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My Assignment

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```
if (!require("remotes"))
  install.packages("remotes", repos = "https://cran.rstudio.com")
if (!require("rmarkdown"))
  install.packages("rmarkdown", repos = "https://cran.rstudio.com")
if (!require("tinytex"))
  install.packages("tinytex", repos = "https://cran.rstudio.com")

if (isFALSE(tinytex::is_tinytex())) tinytex::install_tinytex()
```

1 R Markdown Basics

Here is a brief introduction into using *R Markdown*. *Markdown* is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. *R Markdown* provides the flexibility of *Markdown* with the implementation of **R** input and output. For more details on using *R Markdown* see https://rmarkdown.rstudio.com.

Be careful with your spacing in *Markdown* documents. While whitespace largely is ignored, it does at times give *Markdown* signals as to how to proceed. As a habit, try to keep everything left aligned whenever possible, especially as you type a new paragraph. In other words, there is no need to indent basic text in the Rmd document (in fact, it might cause your text to do funny things if you do).

1.1 Lists

It's easy to create a list. It can be unordered like

- Item 1
- Item 2

or it can be ordered like

1. Item 1
2. Item 2

Notice that I intentionally mislabeled Item 2 as number 4. *Markdown* automatically figures this out! You can put any numbers in the list and it will create the list. Check it out below.

To create a sublist, just indent the values a bit (at least four spaces or a tab). (Here's one case where indentation is key!)

1. Item 1
2. Item 2
3. Item 3
    - Item 3a
    - Item 3b

1.2 Line breaks

Make sure to add white space between lines if you'd like to start a new paragraph. Look at what happens below in the outputted document if you don't:

Here is the first sentence. Here is another sentence. Here is the last sentence to end the paragraph.

This should be a new paragraph.

Now for the correct way:

Here is the first sentence. Here is another sentence. Here is the last sentence to end the paragraph.

This should be a new paragraph.

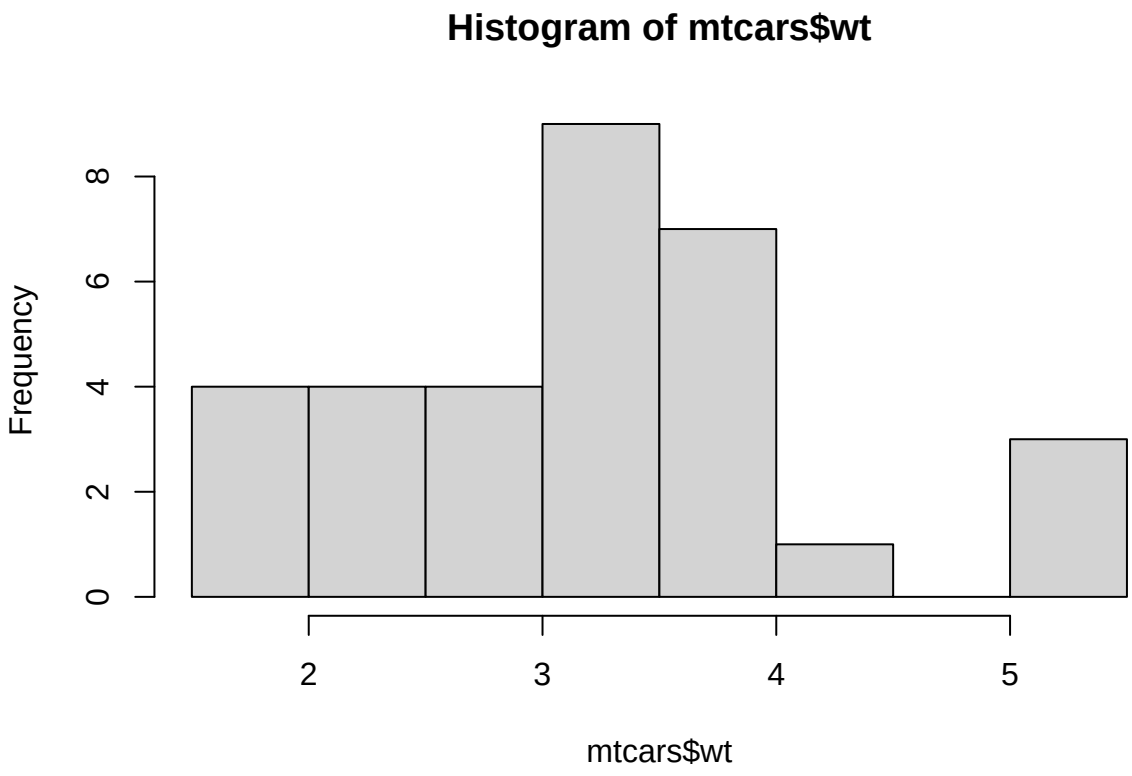
1.3 R chunks

When you click the **Knit** button above 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 (`ntcars` is a built-in **R** dataset):

