

R Markdown Introduction 27Sep2021

Part 1

Why R Markdown?

R Markdown allows you to perform literate programming.

“**Literate programming** is a [programming paradigm](#) introduced by [Donald Knuth](#) in which a [computer program](#) is given an explanation of its logic in a [natural language](#), such as English, interspersed with [snippets](#) of [macros](#) and traditional [source code](#), from which [compilable](#) source code can be generated.^[1] The approach is used in [scientific computing](#) and in [data science](#) routinely for [reproducible research](#) and [open access](#) purposes.^[2] Literate programming tools are used by millions of programmers today.”

Source: https://en.wikipedia.org/wiki/Literate_programming

Literate programming is very suitable to academic research. With R Markdown not only can you perform literate programming in RStudio, but you can also generate journal-suitable pdf files to share with your colleagues. In essence you can create your data analysis and your research paper (or book) in the same environment, i.e., an RStudio project. Furthermore, your data analysis can be reproduced with ease.

FYI regarding Donald Knuth from Wikipedia:

“**Donald Ervin Knuth** ([/kəˈnuːθ/](#)^[3] *kə-NOOTH*; born January 10, 1938) is an American [computer scientist](#), [mathematician](#), and [professor emeritus](#) at [Stanford University](#). He is the 1974 recipient of the [ACM Turing Award](#), informally considered the [Nobel Prize](#) of computer science.^[4] Knuth has been called the "father of the [analysis of algorithms](#)".^[5] “

Source: https://en.wikipedia.org/wiki/Donald_Knuth

The Great News

It is easy to get started with literate programming using RStudio. RStudio makes it straightforward to use R Markdown to create a literate program. This literate program will contain your reproducible research and will also generate your finished research paper with a click of a button.

R Markdown Basics

R Markdown allows you to generate a research paper or book in PDF, HTML, or Word format. This is done automatically from your code and data that you write within RStudio.

R Markdown files end with the file extension Rmd (as opposed to R script files that end with the file extension R).

The Rmd file is just a plain text file, and it allows you to combine five important parts of your research.

1) The R code that shows how you did your study.

2) The results of your R code, e.g., the tables and charts it produces along with the output from your model, for example a multiple regression model.

3) Your write-up that discusses what you did and why, as well as the results that you have discovered.

4) The ability to generate with a click of a button, your final report, book, or research article.

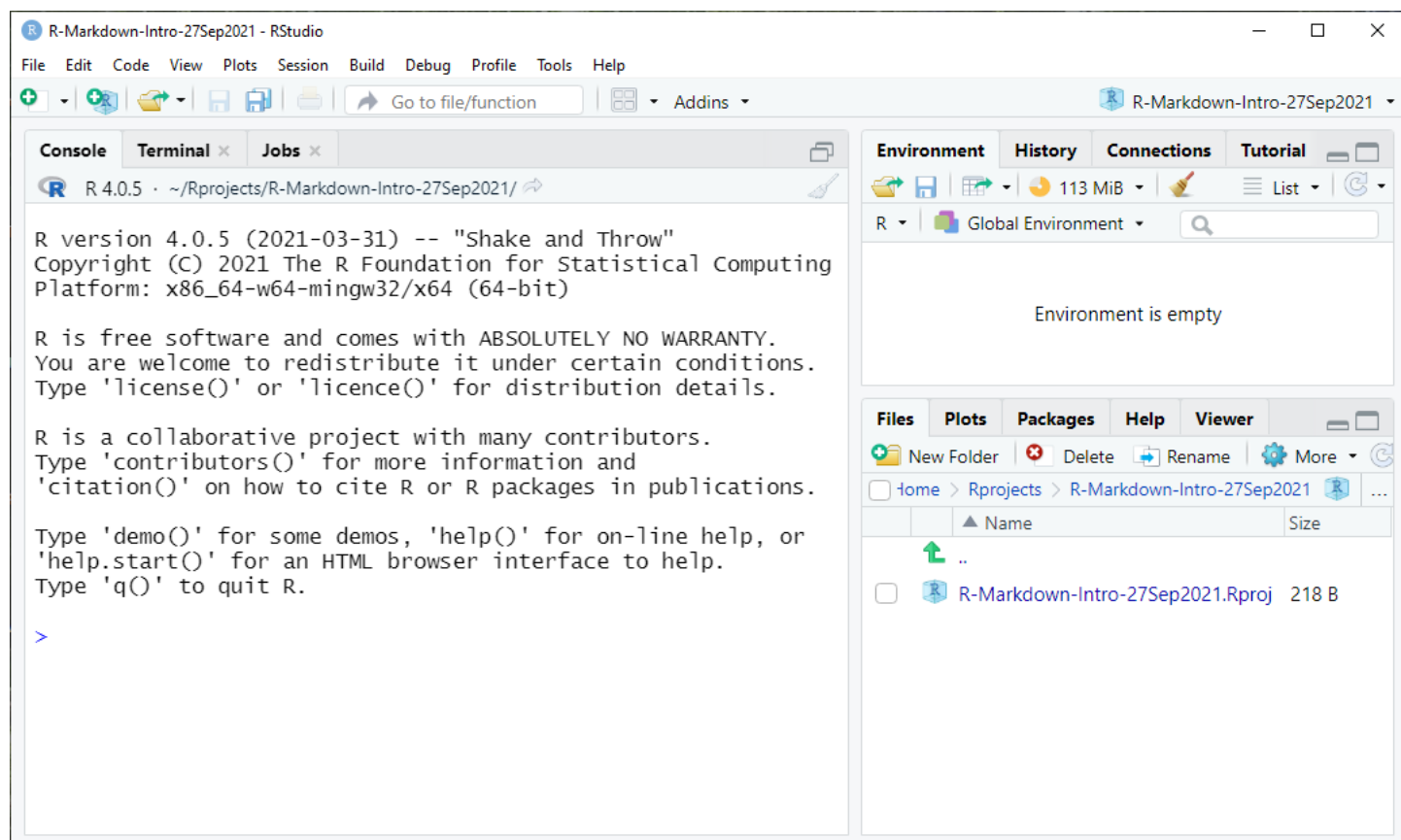
5) Reproducibility! Just give your colleagues a copy of your zipped RStudio project and they can quickly run and evaluate your code and work. Or they can make changes and create their own version of the research that you started!

So how does it work?

1) You will create a plain text .Rmd file. This file will contain blocks of R code. These blocks of code are called chunks. You will also add text (non-R code)

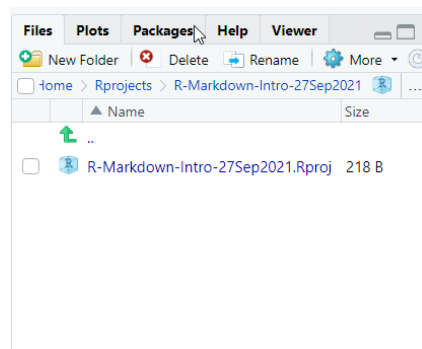
2) The R package knitr will convert the .Rmd file into a Markdown file with extension .md and then the R package markdown can convert the .md file into a PDF, HTML, or Word file.

