

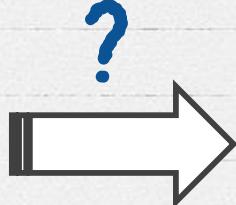
# R Projects and RMarkdown

AACC University 2022

Shannon Haymond, PhD

# A familiar scenario?

	A	B	C	D	E	F	G	H	I	J
1	Subject	Gender	Age_months	Race_ethn	Ft_ngdL	Hgb_gdL	MCV_fL	Fe_ugdL	TIBC_ugdL	Tfsat_pct
2	21046	1	52	1	59	13	78.6	17	346	4.9
3	21121	2	56	1	26	13.3	84.9	81	310	26.1
4	21131	2	49	2	15	12.3	85.3	55	279	19.7
5	21208	1	53	3	53	14.5	84.7	92	331	27.8
6	21222	1	46	4	48	11.4	75	57	278	20.5
7	21235	1	52	3	27	12.5	81.1	48	401	12
8	21251	1	52	5	22	13.1	86.6	103	420	24.5
9	21262	2	47	2	24	12.7	86.6	59	353	16.7
10	21280	1	37	3	14	13.1	84.2	36	356	10.1
11	21354	2	49	4	24	12.1	80.1	15	328	4.6
12	21364	2	50	4	41	11.9	82.8	54	395	13.7
13	21400	2	59	1	33	12.5	87.6	44	346	12.7
14	21405	2	37	1	7	13.1	83.9	76	457	16.6
15	21507	1	37	4	23	12.4	78.8	72	456	15.8
16	21578	2	40	4	78	12.4	79.3	75	335	22.4
17	21633	1	47	2	47	14.1	82.3	94	380	24.7
18	21638	1	49	3	38	13.9	79.9	143	380	37.6
19	21641	1	51	1	25	14	79.6	77	443	17.4
20	21695	1	56	4	24	12.2	77.8	81	337	24
21	21749	1	43	4	10	13.1	76.1	65	475	13.7
22	21827	2	41	1	10	12.5	83.4	69	356	19.4
23	21843	1	36	3	19	12	84.1	128	325	39.4



## Exploratory Data Analysis

NHANES Survey 2003-2004 Iron Biomarkers in Children 3-5 y

Shannon Haymond, PhD

Report Date: 2020-01-29 14:28:11

### Introduction

This report describes a basic exploratory data analysis of laboratory data from the 2003-2004 NHANES Survey measurements of iron status in children aged 3-5 years old.

[NHANES 2003-2004 Laboratory Data Page](#)

### Data Description

The data file was received from a collaborator who accessed the NHANES data source files and performed preliminary clean up and filtering to yield complete cases of children 1-3 years old with ferritin and CBC parameters. The dataset includes 295 observations with 10 variables.

### Summary Statistics

Statistical summary of factor variables

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
subject	0	1	FALSE	295	210: 1, 211: 1, 211: 1, 212: 1
gender	0	1	FALSE	2	Mal: 151, Fem: 144
race_ethn	0	1	FALSE	5	Non: 103, Non: 79, Mex: 74, Oth: 21

*Is your analysis reproducible?  
Are the steps transparent?  
Can you automate the process?  
Can you scale the process?  
Is the process organized?*



# There's a better way!

	A	B	C	D	E	F	G	H	I	J
1	Subject	Gender	Age_months	Race_ethn	Ft_ngdL	Hgb_gdL	MCV_fL	Fe_ugdL	TIBC_ugdL	Tfsat_pct
2	21046	1	52	1	59	13	78.6	17	346	4.9
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20	21695	1	56	4	24	12.2	77.8	81	337	11.7
21	21749	1	43	4	10	13.1	76.1	65	475	17
22	21827	2	41	1	10	12.5	83.4	69	355	29.4
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R Notebooks  
R Projects



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<https://bookdown.org/yihui/rmarkdown/>

## R Markdown: The Definitive Guide

*Yihui Xie, J. J. Allaire, Garrett Grolemund*

2019-12-02



Great resource!

# What is R Markdown?

R Markdown is an R package and a set of tools that are deeply embedded in RStudio

Specific authoring format that enables documents that combine text, R code, and the output from that code (tables, graphics, etc) in a way that is best for human understanding – *facilitates literate programming*

Any R Markdown document can be used as a Notebook

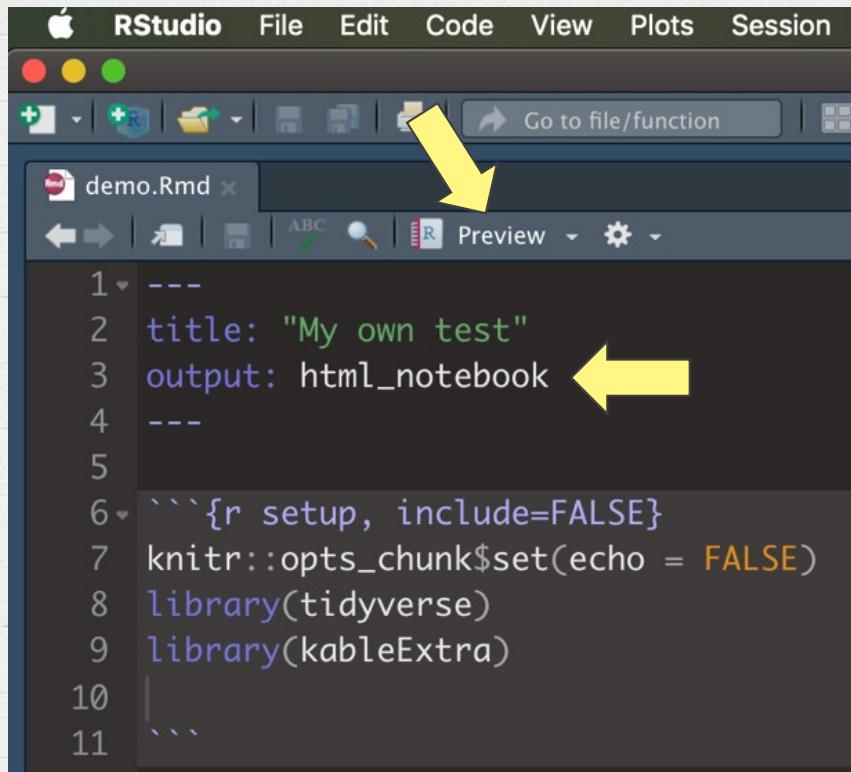
# **What is an R Notebook?**

Notebooks are a special execution mode for R Markdown documents with chunks that can be executed independently and interactively, with output visible immediately beneath the input and Viewer tab – great for iterating code.

