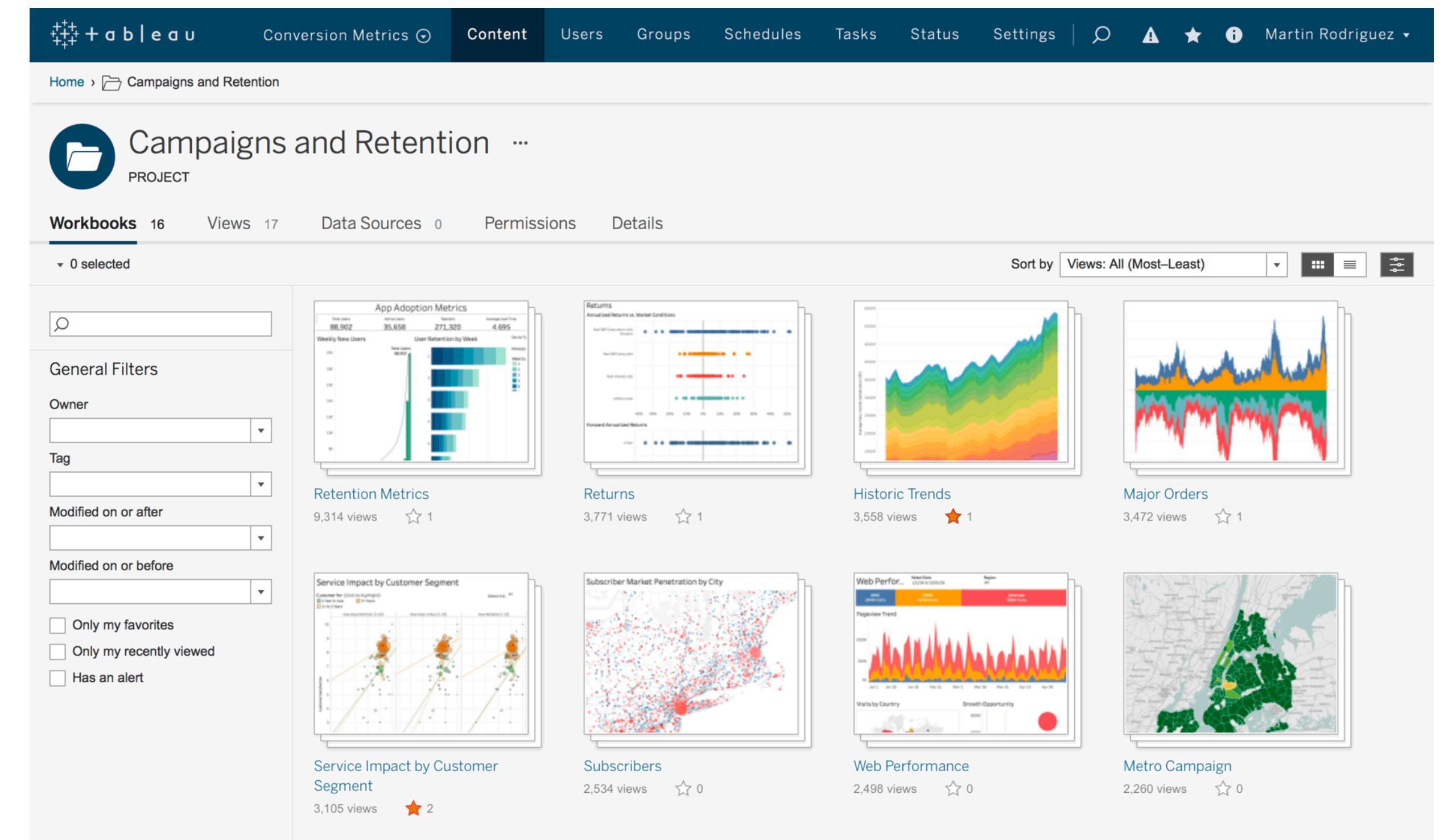
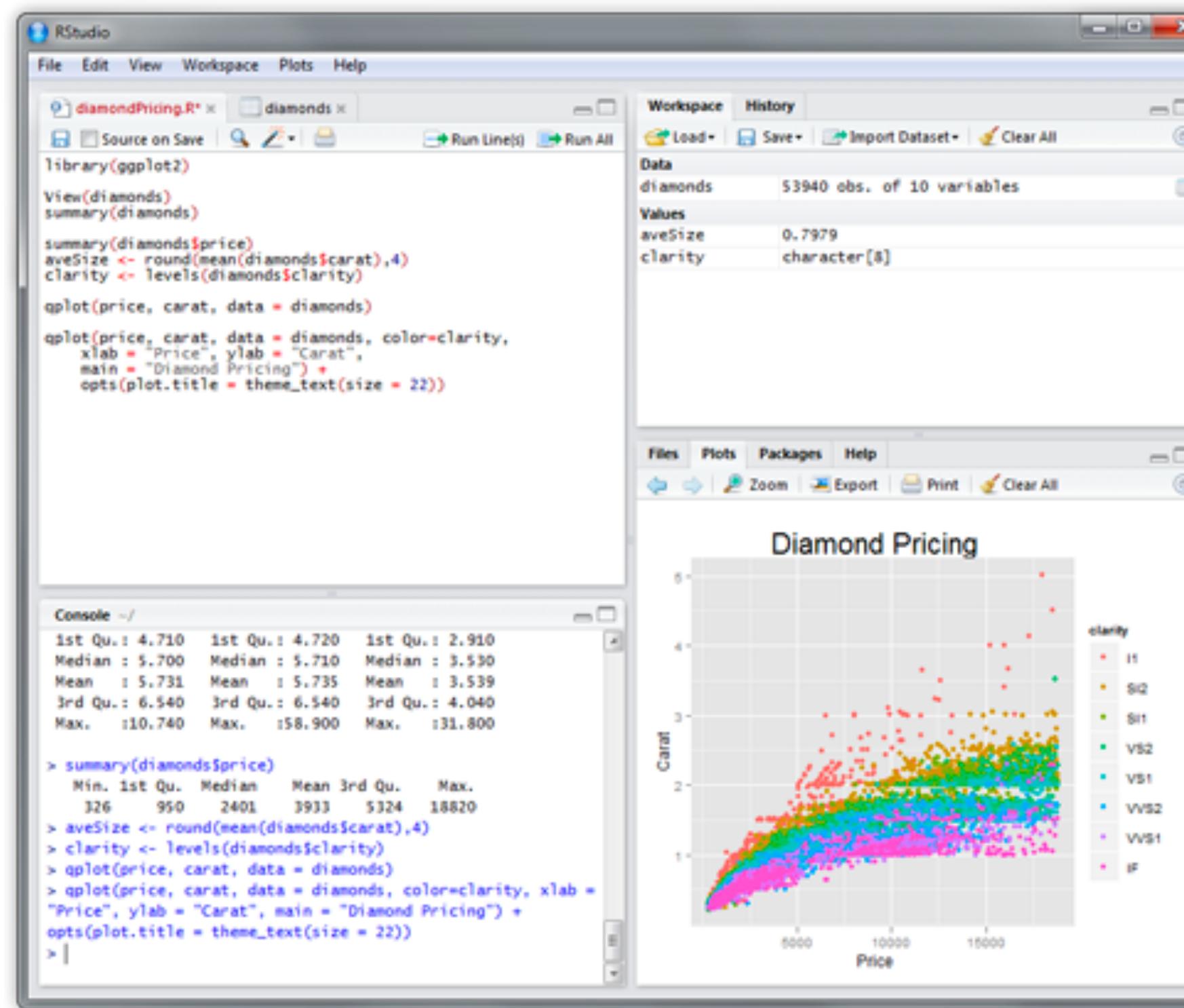


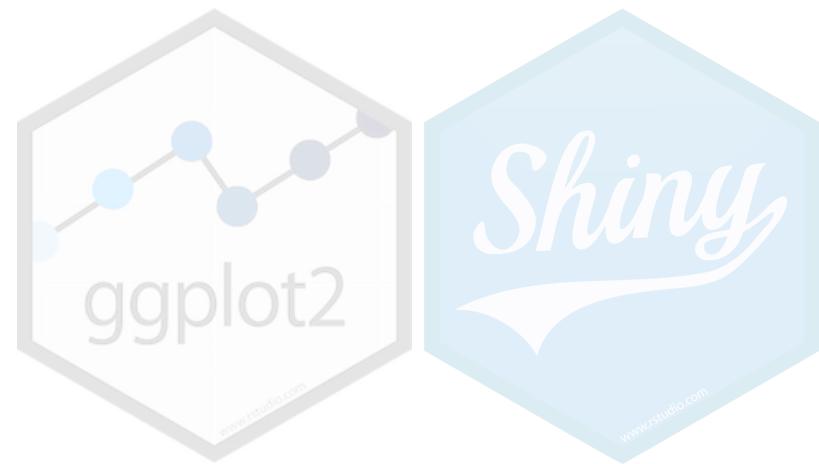
Meet the Toolkit!

