1 How to write in Markdown

1.1 Basics

LaTeX can control every aspect your document by various document class or templates(but we won't worry about that too much).

1.1.1 Headers

The headers' hierarchy (i.e., title, section, subsection, etc.) are controlled by various code:

1.1.2 Body of a document

The body of a document can just be typed in. In LaTeX, a new paragraph is created by skipping a line. To start a new line you can use \\.
Roses are red,
Violets are blue.

Unlike Word, it is not enough to simply press return.

If you need to type words in *italic* or **bold**, you use `\emph{}` and `\textbf{}` around the words or the sentences you want in italic or in bold.

You can also have block quotes, by using the using the `quote` environment. This is useful for quotations, like in:

> It's always better to give than to receive.

1.1.3 Lists

Unordered Lists are set by the `itemize` environment:

- first item
  - first subitem
  - second subitem
- second item
  - first subitem
  - Second subitem
  - third subitem

List can also be numbered lists by using the `enumerate` environment:

1. first numbered item
   (a) first subitem
   (b) second subitem
2. second numbered item

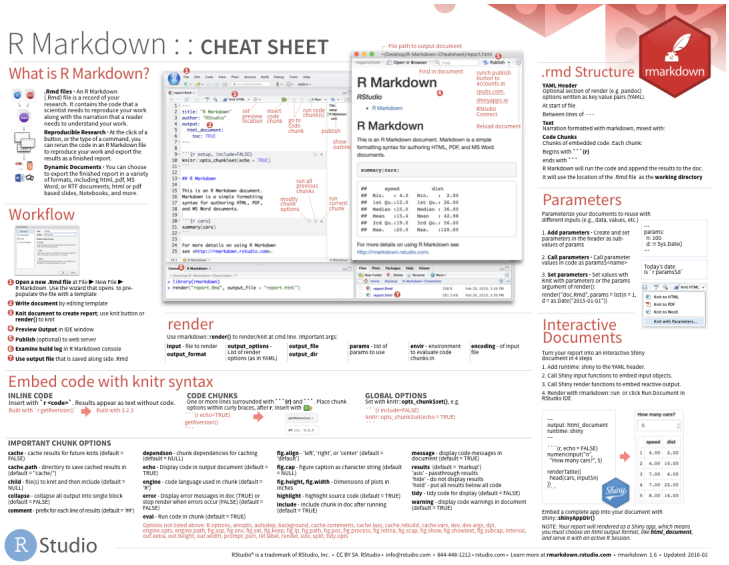
Notice the LaTeX automatically changed the numbering system for nested ordered list.

1.1.4 Links and images

To include link, we have to use the `hyperlink` package and the commands are`\texthref{link}{text}` and `\url{...}`.

Let's include a preview of the cheatsheet we mentioned before (you can find it here.

To include png files into your pdf, we need the `graphicx` package.



Hopefully you are now in a position to appreciate the simplicity and readability of Markdown source code but LaTeX remains the more powerful of the two. Try copying this source code in your editor and compile it. To do so:

- In `RStudio`, open a new R Sweave file
- Name the file (e.g., "test").
- The file will come pre-populated.
- Appreciate that it is divided in two parts, separated by `\begin{document}`.

2 More LaTeX

2.0.1 LaTeX equations

- Use $...$ for inline mathematics.
- \[... \] for displayed mathematics without numbering.
- Use \begin{equation}... \end{equation} for displayed mathematics with numbering.

For example:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2.0.2 Horizontal rules

This is easy. Use `\rule{length}{thickness}`.

2.0.3 Tables

Tables are generated within the `tabular` environment.

First header	Second Header
Content Cell	Content Cell
Content Cell	Content Cell

3 Sampling distributions

3.1 Normal distribution and sample mean

In the following, we take 1000 samples of size $n = 100$ from a standard normal distribution, and study the distribution of the sample mean.

From the theory, we expect the distribution of the sample mean to follow a normal distribution with mean $\mu = 0$ and variance $\sigma = 1/n = 0.01$.

We will illustrate the results plotting the histogram of the sample means and the expected density distribution for $\bar{\mu}$.

```
> set.seed(10)
> library(tidyverse)
> # Create data sampling from std norm distribution
> n <- 100
> n_sim <- 1000
> x0 <- rnorm(n = n * n_sim, mean = 0, sd = 1)
> x <- as_tibble(matrix(x0, nrow = n, ncol = n_sim),
+   .name_repair = "universal"
+ )
> # Compute 1000 (n_sim) sample means
> mu <- x %>%
+   map_dbl(mean)
> # Estimate the main parameters (mean and standard deviation) of the distribution of the sa
> mu_mu <- mean(mu)
> sd_mu <- sd(mu)
> # Plot the histogram to estimate the distribution of the sample mean and the expected dens
> ggplot(tibble(mu = mu), aes(x = mu)) +
```

```
+   geom_histogram(aes(y = ..density..)) +
+   ggtitle("Histogram of sample means and expected distribution") +
+   xlab("mu") +
+   ylab("density") +
+   scale_colour_discrete(name = "density") +
+   geom_function(aes(colour = "normal"),
+                 fun = dnorm,
+     args = list(mean = mu_mu, sd = sd_mu)
+   )
```

As you can see from the graph above, the histogram and the expected distribution are in agreement. We can also look at the numerical summaries.

The mean of the calculated sample means is -0.006, and the expected value of the sample mean is 0.

The standard deviation of the calculated sample means is 0.099, and the expected value of the standard error is $1/\sqrt{n} = 0.1$.