So, let's start with a new RStudio project called R-Markdown-Intro-27Sep2021

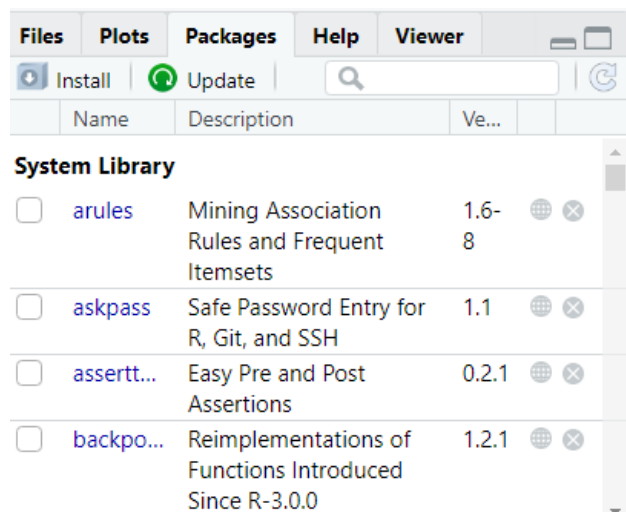


You can install the packages knitr, rmarkdown, and markdown from within RStudio.

Click on **Packages**:



Then your installed packages are displayed (note that an unchecked box means that the package is not loaded into your current R session).



Next

Check to see if the packages knitr, rmarkdown, and markdown are installed.

If they are not there, then they can be installed from within RStudio by clicking install and searching for the package (e.g., type knitr into the search box).



You can add the packages to your R coding session with:

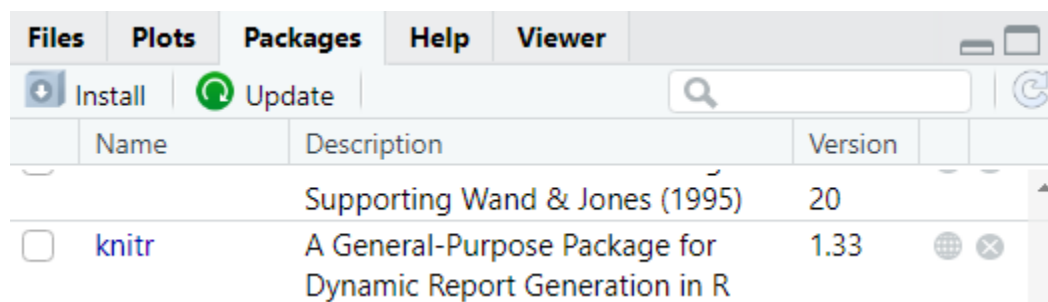
```
library(knitr)
```

```
library(rmarkdown)
```

```
library(markdown)
```

or by just clicking the checkbox by the installed package from within RStudio.

So knitr is installed but not loaded:



Check the box to load knitr (do this for rmarkdown and markdown as well).

n publications.

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

```
> library(knitr)
> |
```

<input checked="" type="checkbox"/>	knitr	A General-Purpose Package for Dynamic Report Generation in R	1.33		
<input type="checkbox"/>	labeling	Axis Labeling	0.4.2		
<input type="checkbox"/>	later	Utilities for Scheduling Functions to Execute Later with Event Loops	1.2.0		
<input type="checkbox"/>	lattice	Trellis Graphics for R	0.20-44		
<input type="checkbox"/>	lazyeval	Lazy (Non-Standard) Evaluation	0.2.2		
<input type="checkbox"/>	leaps	Regression Subset Selection	3.1		
<input type="checkbox"/>	lgr	A Fully Featured Logging Framework	0.4.2		

After checking the box, RStudio adds the line of code

```
library(knitr)
```

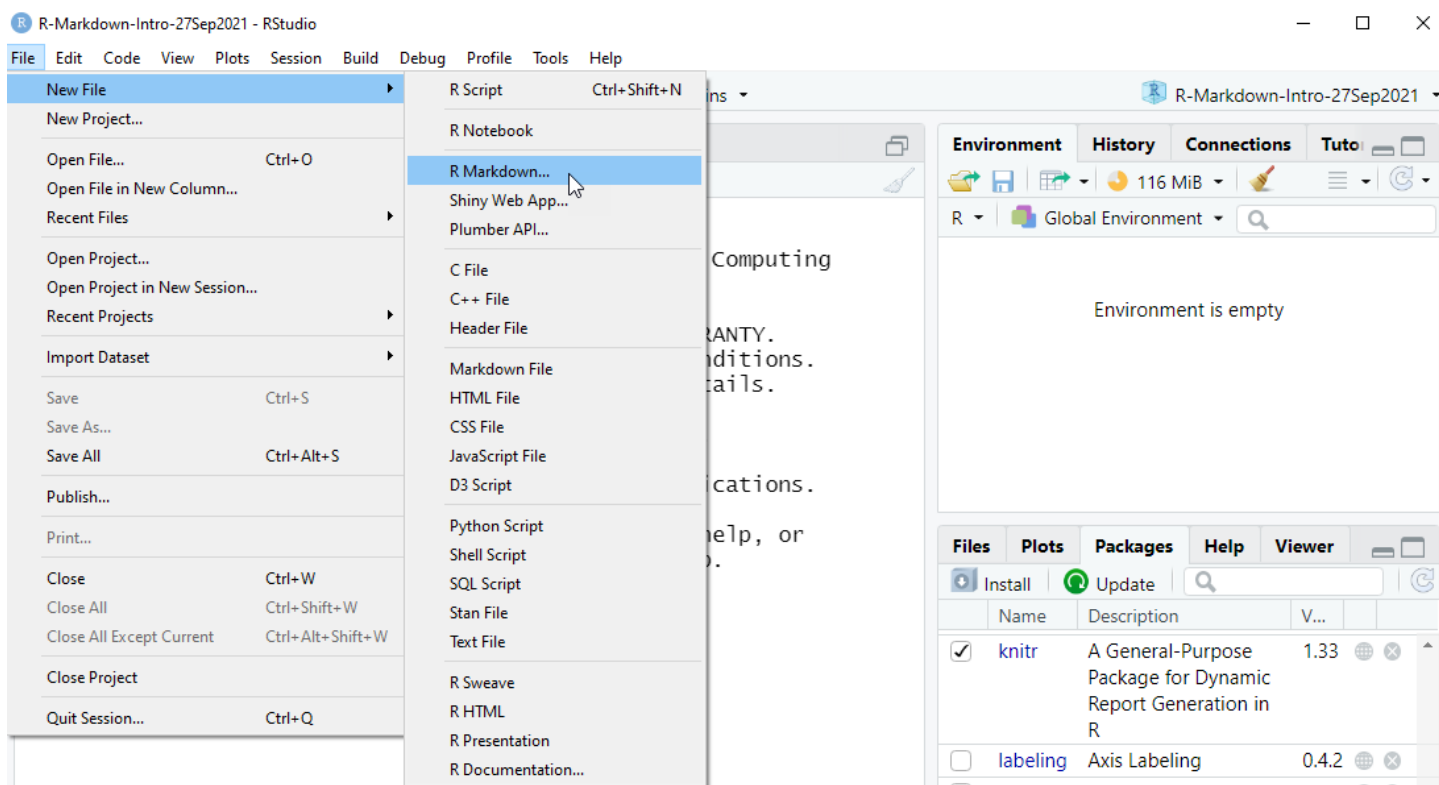
```
e to help.
Type 'q()' to quit R.
```

```
> library(knitr)
> library(rmarkdown)
> library(markdown)
> |
```