STA313 - Data Visualization





Studio®



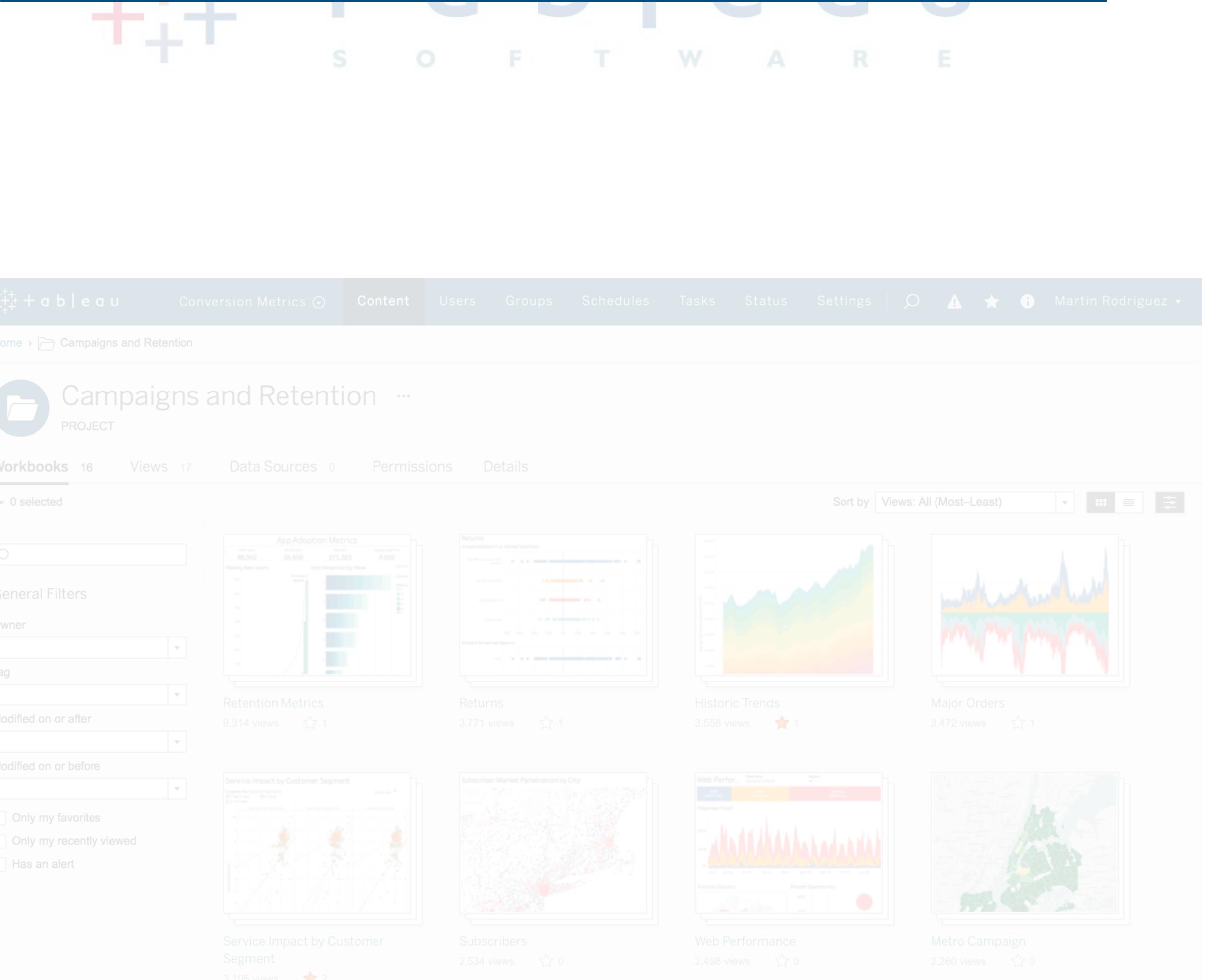
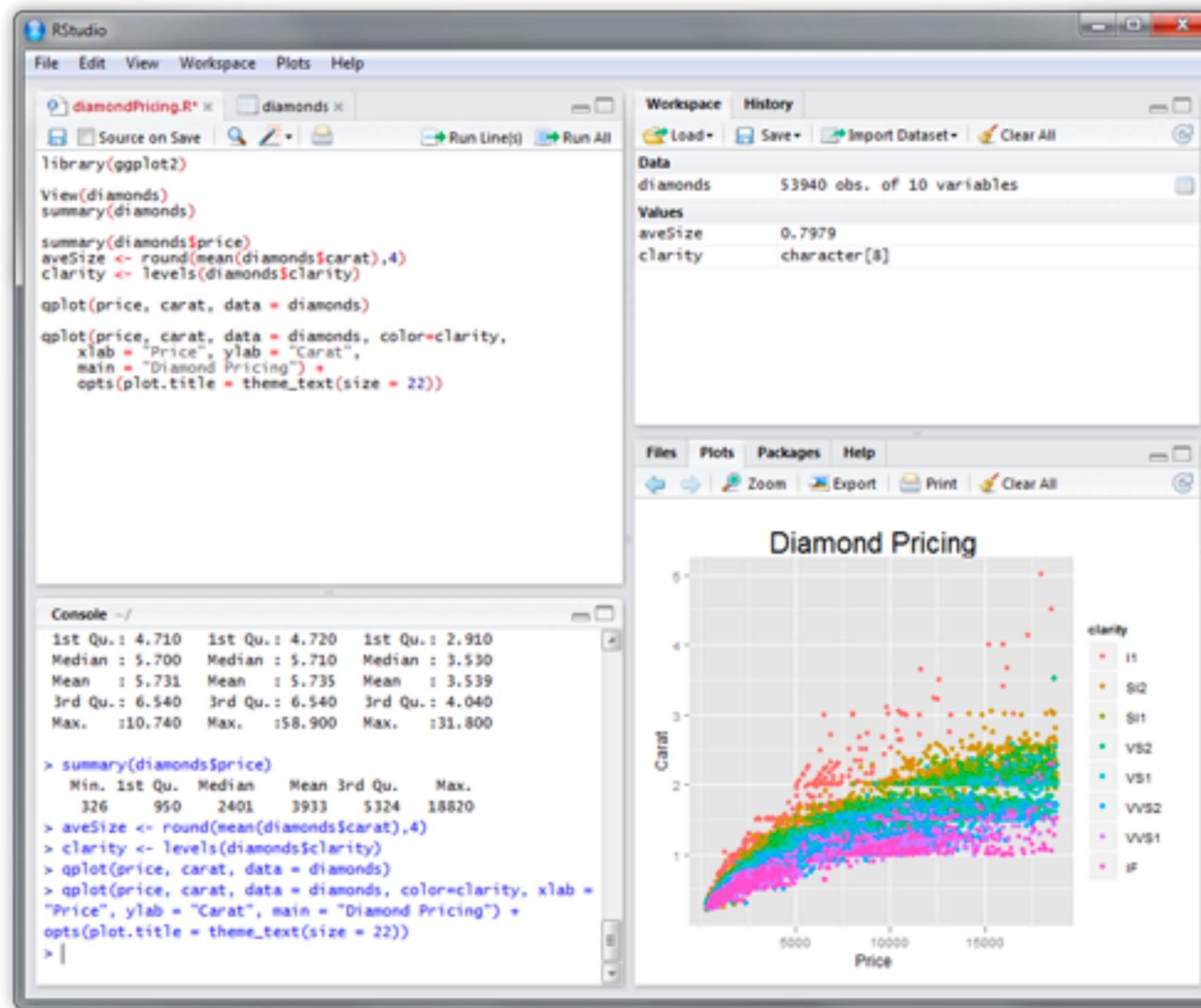
Shiny



rmarkdown



knitr



Two Options for Using R in this course

LOCALLY

Install and run your own copies
of RStudio on your machine.

ONLINE

Run RStudio online via
the University of Toronto
JupyterHub for Teaching

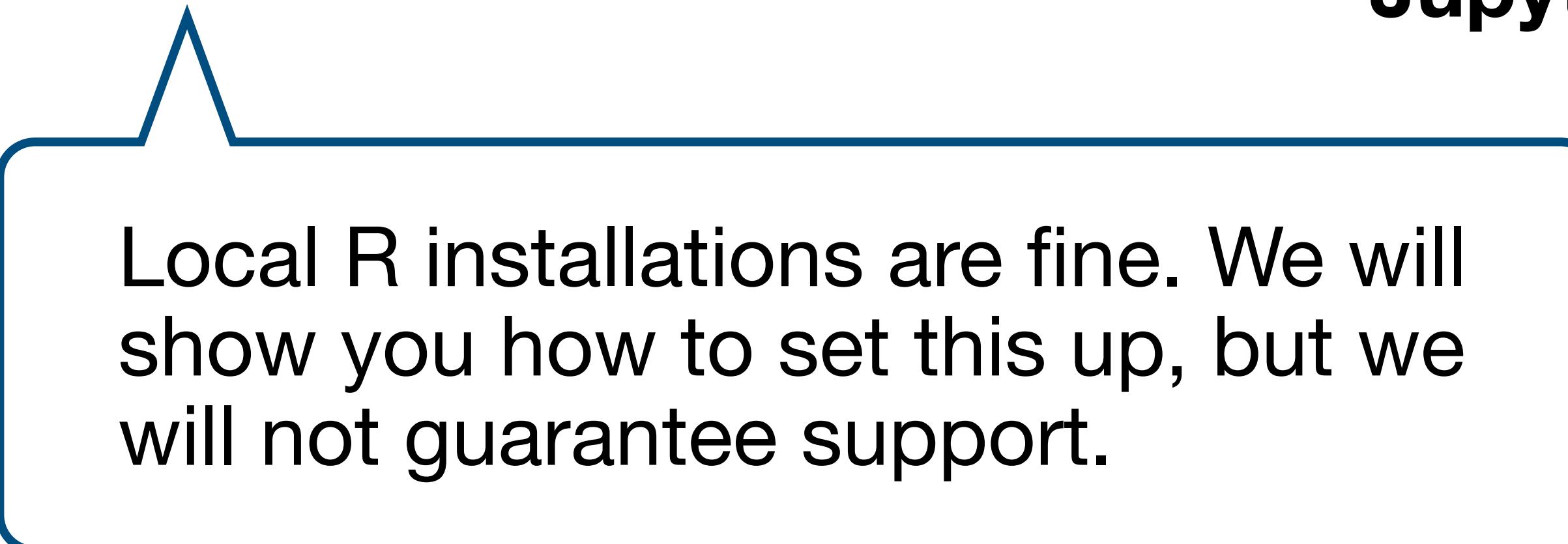
Two Options for Using R in this course

LOCALLY

Install and run your own copies of RStudio on your machine.

ONLINE

Run RStudio online via the University of Toronto **JupyterHub for Teaching**



Local R installations are fine. We will show you how to set this up, but we will not guarantee support.

Two Options for Using R in this course

LOCALLY

Install and run your own copies
of RStudio on your machine.

ONLINE

Run RStudio online via
the University of Toronto
JupyterHub for Teaching

This is the recommended option for
this course.

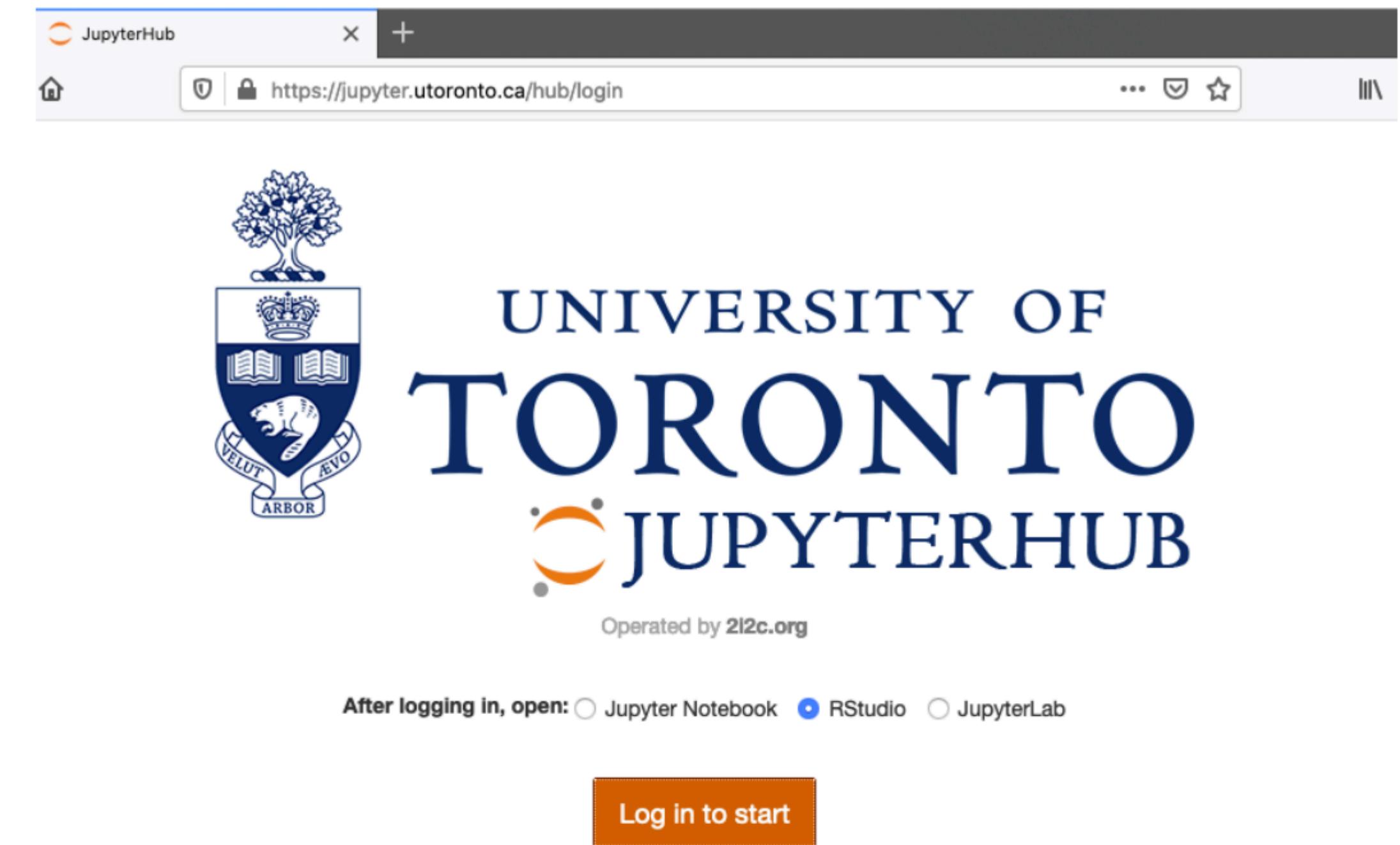
JupyterHub

JupyterHub

Follow the steps to run
RStudio online.

