UNIVERSITY OF LINCOLN

Intro to R, part 2

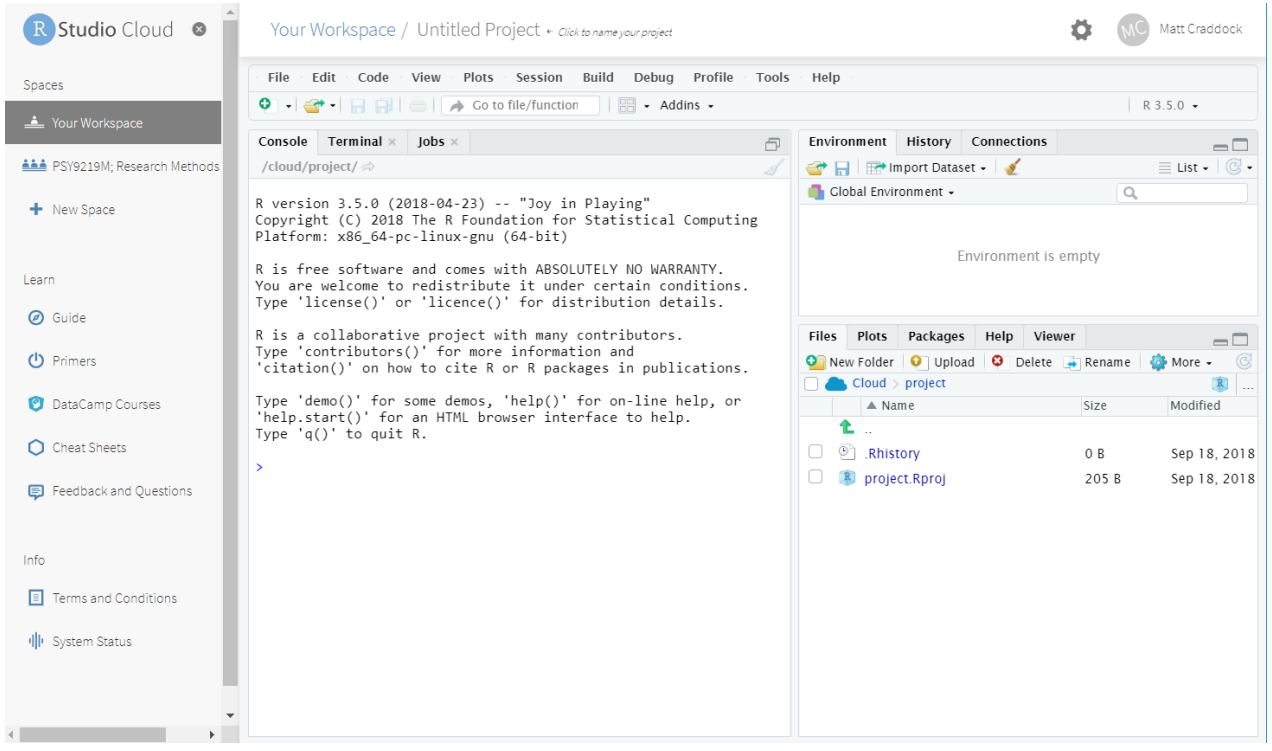
PSY9219M - Research Methods and Skills

Dr Matt Craddock

2/10/2018

Interacting with R

- The R Console
  - REPL: Read Evaluate Print Loop
  - Type stuff in, it tries to do it



Basic use of R

Use of R like a calculator

The R console allows you to use it like a calculator, as below:

```
5 + 5
```

```
## [1] 10
```

```
10 - 6 * 13
```

```
## [1] -68
```

Basic use of R

We can assign values to objects

You assign values to objects using <-

```
test_object <- 5
```

<- can be read as "is now", making the code above roughly mean

```
The object "test_object" is now 5 # Do not run!
```

Objects "stand-in" for their values:

```
test_object
```

```
## [1] 5
```

Basic use of R

Creation of vectors

Vectors are simply a 1-dimensional collection of values of the same type.

We can create a vector using the **c()** function.

```
c(5, 10, 3, -1, -5)
```

```
## [1]  5 10  3 -1 -5
```

This is a one-dimensional vector of length *five*, since it has 5 values.

Basic use of R

Basic use of functions to perform calculations

Functions do things to objects.

Brackets after a word in these slides indicate that something is a function, e.g. **c()**, **mean()**

```
mean(c(5, 8, 2, 4, 5))
```

```
## [1] 4.8
```

```
test_object <- c(5, 8, 2, 4, 5)
mean(test_object)
```

```
## [1] 4.8
```

R Scripts

R Scripts

Scripts are a way of writing out a sequence of commands that you want R to execute.

A typical script looks something like this:

```
# Load in required packages using library()
library(tidyverse)

# Define any custom functions here (we haven't covered this!)

# Now load any data you want to work on. (again, we'll cover this later!)
test_data <-
  read_csv("data/a-random-RT-file.csv") %>% # I'll explain what %>% means later
  rename(RT = `reaction times`)

# The rest of the script then runs whatever analyses or plotting you want to do
ggplot(test_data,
       aes(x = RT,
           fill = viewpoint)) +
  geom_density()
```

R Scripts

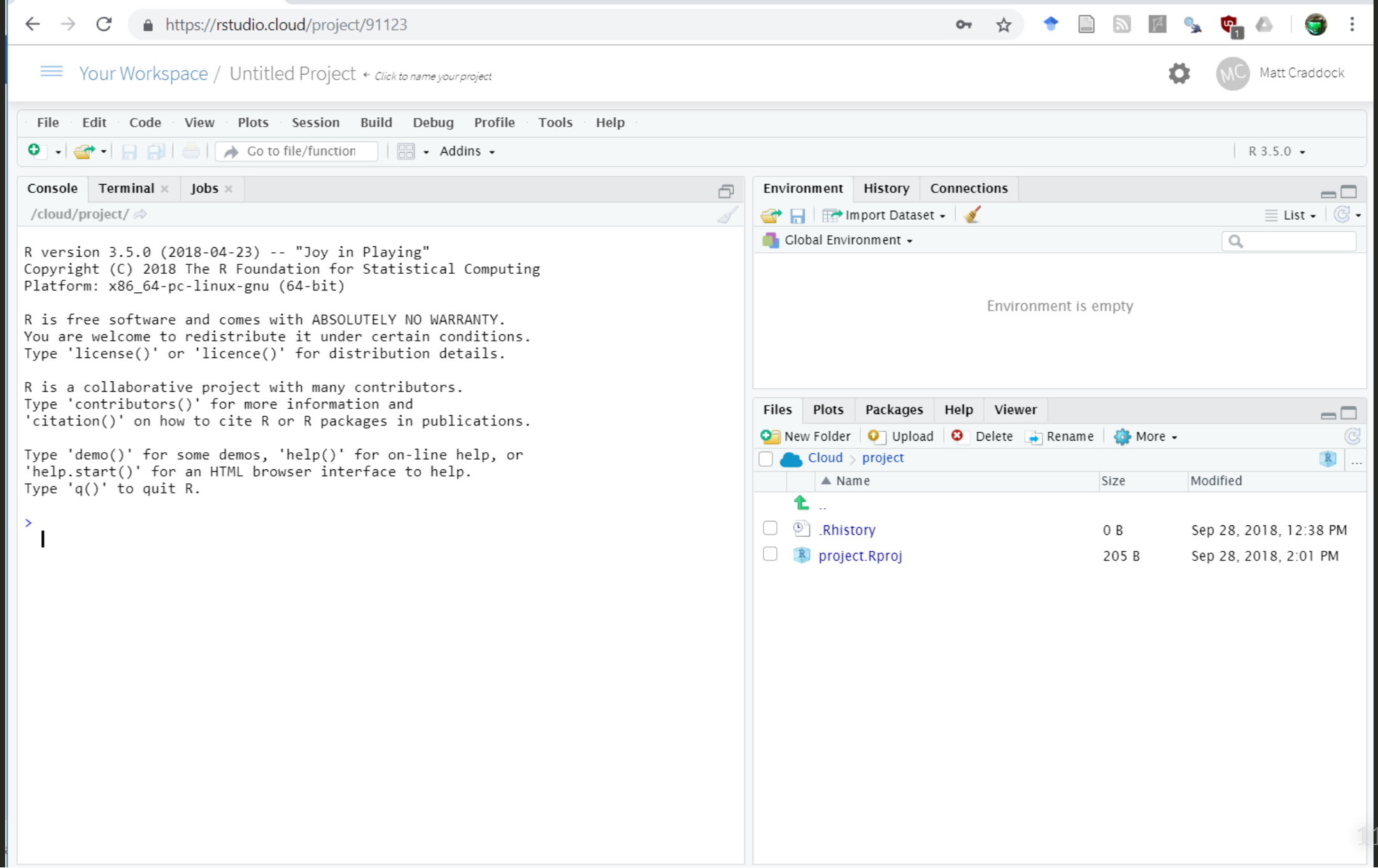
Why is this useful?

