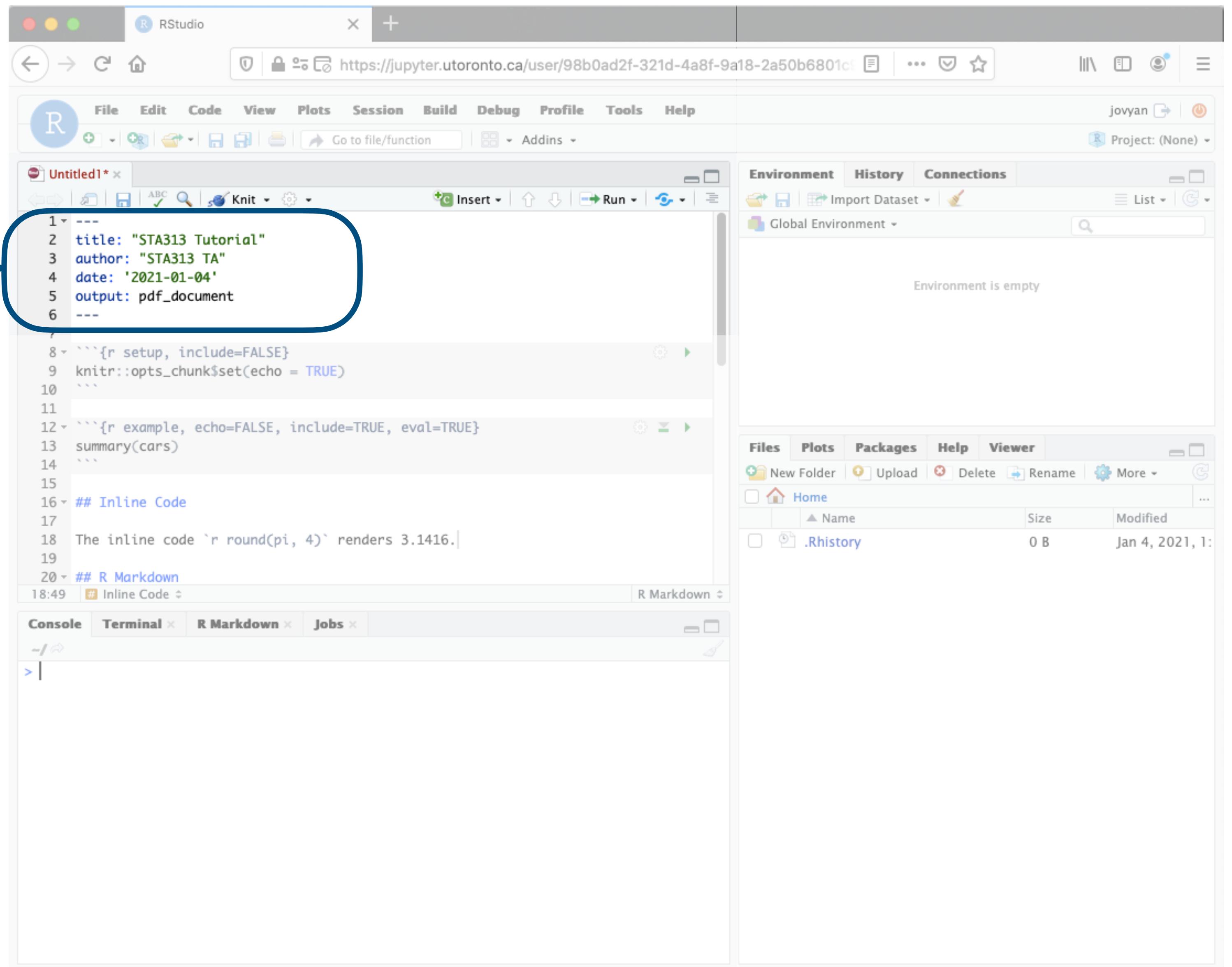
YAML Block

The YAML block at the top lists the metadata for the document. It is enclosed by '---'.