1. Go to UofT JupyterHub

<https://jupyter.utoronto.ca/hub/login>



Welcome to the new
University of Toronto
JupyterHub for Teaching
site.

A proof of concept service, developed as
a partnership between the [Office of the CIO](#) (Information Technology Services), the
Faculty of Arts & Science's new
Computational and Data Science
Education initiative, the [2i2c Consortium](#),
and Microsoft Canada.



JupyterHub

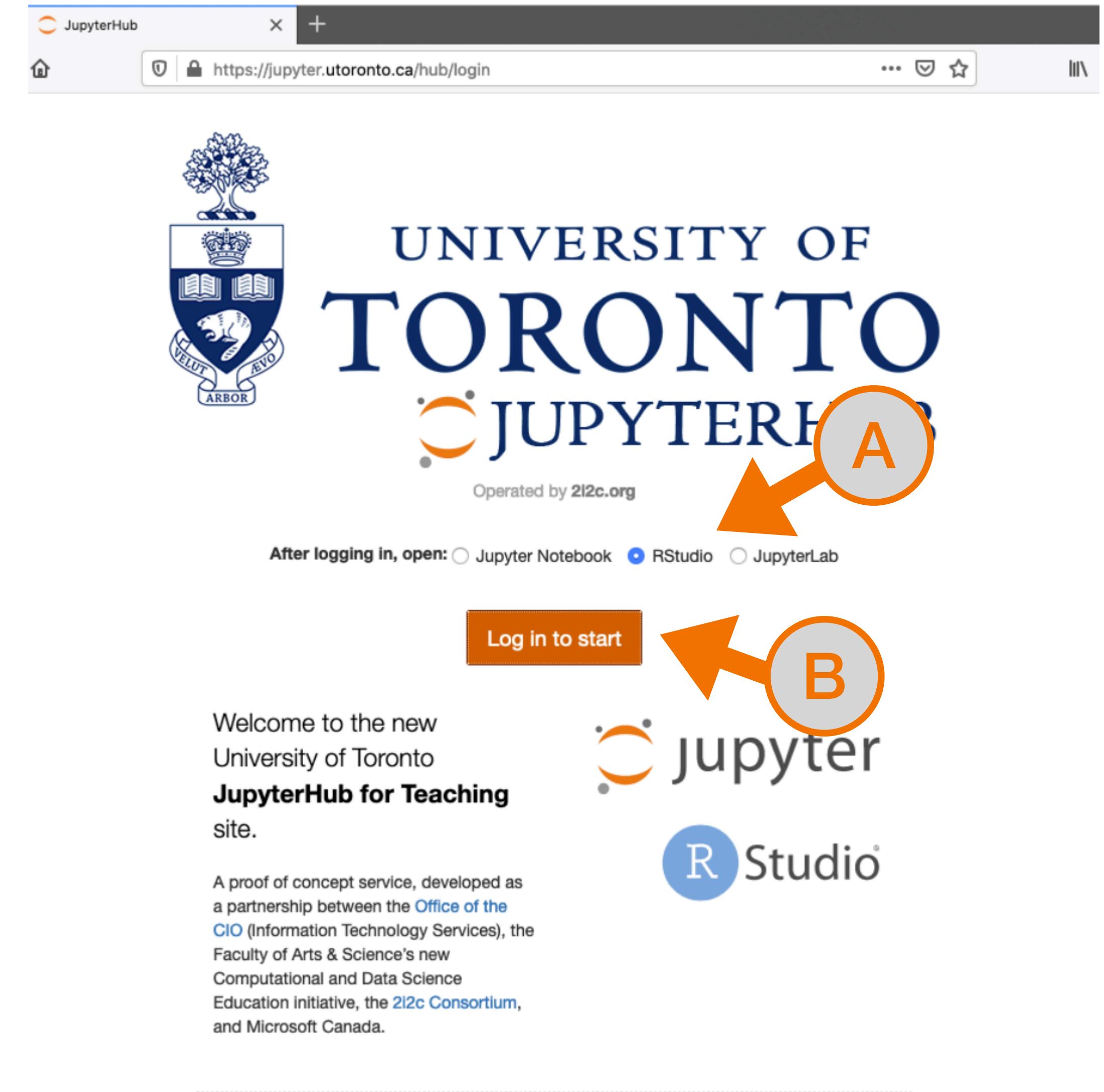
Follow the steps to run
RStudio online.

1. Go to UofT JupyterHub

<https://jupyter.utoronto.ca/hub/login>

2. Select RStudio (A)

and click ‘Log in to start’ (B)



JupyterHub

Follow the steps to run RStudio online.

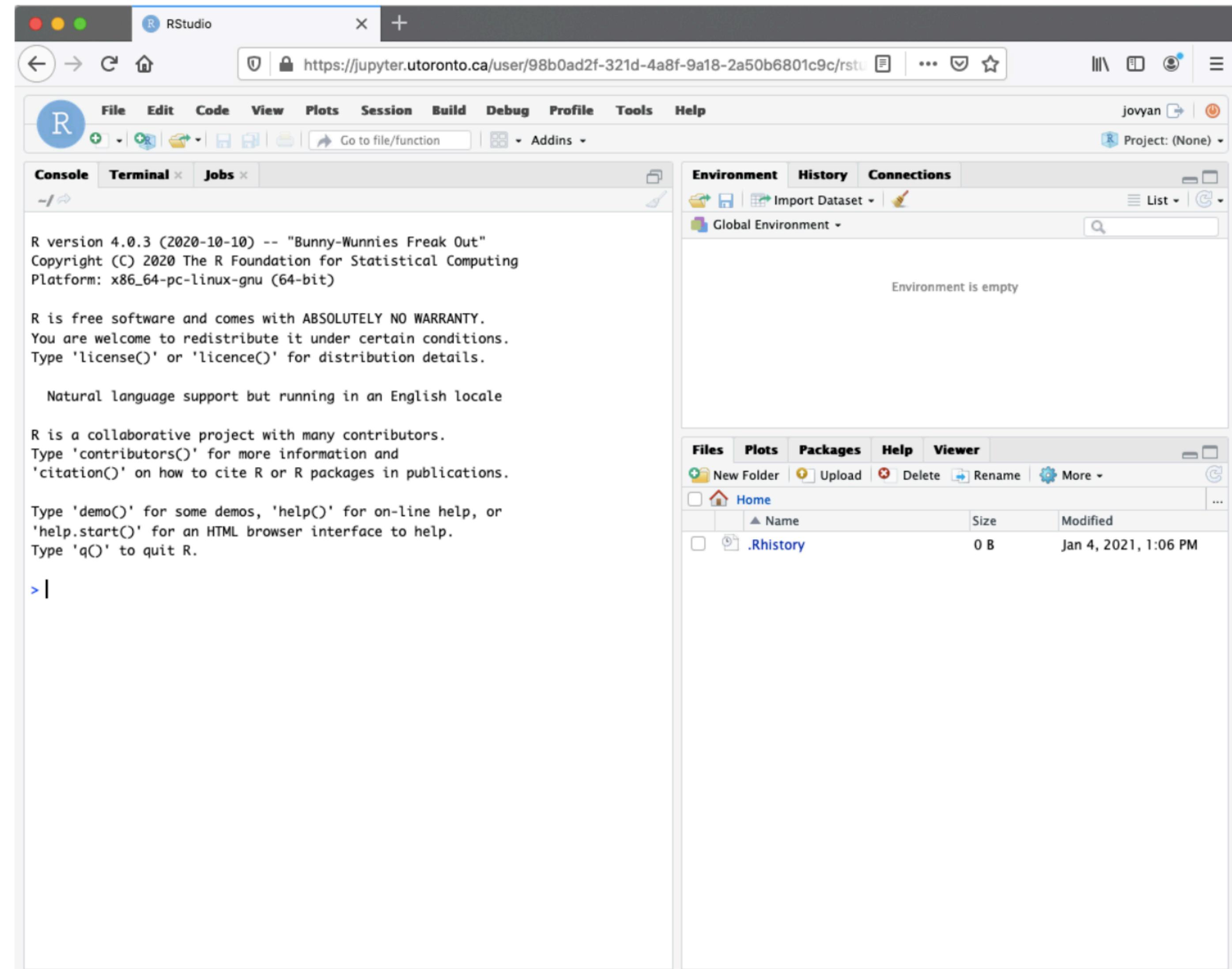
1. Go to UofT JupyterHub
<https://jupyter.utoronto.ca/hub/login>
2. Select RStudio (A)
and click ‘Log in to start’ (B)
3. Follow the prompt to log in using your
UTORid

The image shows the University of Toronto's weblogin idpz interface. At the top, there is a 'Sign in' form with fields for 'UTMail+ email address' and 'Password', and a 'Next' button. Below the form, a banner says 'Welcome to the University of TORONTO'. To the right, the University of Toronto logo is displayed. A sidebar on the right contains the text 'Steps you can take to account:' followed by two green checkmark icons with associated tips: 'Before you begin, make sure you are using a secure connection. This page starts https://idpz.utoronto.ca' and 'When using a public computer, log out of your account when you are finished. This will ensure that your session is terminated when you close your browser or turn off your computer.'

JupyterHub

You will now have access to your personal instance of RStudio Server.

The environment comes with most required packaged installed, including **rmarkdown**.