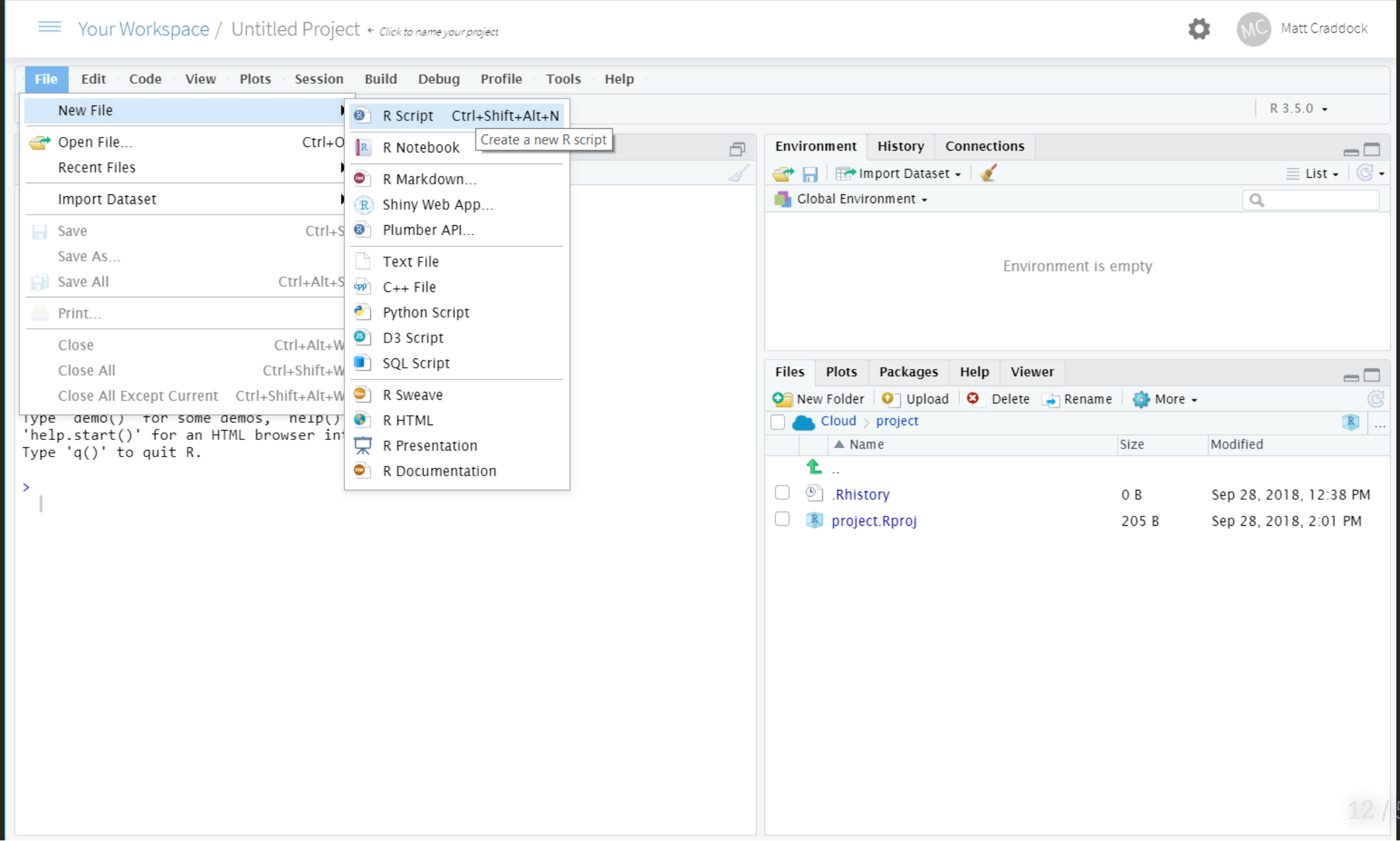
Somebody asks you how you performed a particular analysis. In particular, they want detailed instructions of how you created a plot, filtered out outliers or missing data, and performed a linear regression.

Q1: *How would you do that if you used SPSS?*

Q2: *How would you do that if you used R?*

Creating R Scripts


https://rstudio.cloud/project/91123
Your Workspace / Untitled Project Click to name your project
Matt Craddock
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 3.5.0
Console Terminal Jobs
/cloud/project/
R version 3.5.0 (2018-04-23) -- "Joy in Playing"
Copyright (C) 2018 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu (64-bit)
R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in 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.
>
Environment History Connections
Import Dataset
List
Global Environment
Environment is empty
Files Plots Packages Help Viewer
New Folder Upload Delete Rename More
Cloud project
Name Size Modified
..
.Rhistory 0 B Sep 28, 2018, 12:38 PM
project.Rproj 205 B Sep 28, 2018, 2:01 PM


