

Introduction to R Markdown

STA237: Probability, Statistics and Data Analysis I
University of Toronto

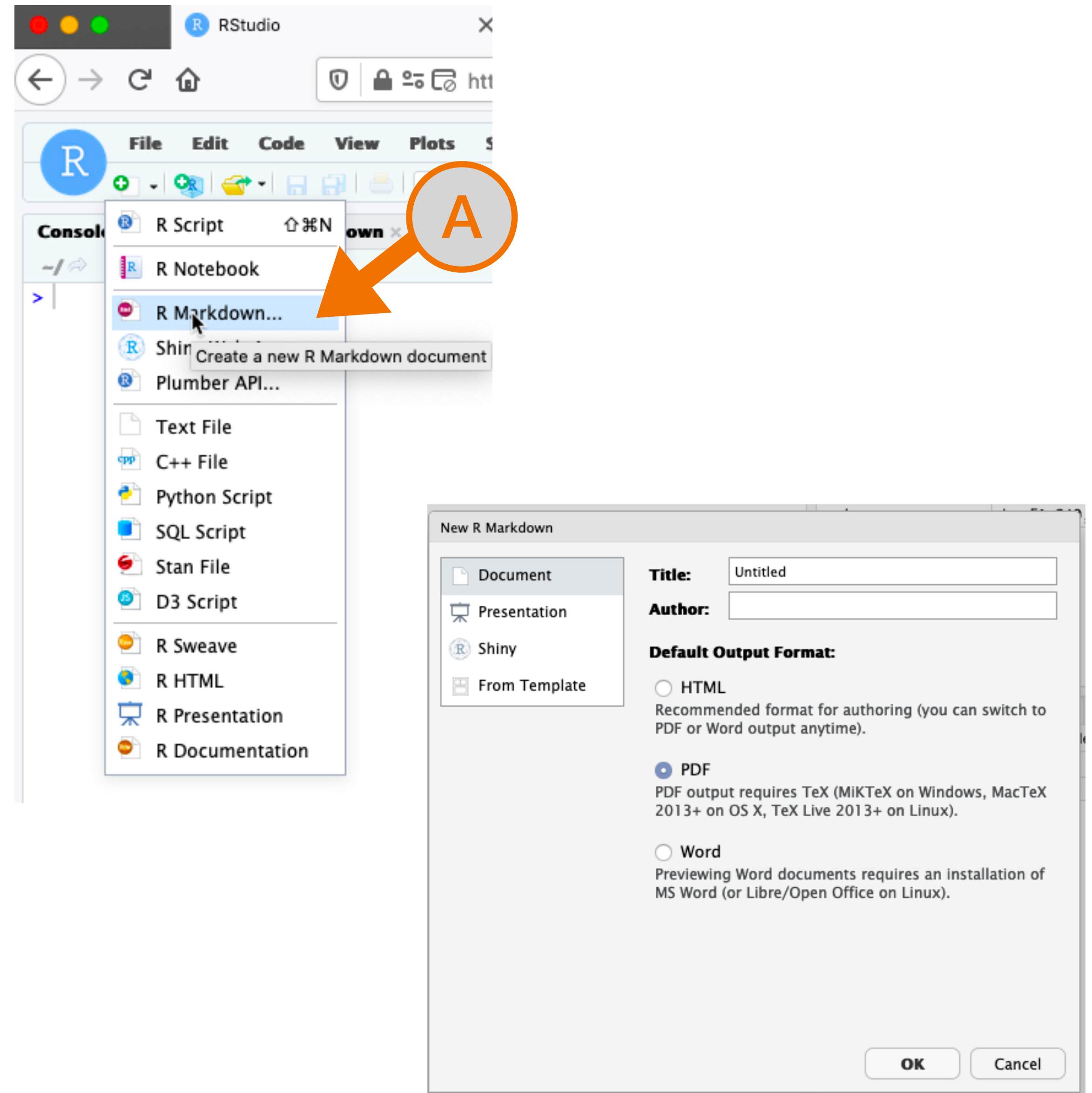
Summer 2021

Creating a PDF document using R Markdown

Create a New Document

Follow the steps to start new R Markdown document.