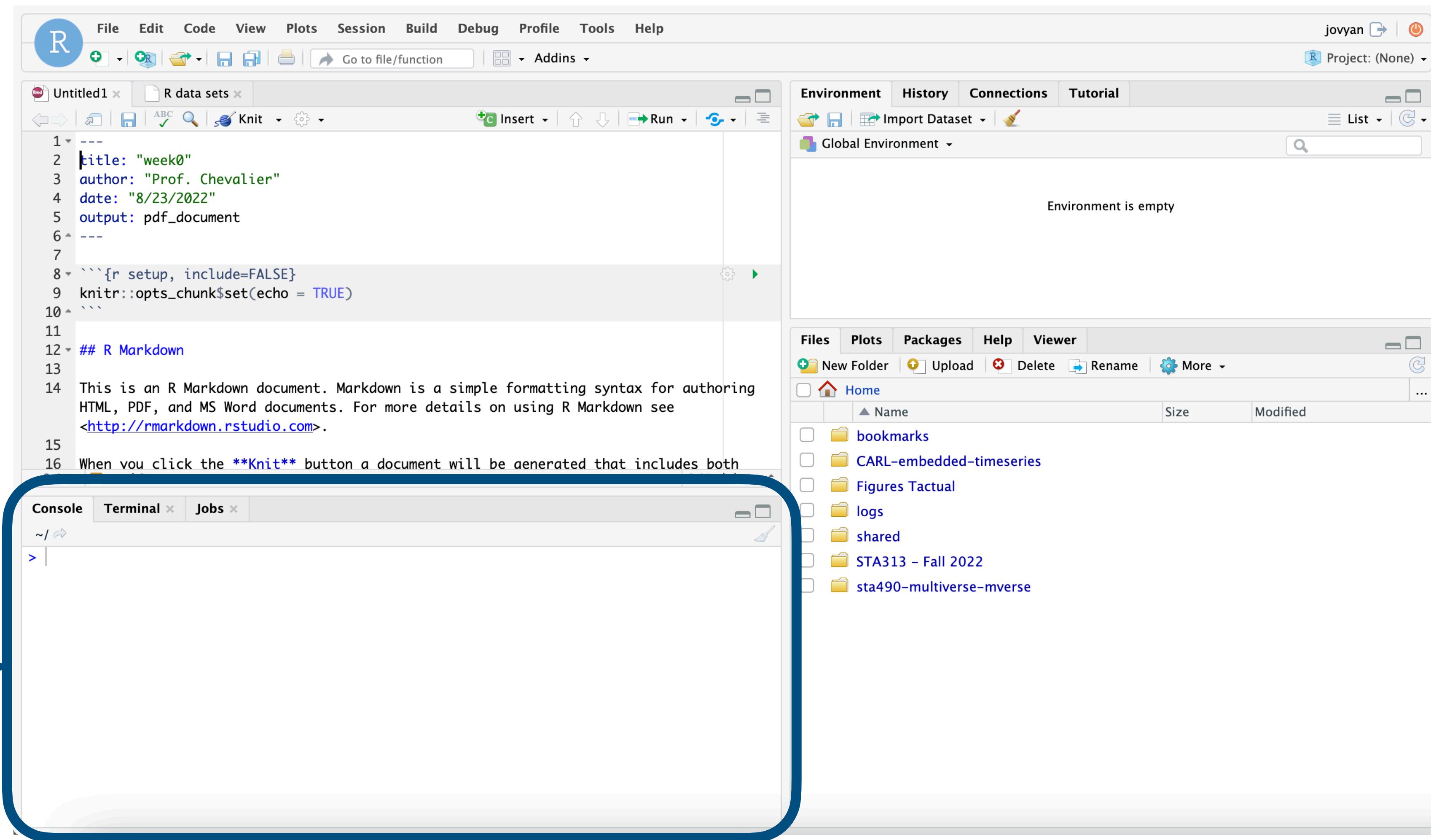


R Script

The screenshot shows the RStudio interface with the following components:

- Top Bar:** File, Edit, Code, View, Plots, Session, Build, Debug, Profile, Tools, Help.
- Project Bar:** Shows "jovyan" and "Project: (None)".
- Code Editor (Untitled1):** Displays an R Markdown script.

```
1 ---  
2 title: "week0"  
3 author: "Prof. Chevalier"  
4 date: "8/23/2022"  
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 documents. For more details on using R Markdown see  
http://rmarkdown.rstudio.com.  
15  
16 When you click the Knit button a document will be generated that includes both  
2:1 # week0
```
- Environment Tab:** Shows "Environment is empty".
- Files Tab:** Shows a file tree with the following contents:
 - bookmarks
 - CARL-embedded-timeseries
 - Figures Tactual
 - logs
 - shared
 - STA313 – Fall 2022
 - sta490-multiverse-mverse
- Console Tab:** Shows the command prompt: >.



The screenshot shows the RStudio interface with the following components:

- R Console:** A blue callout bubble points to the bottom-left panel, which contains the R Console tab. The console output shows the following R code and its results:

```
> knitr::opts_chunk$set(echo = TRUE)
> 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
> plot(pressure)
> plot(pressure)
>
```
- Global Environment:** This panel shows the current environment state. It displays the message "Environment is empty".
- Project Explorer:** This panel shows the project structure under "Home". The visible folders are: bookmarks, CARL-embedded-timeseries, Figures Tactual, logs, shared, STA313 – Fall 2022, and sta490-multiverse-mverse.

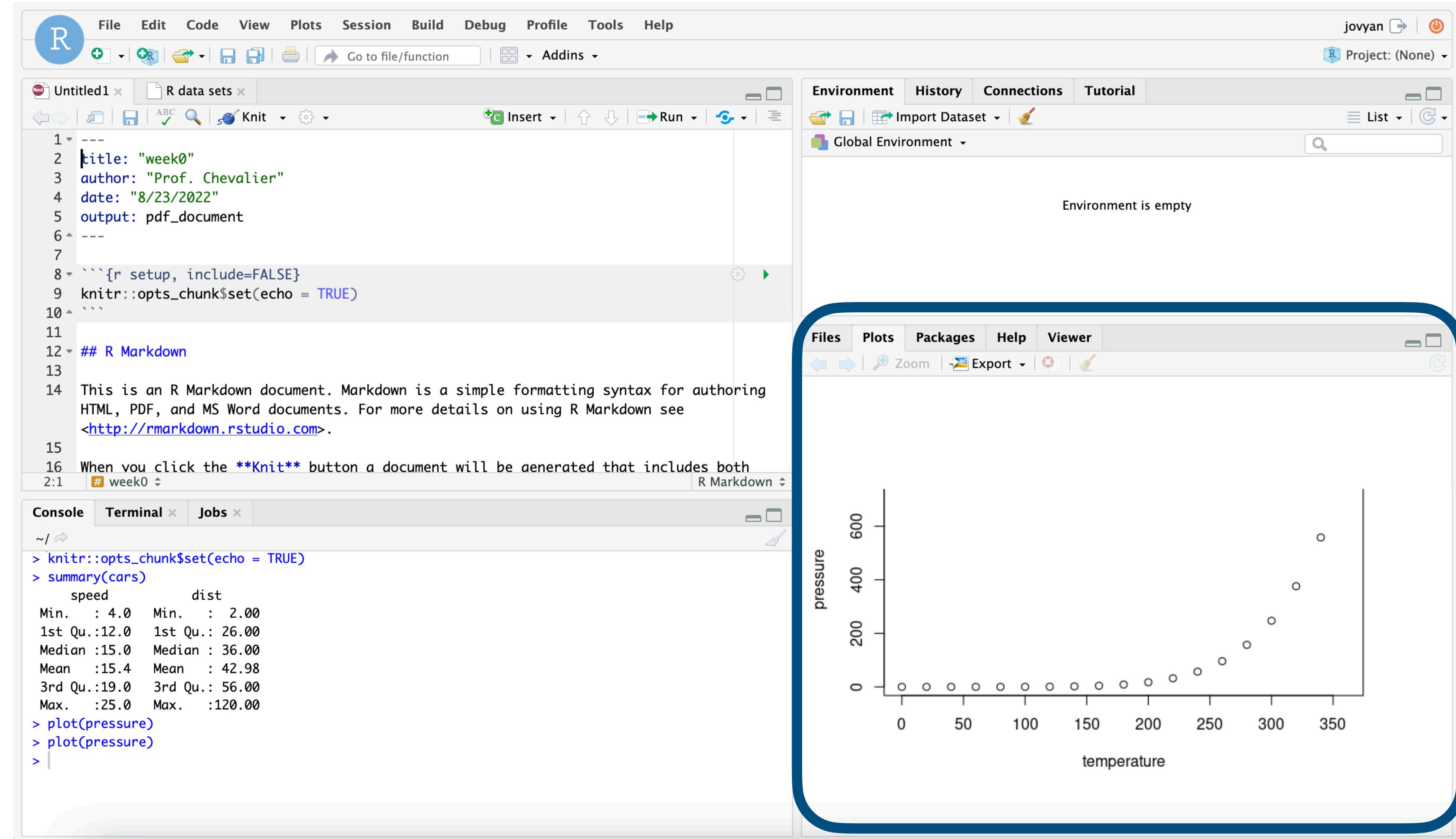
R Console

The screenshot shows the RStudio interface with several panes:

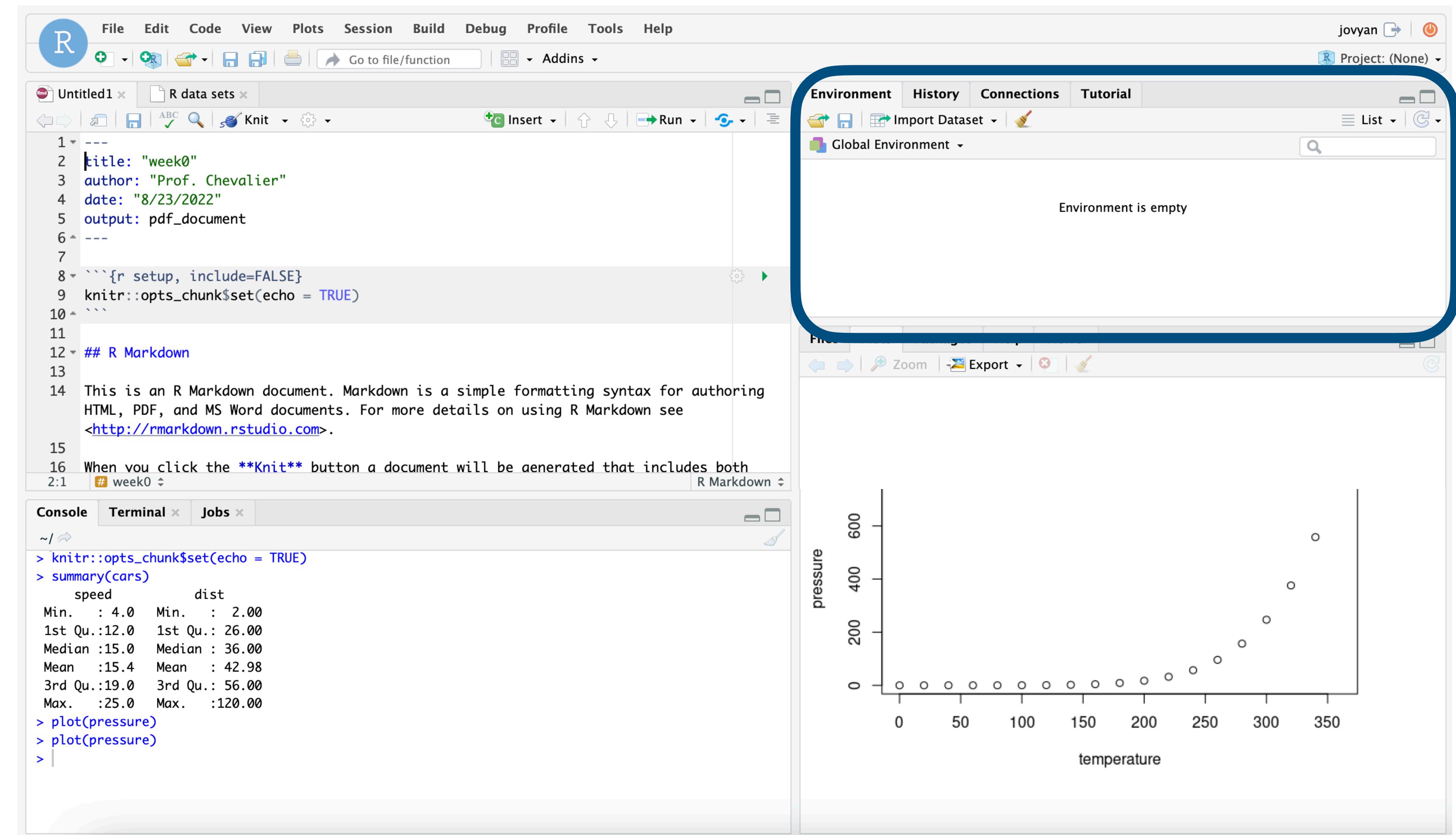
- Code pane:** Displays an R Markdown document named "Untitled1". The code includes setup code for a PDF document, R Markdown syntax, and a summary of the "cars" dataset.
- Console pane:** Shows the output of running the R Markdown code, including the summary of the "cars" dataset and two blank plot commands.
- Environment pane:** Shows the Global Environment, which is currently empty.
- File system pane (highlighted):** A callout bubble labeled "File system" points to this pane. It displays a file tree under "Home" with the following structure:

Name	Size	Modified
bookmarks		
CARL-embedded-timeseries		
Figures Tactual		
logs		
shared		
STA313 – Fall 2022		
sta490-multiverse-mverse		

File system



Graphical output



R environment

vs. JupyterHub from CS Teaching Lab

Some of you may have access to JupyterHub provided by CS Teaching Laboratories. Note that this is a separate system.