Your Workspace / Untitled Project Click to name your project
Matt Craddock
File Edit Code View Plots Session Build Debug Profile Tools Help
New File
Open File... Ctrl+O
Recent Files
Import Dataset
Save Ctrl+S
Save As...
Save All Ctrl+Alt+S
Print...
Close Ctrl+Alt+W
Close All Ctrl+Shift+W
Close All Except Current Ctrl+Shift+Alt+W
R Script Ctrl+Shift+Alt+N
R Notebook
Create a new R script
R Markdown...
Shiny Web App...
Plumber API...
Text File
C++ File
Python Script
D3 Script
SQL Script
R Sweave
R HTML
R Presentation
R Documentation
R 3.5.0
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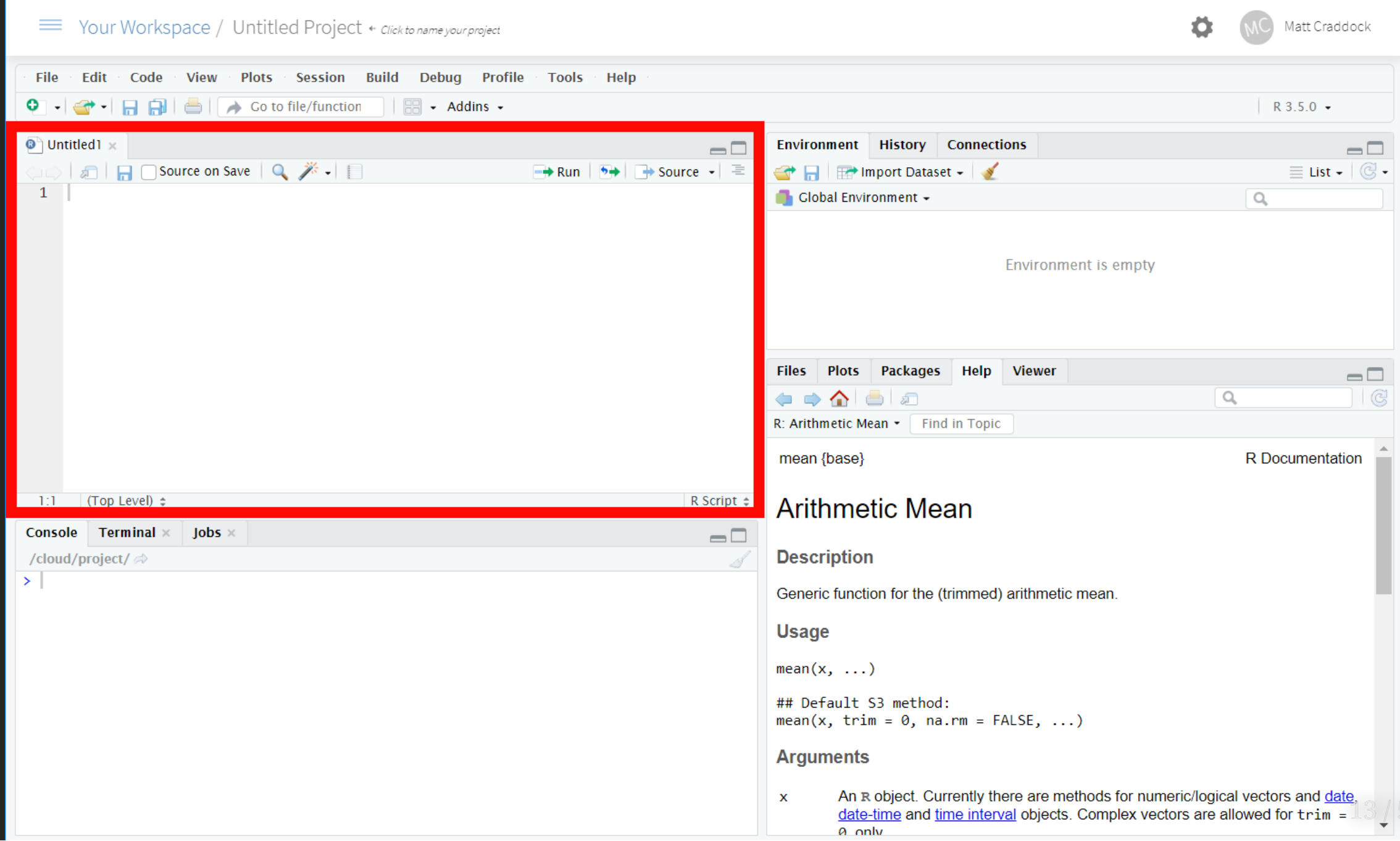
Your Workspace / Untitled Project Click to name your project
Matt Craddock
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 3.5.0
Untitled1
Source on Save
Run
Source
1
1:1
(Top Level)
R Script
Environment History Connections
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Files Plots Packages Help Viewer
R: Arithmetic Mean
Find in Topic
mean {base}
R Documentation
Arithmetic Mean
Description
Generic function for the (trimmed) arithmetic mean.
Usage
mean(x, ...)
Default S3 method:
mean(x, trim = 0, na.rm = FALSE, ...)
Arguments
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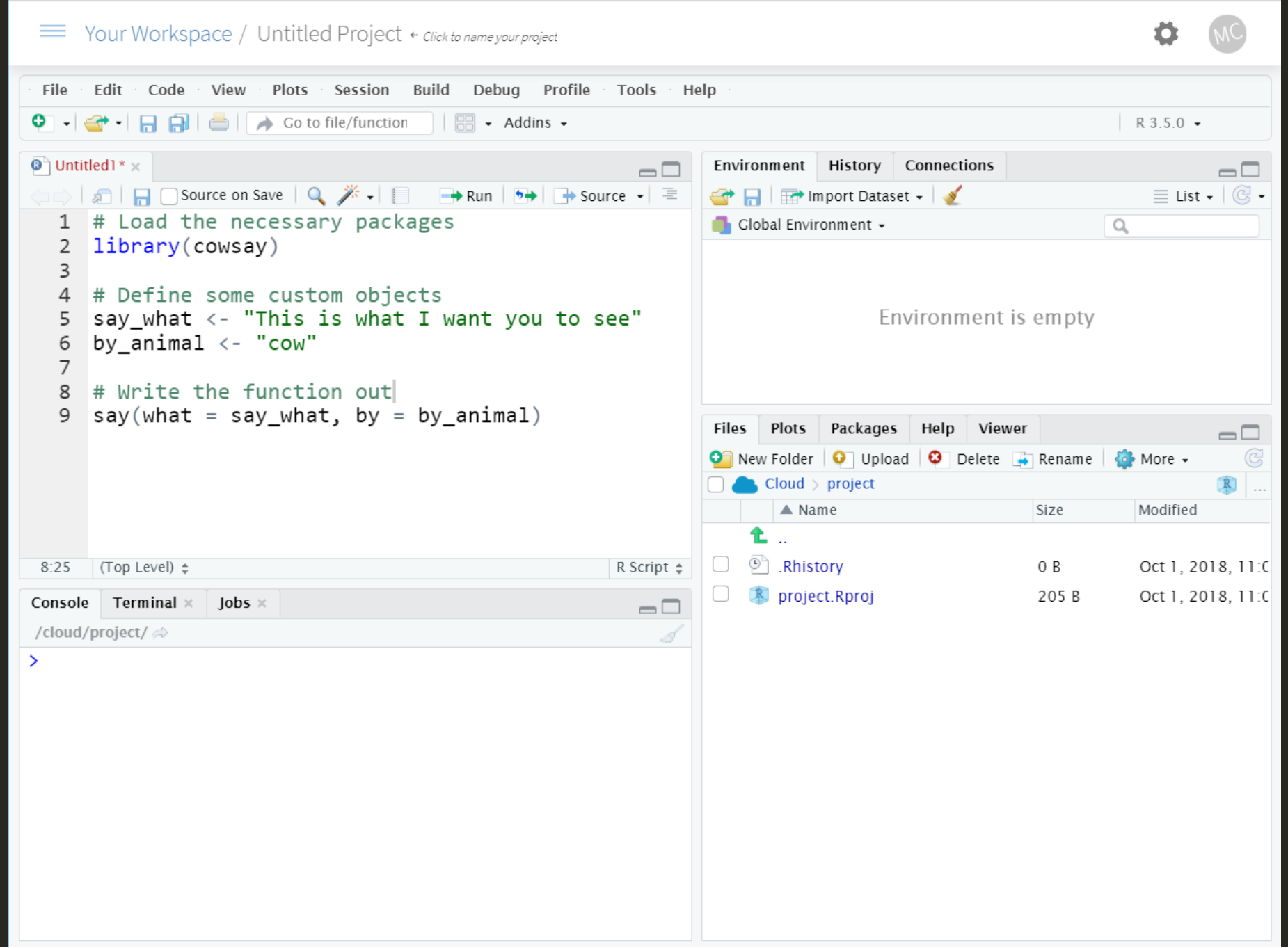
An R object. Currently there are methods for numeric/logical vectors and date, date-time and time interval objects. Complex vectors are allowed for trim = 0 only.
Console Terminal Jobs
/cloud/project/
>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Go to file/function
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Source
1 # Load the necessary packages
2 library(cowsay)
3
4 # Define some custom objects
5 say_what <- "This is what I want you to see"
6 by_animal <- "cow"
7
8 # Write the function out
9 say(what = say_what, by = by_animal)
8:25
(Top Level)
R Script
Console
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/cloud/project/
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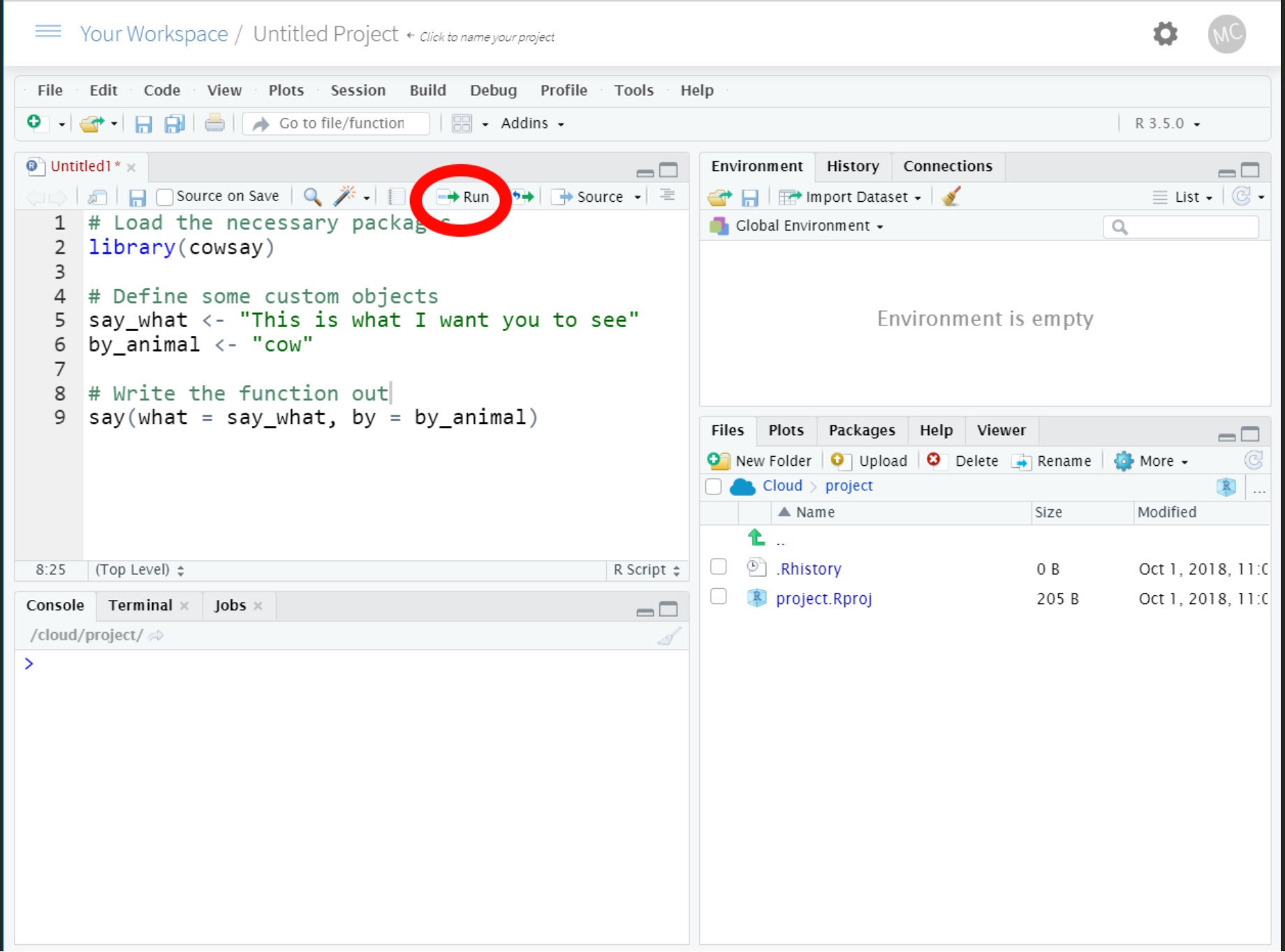
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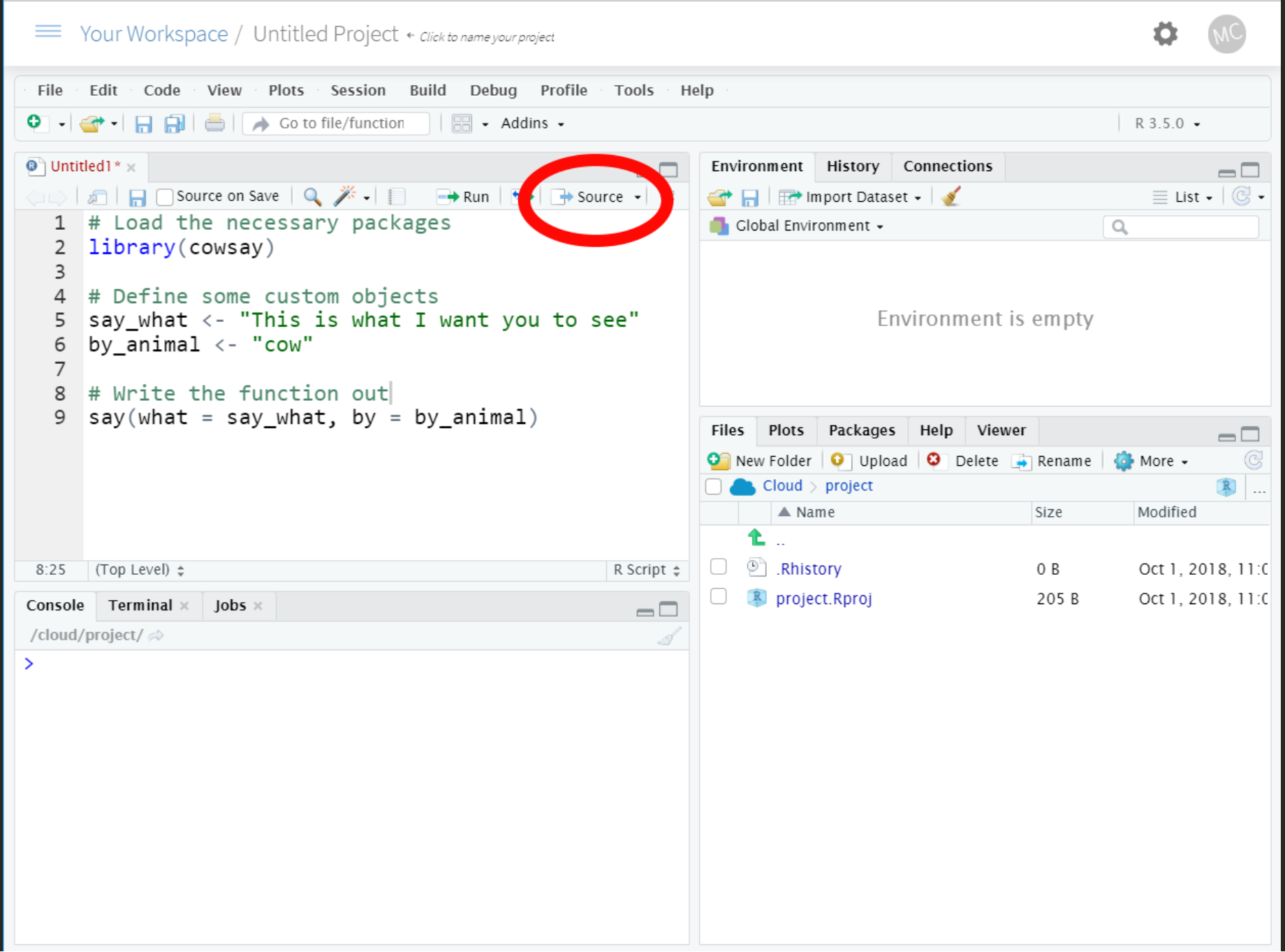
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Environment is empty
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Console Terminal Jobs
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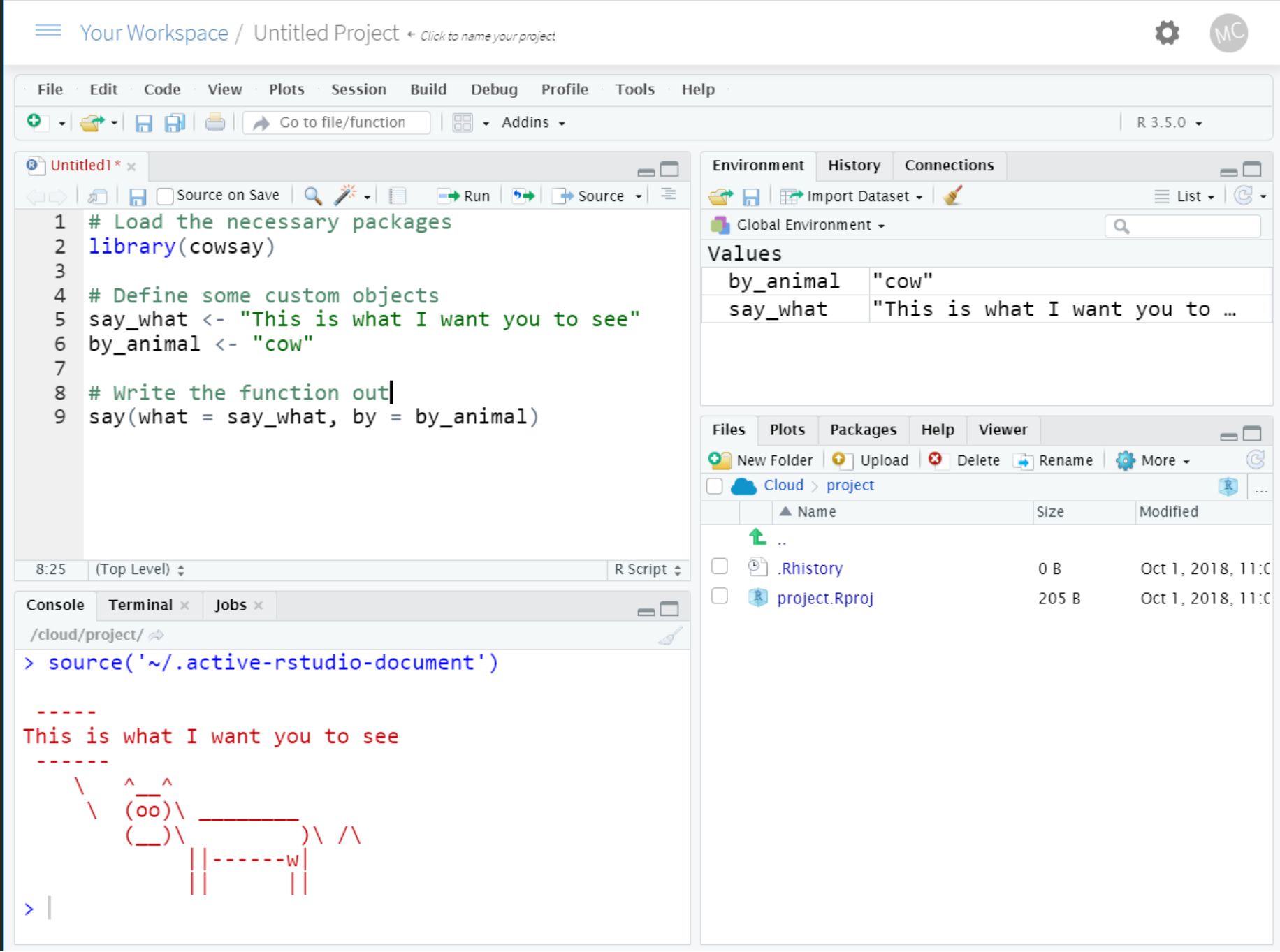
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R Script
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Terminal
Jobs
/cloud/project/
> source('~/.active-rstudio-document')
This is what I want you to see
Environment
History
Connections
Import Dataset
List
Global Environment
Values
by_animal "cow"
say_what "This is what I want you to …
Files
Plots
Packages
Help
Viewer
New Folder
Upload
Delete
Rename
More
Cloud
project
Name
Size
Modified
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project.Rproj 205 B Oct 1, 2018, 11:0