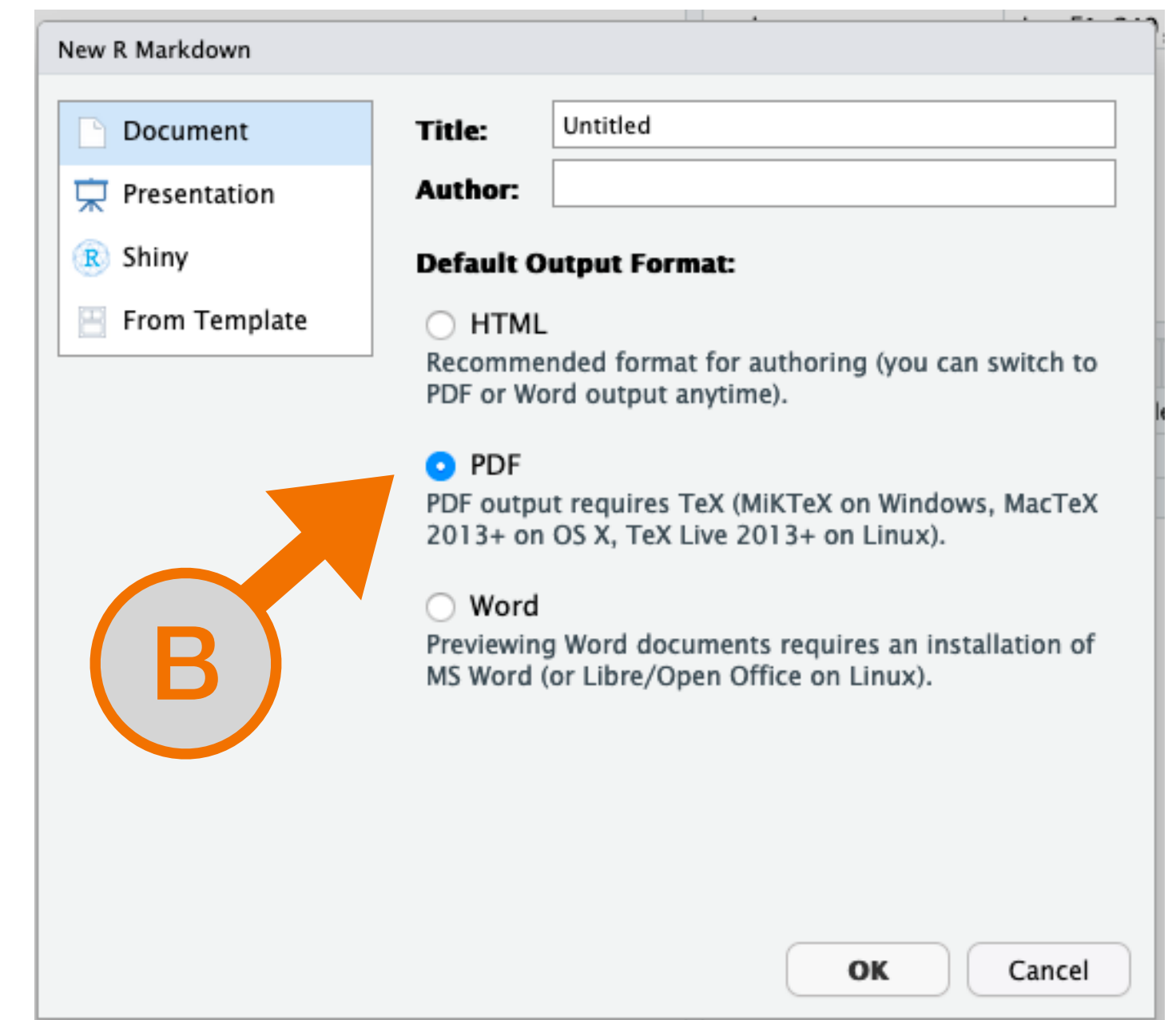
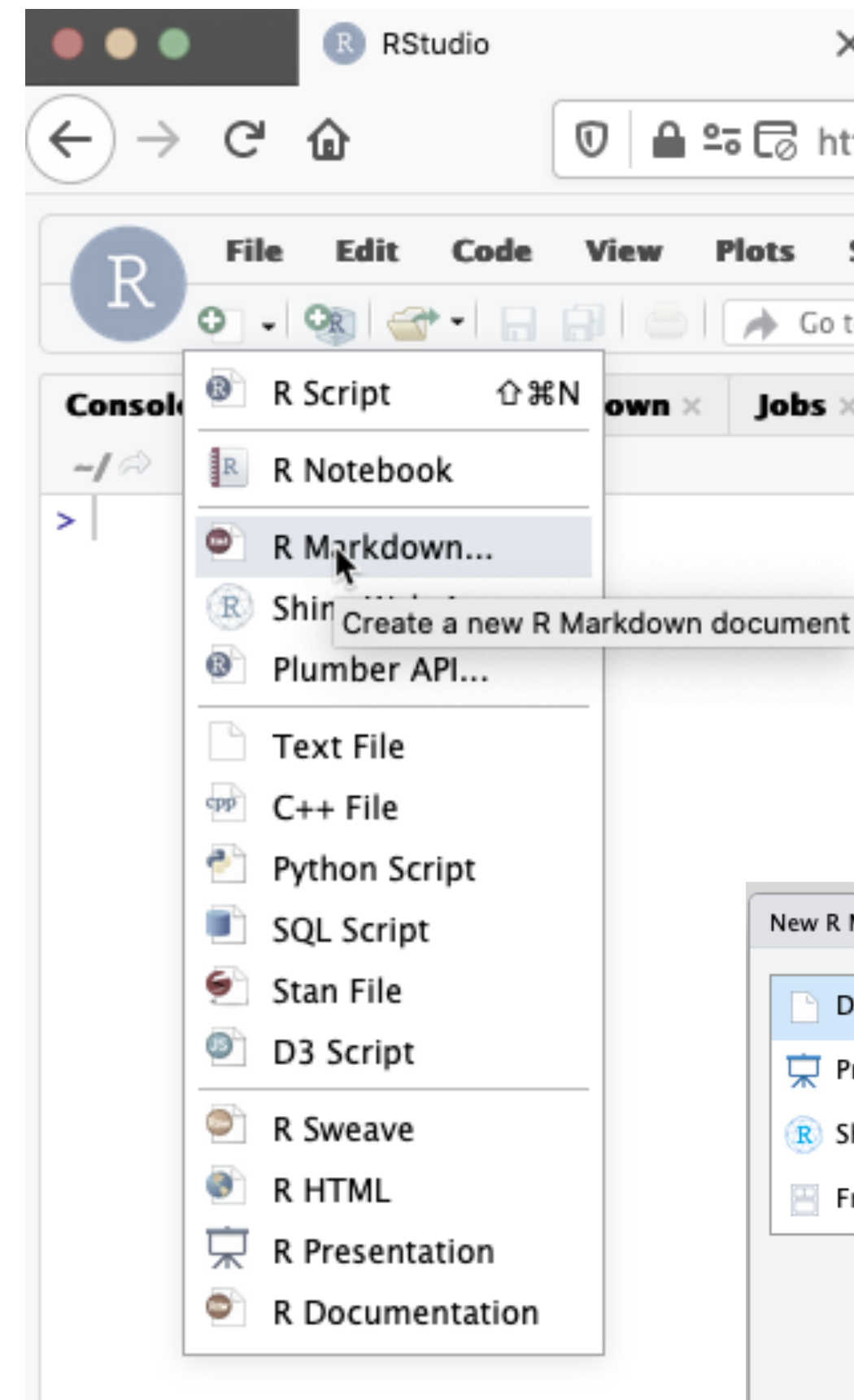
1. Select *R Markdown...* (A) from the New File dropdown menu