CS Teaching Laboratories

- Available at
<https://jupyter.teach.cs.toronto.edu/>
- Uses your local CS lab accounts for file storage
- RStudio is not available

JupyterHub for Teaching

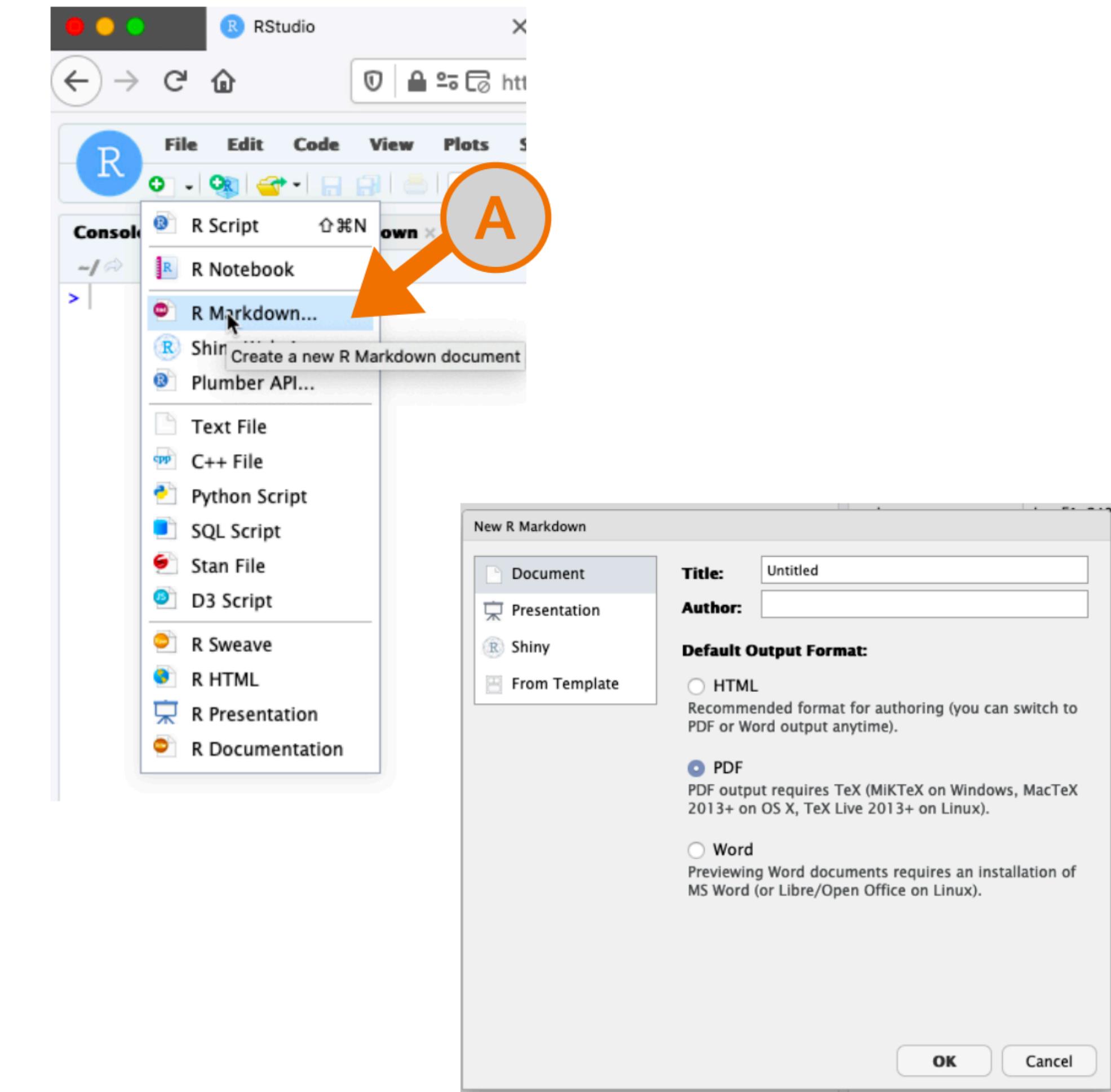
- Available at
<https://jupyter.utoronto.ca/>
- Not linked to your local accounts
- Both RStudio and Jupyter Notebook are available
- For details on accessing and uploading files at the new JupyterHub, see [this video](#) from 0:30

Creating a PDF document using R Markdown

Create a New Document

Follow the steps to start new R Markdown document

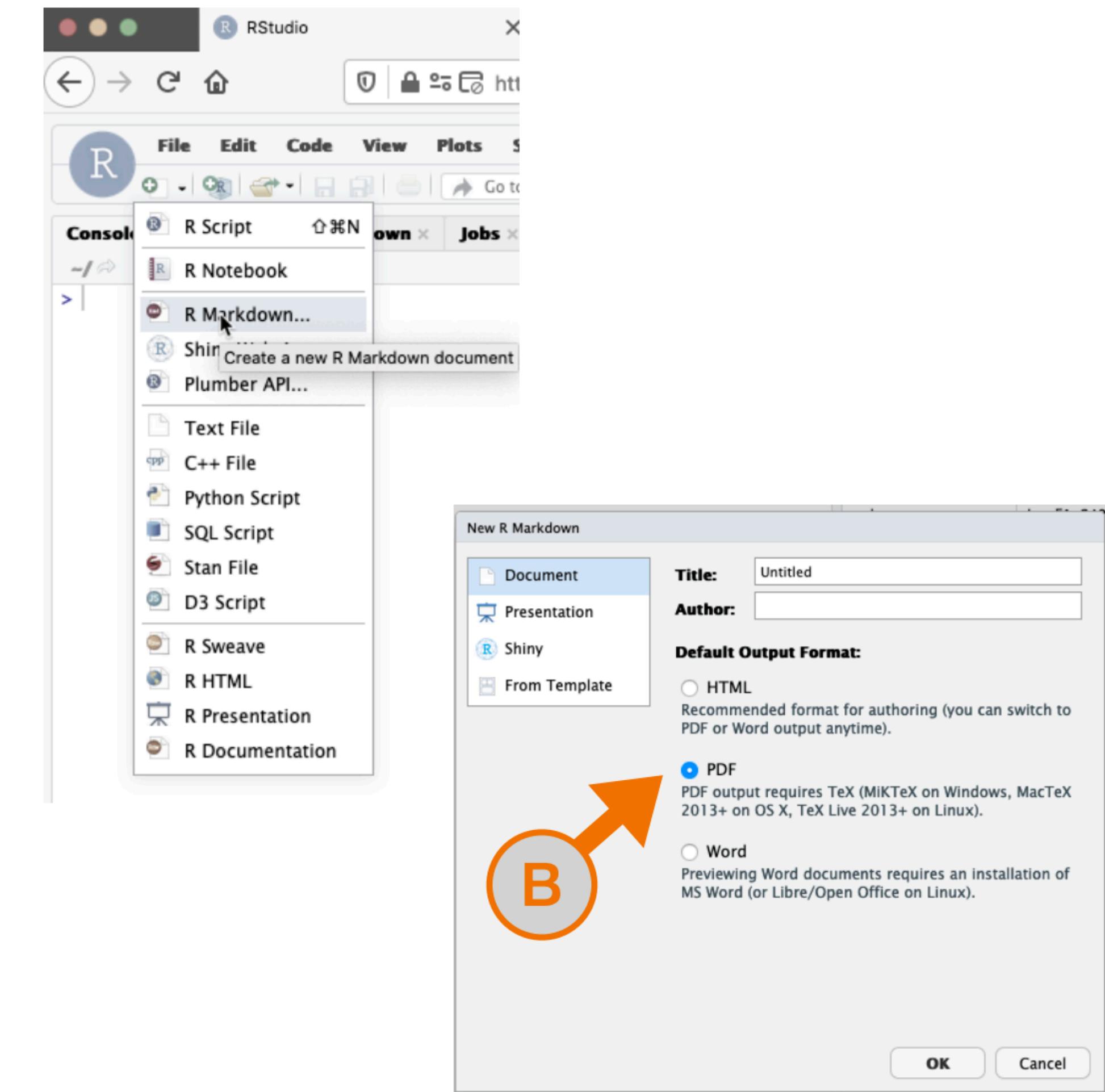
1. Select *R Markdown...* (A) from the New File dropdown menu



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



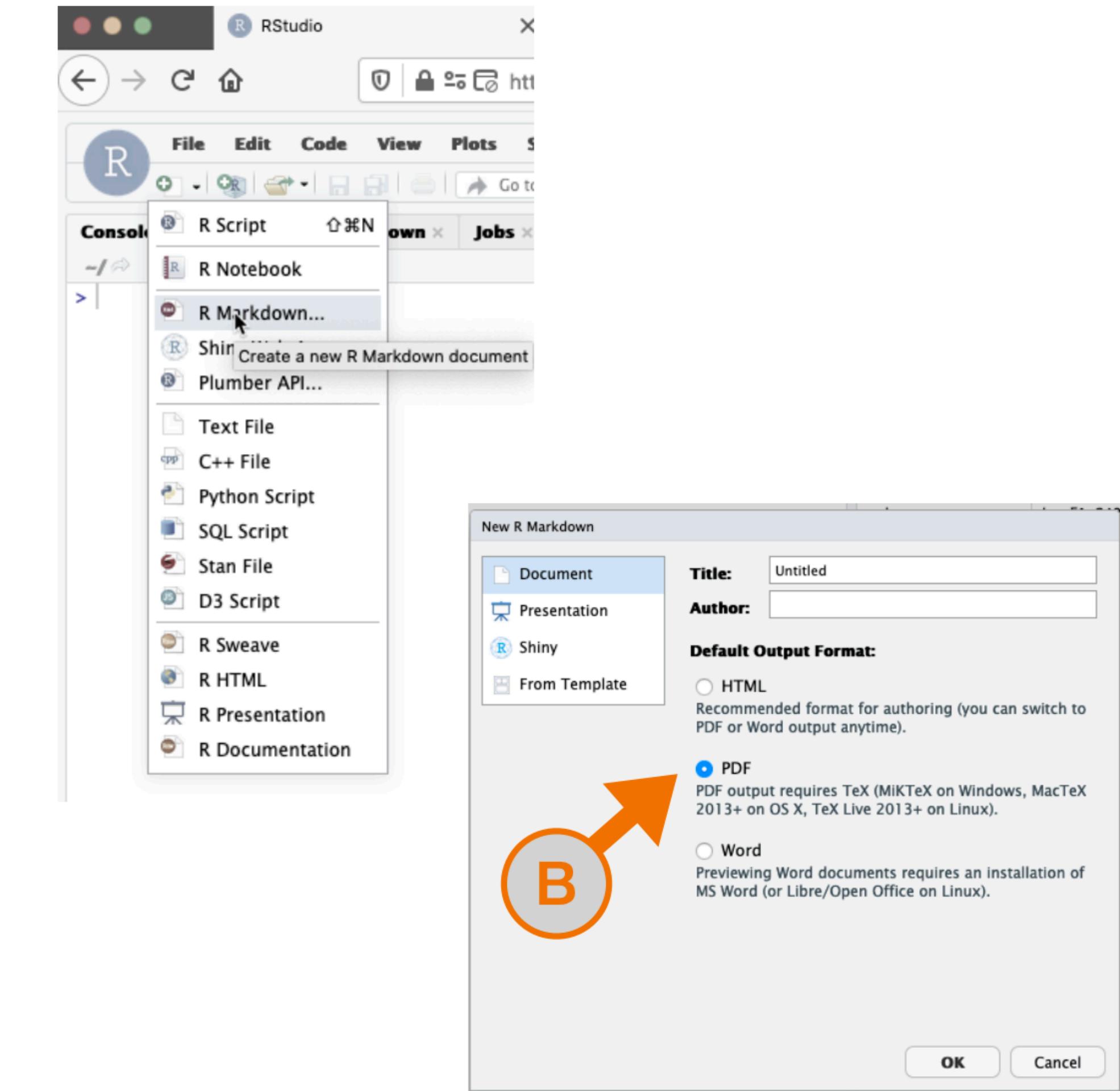
Create a New Document

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 the following details:

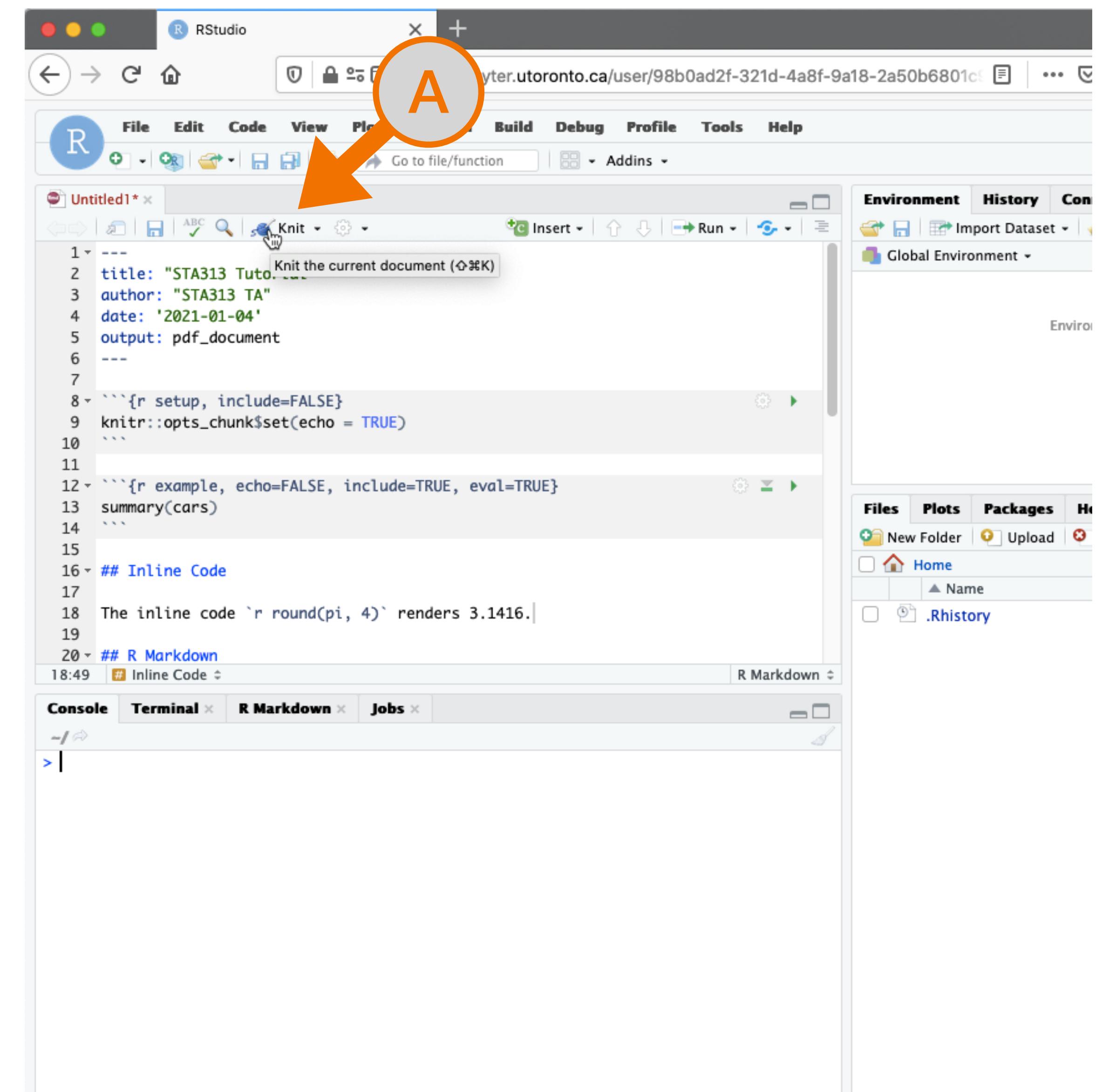
- Title Bar:** RStudio, https://jupyter.utoronto.ca/user/98b0ad2f-321d-4a8f-9a18-2a50b6801c...
- Document Area:** Untitled1.Rmd (highlighted with a red oval).

```
1 ---  
2 title: "STA313 Tutorial"  
3 author: "STA313 TA"  
4 date: '2021-01-04'  
5 output: pdf_document  
---  
8 ```{r setup, include=FALSE}  
9 knitr::opts_chunk$set(echo = TRUE)  
10 ...  
12 ```{r example, echo=FALSE, include=TRUE, eval=TRUE}  
13 summary(cars)  
14 ...  
16 ## Inline Code  
17  
18 The inline code `r round(pi, 4)` renders 3.1416.  
19  
20 ## R Markdown  
18:49 # Inline Code
```
- Environment Tab:** Environment, History, Connections. Global Environment: Environment is empty.
- Files Tab:** Files, Plots, Packages, Help, Viewer. New Folder, Upload, Delete, Rename, More. Home, .Rhistory, Size, Modified.
- Console Tab:** Console, Terminal, R Markdown, Jobs.

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



Knitted 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 displaying a knitted R Markdown document. The document has a title "STA313 Tutorial" and a subtitle "STA313 TA 2021-01-04". It contains several code chunks and inline code. A callout box highlights a code chunk result with "echo=FALSE". Another callout box highlights the result of an inline code chunk. The document also includes a section on R Markdown and a section on including plots.

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. You can embed R code, R Markdown, and plain text in your document. For more information on 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 output of any embedded R code. 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:

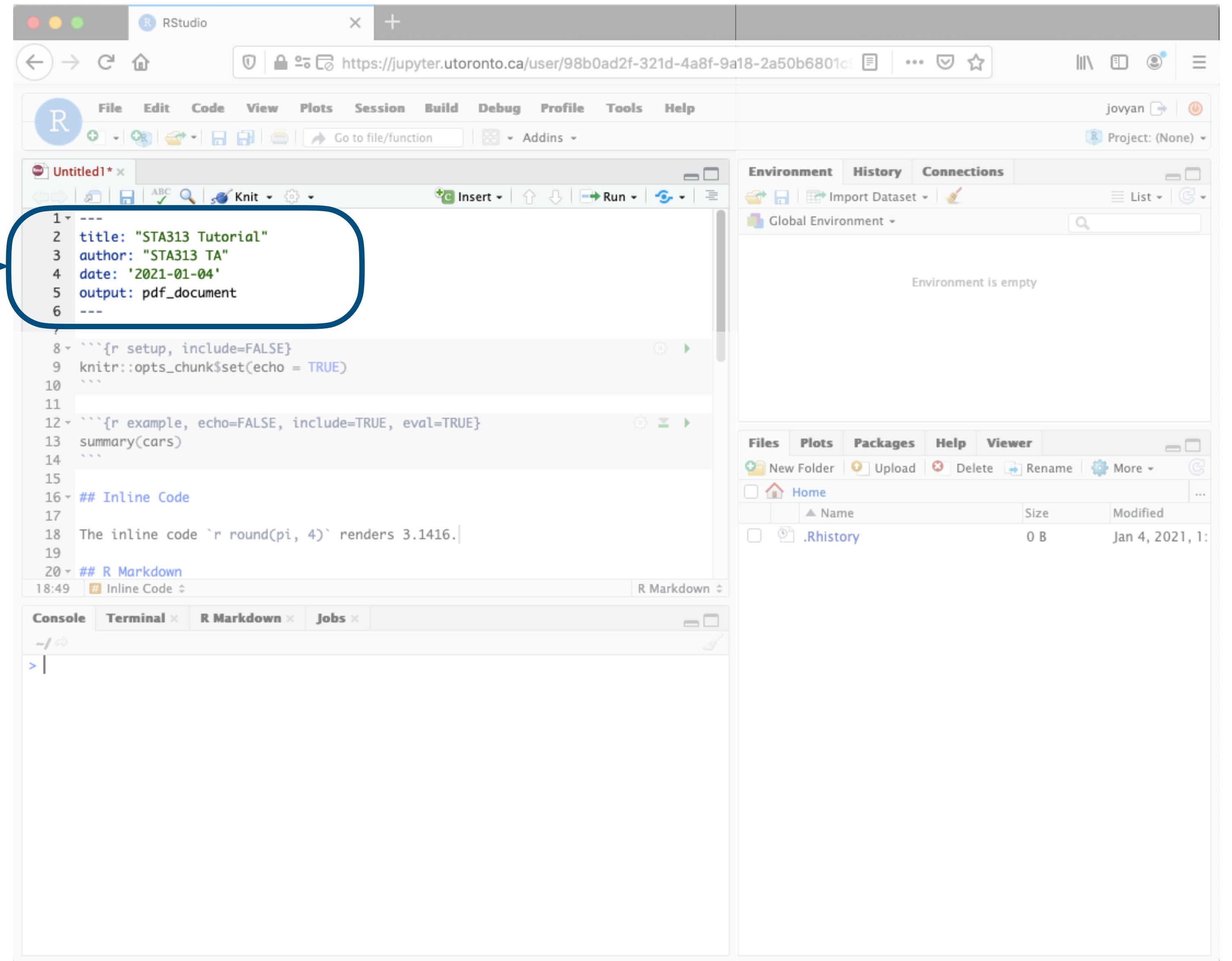
YAML Block

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 named "Untitled1.Rmd". The YAML block at the top of the file is highlighted with a blue rounded rectangle. The YAML code 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  
18:49 # Inline Code
```

The RStudio interface includes the following panels:

- Code Editor:** Shows the R Markdown code with syntax highlighting.
- Environment:** Shows the Global Environment panel.
- Files:** Shows the "Home" directory containing ".Rhistory".
- Console:** Shows the command prompt (>|).

Knitted Document

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

Check to make sure it rendered properly.

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. 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:

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.
```
```

The screenshot shows the RStudio interface with an R Markdown file named "Untitled1". The code editor pane displays 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}  
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 chunk starting at line 8, specifically the line ````{r setup, include=FALSE}`. A blue arrow points from this highlighted area to the corresponding line in the code editor. The RStudio interface includes a browser tab at the top showing a Jupyter notebook URL, and various panels like Environment, Files, and Console on the right.

Code Chunk

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

- `echo=FALSE` hides the code chunk in the rendered PDF.
- `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.
```
```

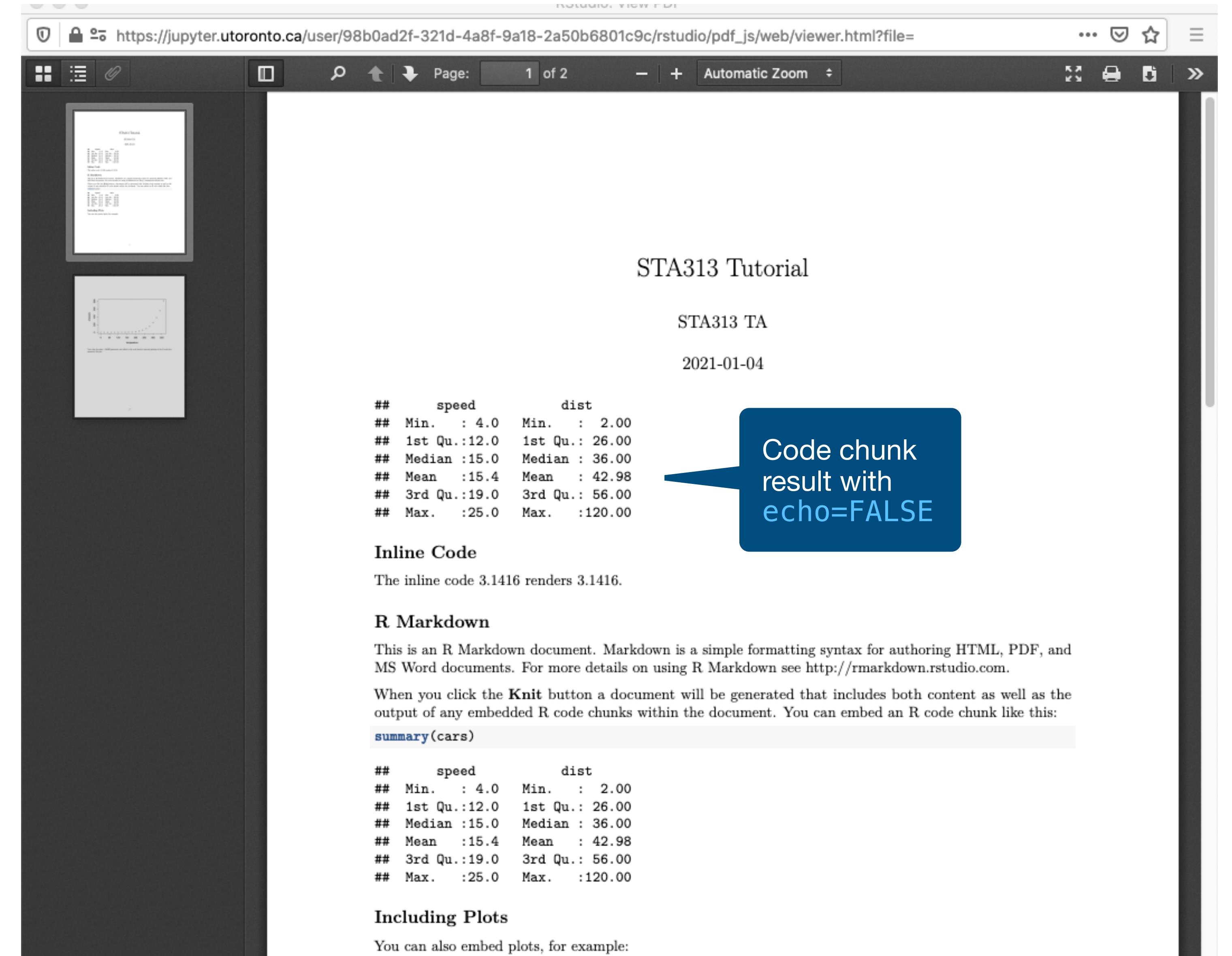
The screenshot shows the RStudio interface with the following details:

- Editor Area:** Displays an R Markdown file named "Untitled1.Rmd". The code includes a YAML front matter block at the top, followed by two code chunks. The first chunk uses `knitr::opts_chunk$set(echo = TRUE)` to set the echo option for all subsequent chunks. The second chunk uses `echo=FALSE, include=TRUE, eval=TRUE` to hide the code and show the results. A callout box highlights the second code chunk.
- Environment Tab:** Shows the global environment is empty.
- Files Tab:** Shows a single file named ".Rhistory" in the "Home" directory.

Knitted 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 the RStudio interface with a preview of a knitted document. The preview window displays a table of data and a scatter plot. The main RStudio area shows the following content:

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. 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)`

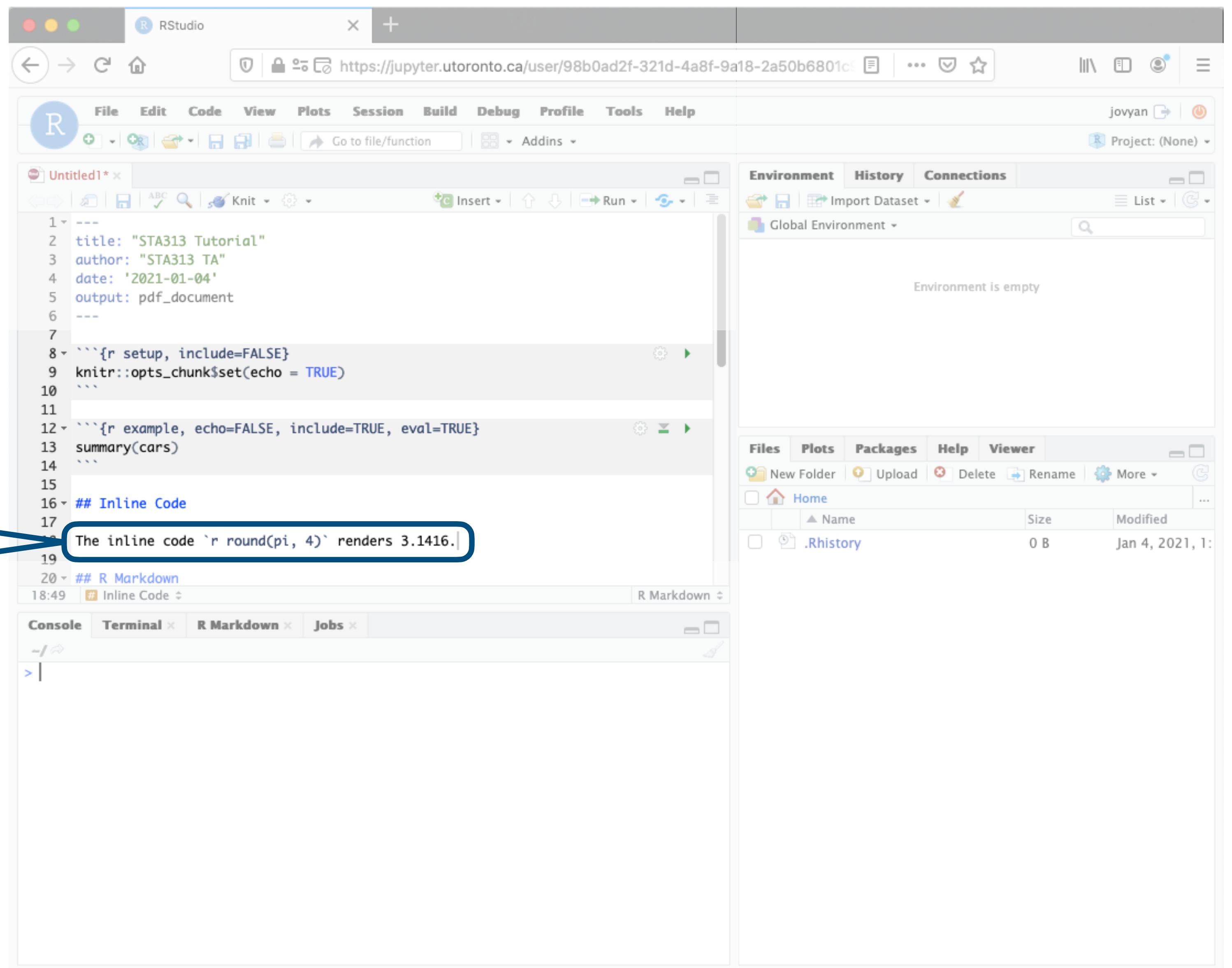
```
## speed dist  
## Min. : 4.0 Min. : 2.00  
## 1st Qu.:12.0 1st Qu.: 26.00  
## Median :15.0 Median : 36.00  
## Mean :15.4 Mean : 42.98  
## 3rd Qu.:19.0 3rd Qu.: 56.00  
## Max. :25.0 Max. :120.00
```

Including Plots
You can also embed plots, for example:

A callout bubble points from the text "Code chunk result with echo=FALSE" to the R code chunk above it.

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}  
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 callout box highlights the line "The inline code `r round(pi, 4)` renders 3.1416." in the code editor, and a blue arrow points from this box to the rendered output "3.1416" in the preview pane below.

Knitted 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 the RStudio interface with a preview window displaying a PDF document titled "STA313 Tutorial STA313 TA 2021-01-04". The PDF contains a table of summary statistics for the "cars" dataset and a scatter plot. Below the preview, the R code for generating the table is shown:

```
##      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. You can embed R code, plots, and other content in your document. For more information, see the R Markdown guide at <http://rmarkdown.rstudio.com>. When you click the Knit button, R Markdown compiles the document into a variety of formats, including HTML, PDF, and MS Word documents. For more information, see the R Markdown guide at <http://rmarkdown.rstudio.com>.

Result of inline code

```
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** :
a WYSIWYG 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

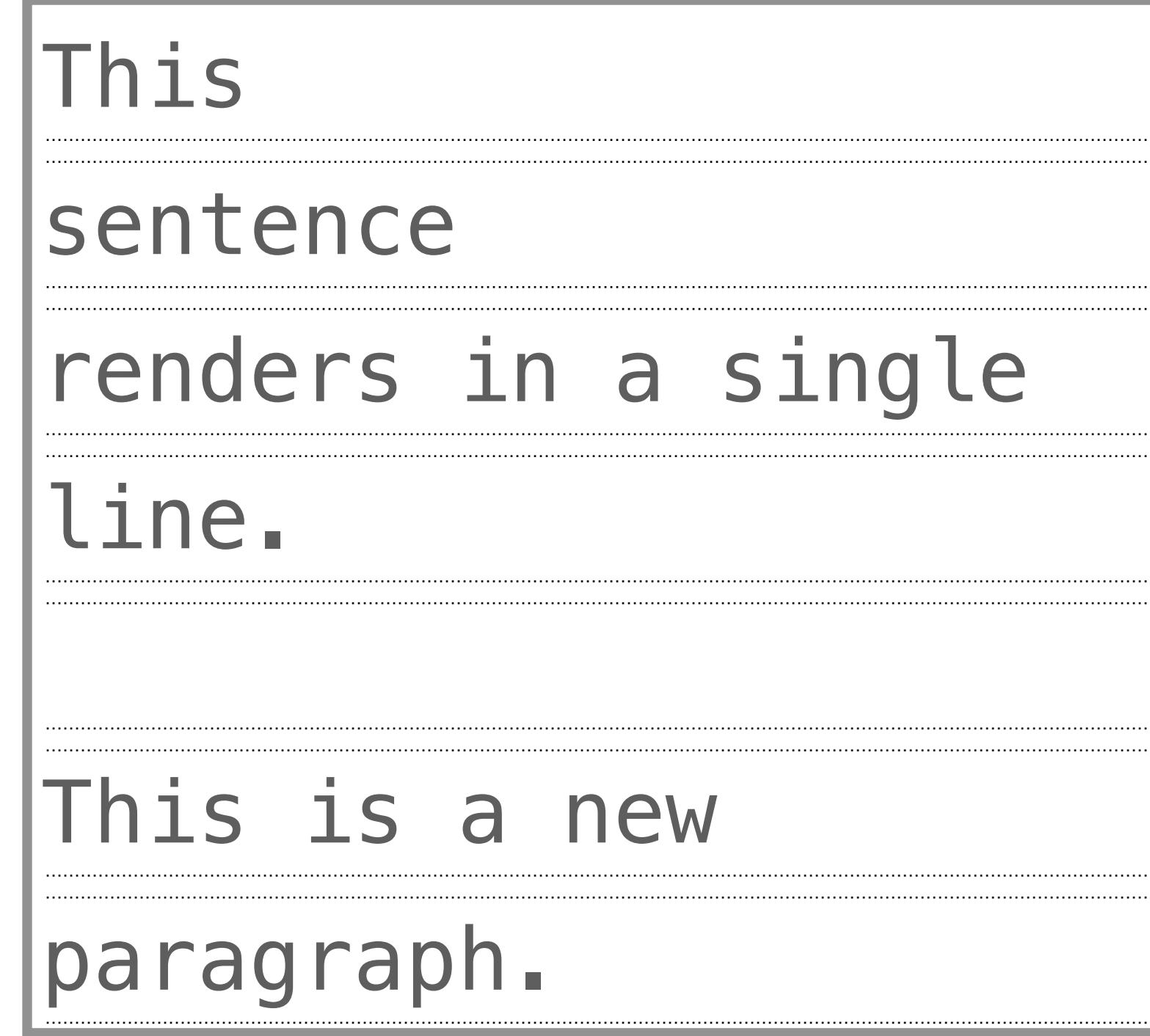
Heading 4

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.

The code renders 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.

Application Exercise

- Download the sample Rmd script from Quercus
- “Upload” the script to your Jupyter R, through the File System
- Edit the script to append the following content to this document, in a new page

STA313 - Meet the R Markdown toolkit Application exercise

- First, we want a summary of the *anscombe* dataset, but we don’t want to show the code