R Markdown

R Markdown

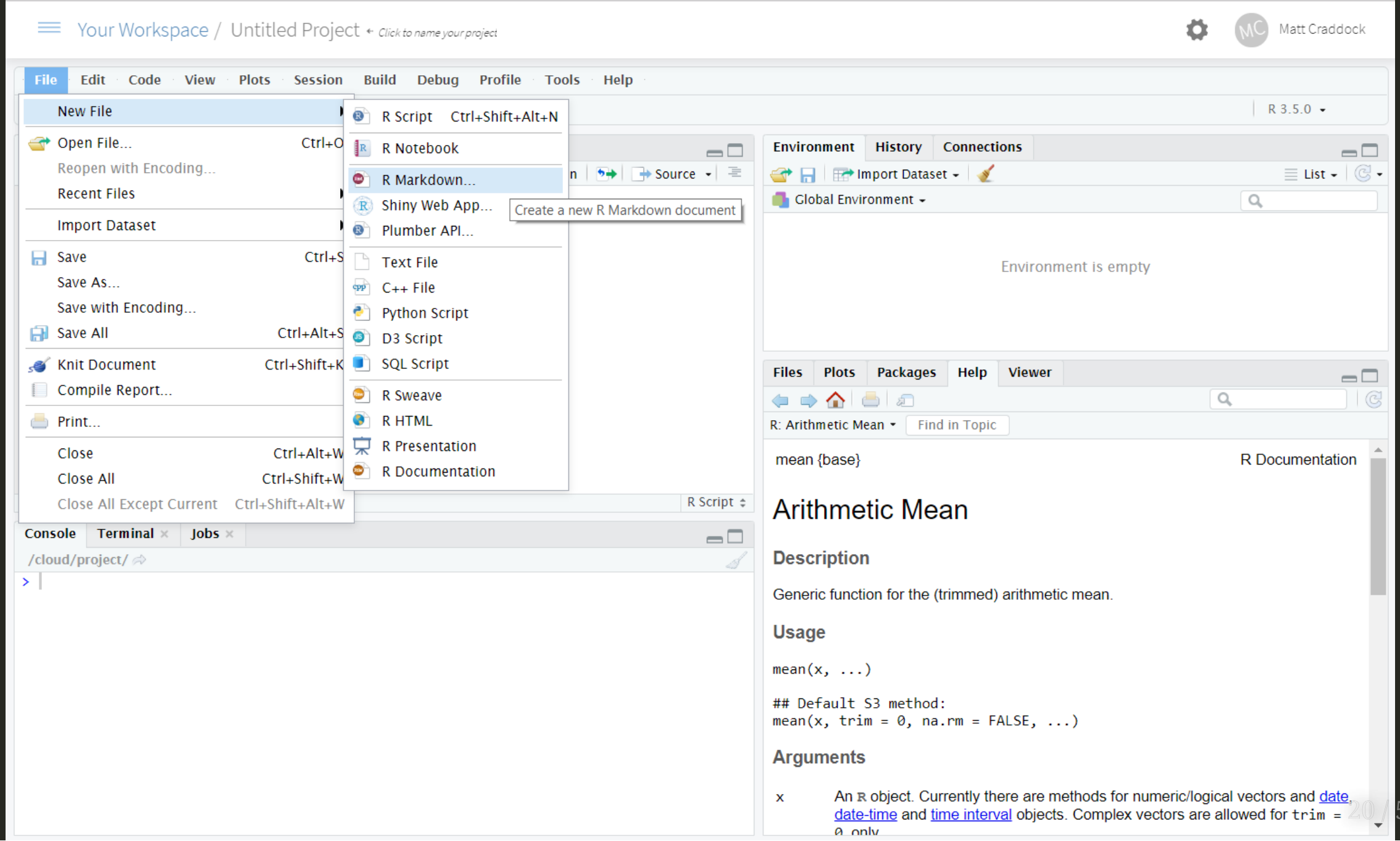
R Markdown is a framework for producing high-quality reports and for what's called **Literate programming**.

Literate programming is a mixture of plain text and code.

Whereas in scripts you need to use the # symbol to indicate comments, as here

```
# This is a comment
```

...with R Markdown you can mix plain text and code using **chunks** to delineate sections of code.