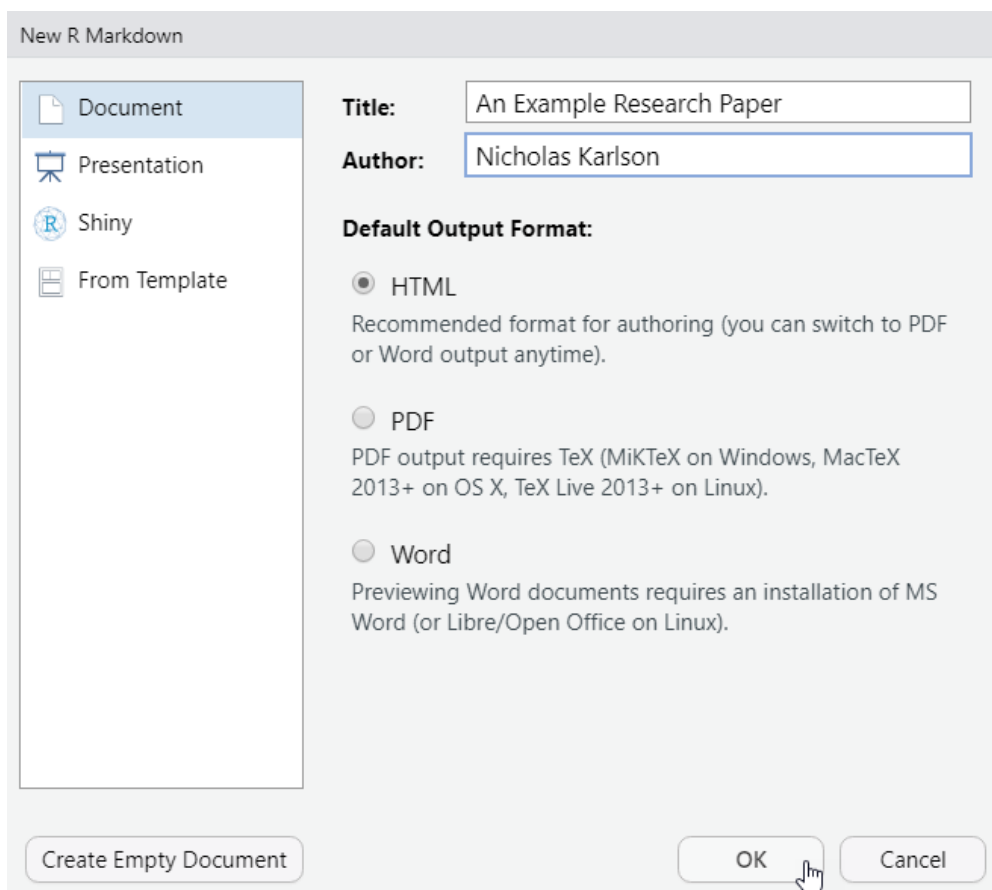
<input checked="" type="checkbox"/>	markdown	Render Markdown with the C Library 'Sundown'	1.1		
<input type="checkbox"/>	MASS	Support Functions and Datasets for Venables and Ripley's MASS	7.3-54		
<input type="checkbox"/>	Matrix	Sparse and Dense Matrix Classes and Methods	1.3-4		
<input type="checkbox"/>	mdlust	Gaussian Mixture Modelling for Model-Based Clustering, Classification, and Density Estimation	5.4.7		

Once this is done then from the RStudio menu...