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



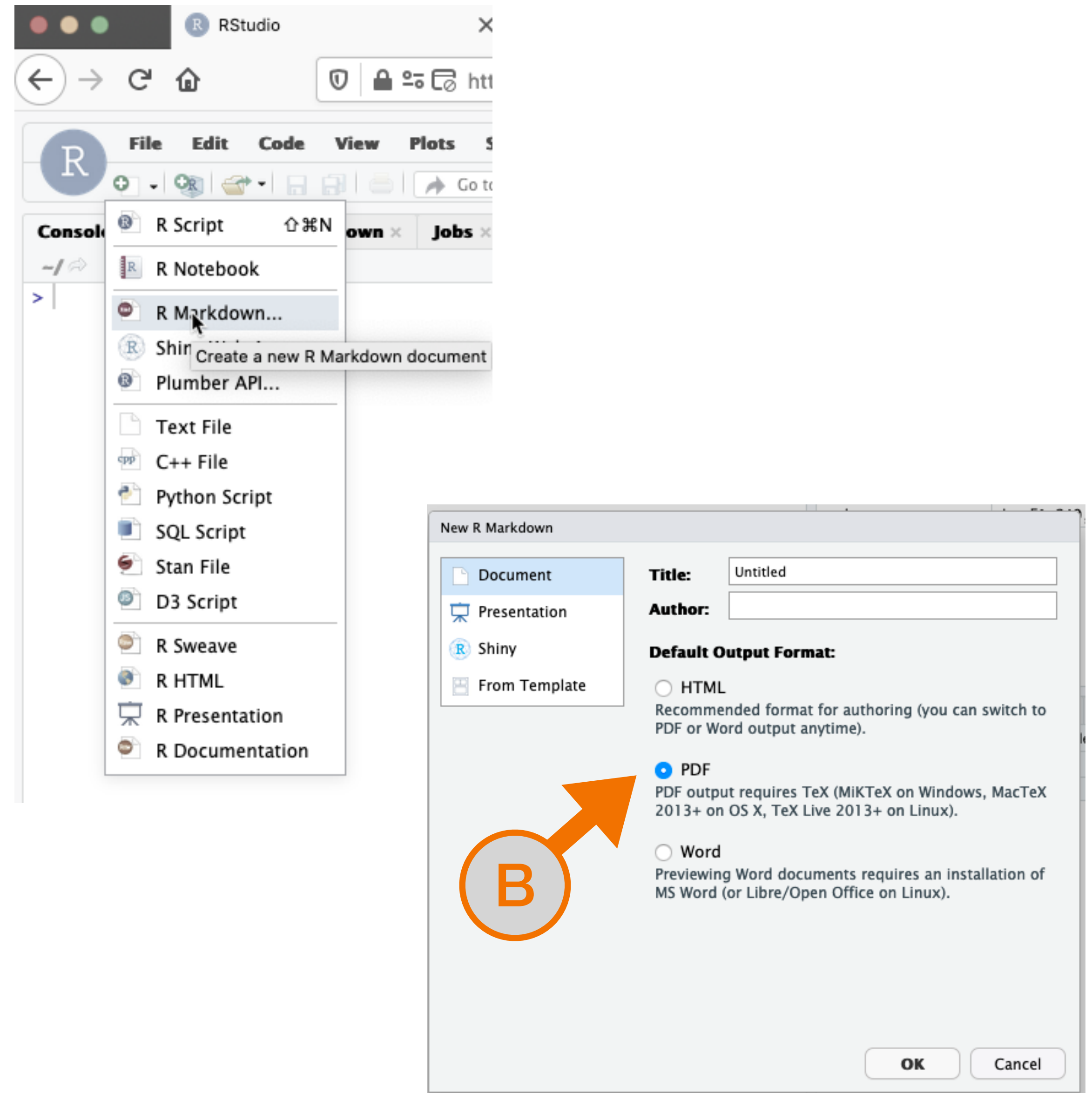
Create a New Document

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

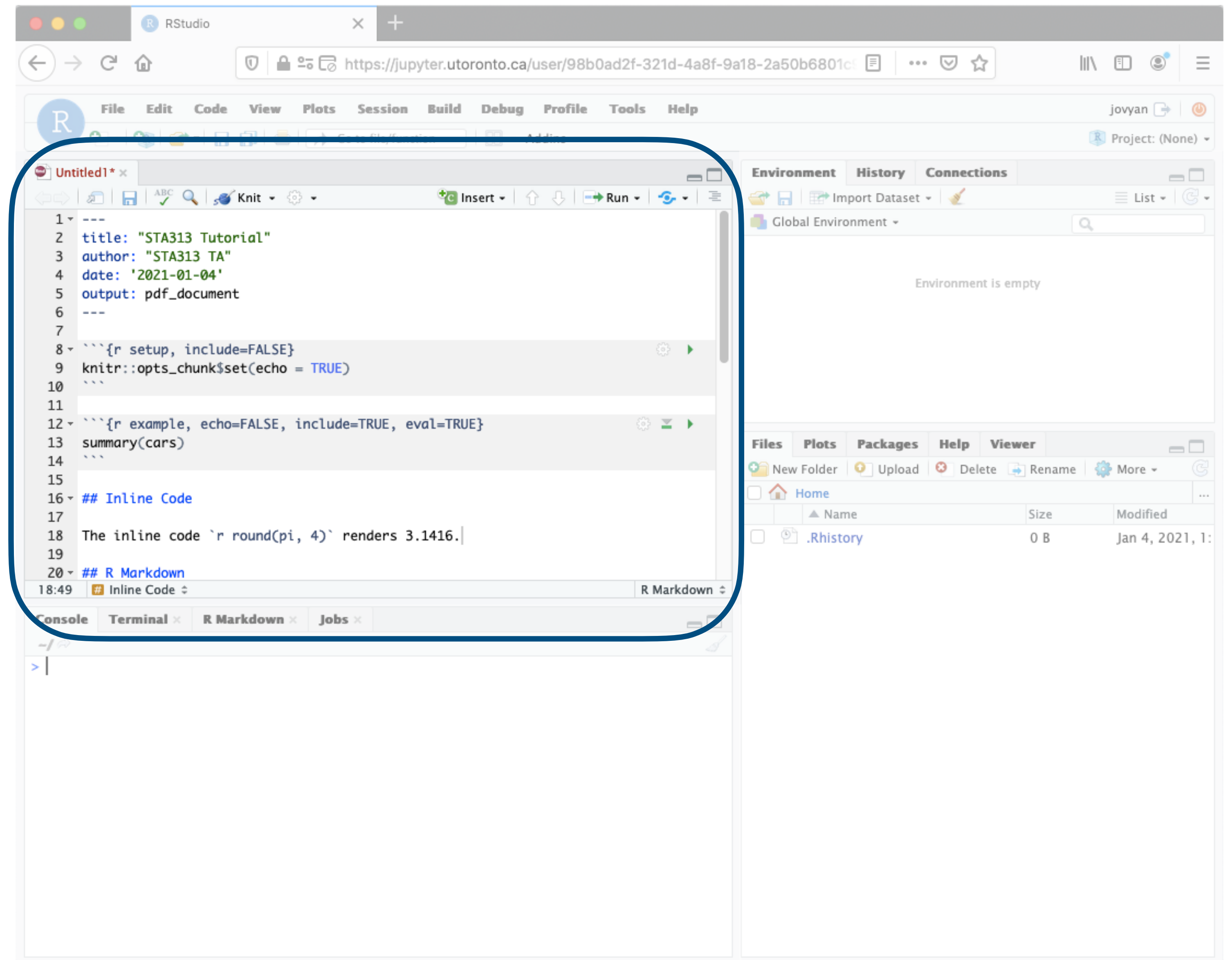
You can also render other document types such as HTML and Word from R Markdown.

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.