Your Workspace / Untitled Project Click to name your project
Matt Craddock
File Edit Code View Plots Session Build Debug Profile Tools Help
New File
Open File... Ctrl+O
Reopen with Encoding...
Recent Files
Import Dataset
Save Ctrl+S
Save As...
Save with Encoding...
Save All Ctrl+Alt+S
Knit Document Ctrl+Shift+K
Compile Report...
Print...
Close Ctrl+Alt+W
Close All Ctrl+Shift+W
Close All Except Current Ctrl+Shift+Alt+W
R Script Ctrl+Shift+Alt+N
R Notebook
R Markdown...
Shiny Web App...
Plumber API...
Text File
C++ File
Python Script
D3 Script
SQL Script
R Sweave
R HTML
R Presentation
R Documentation
Create a new R Markdown document
R 3.5.0
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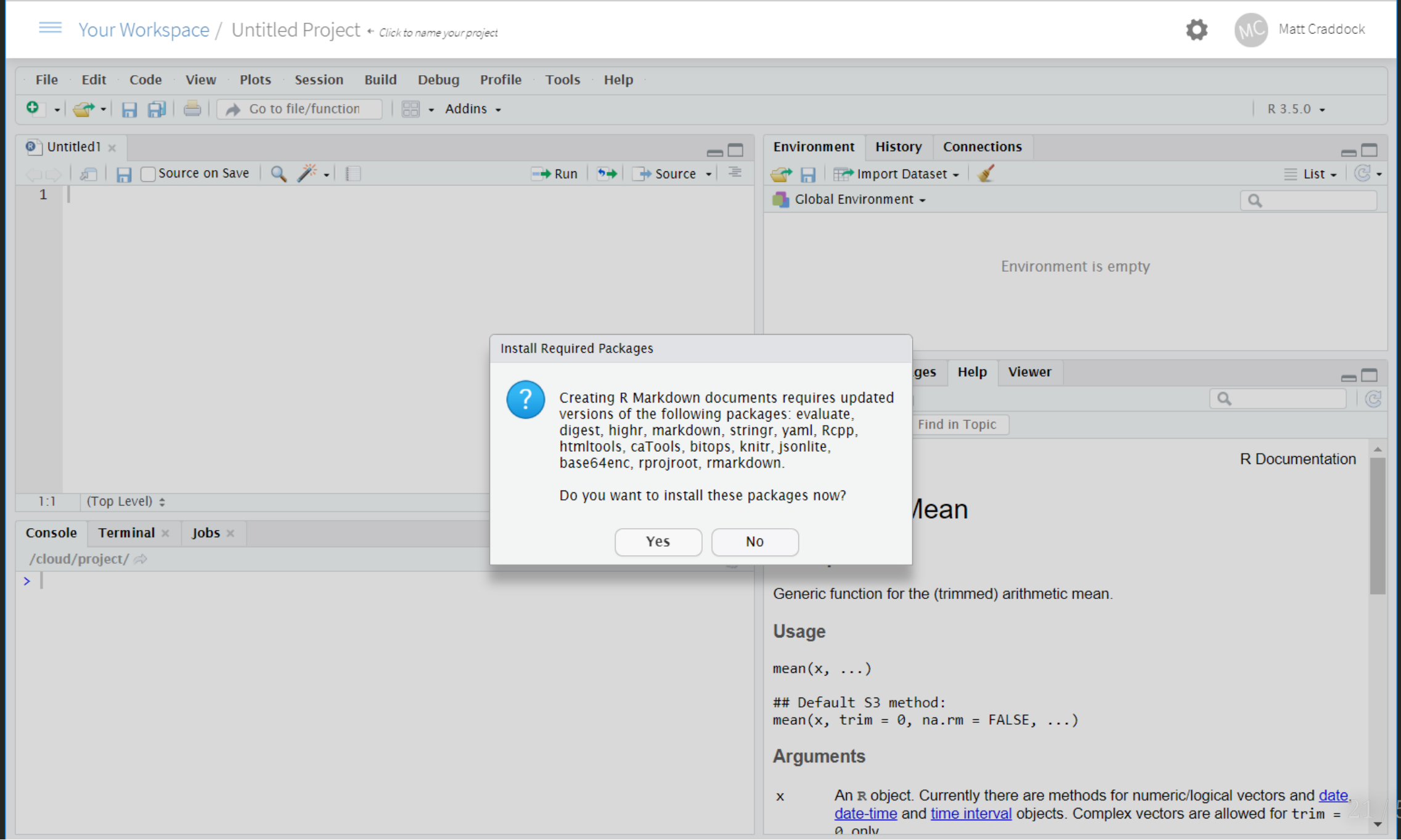
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Import Dataset
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Install Required Packages
Creating R Markdown documents requires updated versions of the following packages: evaluate, digest, highr, markdown, stringr, yaml, Rcpp, htmltools, caTools, bitops, knitr, jsonlite, base64enc, rprojroot, rmarkdown.
Do you want to install these packages now?
Yes
No
Help
Viewer
Find in Topic
R Documentation
Mean
Generic function for the (trimmed) arithmetic mean.
Usage
mean(x, ...)
Default S3 method:
mean(x, trim = 0, na.rm = FALSE, ...)
Arguments
x
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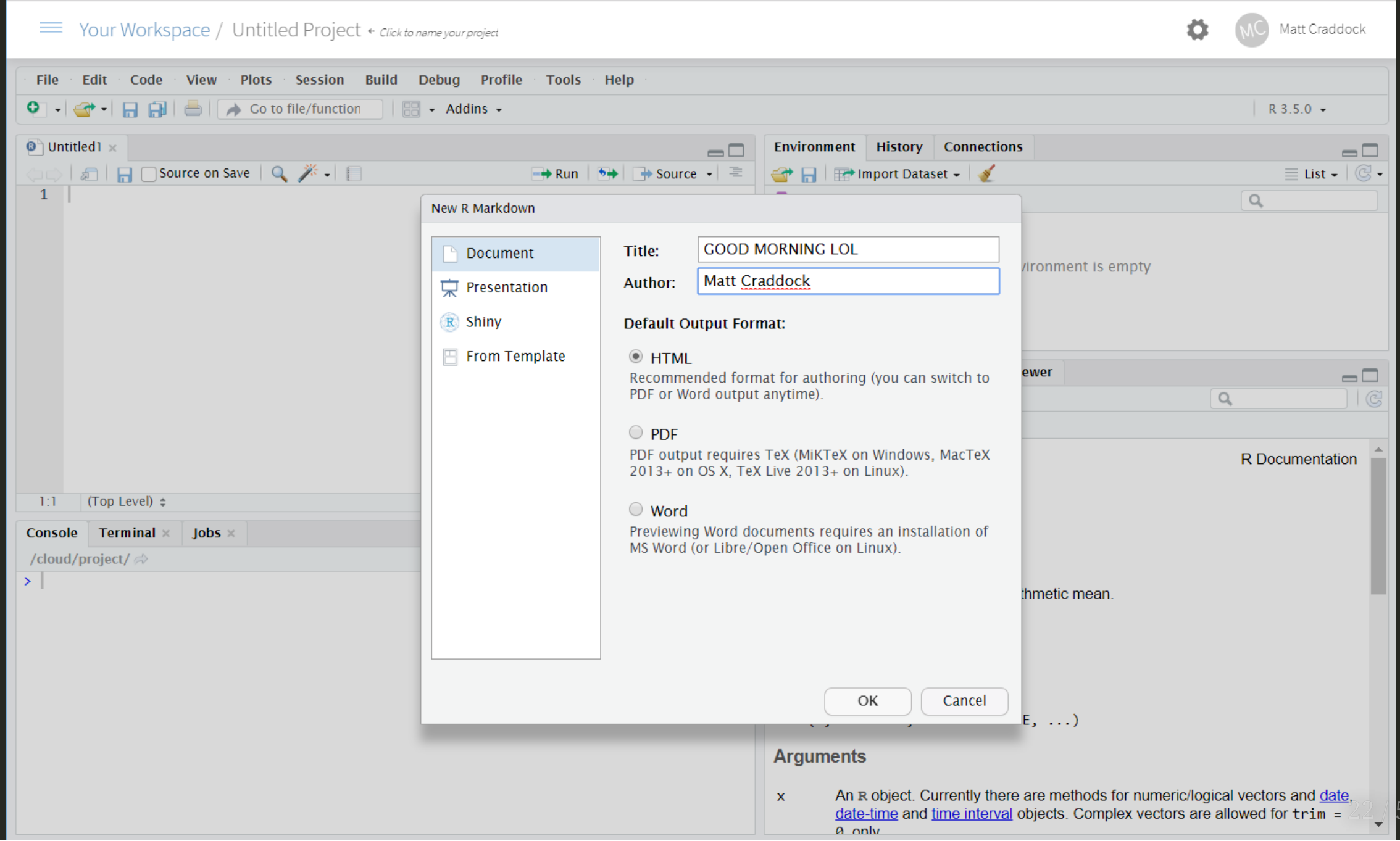
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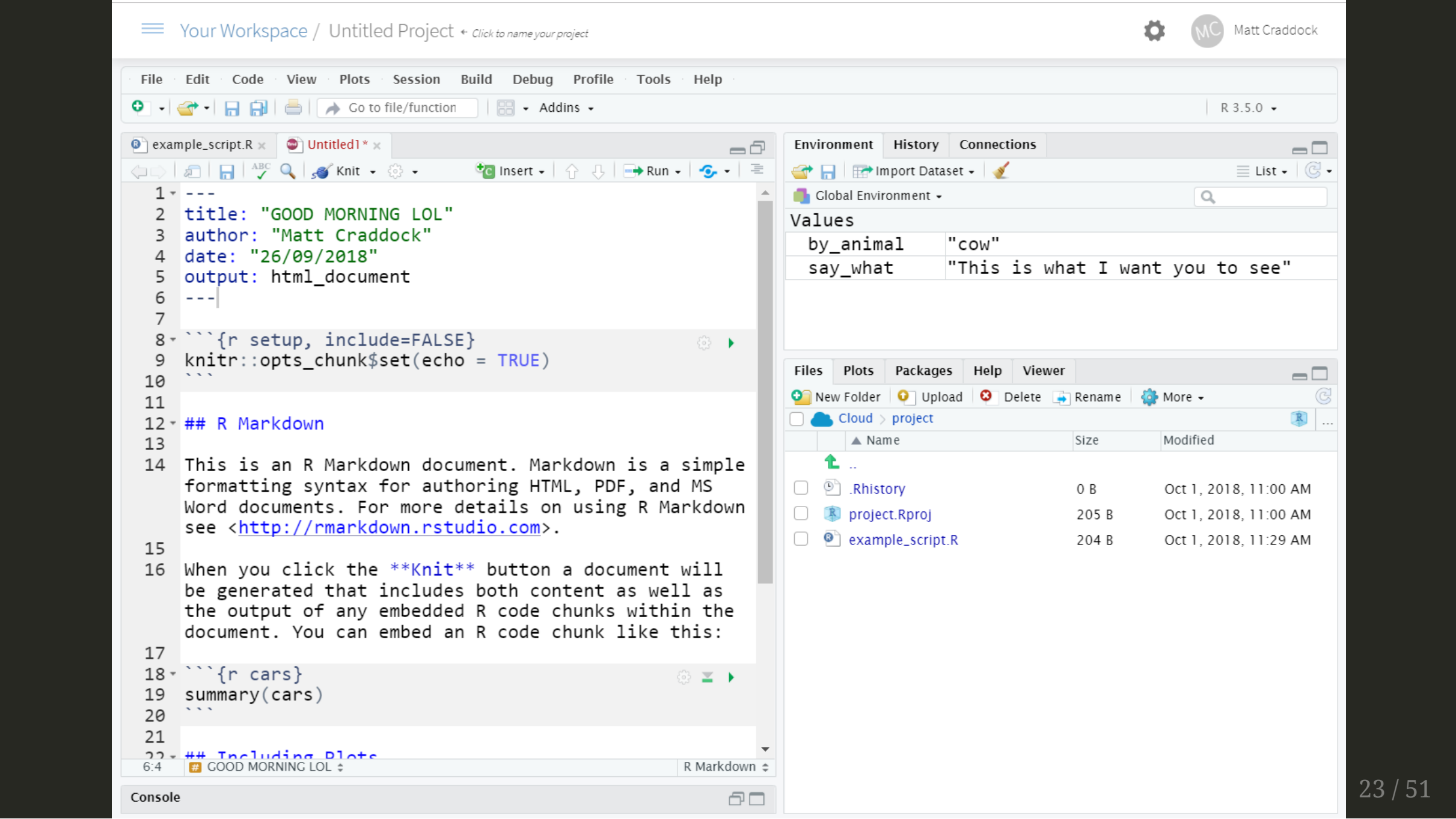
0 only
New R Markdown
Document
Presentation
Shiny
From Template
Title:
GOOD MORNING LOL
Author:
Matt Craddock
Default Output Format:
HTML
Recommended format for authoring (you can switch to PDF or Word output anytime).
PDF
PDF output requires TeX (MiKTeX on Windows, MacTeX 2013+ on OS X, TeX Live 2013+ on Linux).
Word
Previewing Word documents requires an installation of MS Word (or Libre/Open Office on Linux).
OK
Cancel