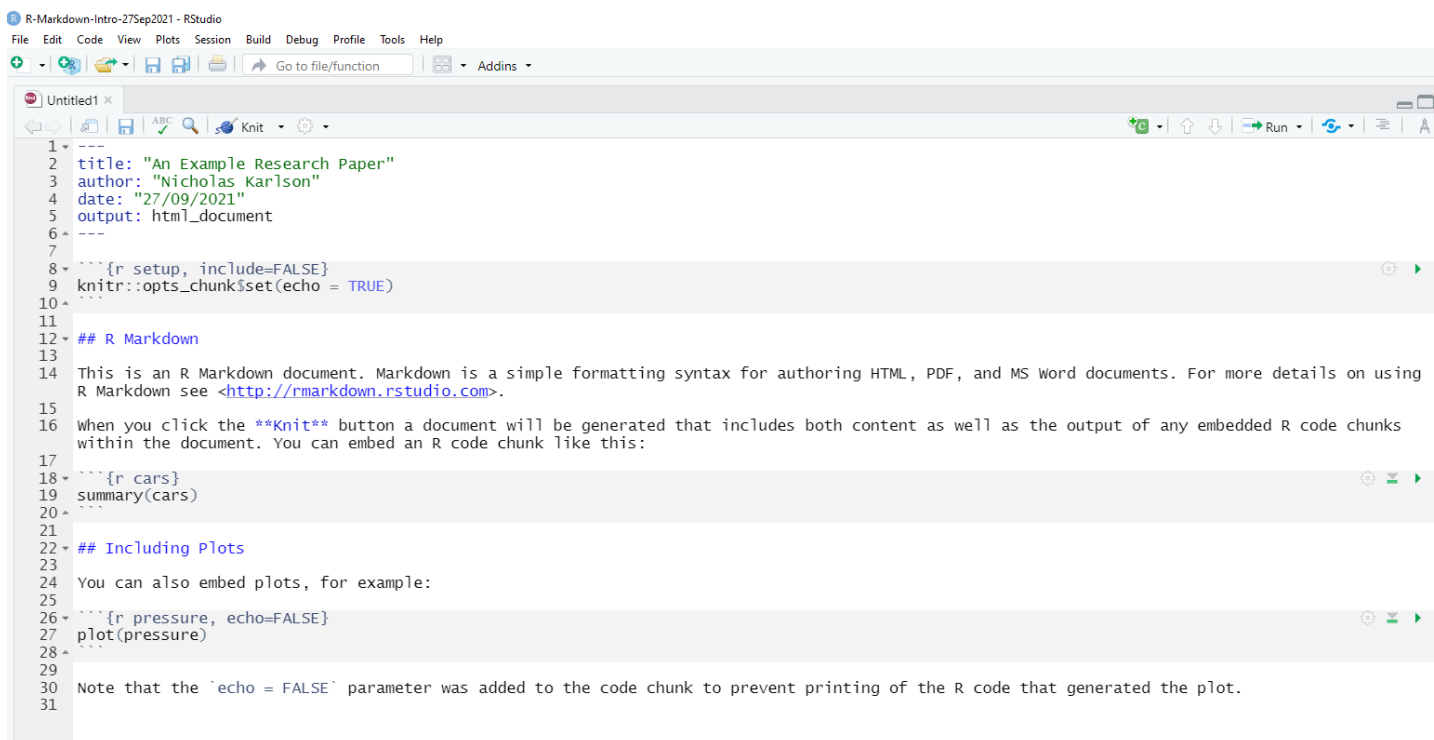
Click on File -> New File -> R Markdown



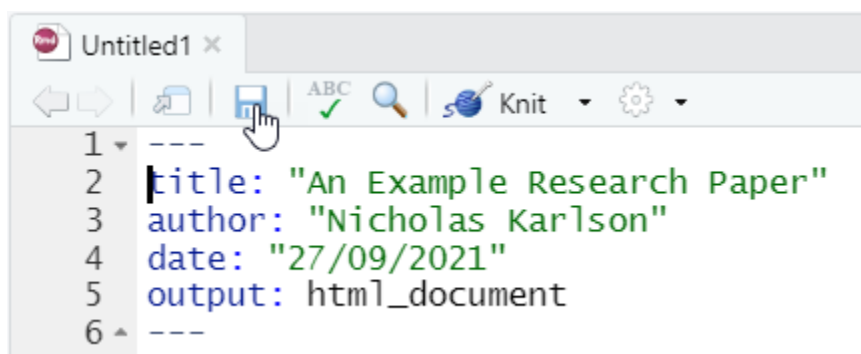
This produces the following dialog box (fill in title, author, select HTML, click OK).



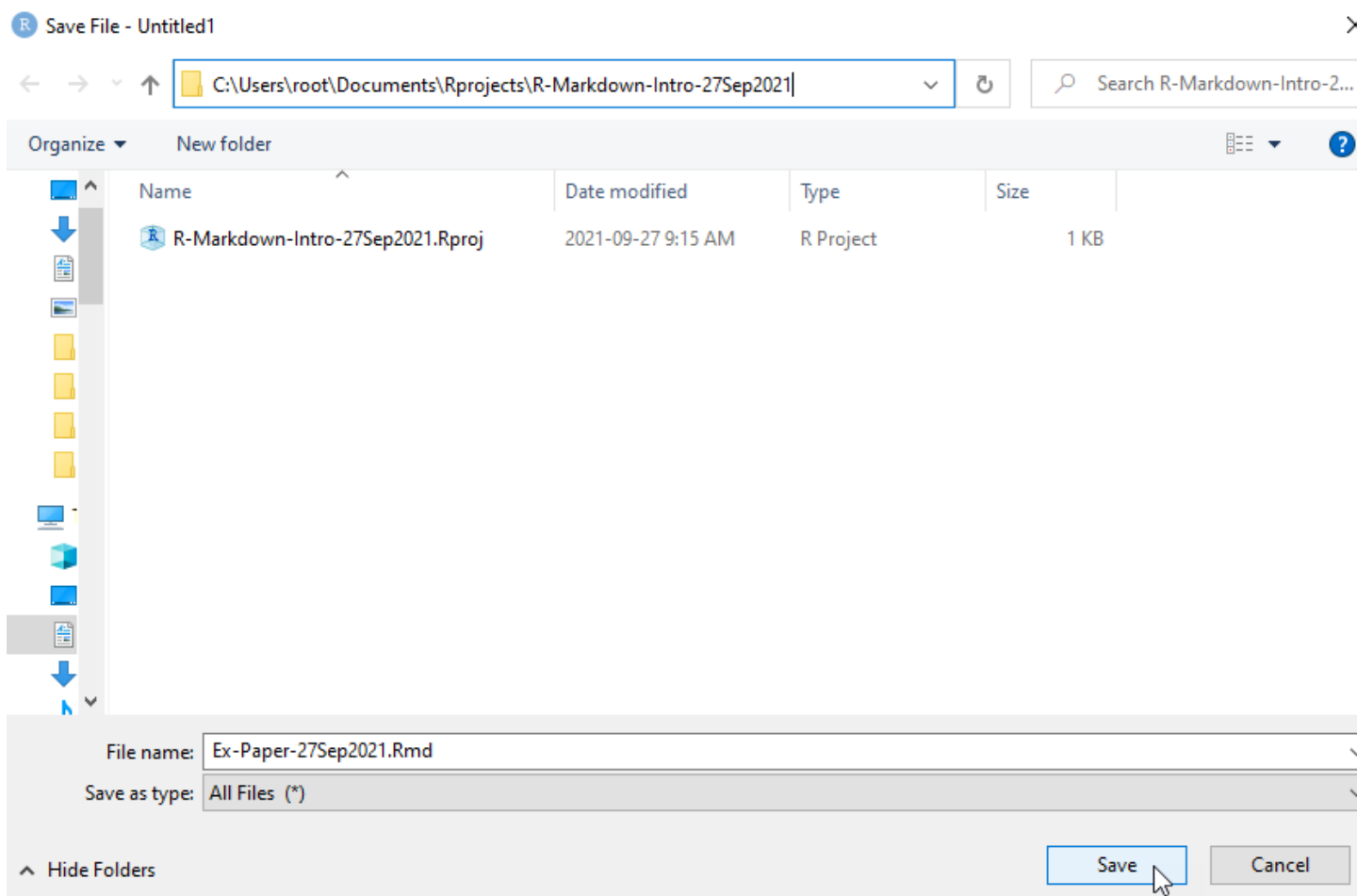
After clicking OK, a new Rmd file is created.