By default, R Markdown enables inline output (notebook) mode

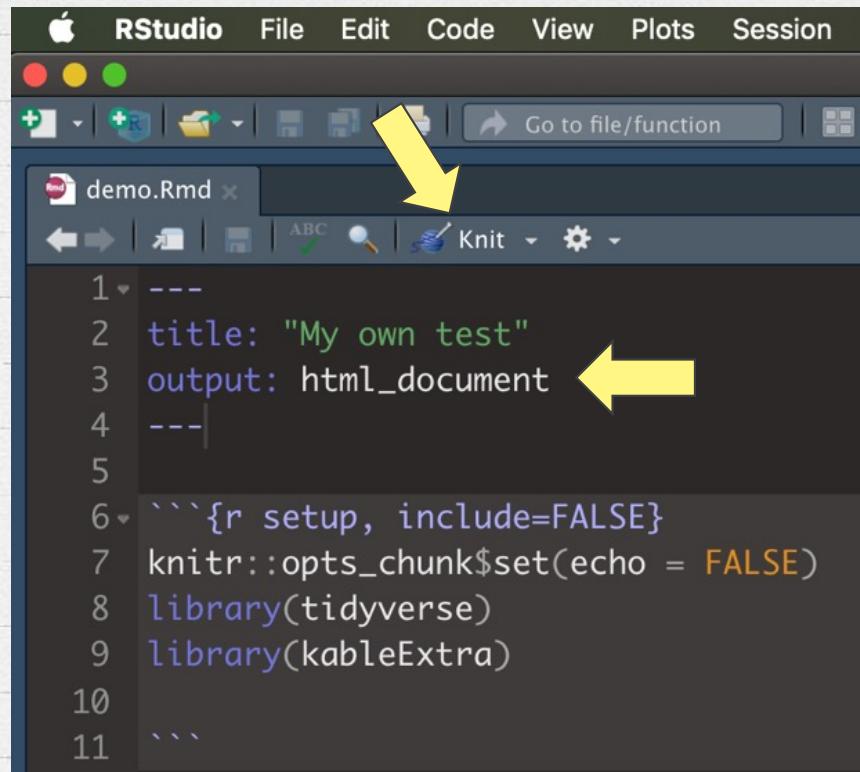
All R Notebooks can be rendered to other R Markdown document types

## R Notebook



```
1 ---  
2 title: "My own test"  
3 output: html_notebook ←  
4 ---  
5  
6 ```{r setup, include=FALSE}  
7 knitr::opts_chunk$set(echo = FALSE)  
8 library(tidyverse)  
9 library(kableExtra)  
10  
11 ...
```

## R Markdown



```
1 ---  
2 title: "My own test"  
3 output: html_document ←  
4 ---  
5  
6 ```{r setup, include=FALSE}  
7 knitr::opts_chunk$set(echo = FALSE)  
8 library(tidyverse)  
9 library(kableExtra)  
10  
11 ...
```

# The future of Rmd is Quarto



Overview Get Started Guide Reference Gallery Blog Help ▾



## Welcome to Quarto

Quarto® is an open-source scientific and technical publishing system built on [Pandoc](#)

- Create dynamic content with [Python](#), [R](#), [Julia](#), and [Observable](#).
- Author documents as plain text markdown or [Jupyter](#) notebooks.
- Publish high-quality articles, reports, presentations, websites, blogs, and books in HTML, PDF, MS Word, ePub, and more.
- Author with scientific markdown, including equations, citations, crossrefs, figure panels, callouts, advanced layout, and more.

[Get Started](#)

[Guide](#)

Hello, Quarto

[Python](#)

[R](#)

[Julia](#)

[Observable](#)

## R Projects

A built-in feature in RStudio to help you keep all the files associated with a project together — input data, R scripts, analytical results, figures.

A lifesaver for your future self and collaborators!

# What have we learned so far?

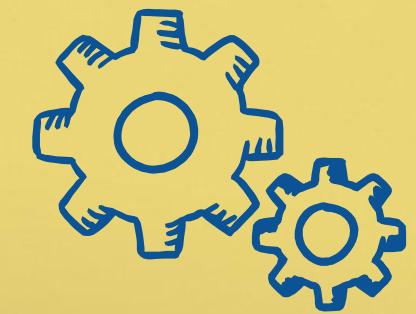
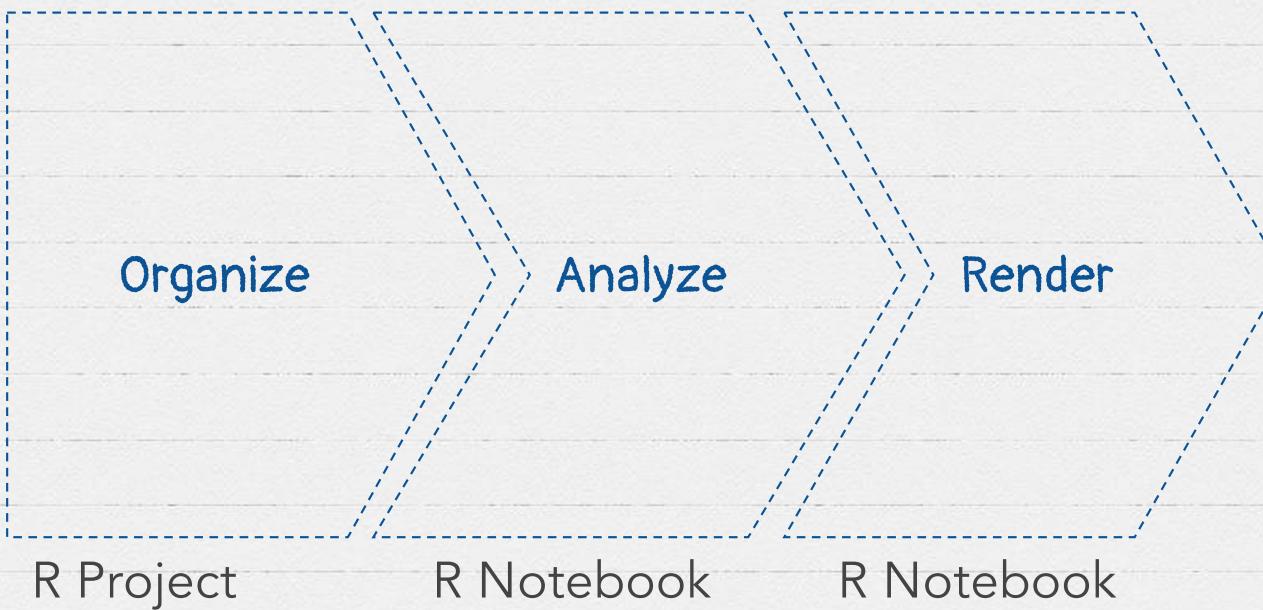
Basic understanding of