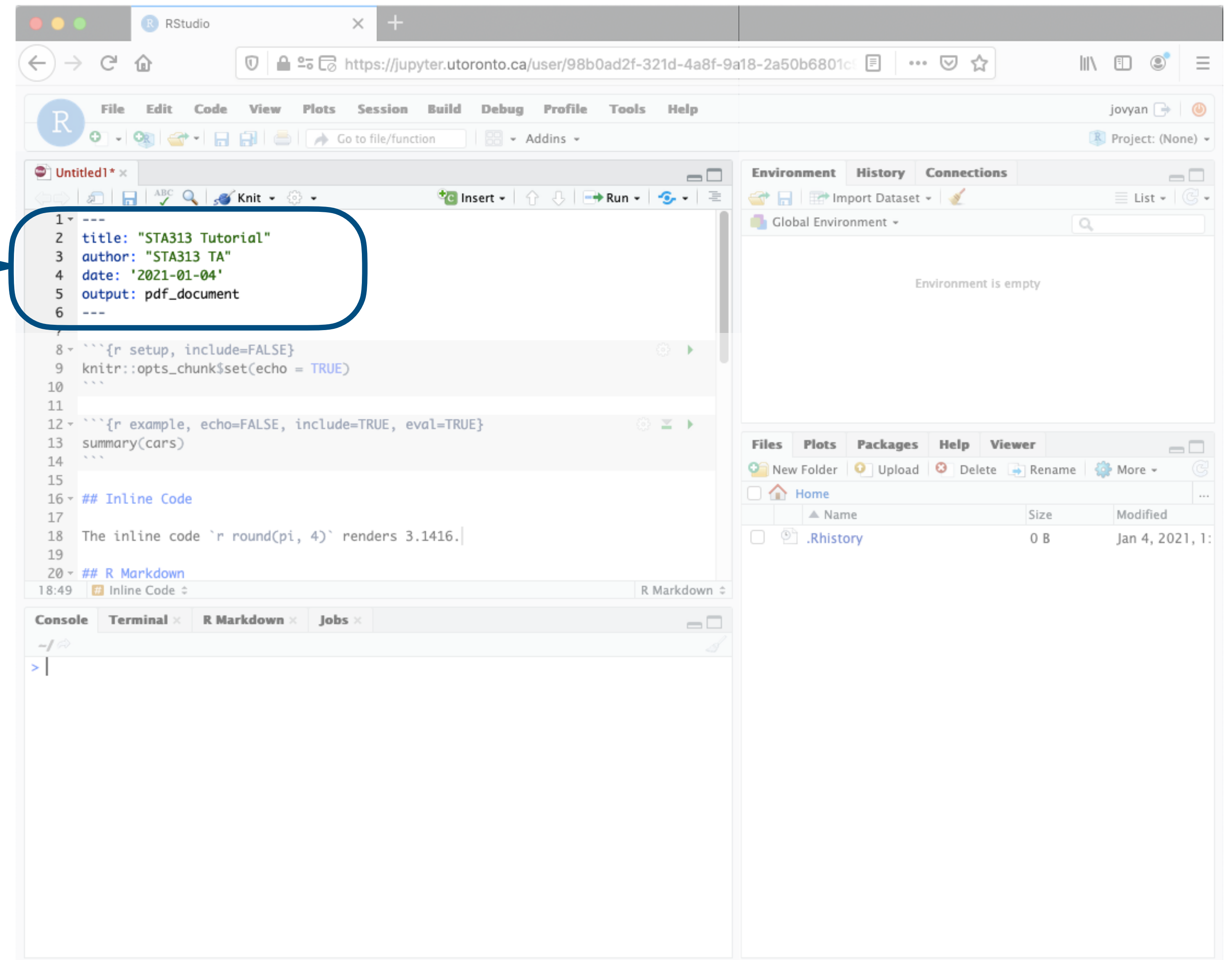
YAML Block

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 a document titled 'Untitled1'. The document content is as follows:

```
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
```