The Rmd file that is created for you is called Untitled1.Rmd, so go ahead and save it as Ex-Paper-27Sep2021.Rmd

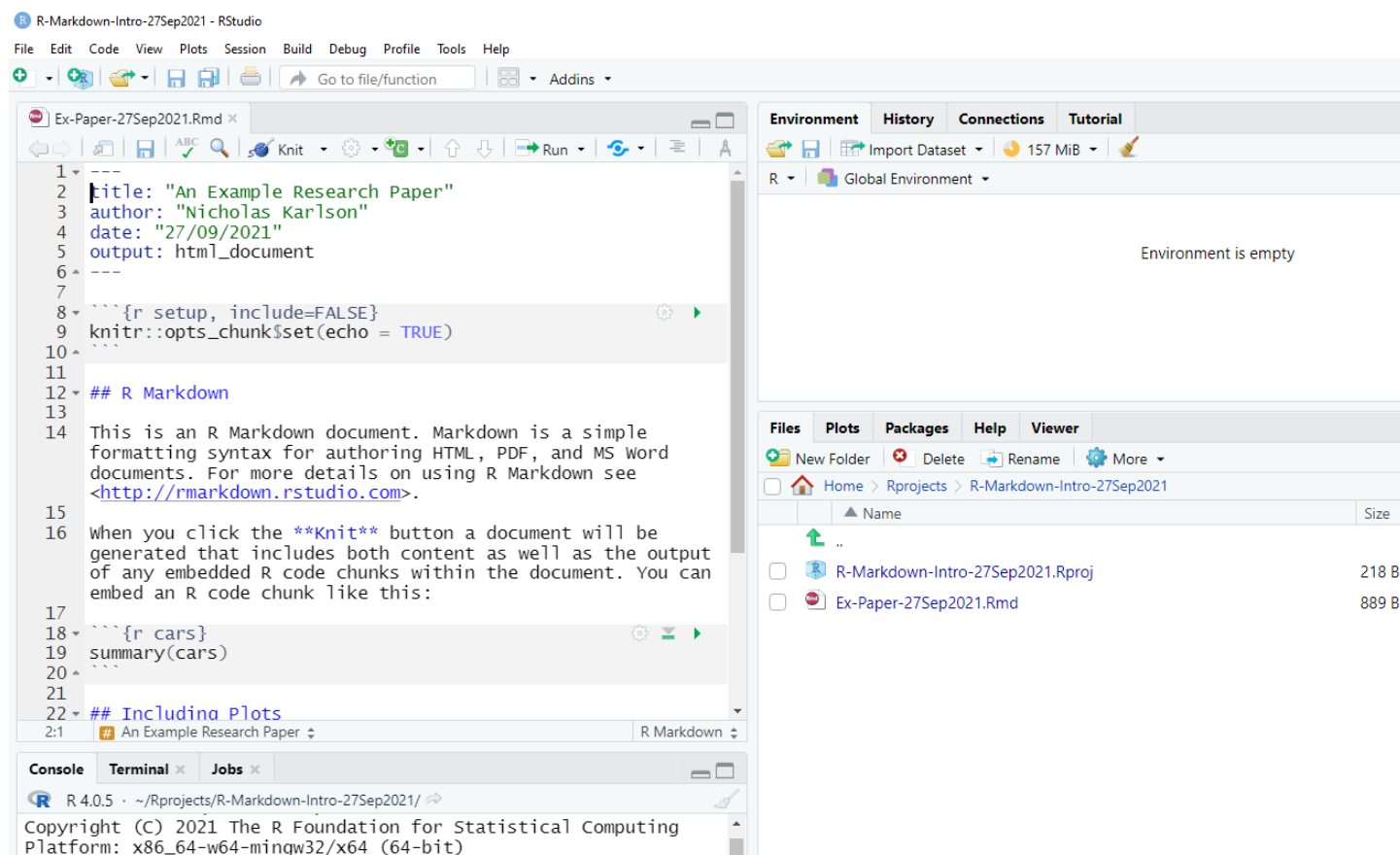


After clicking “Save” icon...



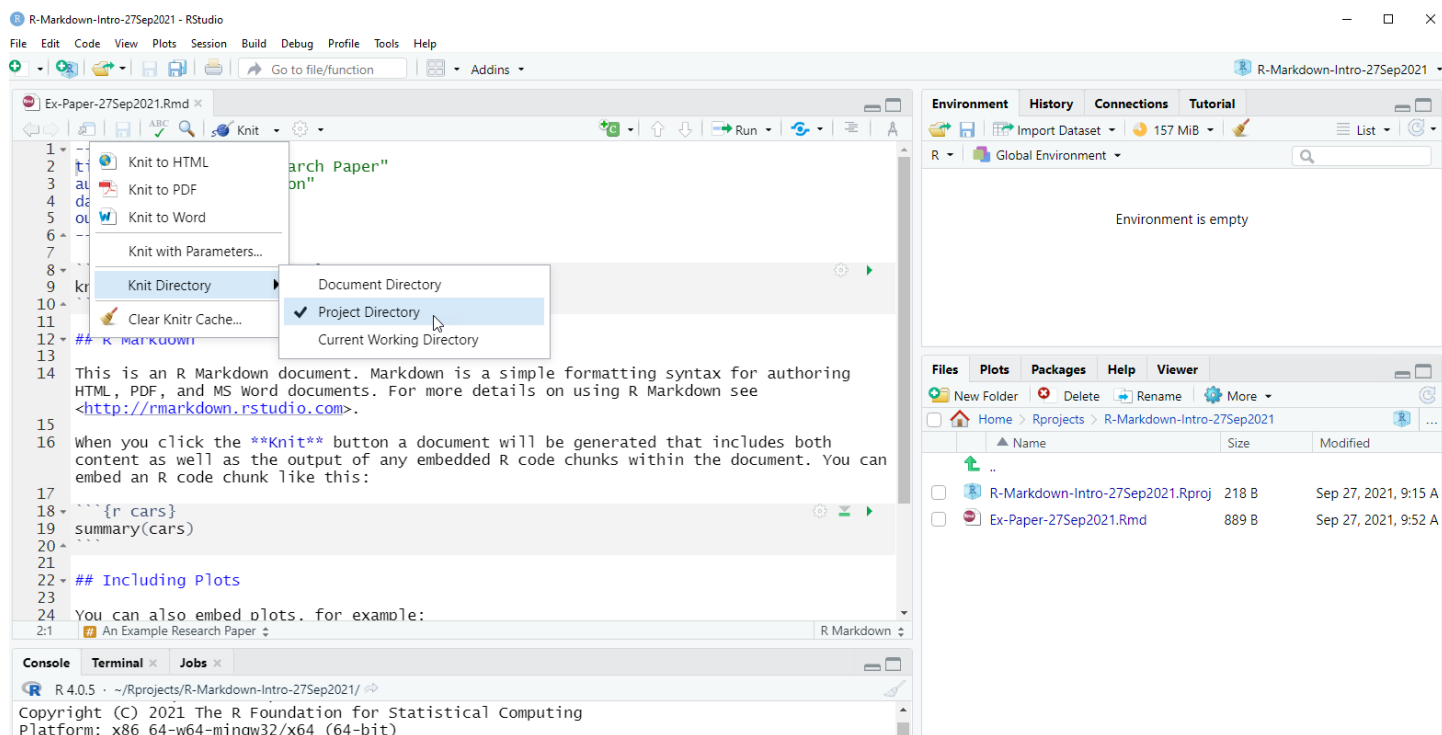
Click on Save...