- R vs RStudio – have seen RStudio IDE and some R code
- R Markdown/Notebooks
- R projects



Let's put it all together and go through a very simple workflow for taking structured data, performing basic EDA, and generating a shareable report

# We'll use 3 steps



# 1. Organize

Let's start by creating an R  
Project for this analysis



1. Use New Project button on toolbar
2. Use New Project command from File tab

# Create a Project

# What happens in RStudio?

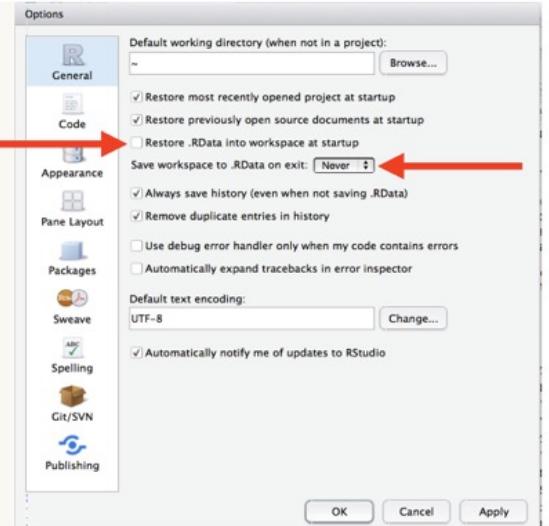
1. Creates a project file (.Rproj extension) within project directory
2. Creates hidden directory for project-specific temporary files
3. A new R session is started
4. The current working directory is set to the project directory
5. Loads in whatever was there prior – if options indicate
6. Loads the project and displays name in Projects toolbar.

hadley RStudio Employee      2017-09-17

greg:

It's more reliable and flexible to just restart R any time you want to clean the slate. From RStudio, that's easy enough to do with a keyboard shortcut.

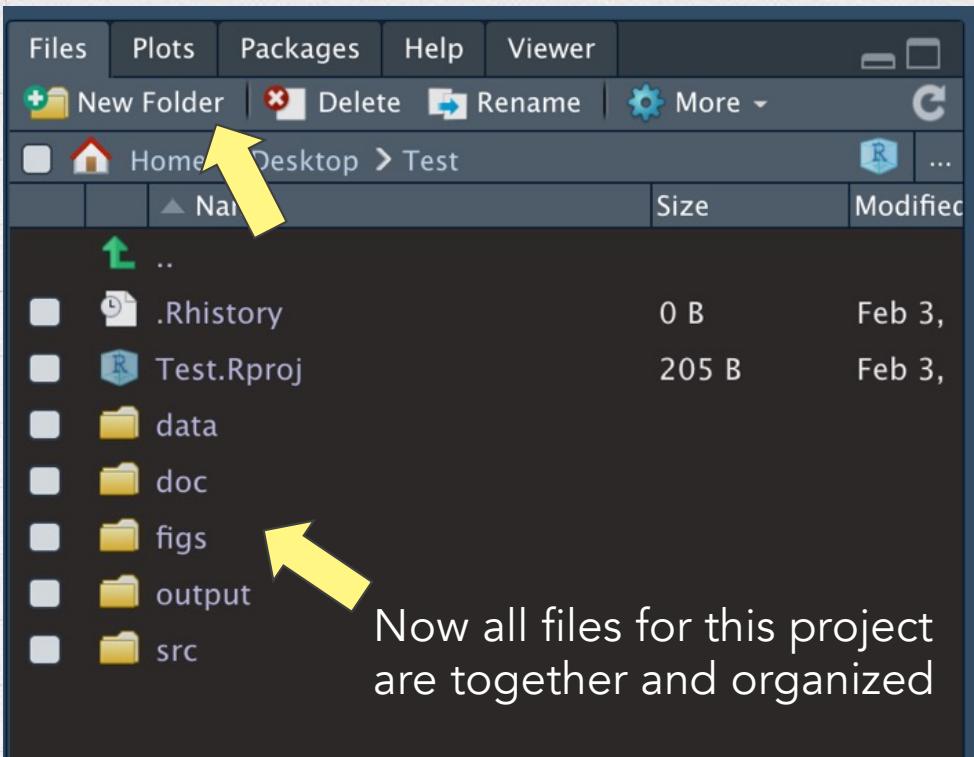
I agree with @greg - it's way better to do this outside of your script than inside of it. Apart from objects and packages there are many other global settings (e.g. `options()`, `par()`, environment variables) that won't get cleanly reset. I also highly recommend never saving or loading your workspace:



That ensures you always get a clean slate when you restart RStudio, and forces you to record all important steps in code.

