

Working with L^AT_EX in RMarkdown

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This entire document was created using RMarkdown

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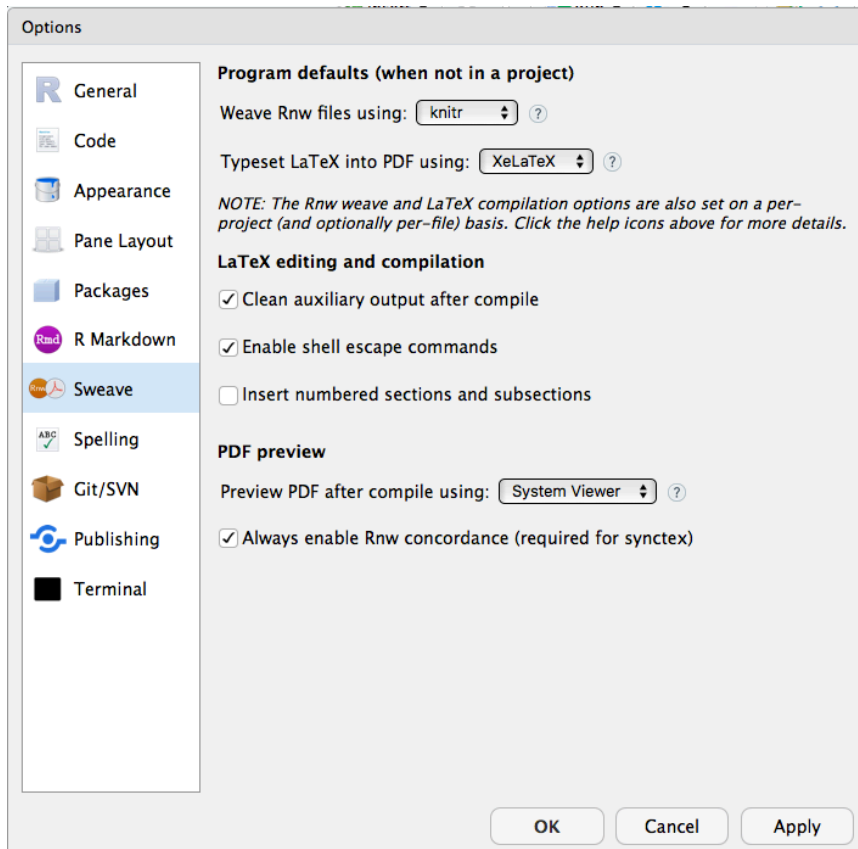
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I Basic Needs: RMarkdown and L^AT_EX

☐ L^AT_EX should be installed on your computer to generate PDFs from RStudio directly (otherwise you could print your HTML page from a browser, but this would affect the pagination)

☐ The R package “knitr” should be installed on your computer. It enables the integration of R code into L^AT_EX, HTML, and Markdown

☐ Your RStudio Sweave preferences should select knitr to “weave” with knitr and your typeset preference **MIGHT** need to be changed to XeLaTeX if you have many modifications to the header of your RMarkdown document (as in this document)



☐ The R “chunk” will use 3 backticks followed by curly brackets with a label and options. This is followed by R code then closed with 3 backticks.

A chunk begins with this at minimum

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

and is closed with 3 backticks

```
```
```

So this:

```
set.seed(12345)
x <- sample(0:999, 20)
mean(x)
```

```
[1] 500.95
```

And the result is set apart from the text.

☐ The inline R result uses a single backtick ‘ followed by the letter r then the R code and is closed with a single back tick. For example `r` is written

```
`r mean(iris$Petal.Width)`
```

☐ Useful chunk options are:

- `comment = “”` removes the default “##”
- `echo = FALSE` suppress R code
- `eval = FALSE` will not run the code
- `fig.height` and `fig.width` each followed by an equal sign and a number will determine the height and width of a plot in inches.
- `highlight = FALSE` suppress highlighting
- `message = FALSE` can be used to suppress package messages
- `warning = FALSE` can be used to suppress code warnings
- `error = TRUE` errors will not stop processing

☐ Obtain an R Markdown Cheatsheet to help you with Pandoc Markdown

- End a line using two spaces to start a new paragraph
- italics is *italics* (**`*italics*`**) so text bracketed by a single asterisk
- bold is **bold** (**`**bold**`**) so text bracketed by double asterisk
- Superscript is 3^2 (`32`) so numbers bracketed by carets
- Subscript is 3_2 (`32`) so number bracketed by tildes
- Sectioning (uses pound # signs, so # for the largest and ##### for the smallest)
- An RMarkdown document consists of a YAML header and a body (written in Pandoc unless one chooses to write with \LaTeX or HTML)

2 Why learn \LaTeX ?

RMarkdown has some limitations but we can get around them with either some knowledge of advanced Pandoc, HTML, or \LaTeX . We can add a lot of \LaTeX to our RMarkdown files which makes it relatively easy for us to produce professional publication quality reports and other documents.

Wikipedia has a decent definition of \LaTeX which you can read. In sum, \LaTeX is a set of libraries built on \TeX which was written in 1978 as a typesetting system that would allow anyone with a computer to produce high quality documents at virtually no cost that would also work on any computer platform. \LaTeX is not WYSIWYG like Microsoft Word, instead a \LaTeX based document looks like a complicated system of markup tags.

Our RMarkdown files cannot accommodate the entirety of \LaTeX commands, there will be some incompatibility (but this is where you would transition to a .Rnw AKA Sweave file or consider learning more Pandoc or HTML). What follows are some common tasks that we can perform using \LaTeX in RMarkdown. Please judge for yourself and decide (but whether you like it or not, Assignment 4 is about demonstrating your \LaTeX abilities) if you will invest time learning \LaTeX .

2.1 A brief note on environments

Throughout this document you will see