And look at the Files window to see your Rmd file (located In the RStudio project's directory with the Rproj file).

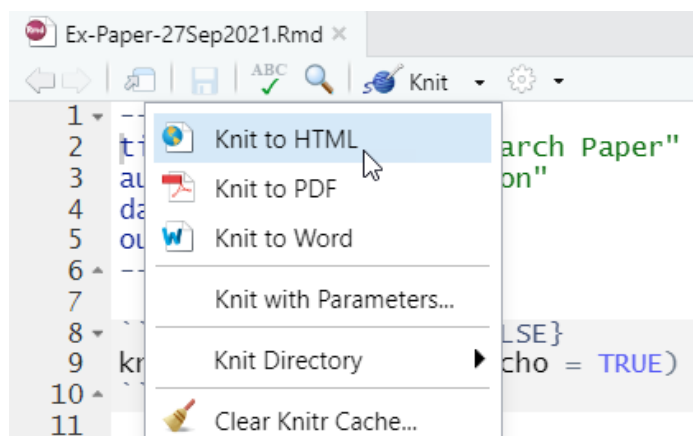


Let's see what we have now with the basic RStudio template. Click on Knit to create the HTML document...

Have the HTML go to the project directory...



Now select Knit to HTML



And it worked...

Your HTML page comes up in a separate viewer and you can see the files have been created to the project directory:

R-Markdown-Intro-27Sep2021 - RStudio

File Edit Code View Plots Session Build Debug Profile Tools Help

~/Rprojects/R-Markdown-Intro-27Sep2021/Ex-Paper-27Sep2021.html

Ex-Paper-27Sep2021.html Open in Browser Find Publish

An Example Research Paper

Nicholas Karlson
27/09/2021

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:

Environment History Connections Tutorial

Import Dataset 158 MiB

R Global Environment

Environment is empty

Files Plots Packages Help Viewer

New Folder Delete Rename More

Home > Rprojects > R-Markdown-Intro-27Sep2021

Name	Size
..	
R-Markdown-Intro-27Sep2021.Rproj	218 B
Ex-Paper-27Sep2021.Rmd	889 B
Ex-Paper-27Sep2021_files	
Ex-Paper-27Sep2021.html	735.2 KB

You can go to your project directory and open the html file in a web browser by clicking on the html file:

This PC > Documents > Rprojects > R-Markdown-Intro-27Sep2021

Name	Date modified	Type	Size
Ex-Paper-27Sep2021.html	2021-09-27 9:59 AM	Microsoft Edge H...	736 KB
Ex-Paper-27Sep2021.Rmd	2021-09-27 9:52 AM	RMD File	1 KB
R-Markdown-Intro-27Sep2021.Rproj	2021-09-27 9:15 AM	R Project	1 KB

An Example Research Paper

Nicholas Karlson

27/09/2021

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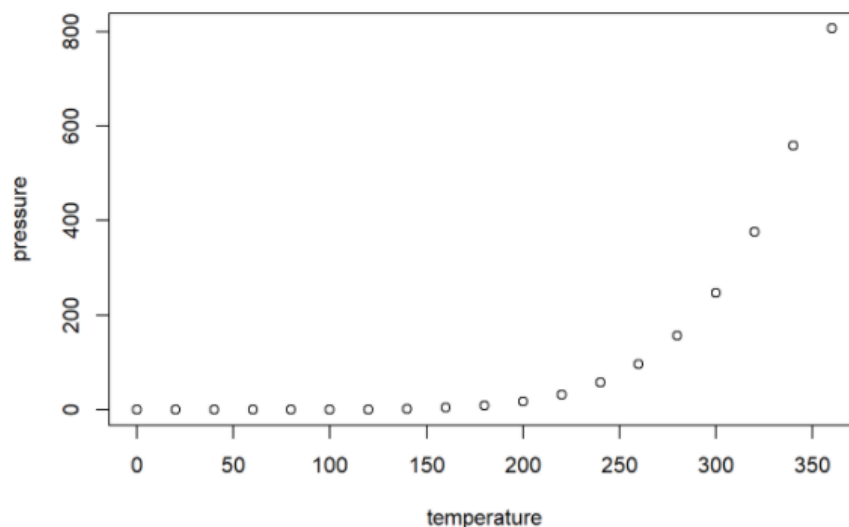
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## 3rd Qu.:19.0    3rd Qu.: 56.00
## Max.   :25.0    Max.   :120.00
```

Including Plots

You can also embed plots, for example:



Copy and paste into a Word doc and then save as a PDF...

An Example Research Paper

Nicholas Karlson

27/09/2021

R Markdown

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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:



Paste into Word Doc, then save as “Ex-Paper-1012am-27Sep2021”

AutoSave On Document6 - Word Search Nicholas Karlson

File Home Insert Draw Design Layout References Mailings Review View Developer Add-ins Help

Clipboard Font Paragraph Styles Editing Voice Editor

An·Example·Research·Paper¶

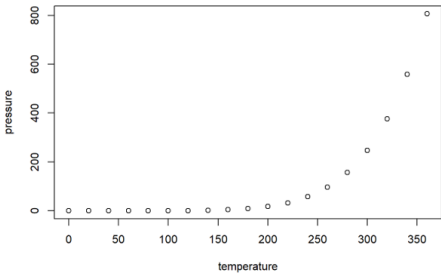
Nicholas·Karlson¶
27/09/2021¶

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-----displacement-----¶
##--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¶
```