*Start each R session with  
a fresh environment!*



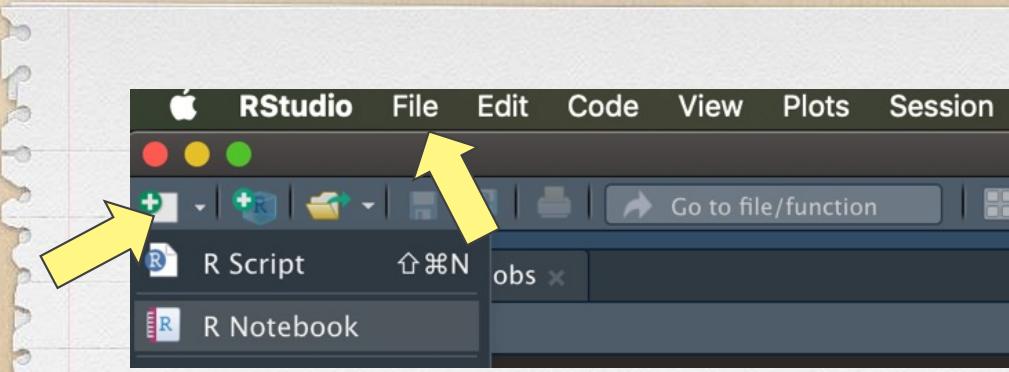


# Set up file system

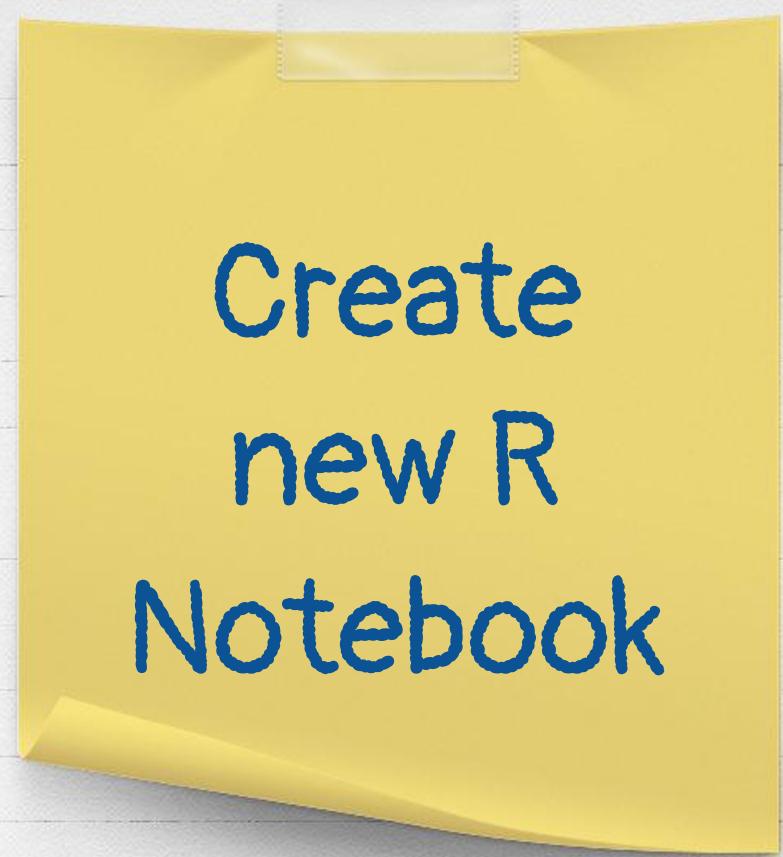
Now all files for this project are together and organized

## 2. **Analyze/Summarize**

Next, we'll use R Notebook to  
analyze/summarize data



1. Use New File >> R Notebook button on toolbar
2. Use New File >> R Notebook command from File tab



The screenshot shows an RStudio interface with an R Markdown notebook titled "Untitled1". The code editor contains the following content:

```
1 ---  
2 title: "R Notebook"  
3 output: html_notebook  
4 ---  
5  
6 This is an [R Markdown](http://rmarkdown.rstudio.com) Notebook. When you  
execute code within the notebook, the results appear beneath the code.  
7  
8 Try executing this chunk by clicking the *Run* button within the chunk or by  
placing your cursor inside it and pressing *Cmd+Shift+Enter*.  
9  
10```{r}  
11 plot(cars)  
12```  
13  
14 Add a new chunk by clicking the *Insert Chunk* button on the toolbar or by  
pressing *Cmd+Option+I*.  
15  
16 When you save the notebook, an HTML file containing the code and output will  
be saved alongside it (click the *Preview* button or press *Cmd+Shift+K* to  
preview the HTML file).  
17  
18 The preview shows you a rendered HTML copy of the contents of the editor.  
Consequently, unlike *Knit*, *Preview* does not run any R code chunks.
```

Annotations with callouts point to specific parts of the code:

- A callout labeled "YAML" points to the YAML front matter at the top of the document.
- A callout labeled "Text with formatting and hyperlinks" points to the explanatory text block starting with "This is an [R Markdown](http://rmarkdown.rstudio.com) Notebook...".
- A callout labeled "R code chunk" points to the R code chunk starting with "```{r}" and ending with "```".

The status bar at the bottom shows the line number "4:1" and the tab "R Notebook".

**R Markdown :: CHEAT SHEET**

What is R Markdown?

- **Good Idea:** An R Markdown document is a simple text file that a scientist needs to write that a computer needs to convert into a readable report.
- **Dynamic Documents:** In the click of a button, or the type of a command, the document can be converted into a presentation, a report, or a variety of formats, including HTML, PDF, or Microsoft Word documents.

**Workflow**

- Open a new R Markdown file. Click "New File" > "R Markdown". Use the template provided.
- Write document by editing template.
- knit document to create report, save the document.
- preview output in RStudio viewer.
- Publish document to a blog or website.
- Review and edit in R Markdown console.
- See output file that is saved using code.

**Embed code with knitr syntax**

**IMPORTANT CHUNK OPTIONS**

- **echo:** - TRUE for results from code in code chunks. Defaults to FALSE.
- **cache:** - TRUE to cache and then include (includes default).
- **cache.path:** - changes all output into single block (outputs one file for each line of code (useful for cache = TRUE)).