```
summary(mtcars)
```

```
##       mpg             cyl             disp             hp       
##  Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0  
##  1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5  
##  Median :19.20   Median :6.000   Median :196.3   Median :123.0  
##  Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7  
##  3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0  
##  Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0  
##       drat             wt             qsec             vs        
##  Min.   :2.760   Min.   :1.513   Min.   :14.50   Min.   :0.0000  
##  1st Qu.:3.080   1st Qu.:2.581   1st Qu.:16.89   1st Qu.:0.0000  
##  Median :3.695   Median :3.325   Median :17.71   Median :0.0000  
##  Mean   :3.597   Mean   :3.217   Mean   :17.85   Mean   :0.4375  
##  3rd Qu.:3.920   3rd Qu.:3.610   3rd Qu.:18.90   3rd Qu.:1.0000  
##  Max.   :4.930   Max.   :5.424   Max.   :22.90   Max.   :1.0000  
##        am              gear            carb      
##  Min.   :0.0000   Min.   :3.000   Min.   :1.000  
##  1st Qu.:0.0000   1st Qu.:3.000   1st Qu.:2.000  
##  Median :0.0000   Median :4.000   Median :2.000  
##  Mean   :0.4062   Mean   :3.688   Mean   :2.812  
##  3rd Qu.:1.0000   3rd Qu.:4.000   3rd Qu.:4.000  
##  Max.   :1.0000   Max.   :5.000   Max.   :8.000
```

```
hist(mtcars$wt)
```



1.4 Inline code

If you'd like to put the results of your analysis directly into your discussion, add inline code like this:

> The `cos` of 2π is 1.

Another example would be the direct calculation of the standard deviation:

> The standard deviation of `speed` in `cars` is 5.2876444.

One last neat feature is the use of the `ifelse` conditional statement which can be used to output text depending on the result of an **R** calculation:

> The standard deviation is less than 6.

Note the use of `>` here, which signifies a quotation environment that will be indented.
As you see with `$2 \pi$` above, mathematics can be added by surrounding the mathematical text with dollar signs. More examples of this are in Mathematical equations.

2 Mathematical equations

2.1 Math

TEX is the best way to typeset mathematics. Donald Knuth designed TEX when he got frustrated at how long it was taking the typesetters to finish his book, which contained a lot of mathematics. One nice feature of *R Markdown* is its ability to read LaTeX code directly.

2.2 An example of *some* of the package's shortcuts

Let K be a field of **scalars**—usually either the real numbers $\mathbb{R}$ or the complex numbers $\mathbb{C}$, or occasionally the rationals $\mathbb{Q}$. A **vector space** over K is a set V of **vectors** equipped with two operations, vector addition $(x, y) \mapsto x+y$, and scalar multiplication $(\alpha, x) \mapsto \alpha x$, where $x, y \in V$ and $\alpha \in K$. The operations satisfy:

V.1 $x + y = y + x$

V.2 $(x + y) + z = x + (y + z)$

V.3 There is a vector 0, satisfying $x + 0 = x$ for every vector x.

V.4 $x + (-1)x = 0$

V.5 $\alpha(\beta x) = (\alpha\beta)x$

V.6 $1x = x$

V.7 $\alpha(x + y) = (\alpha x) + (\alpha y)$

V.8 $(\alpha + \beta)x = (\alpha x) + (\beta x)$

You can also type matrices with relative efficiency

$$\begin{array}{cc} \text{indices} & \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{array}{c} 1 \\ 2 \end{array} & \left[\begin{array}{cccc} M_{1,1} & M_{1,2} & M_{1,3} & M_{1,4} \\ M_{2,1} & M_{2,2} & M_{2,3} & M_{2,4} \end{array}\right] \end{array}$$

$$\begin{array}{cc} \text{indices} & \begin{array}{cc|cc} 1 & 2 & 3 & 4 \end{array} \\ \begin{array}{c} 1 \\ 2 \end{array} & \left[\begin{array}{cc|cc} M_{1,1} & M_{1,2} & M_{1,3} & M_{1,4} \\ M_{2,1} & M_{2,2} & M_{2,3} & M_{2,4} \end{array}\right] \end{array}$$

3 Additional resources

- *Markdown* Cheatsheet - https://github.com/adam-p/markdown-here/wiki/Markdown-Cheatsheet
- *R Markdown*
  - Reference Guide - https://www.rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf
  - Cheatsheet - https://github.com/rstudio/cheatsheets/raw/master/rmarkdown-2.0.pdf
- *RStudio IDE*

  - Cheatsheet - https://github.com/rstudio/cheatsheets/raw/master/rstudio-ide.pdf
  - Official website - https://rstudio.com/products/rstudio/

- Introduction to `dplyr` - https://cran.rstudio.com/web/packages/dplyr/vignettes/dplyr.html

- `ggplot2`

  - Documentation - https://ggplot2.tidyverse.org/
  - Cheatsheet - https://github.com/rstudio/cheatsheets/raw/master/data-visualization-2.1.pdf

References

Angel, Edward. *Batch-File Computer Graphics : A Bottom-up Approach with QuickTime*. Boston, MA: Wesley Addison Longman, 2001.

———. *Interactive Computer Graphics : A Top-down Approach with OpenGL*. Boston, MA: Addison Wesley Longman, 2000.

———. *Test Second Book by Angel*. Boston, MA: Wesley Addison Longman, 2001.