Your Workspace / Untitled Project
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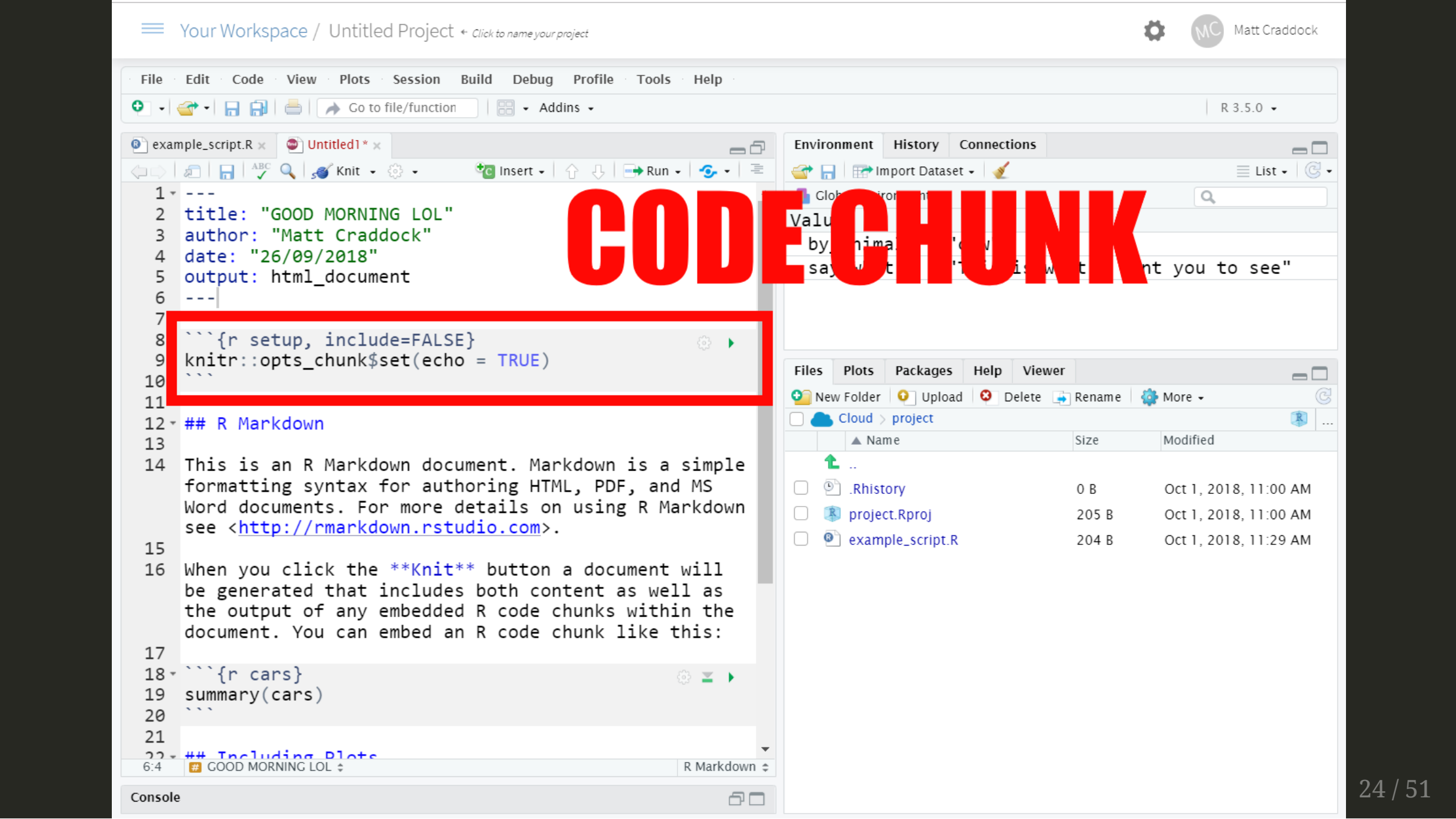
Matt Craddock
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 3.5.0
example_script.R
Untitled1 *
Knit
Insert
Run
---
title: "GOOD MORNING LOL"
author: "Matt Craddock"
date: "26/09/2018"
output: html_document

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```
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:
```{r cars}
summary(cars)
```
Including Plots
6:4
GOOD MORNING LOL
R Markdown
Console
Environment History Connections
Import Dataset
List
Global Environment
Values
by_animal "cow"
say_what "This is what I want you to see"
Files Plots Packages Help Viewer
New Folder
Upload
Delete
Rename
More
Cloud project
Name Size Modified
.Rhistory 0 B Oct 1, 2018, 11:00 AM
project.Rproj 205 B Oct 1, 2018, 11:00 AM
example_script.R 204 B Oct 1, 2018, 11:29 AM