**CODE CHUNKS**

- **depends:** - chunk dependencies for caching.
- **echo:** - TRUE for results from code in code chunks. Defaults to FALSE.
- **engine:** - code language used in chunk (defaults to R).
- **eval:** - displays error messages in R (TRUE or FALSE).
- **fig.cap:** - figure caption as character string in chunk (TRUE or FALSE).
- **fig.height:** - dimension of plots in chunk (TRUE or FALSE).
- **fig.width:** - dimension of plots in chunk (TRUE or FALSE).
- **highlight:** - highlight source code (defaults to TRUE).
- **include:** - TRUE to include chunk in document (TRUE or FALSE).
- **keep.source:** - TRUE to keep source code in chunk (TRUE or FALSE).
- **message:** - TRUE to show messages in chunk (TRUE or FALSE).
- **results:** - chunk results (TRUE or FALSE).
- **return:** - TRUE to return results from code in chunk (TRUE or FALSE).
- **tidy:** - TRUE to tidy up code before it is run (TRUE or FALSE).
- **warning:** - TRUE to show warning messages in chunk (TRUE or FALSE).

**R Markdown Reference Guide**

Learn more about R Markdown at [rmarkdown.rstudio.com](http://rmarkdown.rstudio.com)  
Learn more about Interactive Docs at [shiny.rstudio.com/articles](http://shiny.rstudio.com/articles)

**Contents:**

1. **Markdown Syntax**
2. **Knitr chunk options**
3. **Pandoc options**

**Syntax**

Plain text	Becomes
End a line with two spaces to start a new paragraph.	Plain text
<code>*italics*</code> and <code>_italics_</code>	<i>italics</i> and <i><u>italics</u></i>
<code>**bold**</code> and <code>__bold__</code>	<b>bold</b> and <b><u>bold</u></b>
<code>superscript2x</code>	<sup>superscript</sup>
<code>--strikethrough--</code>	<del>strikethrough</del>
<code>[link](www.rstudio.com)</code>	<a href="http://www.rstudio.com">link</a>

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**Header 734**

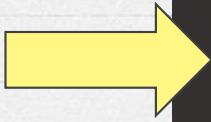
**Header 735**

## **Customize the output using the YAML**

1. Change the YAML title to your own title
2. Add a YAML option for author

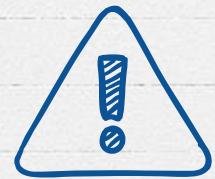
*Hint: see page 4 of RMarkdown Reference Guide*

```
1 --
2 title: "My Test"
3 author: Shannon Haymond, PhD
4 output: html_notebook
5 ---
```



## Create a new code chunk to define the setup options.

1. Label the chunk, tell R what to do with the chunk when rendering
2. Set options for the document
3. Load necessary packages
4. Execute your code.



Setup chunk  
goes at the top,  
so it runs first!

# Add a new code chunk

```
```{r}
```

Note syntax for R chunk

New chunk:  
\*Insert Chunk\* button on the toolbar or by pressing Cmd+Option+I or Ctrl+Alt+I



Execute code:  
Press \*play\* button to run entire chunk or select and press Cmd+Enter or Ctrl+Enter

# Code chunk options

- How code is evaluated and rendered
- How results are displayed
- Features of plots
- Many others – see <https://yihui.org/knitr/options/>

All chunk options have defaults – you only need to worry about setting the options if you want to change from default

Chunk label

Prevents code and results for  
this chunk from appearing in the  
finished file (default = TRUE)

```
7  ````{r setup, include=FALSE}
8  knitr::opts_chunk$set(echo = FALSE)
9  library(tidyverse)
10 library(kableExtra)
11 ...
12 ...
13
```

Do not display code in output  
document (default = TRUE) –  
here for all chunks

## **Add your own text and create a new code chunk to read in your data.**

1. Write some text that describes your report.
2. Create a new code chunk and label it.
3. Tell R what to do with the chunk when rendering.
4. Write the code to read in your data.
5. Execute your code.

```
14 This notebook was made using RMarkdown and some of its very useful features.  
15 |  
16  
17 ````{r data, include = FALSE}  
18 my_data <- read_csv(file = "data/NHANES_FeMarkers_3to5y.csv")  
19 ````
```

# Formatting Text

Inline text formatting requires specific syntax

<https://rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>

The screenshot shows the R Markdown Reference Guide website. At the top right, there is a navigation bar with a large 'R' logo, the title 'R Markdown Reference Guide', and links to 'markdown.rstudio.com' and 'shiny.rstudio.com/articles'. Below the navigation, there is a 'Contents' section with three items: '1. Markdown Syntax', '2. Knitr chunk options', and '3. Pandoc options'. The main content area is divided into two columns: 'Syntax' and 'Becomes'. The 'Syntax' column contains code snippets for various R Markdown features, and the 'Becomes' column shows the resulting output or transformation. For example, the code `# Header 1` becomes 'Header 1'. The 'Syntax' column also includes tables for lists and tables.

Table Header	Second Header
Table Cell	Cell 2
Cell 3	Cell 4

# **Formatting Tables**

Requires additional packages/functions

- knitr::kable for basic tables
- kableExtra for advanced styling

[https://cran.r-project.org/web/packages/kableExtra/vignettes/awesome\\_table\\_in\\_html.html](https://cran.r-project.org/web/packages/kableExtra/vignettes/awesome_table_in_html.html)

## **Make a basic stats summary table with a bold title.**

1. Use syntax for text to make the table's title bold.
2. Create a new code chunk and label it.
3. Write the code to create your summary table and format it.
4. Execute your code.

**\*\*words\*\* = words**

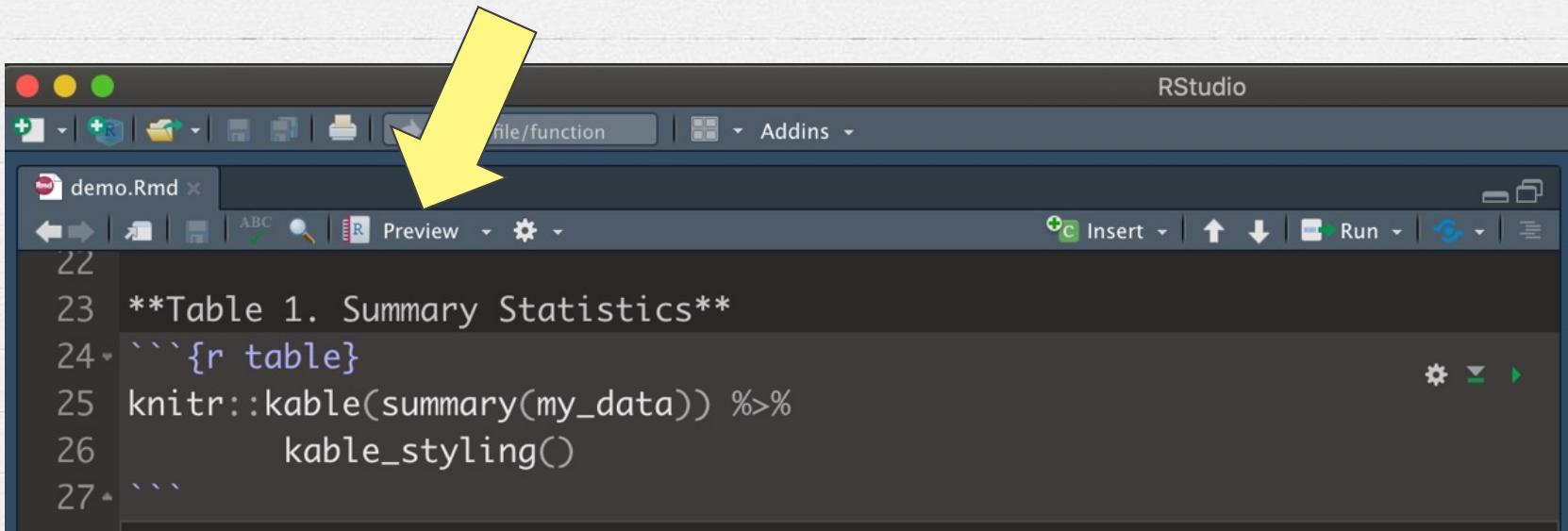
```
**Table 1. Summary Statistics**  
```{r table}  
knitr::kable(summary(my_data)) %>%  
  kable_styling()  
...``
```