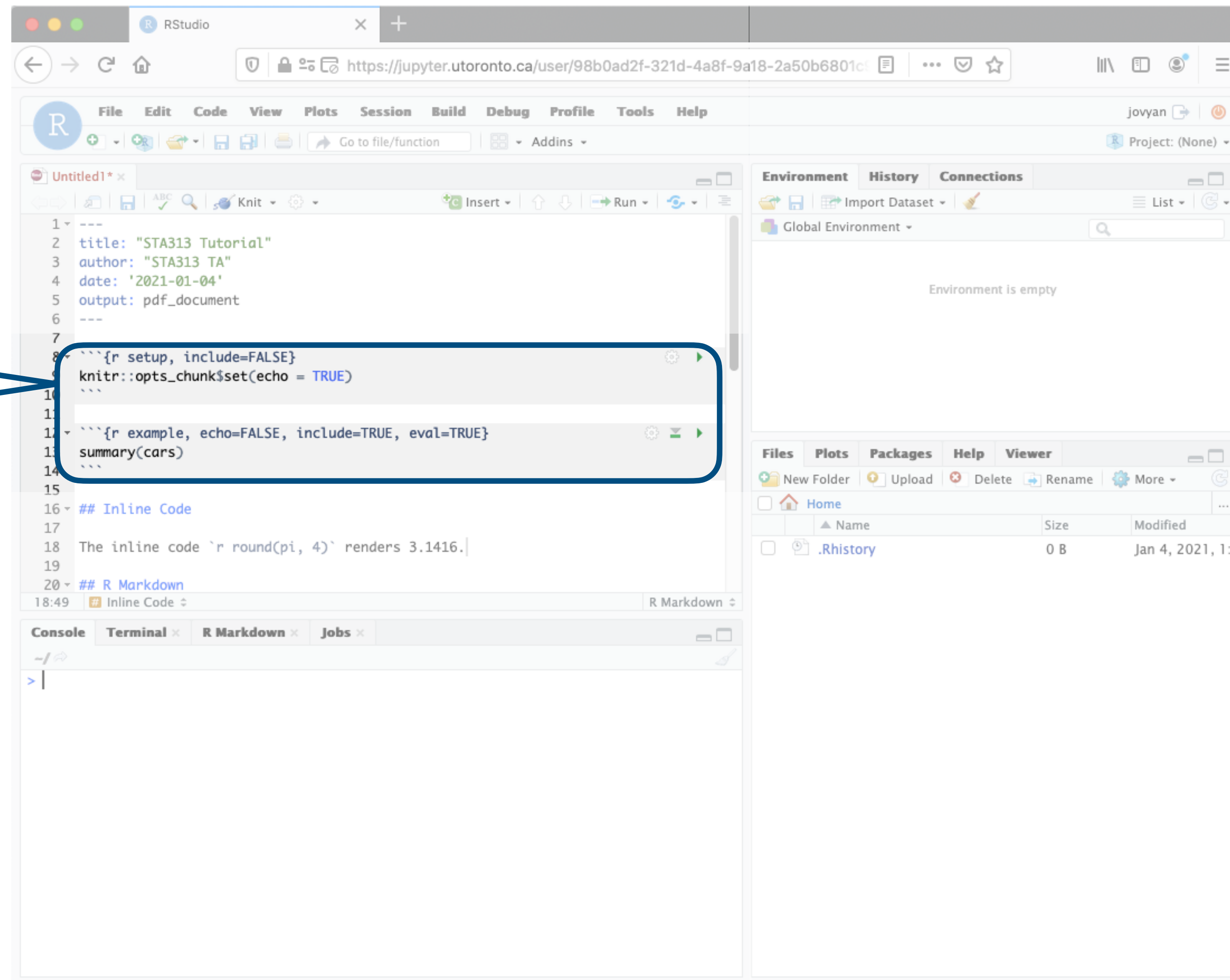
A blue callout box highlights the YAML block (lines 1-6). The right sidebar shows the 'Environment' pane with 'Global Environment' and 'Environment is empty'. The bottom pane shows the 'Console' with a prompt '> |'.

Code Chunk

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

Code chunks are evaluated in the order they appear in the document.