The list may include

- Title, Author, Date
- Output type and output rendering options
- Font size and document dimensions

For more options, see <https://bookdown.org/yihui/rmarkdown/pdf-document.html>



The screenshot shows the RStudio interface with an R Markdown file titled "Untitled1". The YAML block at the top of the file is highlighted with a blue rounded rectangle. The YAML content is as follows:

```
1 ---  
2 title: "STA313 Tutorial"  
3 author: "STA313 TA"  
4 date: '2021-01-04'  
5 output: pdf_document  
6 ---
```

The rest of the file contains R code and comments:

```
8 `r setup, include=FALSE`  
9 knitr::opts_chunk$set(echo = TRUE)  
10 `r`  
11  
12 `r example, echo=FALSE, include=TRUE, eval=TRUE`  
13 summary(cars)  
14 `r`  
15  
16 ## Inline Code  
17  
18 The inline code `r round(pi, 4)` renders 3.1416.  
19  
20 ## R Markdown
```

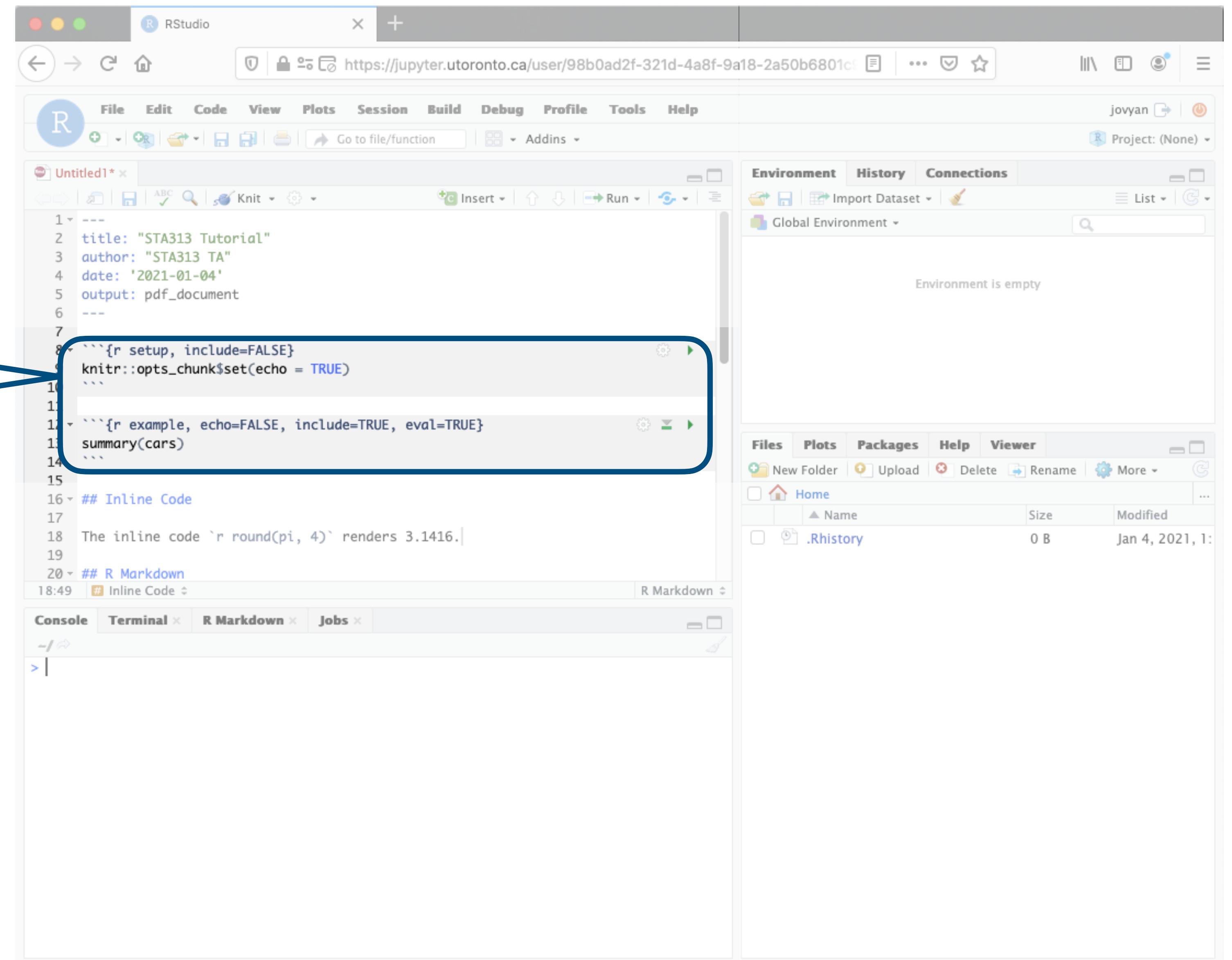
The RStudio interface includes a browser tab at the top showing a Jupyter notebook URL, and various panels for Environment, Files, Plots, Packages, Help, and Viewer on the right.