Function calls for  
styling table

Function call to make the  
summary stats table

# Preview your document

Using an R Notebook allows us to preview the output of our document.



## **Use syntax to write inline code that summarizes results from the table.**

1. Use inline code syntax to calculate the number of rows in the data table and include this within a sentence.

Inline code syntax:  
`r code here`

26 There are `r nrow(my\_data)` observations in this dataset. The mean age is `r round(mean(my\_data\$Age\_months),0)` months.



Use backtick, not  
single quote!

## Create a scatterplot of TfSat\_pct and Fe\_ugdL with an italicized title.

1. Use syntax for text to italicize the plot's title.
2. Create a new code chunk and label it.
3. Write the code to create your plot.
4. Execute your code.

```
28 *Figure 1. Transferrin vs Iron*
29 ````{r plot}
30 ggplot(my_data, aes(x = Fe_ugdL, y = TfSat_pct)) +
31   geom_point()
32 ````
```

\*words\* = words

```
ggplot(data = <DATA>, aes(x = <X_DATA>, y = <Y_DATA>)) +
  <GEOM_FUNCTION>
```

### 3. **Render**

Finally, we'll format our report  
and export it

## When you render, R Markdown

1. runs the R code, embeds results and text into .md file with knitr
2. then converts the .md file into the finished format with pandoc



Set a document's default output format in the YAML header:

```
---
```

```
output: html_document
```

```
---
```

```
# Body
```

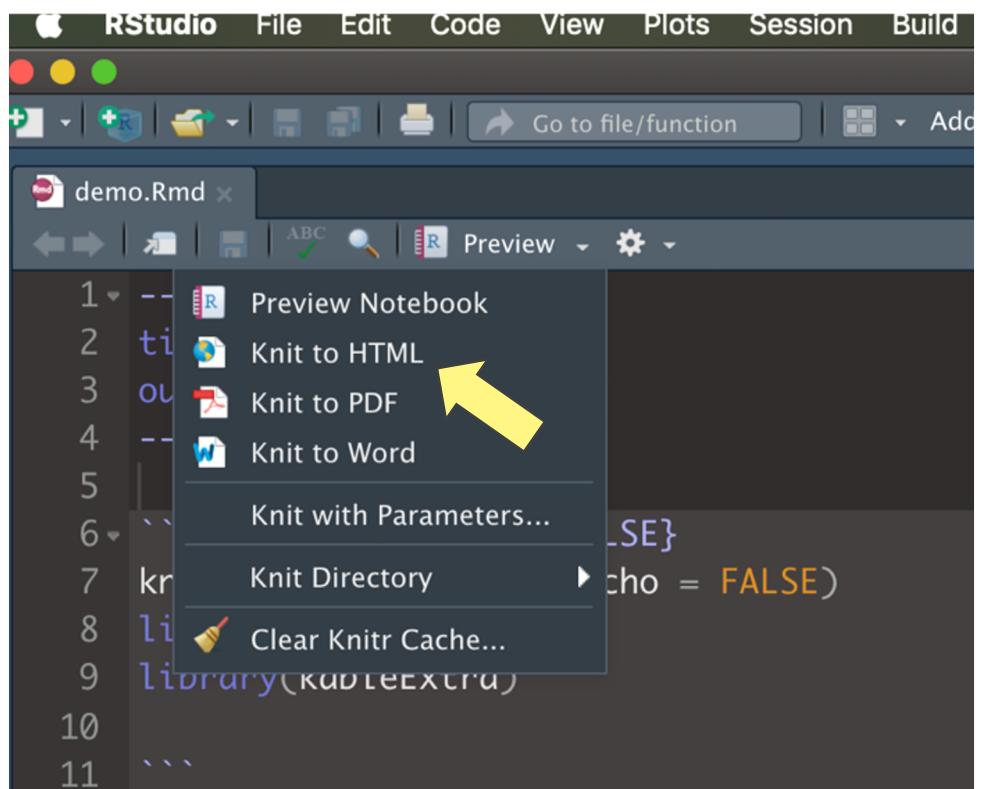
<b>output value</b>	<b>creates</b>
<b>html_document</b>	html
<b>pdf_document</b>	pdf (requires Tex )
<b>word_document</b>	Microsoft Word (.docx)
<b>odt_document</b>	OpenDocument Text
<b>rtf_document</b>	Rich Text Format
<b>md_document</b>	Markdown
<b>github_document</b>	Github compatible markdown
<b>ioslides_presentation</b>	ioslides HTML slides
<b>slidy_presentation</b>	slidy HTML slides
<b>beamer_presentation</b>	Beamer pdf slides (requires Tex)

R Markdown from  R Studio®

# Gallery

Check out the range of outputs and formats you can create using R Markdown.