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

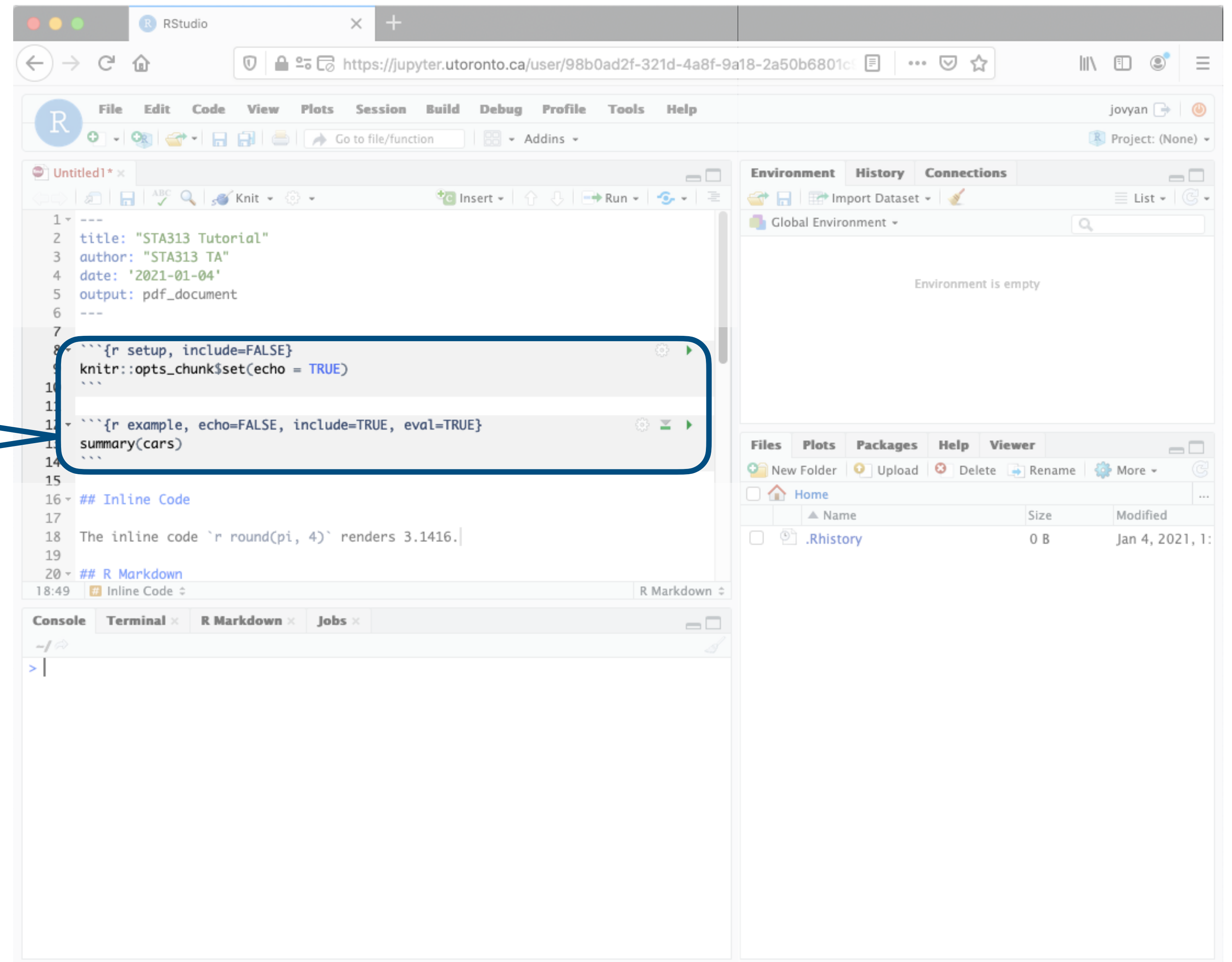


Code Chunk

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

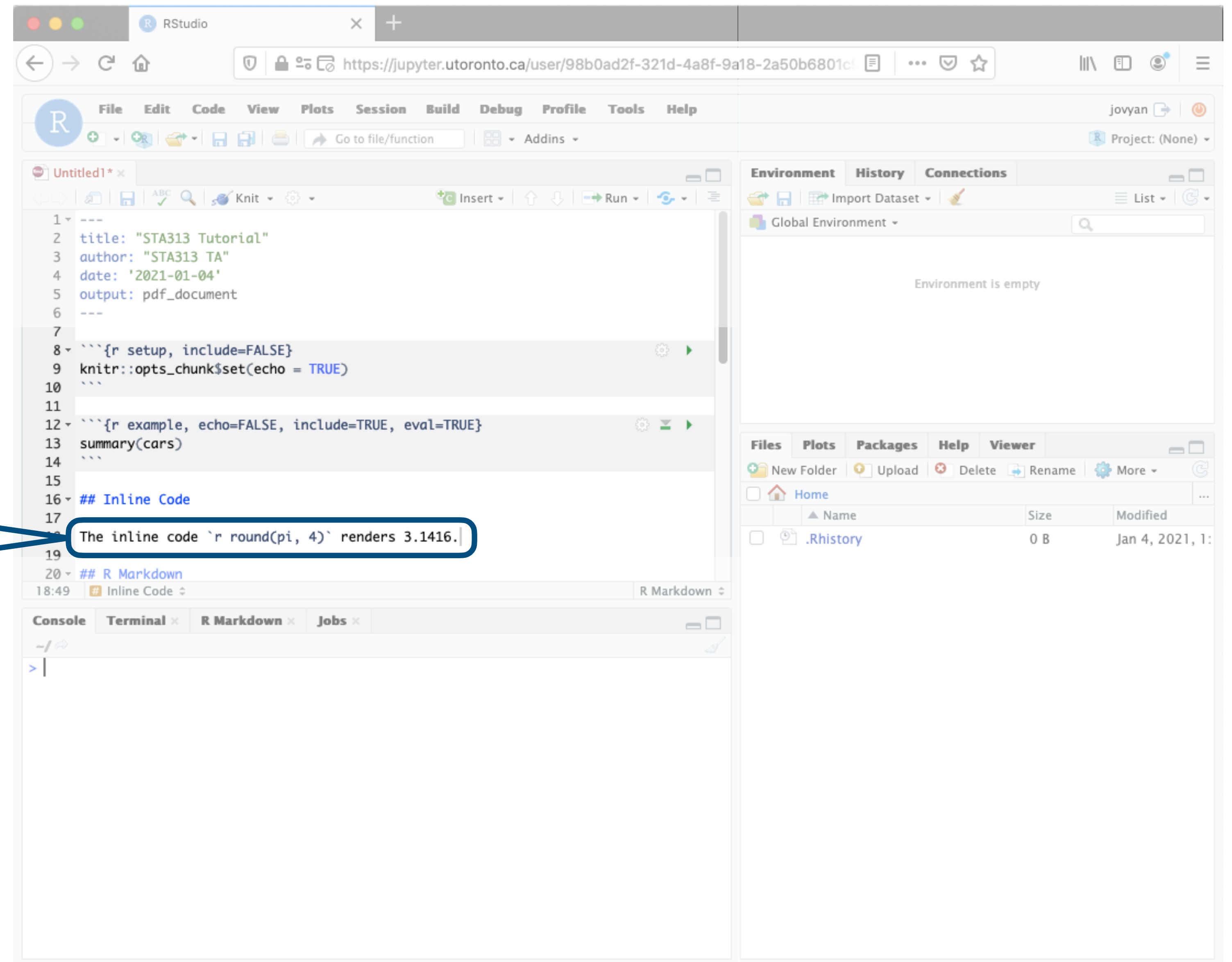
- `echo=FALSE` hides the code chunk
- `include=FALSE` hides the code chunk and the results
- `eval=FALSE` prevents evaluation of the chunk
- `knitr::opts_chunk$set(...)` applies the options to all following chunks