Code Chunk

Code chunks enclosed by ````{r}` and ````` allow running blocks of R codes and including their outputs in the document.

Code chunks are evaluated in the order they appear in the same environment.

```
```{r <name>, <parameter(s)>}  
R codes.
```
```



Code Chunk

Optionally, you can include chunk-specific parameters separated by commas.

- `echo=FALSE` hides the code chunk
- `include=FALSE` hides the code chunk and the results
- `eval=FALSE` prevents evaluation of the chunk
- `knitr::opts_chunk$set(...)` applies the options to all following chunks

```
```{r <name>, <parameter(s)>}
R codes.
```
```

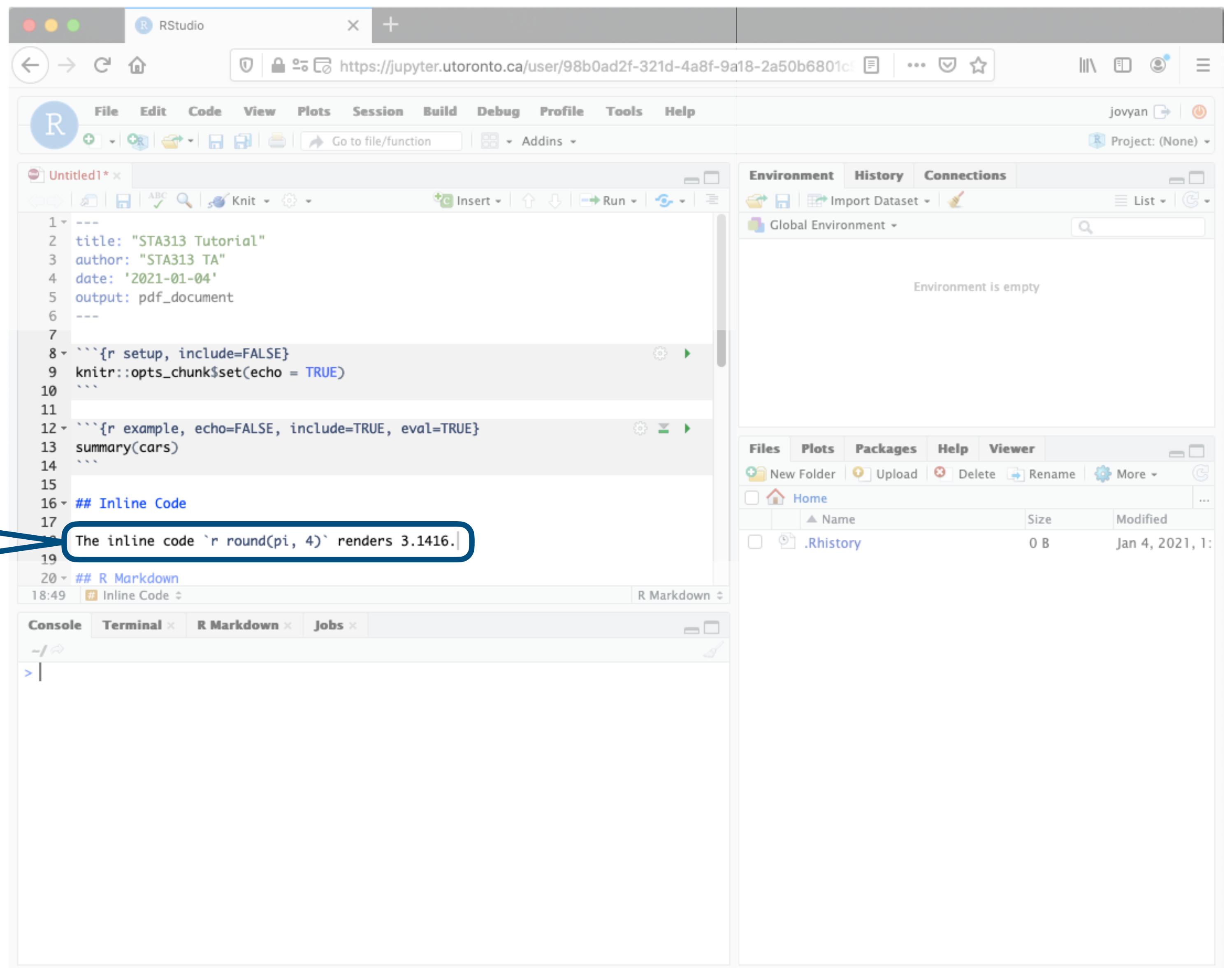
The screenshot shows the RStudio interface with an R Markdown file named "Untitled1" open. The code editor pane displays the following content:

```
1 ---  
2 title: "STA313 Tutorial"  
3 author: "STA313 TA"  
4 date: '2021-01-04'  
5 output: pdf_document  
6 ---  
7  
8 ```{r setup, include=FALSE}  
9 knitr::opts_chunk$set(echo = TRUE)  
10 ````  
11  
12 ```{r example, echo=FALSE, include=TRUE, eval=TRUE}  
13 summary(cars)  
14 ````  
15  
16 ## Inline Code  
17  
18 The inline code `r round(pi, 4)` renders 3.1416.  
19  
20 ## R Markdown  
18:49 # Inline Code
```