pressure

temperature

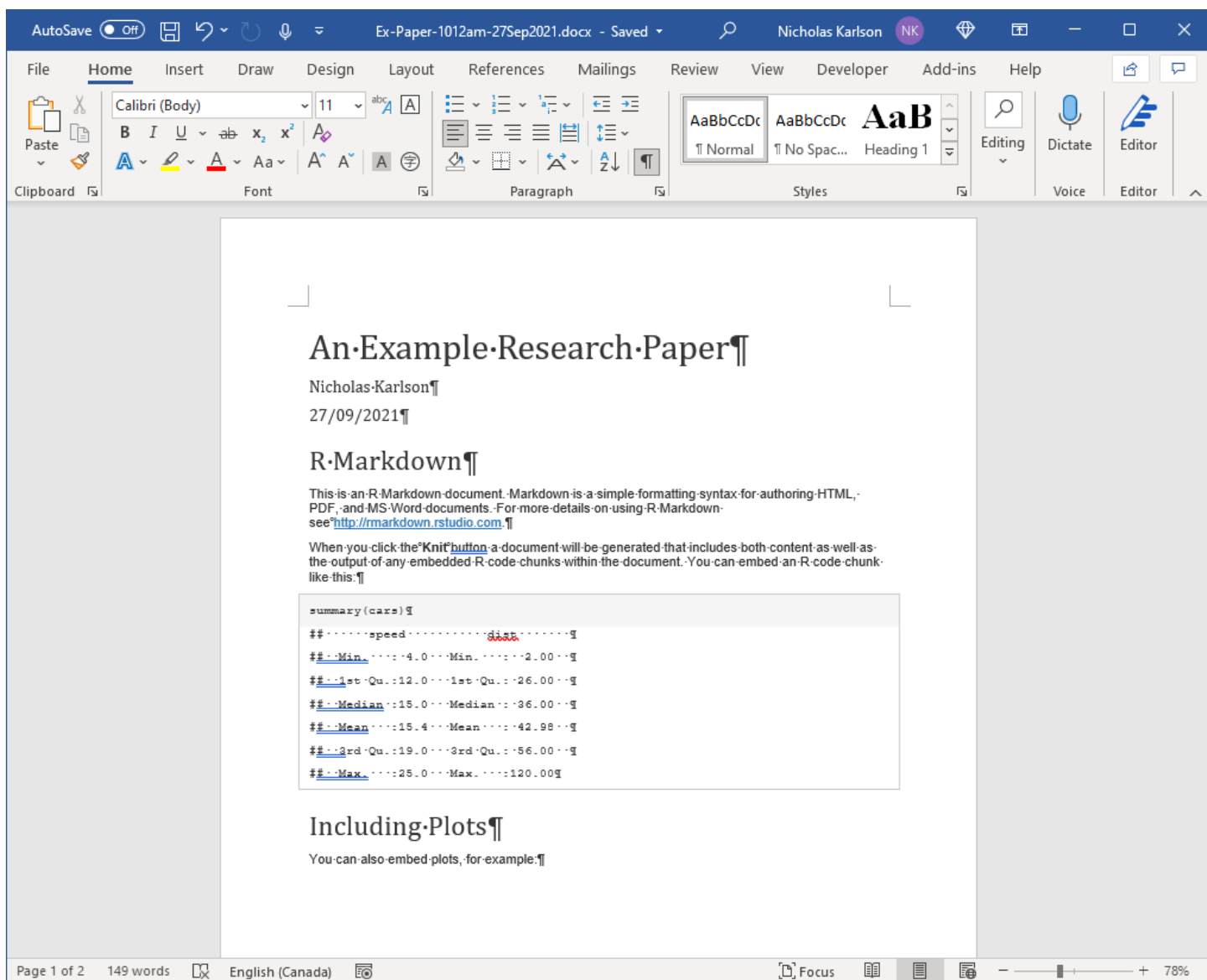
Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot¶

Including·Plots¶

You can also embed plots, for example¶

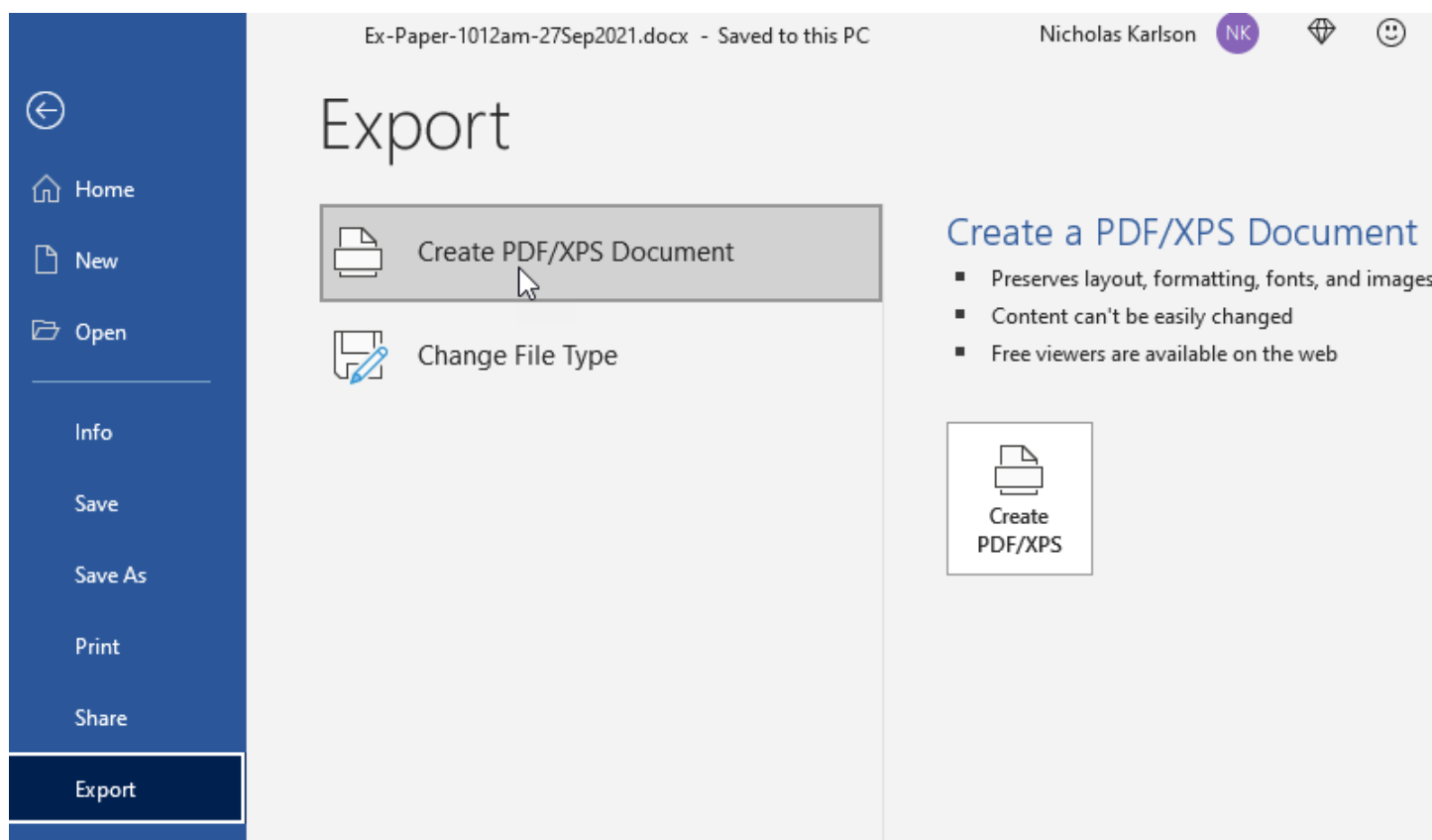
Page 2 of 2 149 words English (Canada) 100%

The saved Word doc:

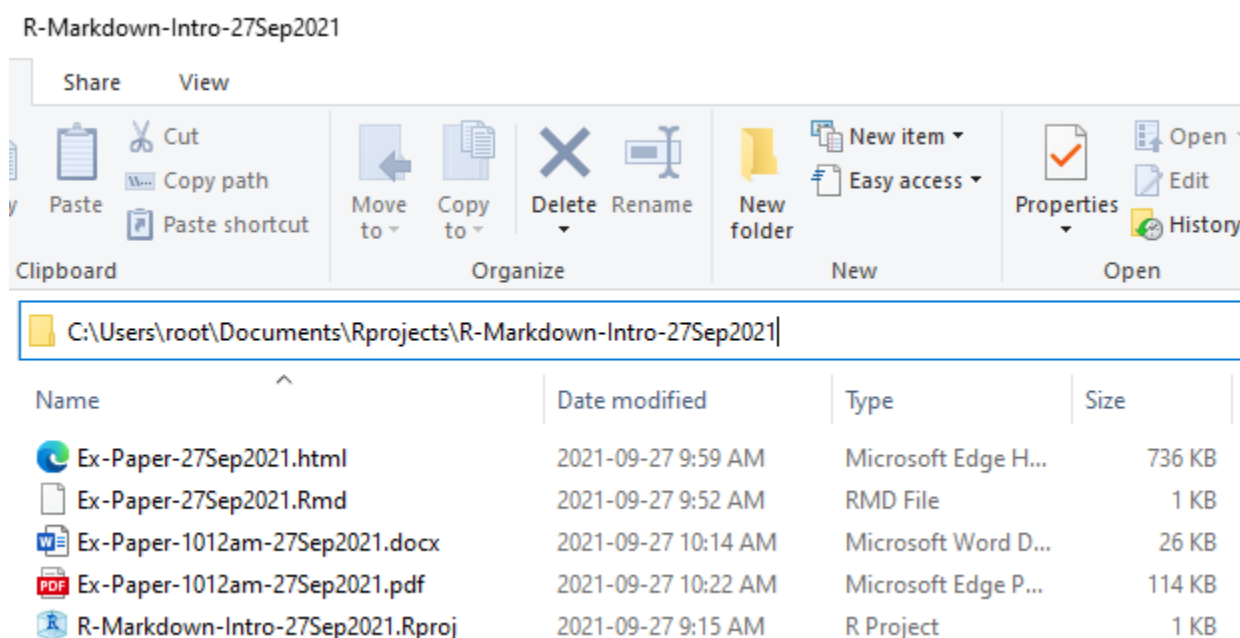


Now

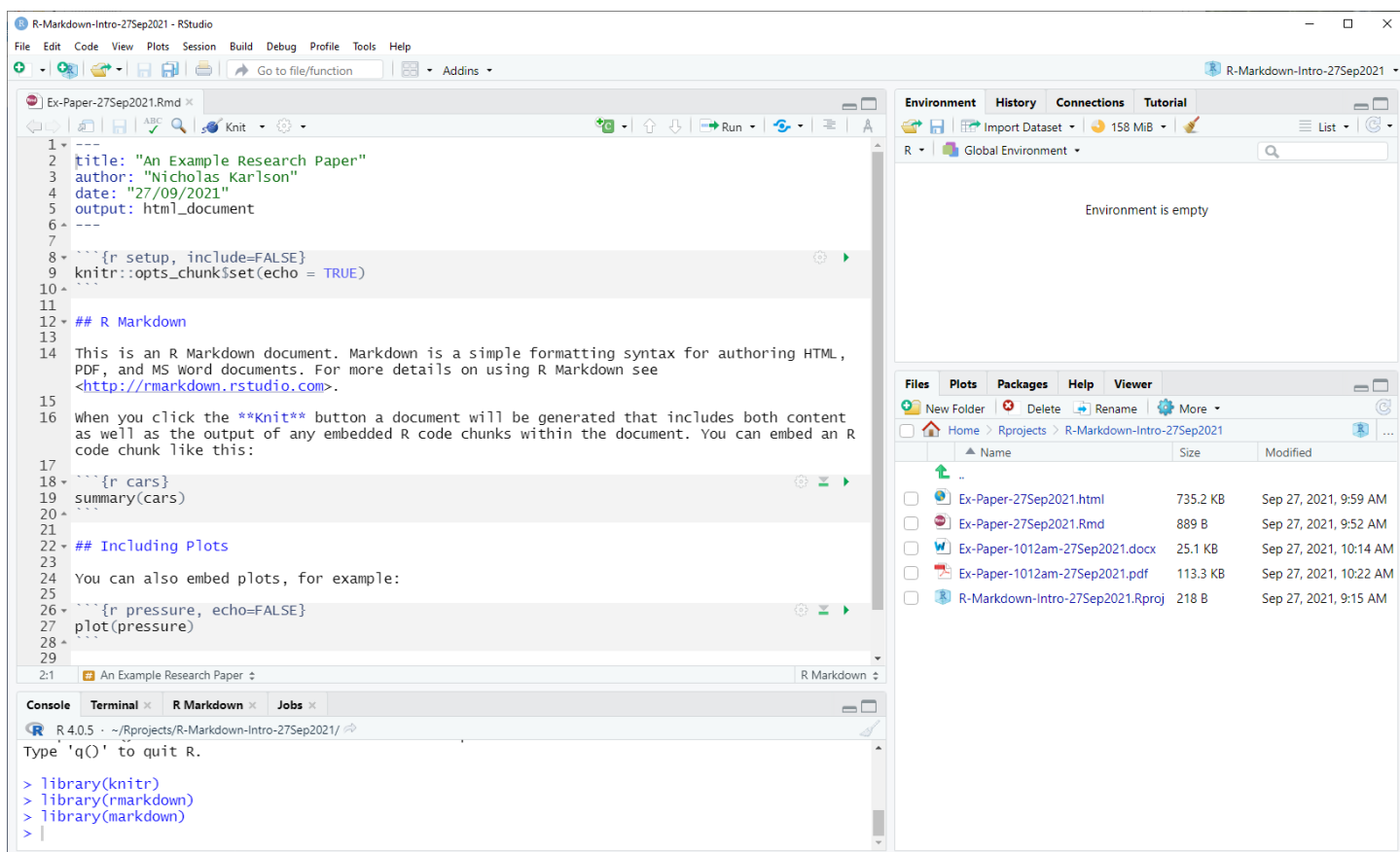
- 1) export it as a PDF
- 2) place both the Word doc and the PDF file in the RStudio project directory
- 3) upload all of this to my GitHub account where it can be downloaded and the results reproduced.
- 4) This ends Part 1 of an introduction to R Markdown (more parts to be announced on EDSS)



After exporting, put docx and pdf file in project directory:



You can see it is now in the RStudio project by looking at the RStudio files window...



This project should be my GitHub site (the URL is below).

<https://github.com/nicholaskarlson>