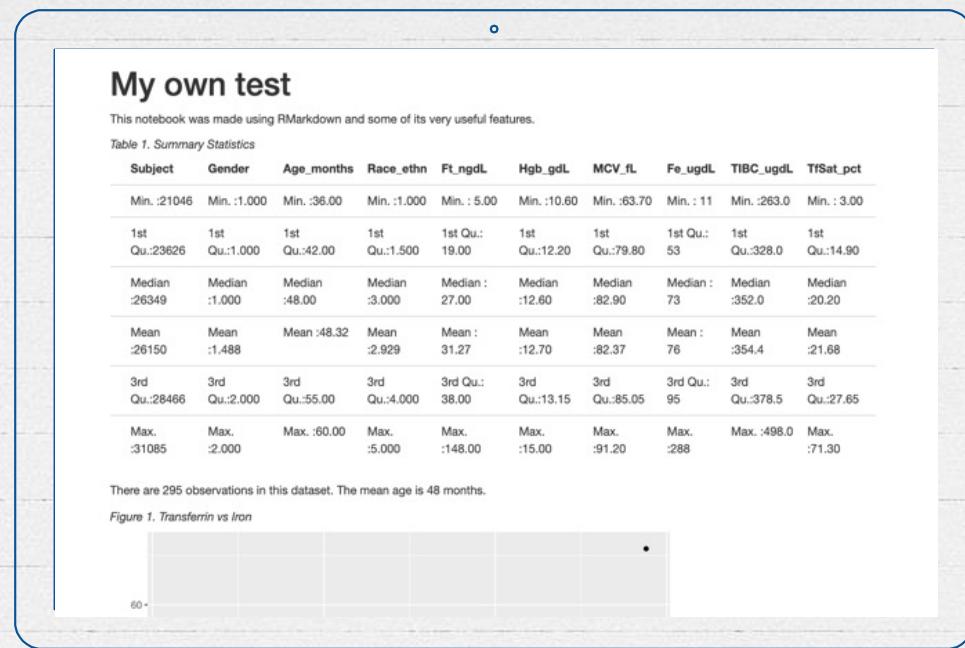
<https://rmarkdown.rstudio.com/gallery.html>



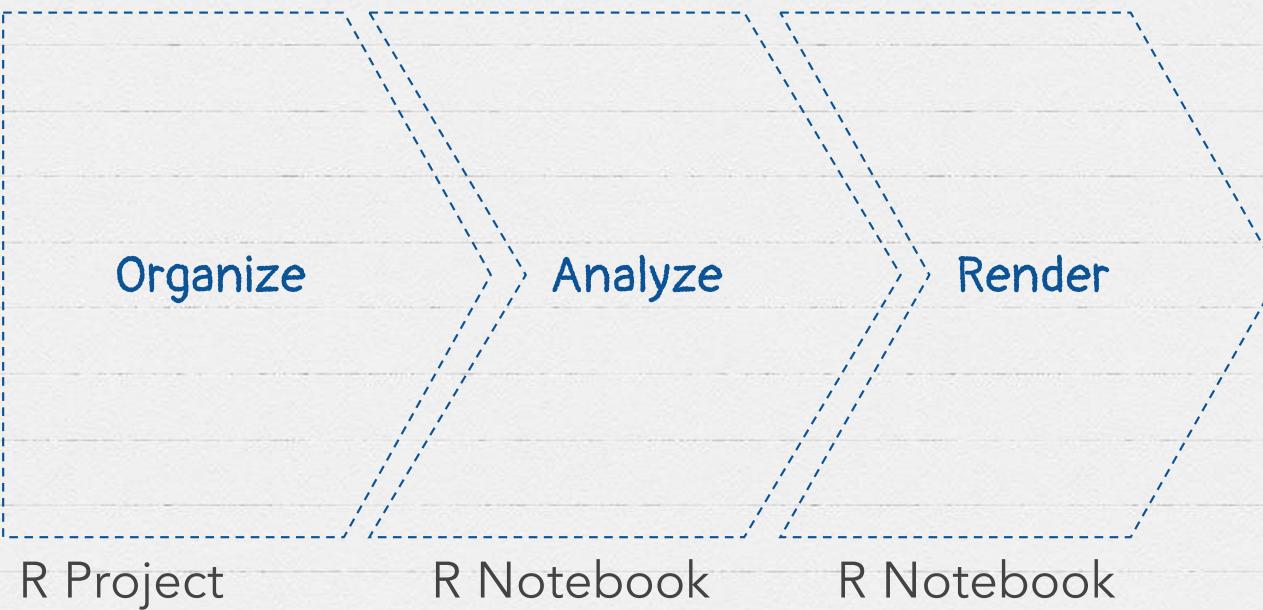
Export  
our  
Report

# HTML Reports

- Customization
- Distribution
- Interactivity



# We did it!



## What's Next?

Other output formats,  
customization, and interactivity



CODE ▾

Text formating

Horizontal lines

Chapter auto numbering

Skip a line

Center an image

White space around img

Footer and header

Space before title

Figures caption

Custom caption

Equations

2 figures in 2 columns

Several columns

# Pimp my RMD: a few tips for R Markdown

by *Yan Holtz* - 10 December 2018 -

R markdown creates interactive reports from R code. This post provides a few tips I use on a daily basis to improve the appearance of output documents. In any case, an unavoidable resource is the [Rstudio documentation](#).