A blue box highlights the code block starting at line 8, specifically the chunk options and the `summary(cars)` command. Two arrows point from this highlighted area to the corresponding sections in the list above: the first arrow points to the entry for `knitr::opts_chunk\$set(...)` and the second to the entry for `eval=TRUE`.

Inline Code

- You can directly include R outputs in markdown texts by enclosing codes with ``r`` and `` ``
- For example,
``r round(pi, 4)``
renders 3.1416 in the output document
- This is useful when you want to include results from your analysis in your report text body



The screenshot shows the RStudio interface with an R Markdown file named "Untitled1". The code block contains the following R Markdown code:

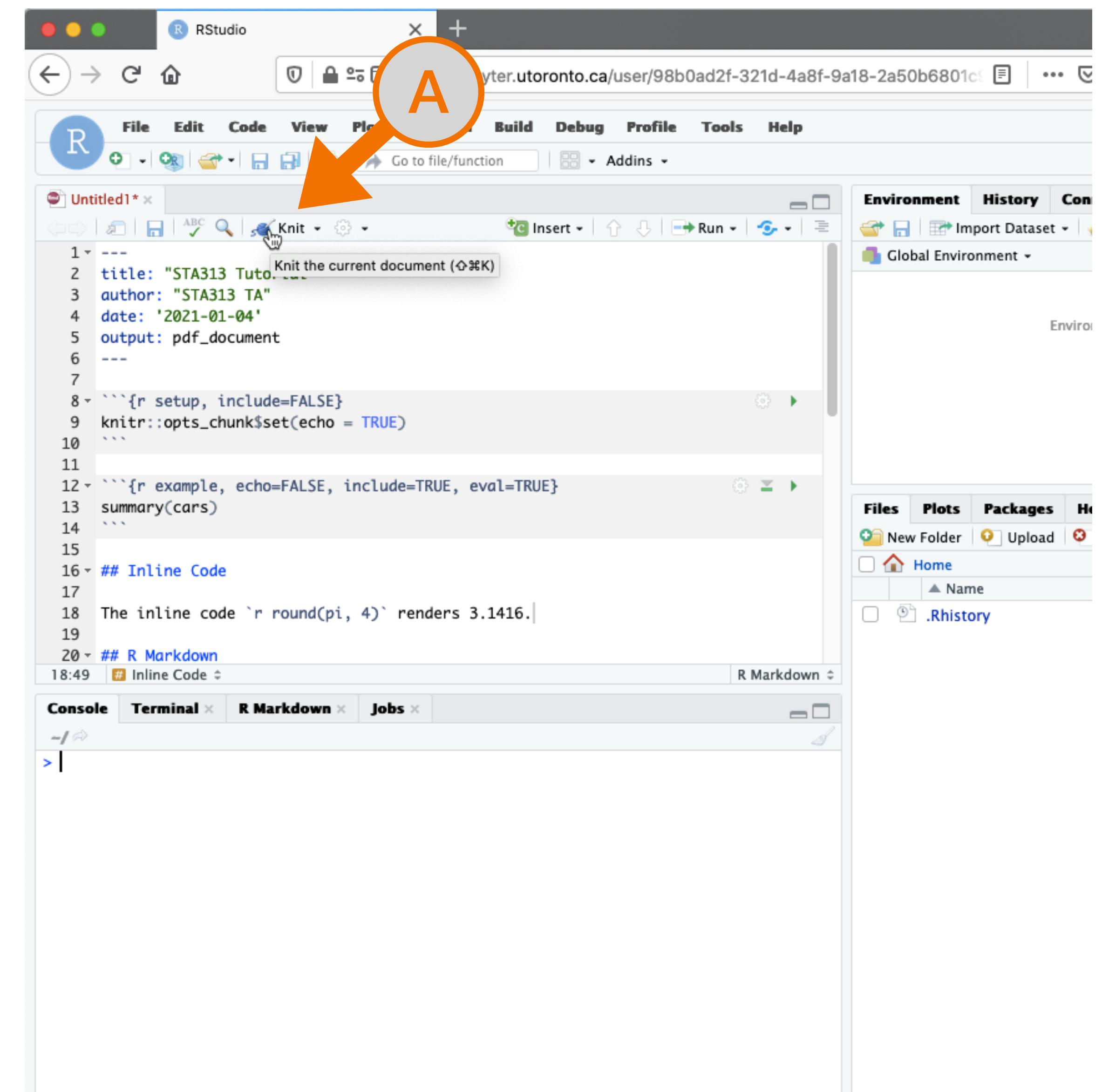
```
1 ---  
2 title: "STA313 Tutorial"  
3 author: "STA313 TA"  
4 date: '2021-01-04'  
5 output: pdf_document  
6 ---  
7  
8 ```{r setup, include=FALSE}  
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13 summary(cars)  
14 ```  
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19  
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18:49 # Inline Code
```

A callout box highlights the line "The inline code `r round(pi, 4)` renders 3.1416." in the code editor, which is rendered as plain text in the R Markdown preview pane below.

Knitting Document

Knitting renders the document into a PDF document.

1. You can knit the document by
 - i. Clicking **knit (A)** button; or
 - ii. Pressing **Ctrl/Cmd+Shift+K** on keyboard
2. You will be asked to save the document if you haven't
3. **Knit** often to identify errors



Kintted Document

After knitting the document, R Studio will display a preview of the PDF document.

Check to make sure it rendered properly.

The screenshot shows a web browser window displaying a rendered R Markdown document. The page title is "STA313 Tutorial". Below the title are the subtitles "STA313 TA" and "2021-01-04". A callout box points to the YAML block in the top left, which contains metadata like "title: STA313 Tutorial". Another callout box points to a code chunk result, indicating "Code chunk result with echo=FALSE". A third callout box points to the "Result of inline code" section, which displays the output of the R command `summary(cars)`. The page also includes sections for "Inline Code", "R Markdown", and "Including Plots".

The metadata in the YAML block.

STA313 Tutorial

STA313 TA

2021-01-04

```
##      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
```

Inline Code

The inline code 3.1416 renders 3.1416.

R Markdown

This is an R Markdown document. It uses a simple syntax for authoring documents that looks like plain text. For more information about R Markdown, see <http://rmarkdown.rstudio.com>.