Your Workspace / Untitled Project
Click to name your project
Matt Craddock
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 3.5.0
example_script.R
Untitled1*
Knit
Insert
Run
CODE CHUNK
1 ---
2 title: "GOOD MORNING LOL"
3 author: "Matt Craddock"
4 date: "26/09/2018"
5 output: html_document
6 ---
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 ```
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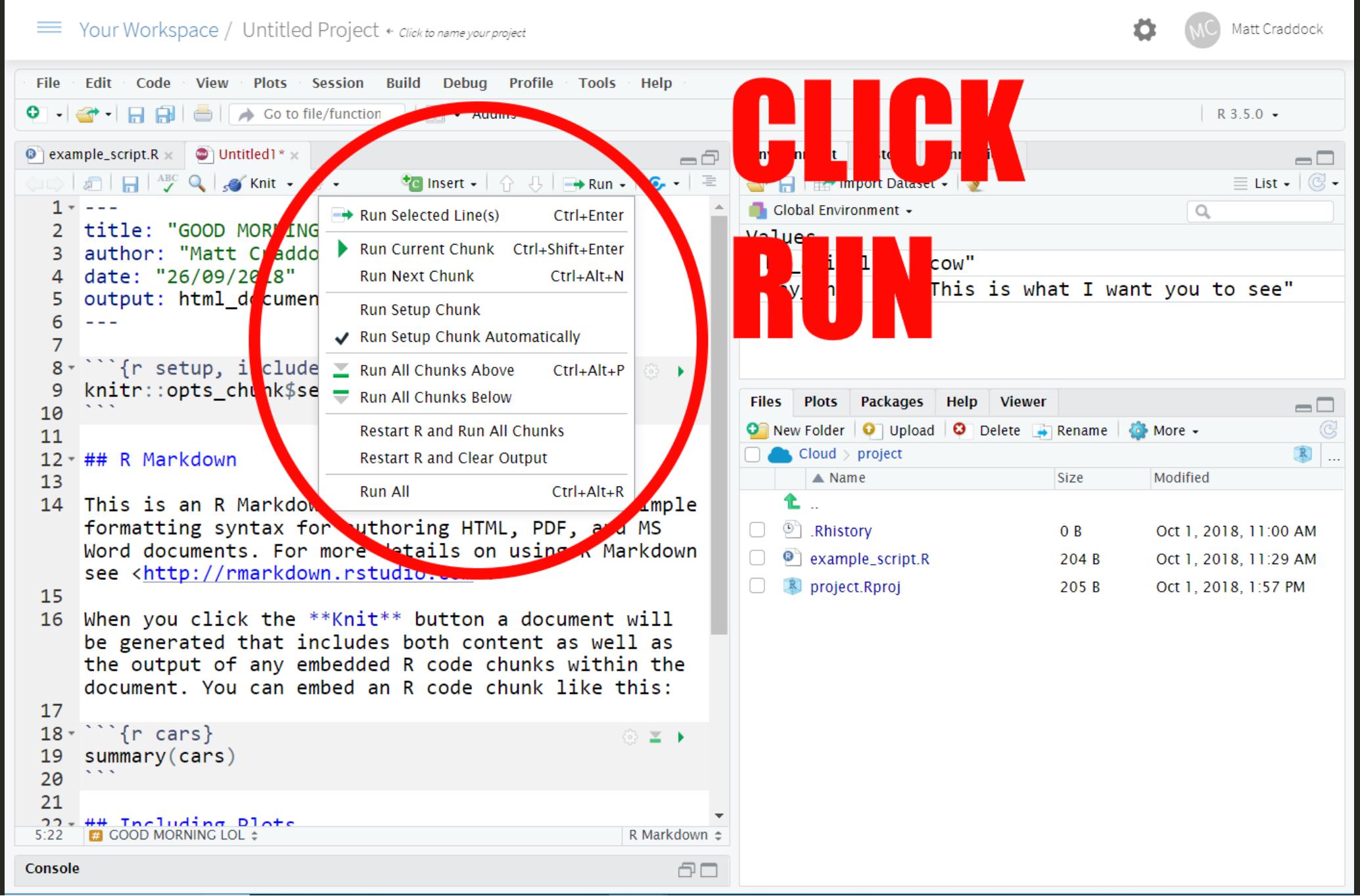
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Go to file/function
R 3.5.0
example_script.R
Untitled1*
Knit
Insert
Run
Run Selected Line(s) Ctrl+Enter
Run Current Chunk Ctrl+Shift+Enter
Run Next Chunk Ctrl+Alt+N
Run Setup Chunk
Run Setup Chunk Automatically
Run All Chunks Above Ctrl+Alt+P
Run All Chunks Below
Restart R and Run All Chunks
Restart R and Clear Output
Run All Ctrl+Alt+R
CLICK
RUN
Import Dataset
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Cloud project
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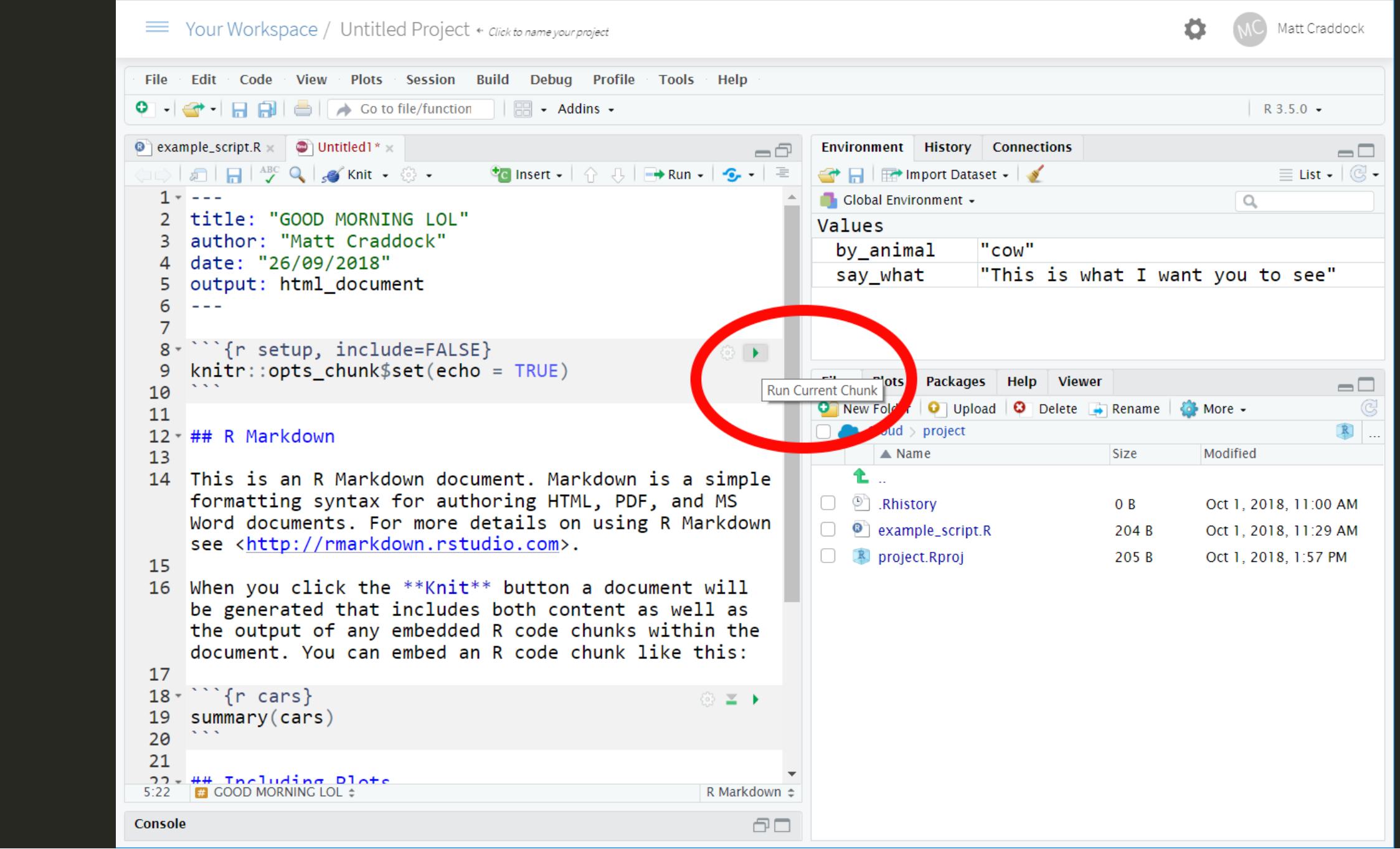
5:22 GOOD MORNING LOL R Markdown
Console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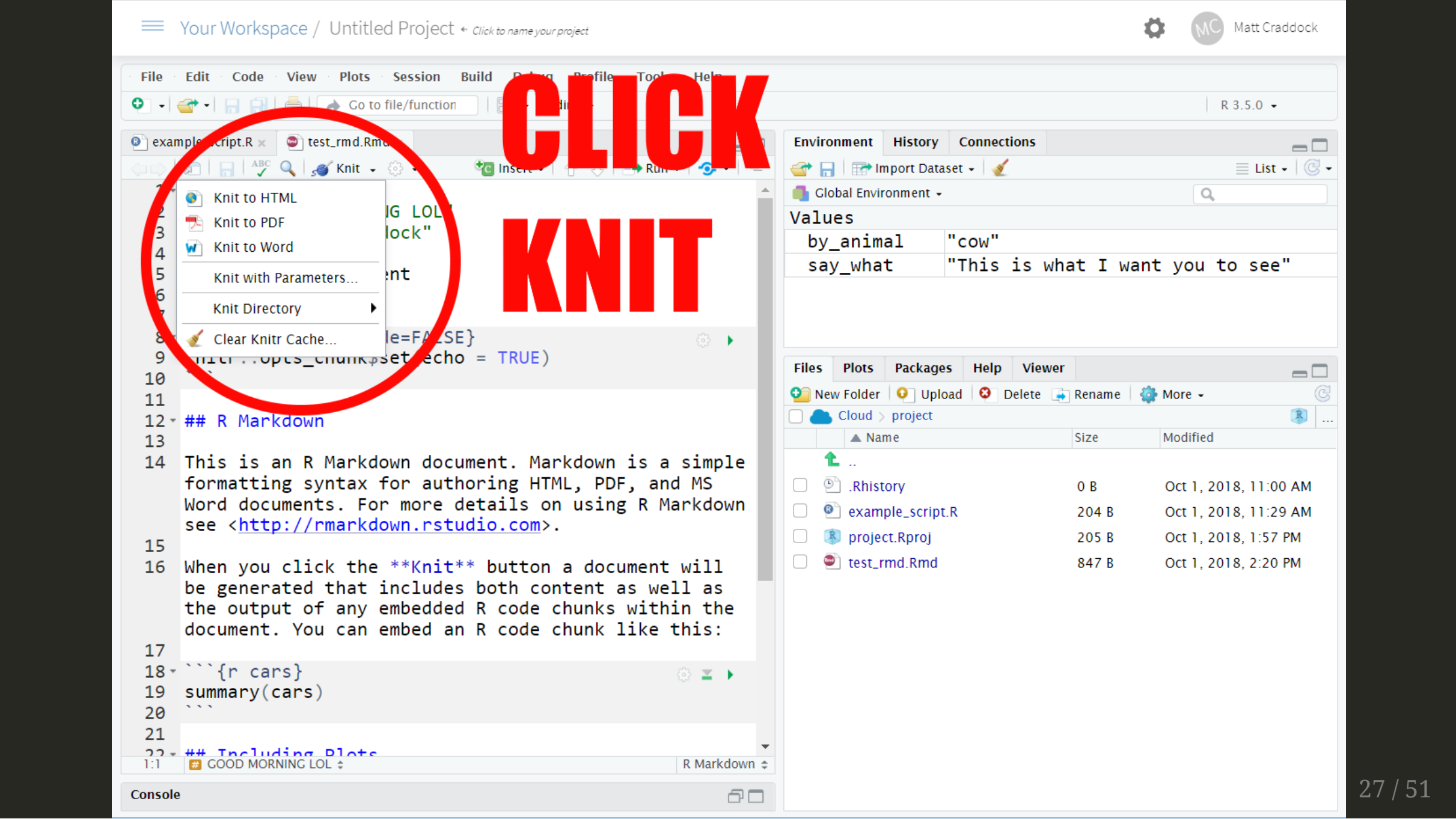
example_script.R 204 B Oct 1, 2018, 11:29 AM
project.Rproj 205 B Oct 1, 2018, 1:57 PM


Your Workspace / Untitled Project
Click to name your project
Matt Craddock
File Edit Code View Plots Session Build
Go to file/function
R 3.5.0
CLICK
KNIT
Knit to HTML
Knit to PDF
Knit to Word
Knit with Parameters...
Knit Directory
Clear Knitr Cache...
Environment History Connections
Import Dataset
List
Global Environment
Values
by_animal "cow"
say_what "This is what I want you to see"
Files Plots Packages Help Viewer
New Folder Upload Delete Rename More
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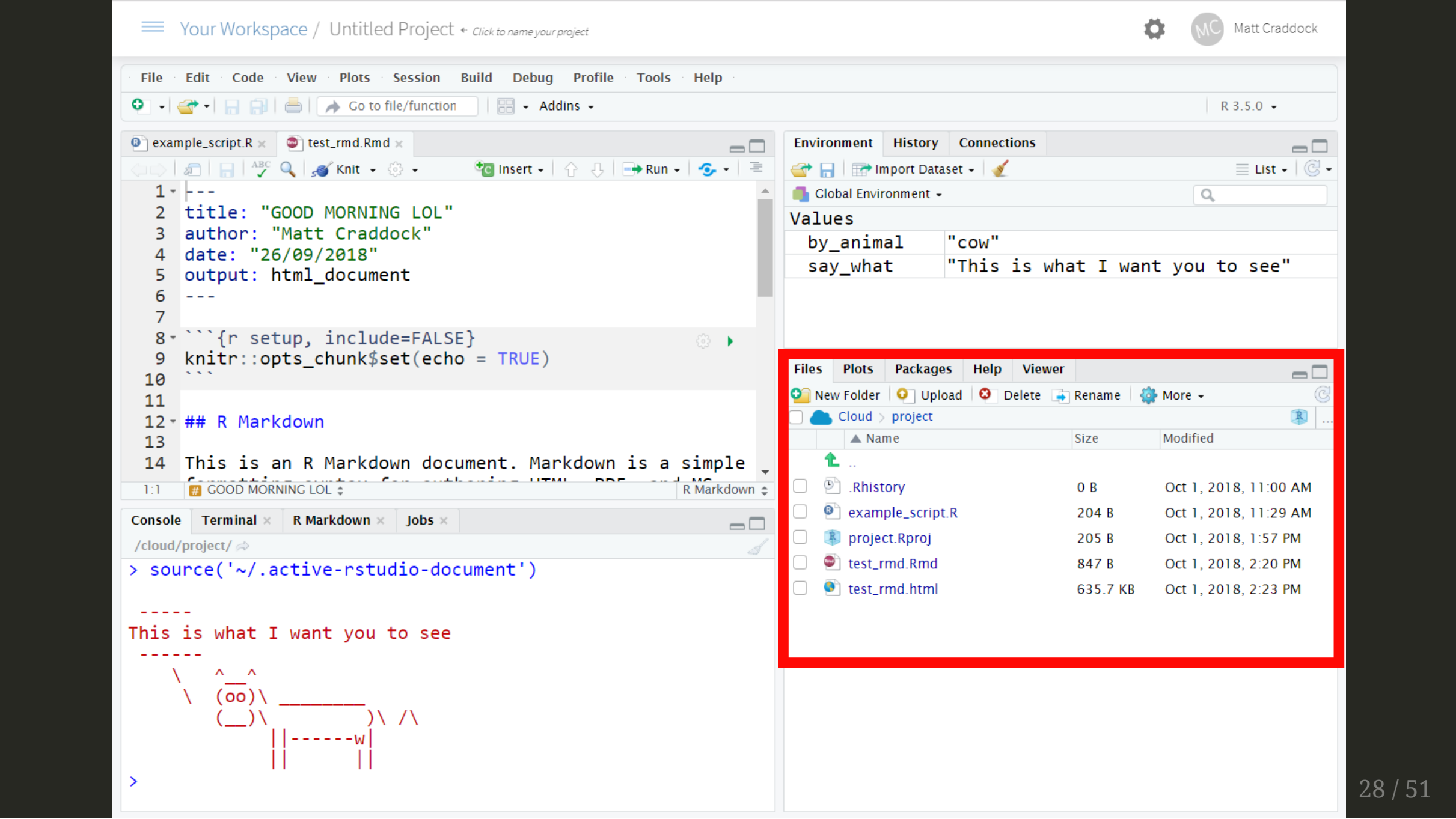
project.Rproj 205 B Oct 1, 2018, 1:57 PM
test_rmd.Rmd 847 B Oct 1, 2018, 2:20 PM
R Markdown
This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.
When you click the **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:
```{r cars}
summary(cars)
```
GOOD MORNING LOL
R Markdown
Console