<https://holtzy.github.io/Pimp-my-rmd/>

Andrew Zieffler

HOME ABOUT CONTACT PUBLICATIONS TEACHING BLOGROLL

R Markdown

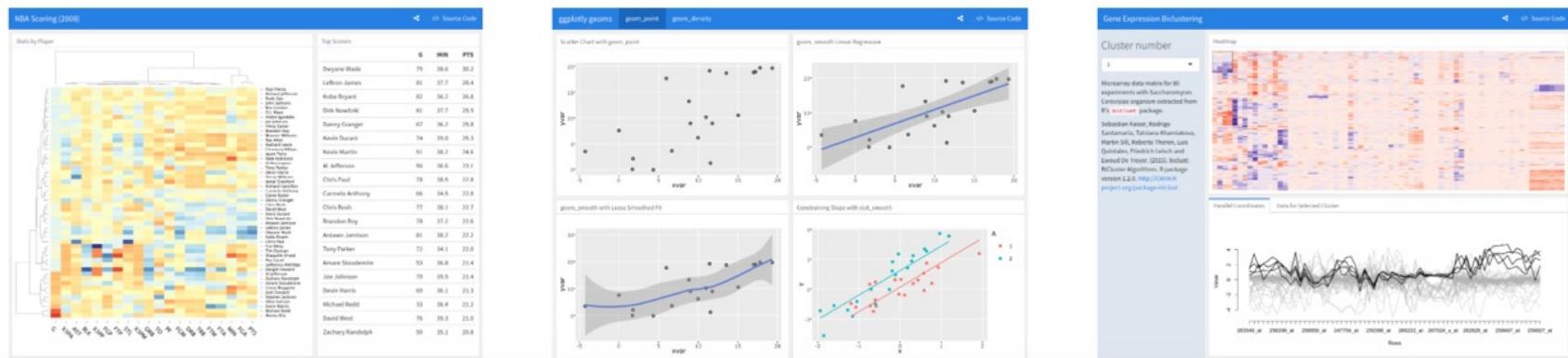
# R Markdown Theme Gallery

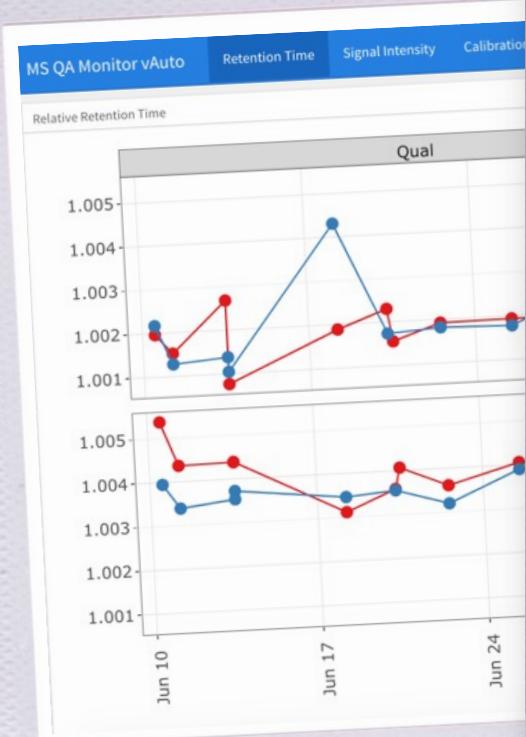
Posted by Andrew Zieffler on Thursday, April 12, 2018

<https://www.datadreaming.org/post/r-markdown-theme-gallery/>

# flexdashboard: Easy interactive dashboards for R

- Use [R Markdown](#) to publish a group of related data visualizations as a dashboard.
- Support for a wide variety of components including [htmlwidgets](#); base, lattice, and grid graphics; tabular data; gauges and value boxes; and text annotations.
- Flexible and easy to specify row and column-based [layouts](#). Components are intelligently re-sized to fill the browser and adapted for display on mobile devices.
- [Storyboard](#) layouts for presenting sequences of visualizations and related commentary.
- Optionally use [Shiny](#) to drive visualizations dynamically.





flexdashboard w/  
ggplotly

## Exploratory Data Analysis

NHANES Survey 2003-2004 Iron Biomarkers in Children 3-5 y

Shannon Haymond, PhD

Report Date: 2020-01-29 14:28:11

### Introduction

This report describes a basic exploratory data analysis of laboratory data from the 2003-2004 NHANES Survey measurements of iron status in children aged 3-5 years old.

[NHANES 2003-2004 Laboratory Data Page](#)

### Data Description

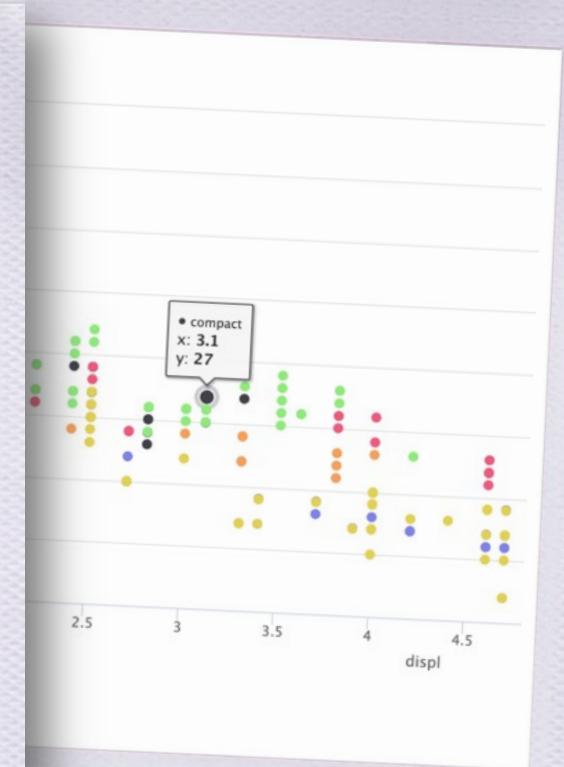
The data file was received from a collaborator who accessed the NHANES data source files and performed preliminary clean up and filtering to yield complete cases of children 1-3 years old with ferritin and CBC parameters. The dataset includes 295 observations with 10 variables.

### Summary Statistics

Statistical summary of factor variables

skim_variable	n_missing	complete_rate	ordered	n_unique	top_counts
subject	0	1	FALSE	295	210: 1, 211: 1, 211: 1, 212: 1
gender	0	1	FALSE	2	Mal: 151, Fem: 144
race_ethn	0	1	FALSE	5	Non: 103, Non: 79, Mex: 74, Oth: 21

cosmos theme



highcharter

# Thanks!

## Any questions?

You can find me at:

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Special thanks to the people who made and released this presentation template for free at [SlidesCarnival](#)