```
##      x1          x2          x3          x4          y1
##  Min.   : 4.0   Min.   : 4.0   Min.   : 4.0   Min.   : 8   Min.   : 4.260
##  1st Qu.: 6.5   1st Qu.: 6.5   1st Qu.: 6.5   1st Qu.: 8   1st Qu.: 6.315
##  Median : 9.0   Median : 9.0   Median : 9.0   Median : 8   Median : 7.580
##  Mean   : 9.0   Mean   : 9.0   Mean   : 9.0   Mean   : 9   Mean   : 7.501
##  3rd Qu.:11.5   3rd Qu.:11.5   3rd Qu.:11.5   3rd Qu.: 8   3rd Qu.: 8.570
##  Max.   :14.0   Max.   :14.0   Max.   :14.0   Max.   :19   Max.   :10.840
##              y2          y3          y4
##  Min.   :3.100   Min.   : 5.39   Min.   : 5.250
##  1st Qu.:6.695   1st Qu.: 6.25   1st Qu.: 6.170
##  Median :8.140   Median : 7.11   Median : 7.040
##  Mean   :7.501   Mean   : 7.50   Mean   : 7.501
##  3rd Qu.:8.950   3rd Qu.: 7.98   3rd Qu.: 8.190
##  Max.   :9.260   Max.   :12.74   Max.   :12.500
```

Application Exercise

- Continue to edit the script to append the following content to the document
 - Then, we want to plot the `x1` and `y1` dimensions of this dataset, as a scatterplot. Again, we don't want to show the code in the knitted document.

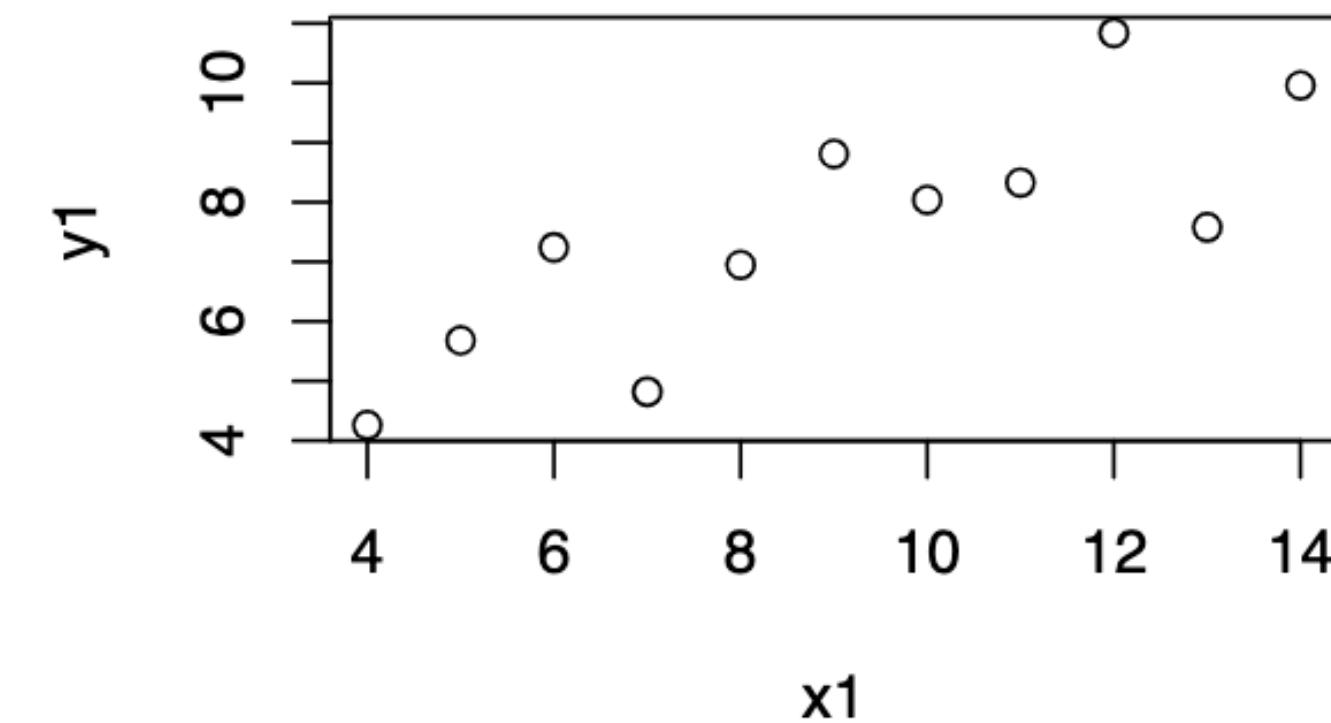


Figure 2: Scatterplot I of the Anscombe's dataset

Application Exercise

- Continue to edit the script to append the following content to the document

- Now, create the same plot, and include a linear regression line

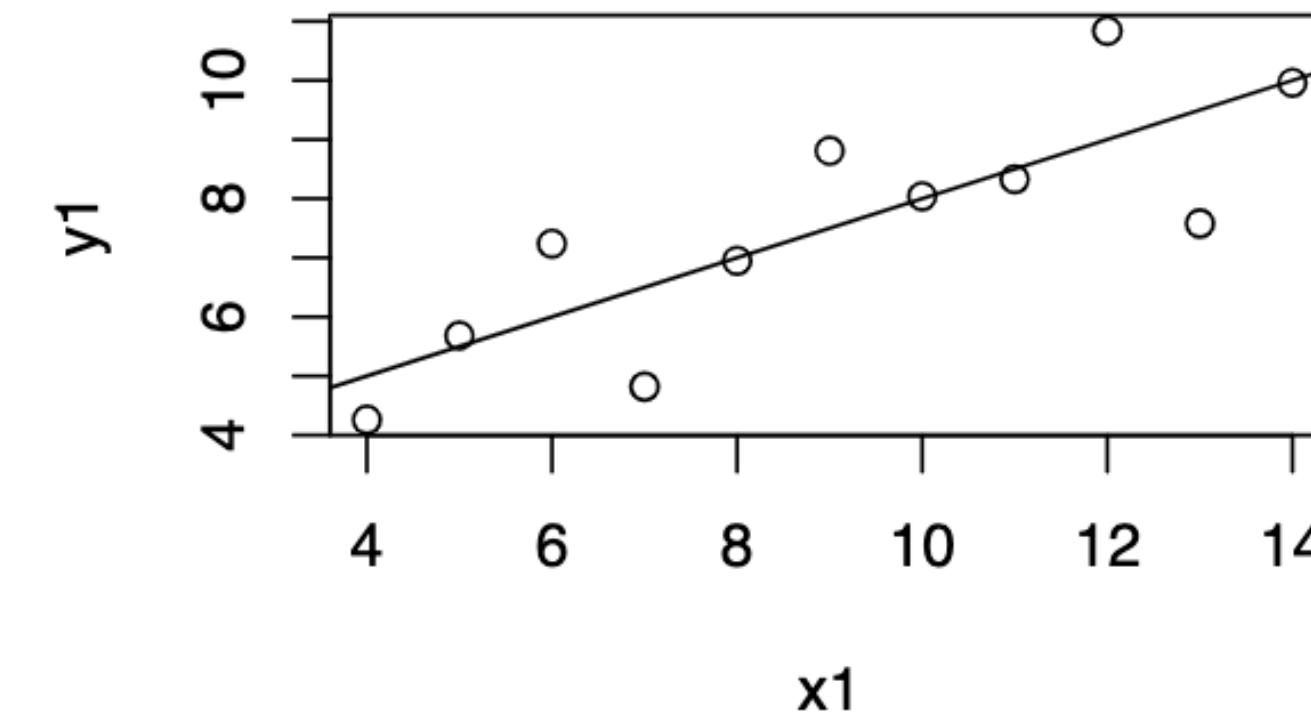


Figure 3: Scatterplot I of the Anscombe's dataset, showing the linear regression line

Application Exercise

- Continue to edit the script to append the following content to the document

- Using inline code, indicate that the max value along the `x1` dimension of the dataset is 14

Application Exercise

- Continue to edit the script to append the following content to the document

Table 2: Min and max

| Dimension | Min | Max |
|-----------|-----|-----|
| x1 | 4 | 14 |
| y1 | 4 | 11 |

- Finally, create a table using to show the min, max and mean values for the `x1` and `y1` data dimensions of the `anscombe` dataset

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

Local Installation

(self-guided instructions)

Local Installation

Follow the steps to set up R & R Studio locally, on your machine

1. Download and install R

- Download available at <https://cran.rstudio.com/>
- Select your OS and download the latest release
- If you are using a Windows machine, download the base package
- If you are using a Mac, download the latest binary (R-4.#.#.pkg) the library is pre-installed.

Local Installation

Follow the steps to set up R & R Studio locally, on your machine

1. Download and install R
2. Download and install R Studio

- Download available at
<https://www.rstudio.com/products/rstudio/download/#download>
- Download the free **RStudio Desktop**
(not RStudio Server or the Pro versions)

Local Installation

Follow the steps to set up R & R Studio locally, on your machine

1. Download and install R
2. Download and install R Studio
3. Install **rmarkdown**

- Open RStudio
- In the RStudio **Console** type
`install.packages('rmarkdown')`

Local Installation

Follow the steps to set up R & R Studio locally, on your machine

1. Download and install R
2. Download and install R Studio
3. Install rmarkdown
4. Install **tinytex**

- In the RStudio **Console** type

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

- It enables PDF document rendering from RMarkdown

Local Installation

You will now have a local R and RStudio installed with **rmarkdown** set up for PDF rendering.

You can access your local files from RStudio.