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



Inline Code

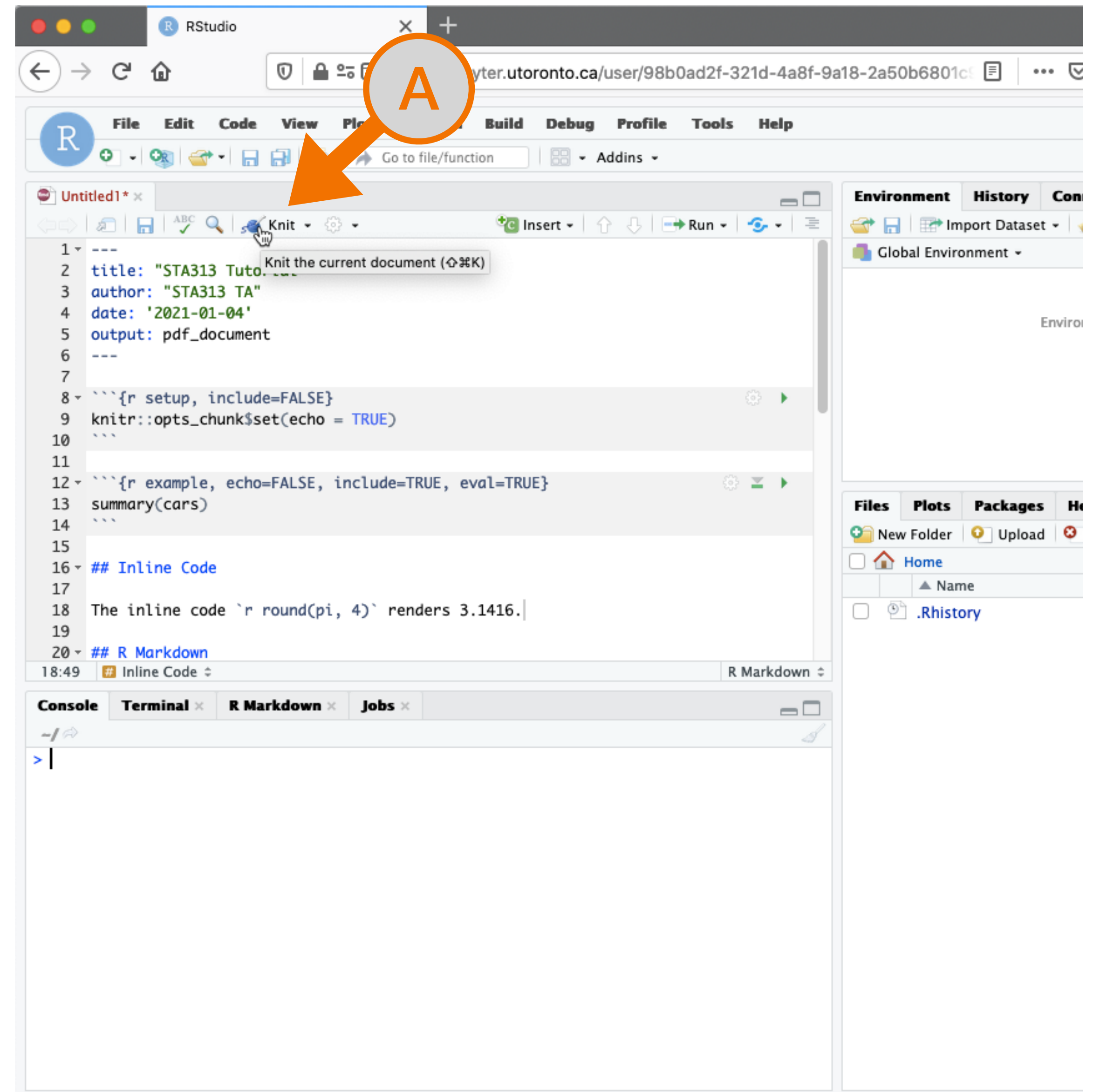
- You can directly include r outputs in markdown texts by enclosing codes with ``r`` and ```
- For example, ``r round(pi,4)`` renders 3.1416 in the output document
- This is useful when you want to include results from your analysis in your report text body



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 PDF document generated from R Markdown. The browser address bar shows the URL: https://jupyter.utoronto.ca/user/98b0ad2f-321d-4a8f-9a18-2a50b6801c9c/rstudio/pdf_js/web/viewer.html?file=. The PDF content includes:

Metadata:

- STA313 Tutorial
- STA313 TA
- 2021-01-04

Code chunk result with `echo=FALSE`:

```
##      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 the same formatting syntax for authoring HTML, PDF, and MS Word documents. For more information on R Markdown, see <http://rmarkdown.rstudio.com>.

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

```
summary(cars)
```

Result of inline code:

```
##      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.

`$$\beta_2$$` renders
in a separate
paragraph.

Tables

You can use `knitr::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.

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

booktabs is a LaTeX package
that creates clean-looking
tables.

You need to include
`\usepackage{booktabs}`
in the YAML under header-
includes.

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