Your Workspace / Untitled Project Click to name your project
Matt Craddock
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 3.5.0
example_script.R
test_rmd.Rmd
Knit
Insert
Run
1 ---
2 title: "GOOD MORNING LOL"
3 author: "Matt Craddock"
4 date: "26/09/2018"
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
1:1
GOOD MORNING LOL
R Markdown
Console
Terminal
R Markdown
Jobs
/cloud/project/
> source('~/.active-rstudio-document')

This is what I want you to see

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|| ||
>
Environment
History
Connections
Import Dataset
List
Global Environment
Values
by_animal "cow"
say_what "This is what I want you to see"
Files
Plots
Packages
Help
Viewer
New Folder
Upload
Delete
Rename
More
Cloud
project
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.Rhistory 0 B Oct 1, 2018, 11:00 AM
example_script.R 204 B Oct 1, 2018, 11:29 AM
project.Rproj 205 B Oct 1, 2018, 1:57 PM
test_rmd.Rmd 847 B Oct 1, 2018, 2:20 PM
test_rmd.html 635.7 KB Oct 1, 2018, 2:23 PM

Basic data types

Basic data types

There are five basic data types in R:

Type	Description	Examples
double	Floating point value	3.12
integer	Integer	1, 2, 3
numeric	Any real number	3.4, 2, -2.3
character	Text	"Hi there", "8.5", "ABC123"
logical	Assertion of truth/falsity	TRUE, FALSE

There are some additional types to be aware of, particularly *factors*, but we'll come back to them in a later session.

Checking data types

We can use the **class()** function to check what type a given object is.

```
class(10)
```

```
## [1] "numeric"
```

```
class(10L) # using L after the number turns it into an *integer*
```

```
## [1] "integer"
```

```
class(TRUE)
```

```
## [1] "logical"
```

```
class("Wednesday")
```

```
## [1] "character"
```

Basic containers

Vectors

A vector is a collection of values which all have the same basic **type**.

A numeric vector is thus a collection of numeric values:

```
some_numbers <- c(5, 3, 6, 8)
some_numbers
```

```
## [1] 5 3 6 8
```

... and a character vector is a collection of character values

```
char_example <- c("Monday", "Tuesday", "Wednesday", "Thursday")
char_example
```

```
## [1] "Monday"    "Tuesday"   "Wednesday" "Thursday"
```

More about vectors

The colon (:) operator can be used to produce a sequence of numbers:

```
one_to_ten <- 1:10
one_to_ten
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10
```

Vectors can also be given names:

```
one_to_four <- 1:4
names(one_to_four) <- char_example
one_to_four
```

```
##    Monday   Tuesday Wednesday  Thursday
##         1         2         3         4
```

Extracting values

Sometimes you only want a specific subset of a vector. For example, suppose that you only want the third value. For this, we need the **[]** (square brackets) operator.

We put an *index* inbetween the **[]** operator.

```
char_example[3]
```

```
## [1] "Wednesday"
```

Note that you can also supply *multiple* values:

```
char_example[2:3]
```

```
## [1] "Tuesday"   "Wednesday"
```

```
char_example[c(2, 4)]
```

```
## [1] "Tuesday"  "Thursday"
```

Extracting values

If your vector is *named*, you can also use the names as *indices*.

```
one_to_four
```

```
##    Monday   Tuesday Wednesday  Thursday
##         1         2         3         4
```

```
one_to_four["Wednesday"]
```

```
## Wednesday
##         3
```

```
one_to_four[c("Monday", "Wednesday")]
```

```
##    Monday Wednesday
##         1         3
```

Matrices

Matrices are 2-dimensional collections of values.

All values must be of the same type.

```
matrix(1:9, nrow = 3, ncol = 3)
```

```
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
```

This is quite a common format. For example, each row could represent an individual participant. Each column could represent a different numerical measure.

Matrices

Accessing matrices

Since matrices are two-dimensional, you need to give two indices to make sure you get the value you want. Again, you can use the **[]** operator.

```
[row, col]
```

Here I extract the number from the 2nd row down, 3rd column across.

```
test_matrix <- matrix(1:9, nrow = 3, ncol = 3)
test_matrix
```

```
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
```

```
test_matrix[2, 3]
```

```
## [1] 8
```

Lists

Lists

Lists are a collection of objects of varying length and type.

```
album_list <-
  list(The_Beatles = c(
    "Sgt. Pepper",
    "The White Album",
    "Revolver",
    "Abbey Road"),
    Nirvana = c(
      "Bleach",
      "Nevermind",
      "In Utero")
    )
```

Each element is labelled, just like a mason jar on a shelf.

Each element has different contents, just like our mason jars.

Lists

```
names(album_list)
```

```
## [1] "The_Beatles" "Nirvana"
```

```
length(album_list)
```

```
## [1] 2
```

```
album_list["The_Beatles"]
```

```
## $The_Beatles
## [1] "Sgt. Pepper"     "The White Album" "Revolver"        "Abbey Road"
```

Data frames

Data frames are rectangular collections of data. Most of the data you encounter in psychology is in this kind of format.

Data frames can be a mix of different types. Each column contains only values of one *type*. Each row thus contains different types of information about one thing, which could be a participant, or a single trial's worth of data from one participant.

Show 5 entries Search:

	mpg	cyl	disp	hp	drat
Mazda RX4	21	6	160	110	3.9
Mazda RX4 Wag	21	6	160	110	3.9
Datsun 710	22.8	4	108	93	3.85
Hornet 4 Drive	21.4	6	258	110	3.08
Hornet Sportabout	18.7	8	360	175	3.15

Showing 1 to 5 of 32 entries Previous 1 2 3 4 5 6 7 Next

Creating a data frame

```
days_of_the_week <-
  data.frame(day_name = c("Sunday",
                          "Monday",
                          "Tuesday",
                          "Wednesday",
                          "Thursday",
                          "Friday",
                          "Saturday"),
             day_number = 1:7
             )
days_of_the_week
```

```
##    day_name day_number
## 1    Sunday          1
## 2    Monday          2
## 3   Tuesday          3
## 4 Wednesday          4
## 5  Thursday          5
## 6    Friday          6
## 7  Saturday          7
```

Extracting information from data frames

The **[]** operator works:

```
days_of_the_week[1, 2]
```

```
## [1] 1
```

Alternatively you can specify a column name:

```
days_of_the_week["day_number"]
```

```
##   day_number
## 1          1
## 2          2
## 3          3
## 4          4
## 5          5
## 6          6
## 7          7
```

Extracting information from data frames

A special operator you can use for data frame columns is the dollar sign, **$**

Combine the data frame's name with the column name as below:

```
days_of_the_week$day_name
```

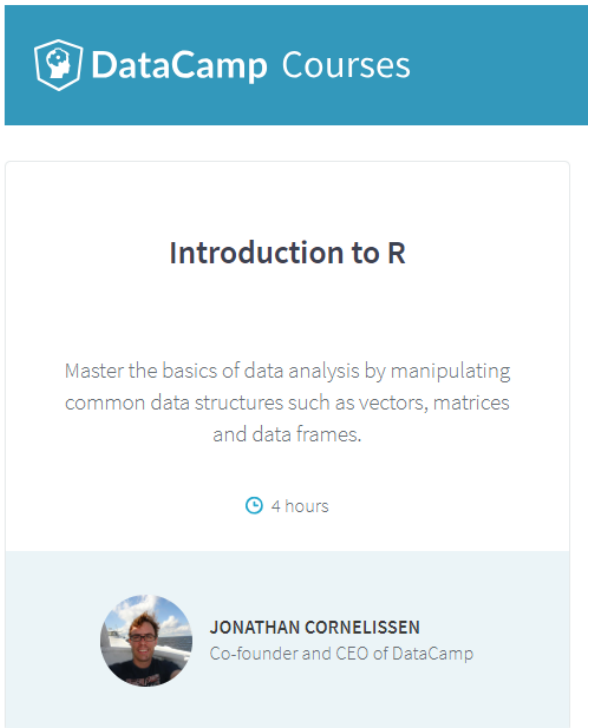
```
## [1] Sunday    Monday    Tuesday   Wednesday Thursday  Friday    Saturday
## Levels: Friday Monday Saturday Sunday Thursday Tuesday Wednesday
```

Question: what **class()** is this?

Wrapping up

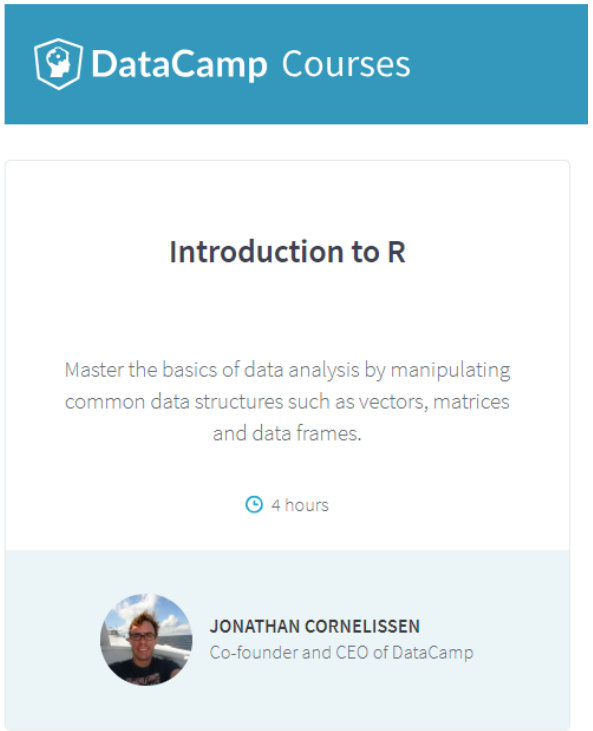
This week's concepts

- R Markdown - Chapter 27 of R4DS - see also https://rmarkdown.rstudio.com
- **vectors** and **lists** in Chapter 20 of R4DS
- Practice using **vectors**, **matrices**, **lists**, and **data.frames** using DataCamp's Intro to R course



Prep for next week

- Get on DataCamp!
- Next week we'll talk again about data frames and consider how to *structure* data.
- Look at Section 2 (Wrangle) of R4DS for information on **tibbles** (which are essentially data frames...).



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