When you click the Knit button, R Markdown generates a document that includes both content as well as the R code used to generate it. 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:

Markdown and LaTeX

Markdown

R Markdown uses markdown to format text.

Markdown is a mark-up language for
formatting texts.

You can think of HTML but with
simpler, typing-friendly syntax.

What it is NOT is a WYSWYG word
processor like MS Word.

Headings

Organise your document using appropriate headings. # indicates the line of text is a heading.

There should be no space in front of #

Heading 1

Heading 2

Heading 3

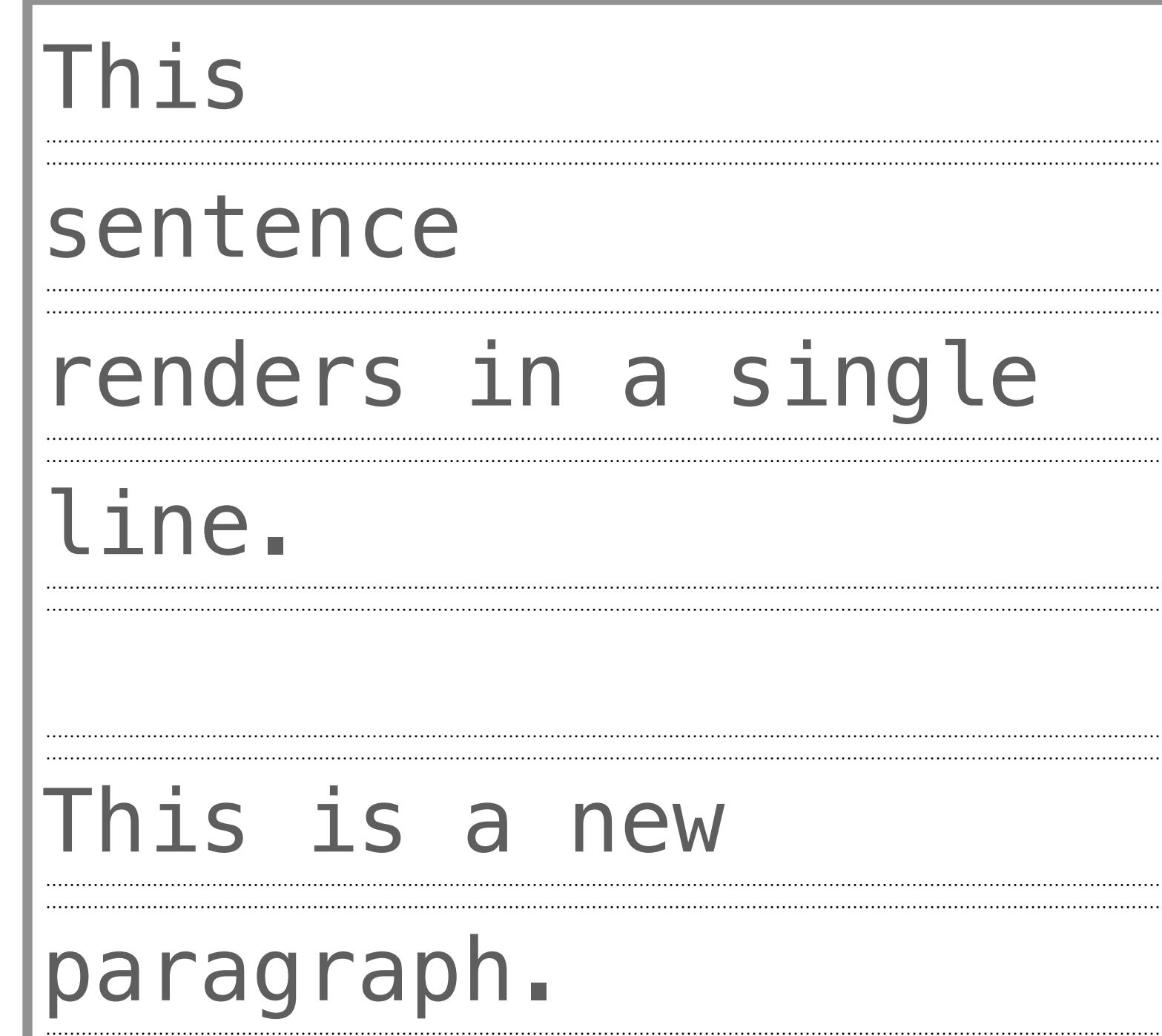
Heading 4

There should be a single space between # and heading text

Paragraphs

In markdown, you need to explicitly mark where to start a new line or a new paragraph.

