# How Rmarkdown Works
# CSUF - Math Dept.

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## Introduction

The goal of this document is to show what you may need to generate a document using R Markdown, a file with Rmd extension. For more details on using R Markdown see http://rmarkdown.rstudio.com.

### Prerequisites

To be able to use R Markdown, an installation of R software is essential; use one of these CRAN Mirrors to find an appropriate installation file.

Although not necessary, it is highly recommended that RStudio, an integrated development environment (IDE) for R (and Python!), is also installed: the free RStudio Desktop version is sufficient.

Finally, if not installed, these packages need to be installed:

- knitr
- rmarkdown

Those may need other packages, including *evaluate, digest, highr, markdown, yaml, Rcpp, htmltools, jsonlite, base64enc,* and *mime*.

The following code **chunk**, named `installPreReq`, install those packages and other requirements that could come handy:

```
install.packages("installr")
library(installr)
install.Rtools()
install.packages('devtools')
install.packages(c('evaluate', 'digest', 'highr', 'markdown', 'yaml',
                   'Rcpp', 'htmltools', 'knitr', 'jsonlite', 'base64enc',
                   'mime', 'rmarkdown'))
```

The following code **chunk**, named `loadPackages` shows how to run an R code to perform some tasks, and generate some outputs for inclusion in the final document.

When these are installed, RStudio shows the **Knit** button that starts the process of converting an Rmd file into a HTML, PDF or MS Word file.

```
cat('Loading knit and rmarkdown packages . . .')
```

```
## Loading knit and rmarkdown packages . . .
```

```
if(!require("knitr")){
  # if failed to load knitr, install it
  install.packages("knitr")
  # then load it
  library("knitr")
}
```

```
## Loading required package: knitr
```

```
if(!require("rmarkdown")){
  # if failed to load rmarkdown, install it
  install.packages("rmarkdown")
  # then load it
  library("rmarkdown")
}
```

```
## Loading required package: rmarkdown
```

```
cat('Loading knit and rmarkdown packages done.\n')
```

```
## Loading knit and rmarkdown packages done.
```

# Capabilities

The text shown above is an example of how code and text can be combined in an Rmd file to create a document.

In the rest of this document, examples of other capabilities of R Markdown are shown. In these examples, it is assumed that the document is generated in Rstudio.

## Adding an Image

The following image shows the folder structure used for this lab-template:

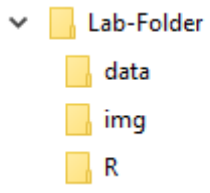



Figure 1: Folder Strucrure

This Rmd file is located in `R` folder, image files used here (like the one above) are located in `img` folder, data files are located in `data` folder. All these folders are are located under `Lab-Folder`.

Instead of embedding an image, a link to it can be provided; here is a link to the same Folder Strucrure.

## Adding formula

Simple LaTeX commands can be used as inline formulas, like $\hat{y} = b_0 + b_1 x$, or displayed formulas

$$\bar{x} = \sum_{i=1}^{n} \frac{x_i}{n}.$$

Images of formulas, be it produced by online tools (like atomurl.net/math) or handwritten, could be a quick substitute for typing equations for novices.

## Data Structure and Summaries

There are many internal datasets in R that can be used right away; for example, `cars` contains the information on speed and stopping distance of some cars from 1977. Here is how to show the structure of the dataset:

```
str(cars)
```

```
## 'data.frame':    50 obs. of  2 variables:
##  $ speed: num  4 4 7 7 8 9 10 10 10 11 ...
##  $ dist : num  2 10 4 22 16 10 18 26 34 17 ...
```

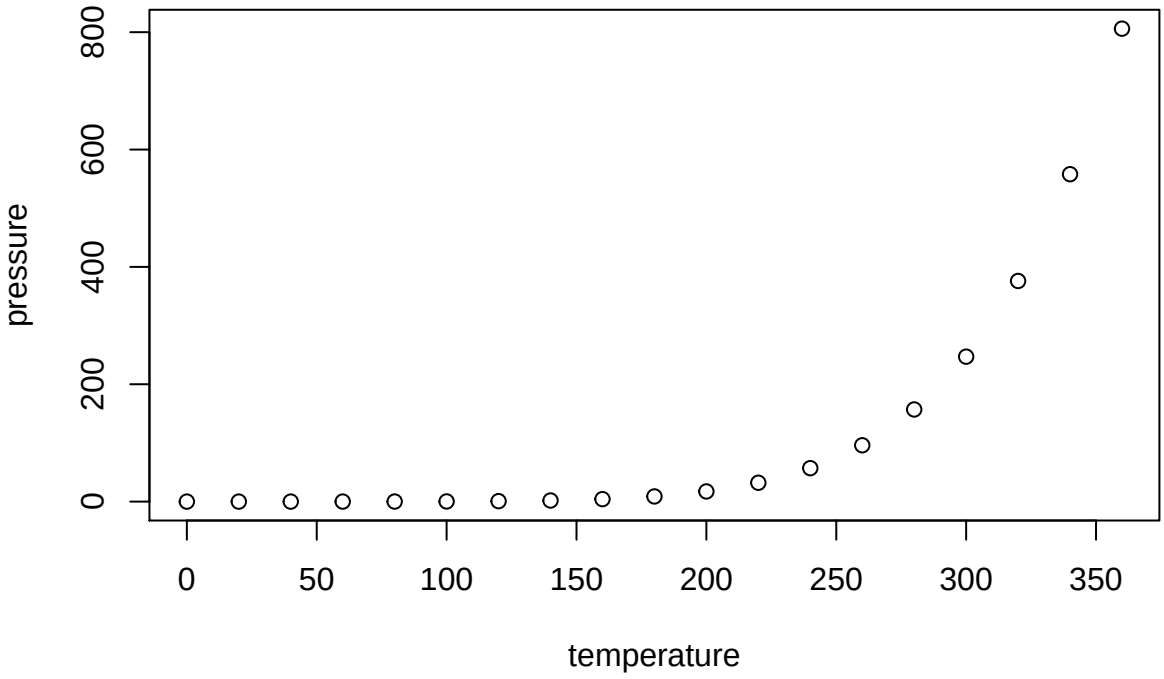
and its summaries:

```
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

Another example of an internal dataset is `pressure` that contains vapor pressure of mercury as a function of temperature. The following code chunk shows how a plot can be produced while printing of the code is prevented by adding `echo=FALSE` option.




### Reading Data

When an external is needed to be used, R can read data from a local file; for example:

```
x = read.csv(file = '../data/CheeseTaste.csv', header = TRUE)
head(x)
```

```
##   ï..taste acetic   h2s lactic
## 1     12.3  4.543 3.135   0.86
## 2     20.9  5.159 5.043   1.53
## 3     39.0  5.366 5.438   1.57
## 4     47.9  5.759 7.496   1.81
## 5      5.6  4.663 3.807   0.99
## 6     25.9  5.697 7.601   1.09
```

R can also read files online from a given url; for example, `bac` (bear alcohol content) is a CSV file on OpenIntro site:

```
y = read.csv(file = 'https://www.openintro.org/data/csv/bac.csv',
             header = TRUE)
```

## Conclusion

R markdown is a flexible and powerful tool for generating reproducible documents.

This tool can produce reports in HTML, PDF and even (perhaps) MS Word formats. However,