- An empty line separate two paragraphs
- Two empty spaces followed by a new line inserts a line break without creating a new paragraph
- Alternatively, you can use LaTeX syntax `\\"` to mark a new line



This
sentence
renders in a single
line.

This is a new
paragraph.

Lists

Lists can be easily typed in markdown - ordered or unordered.

- You can use +, -, or * to create unordered lists
- You can create ordered (numbered) lists with numbers followed by . or)
- There are no spaces before the symbols and at least one space between the symbol and item text

```
+ This is  
+ an unordered  
+ list rendered  
+ with bullet points  
  
1. This is an item  
2. in a numbered list
```

Math Equations

You can include math expressions using LaTeX syntax.

- `$...$` renders mathematical expressions inline
- `$$...$$` renders mathematical expressions in display mode in a separate paragraph and centred
- See <https://en.wikibooks.org/wiki/LaTeX> and <http://ctan.mirror.colo-serv.net/info/lshort/english/lshort.pdf> if you need resources on LaTeX

This α^1
renders inline.

β_2 renders
in a separate
paragraph.

Tables

You can use `knit::kable` inside a code chunk to display data in a nicely formatted tables.

Below code chunk creates a table with a caption.

```
```{r sometable}
library(knitr)
tbl <- data.frame(...)
kable(tbl,
 format='latex',
 booktabs=TRUE,
 caption='Caption for table',
 digits=2)
```

Indicates the table is for a PDF document.

booktabs is a LaTeX package that creates clean-looking tables.  
You need to include `\usepackage{booktabs}` in the YAML under header-includes.

The code render a formatted table with a caption in PDF.

Table: Caption for table

Labels	Numbers	Decimals
Label 1	1000	1.00
Label 2	200	3.14
Label 3	-35	2.72

# Figures

**You can include plots by generating plots in code chunks with rendering options specified using code chunk parameters.**

Below code chunk renders a plot

fitted to 50% of the line width.

```
```{r someplot, fig.width=4, fig.height=3,
out.width=".5\\linewidth", fig.cap="Figure
Caption", fig.align="center"}
plot(...)

# plotting code here

)
```

```

- `fig.width` and `fig.height` specify width and height of the figure in inches before placing on the document
  - `out.width` specifies the width of the rendered image on the document; you can specify relative to the document width
  - Try different values for the figure sizes to render your figure in the desired size and resolution.
  - `fig.cap` specifies the figure caption
  - `fig.align` specifies figure alignment

A sample R Markdown document is available at Quercus for you to try rendering different components on your own.

# Final Tips and References

# Final Tips

- RStudio will explicitly point out errors found in R codes
- output file: <filename>.knit.md followed by error messages in the error log likely indicates that there is a LaTeX syntax error
- Characters with special functions in LaTeX may cause unintended behaviours when used outside markdown text - e.g., `fig.cap`. Often, you can fix errors with these characters by placing \\ in front of the character. e.g., `fig.cap="...50\\%..."` instead of `fig.cap="...50%"`
- Knit your document often, especially after complex LaTeX commands to identify errors early

# Resources

- A quick markdown introduction.  
<https://commonmark.org/help/tutorial/index.html>
- Another markdown reference.  
<https://daringfireball.net/projects/markdown/>
- A simple R Markdown tutorial.  
<https://rmarkdown.rstudio.com/lesson-1.html>
- A comprehensive documentation.  
<https://bookdown.org/yihui/rmarkdown>
- Reference for kable and kableExtra for formatting tables.  
[https://haozhu233.github.io/kableExtra/awesome\\_table\\_in\\_pdf.pdf](https://haozhu233.github.io/kableExtra/awesome_table_in_pdf.pdf)