```
\begin{something}
some \LaTeX, some text and/or a graphic
\end{something}
```

The begin and end are the start and end of an “environment” in \LaTeX and they are used to format blocks of text or images. If you use a begin, you will need a matching end – always.

3 Tables in RMarkdown and L^AT_EX

□ Tables

Tables are not so great in RMarkdown because RMarkdown is designed to give minimal functionality. But there are some useful R packages. All of the messages, warnings and errors are being shut off to prevent messages like “loading...” from being printed on our document.

3.1 stargazer

The R function stargazer is best for comparing models, make sure you give it enough space on a page as it does not like page breaks.

```
library(stargazer)
stargazer(lm(iris$Sepal.Length ~ iris$Sepal.Width),
          lm(iris$Petal.Length ~ iris$Petal.Width), header = FALSE)
```

Table 1:

| | <i>Dependent variable:</i> | |
|-----------------------------------|----------------------------|---------------------|
| | Sepal.Length
(1) | Petal.Length
(2) |
| Sepal.Width | -0.223
(0.155) | |
| Petal.Width | | 2.230***
(0.051) |
| Constant | 6.526***
(0.479) | 1.084***
(0.073) |
| Observations | 150 | 150 |
| R ² | 0.014 | 0.927 |
| Adjusted R ² | 0.007 | 0.927 |
| Residual Std. Error (df = 148) | 0.825 | 0.478 |
| F Statistic (df = 1; 148) | 2.074 | 1,882.452*** |
| Note: *p<0.1; **p<0.05; ***p<0.01 | | |

3.2 pander

The R function pander prints nicely and allows page breaks within a table.

```
library(pander)
panderOptions('table.split.table', Inf)
set.caption("Data on cars")
pander(mtcars[1:12,1:7], style = 'rmarkdown')
```

Table 2: Data on cars

| | mpg | cyl | displacement | hp | drat | wt | qsec |
|------------------|-----|-----|--------------|-----|------|------|-------|
| Mazda RX4 | 21 | 6 | 160 | 110 | 3.9 | 2.62 | 16.46 |

| | mpg | cyl | disp | hp | drat | wt | qsec |
|--------------------------|------|-----|-------|-----|------|-------|-------|
| Mazda RX4 Wag | 21 | 6 | 160 | 110 | 3.9 | 2.875 | 17.02 |
| Datsun 710 | 22.8 | 4 | 108 | 93 | 3.85 | 2.32 | 18.61 |
| Hornet 4 Drive | 21.4 | 6 | 258 | 110 | 3.08 | 3.215 | 19.44 |
| Hornet Sportabout | 18.7 | 8 | 360 | 175 | 3.15 | 3.44 | 17.02 |
| Valiant | 18.1 | 6 | 225 | 105 | 2.76 | 3.46 | 20.22 |
| Duster 360 | 14.3 | 8 | 360 | 245 | 3.21 | 3.57 | 15.84 |
| Merc 240D | 24.4 | 4 | 146.7 | 62 | 3.69 | 3.19 | 20 |
| Merc 230 | 22.8 | 4 | 140.8 | 95 | 3.92 | 3.15 | 22.9 |
| Merc 280 | 19.2 | 6 | 167.6 | 123 | 3.92 | 3.44 | 18.3 |
| Merc 280C | 17.8 | 6 | 167.6 | 123 | 3.92 | 3.44 | 18.9 |
| Merc 450SE | 16.4 | 8 | 275.8 | 180 | 3.07 | 4.07 | 17.4 |

3.3 xtable

The R function `xtable` generates \LaTeX code, so the chunk option `results = 'asis'` will render it correctly:

```
library(xtable)
options(xtable.comment = FALSE)
data(tli)
xtable(tli[1:10, ])
```

| | grade | sex | disadv | ethnicity | timth |
|----|-------|-----|--------|-----------|-------|
| 1 | 6 | M | YES | HISPANIC | 43 |
| 2 | 7 | M | NO | BLACK | 88 |
| 3 | 5 | F | YES | HISPANIC | 34 |
| 4 | 3 | M | YES | HISPANIC | 65 |
| 5 | 8 | M | YES | WHITE | 75 |
| 6 | 5 | M | NO | BLACK | 74 |
| 7 | 8 | F | YES | HISPANIC | 72 |
| 8 | 4 | M | YES | BLACK | 79 |
| 9 | 6 | M | NO | WHITE | 88 |
| 10 | 7 | M | YES | HISPANIC | 87 |

3.4 Advanced tables

You would need \LaTeX skills for all of these. This is strictly about table construction (usually with text or a mix, not matrices or output from functions.) The tabular environment (there are others) are good for this. Important parts are the table structure specification, the ampersand & separator and the double slash (line break)

```
\begin{tabular}{l c r }
  A & 1 & \Smiley \\
  B & 2 & \Frowny \\
  C & 3 & \Heart \\
\end{tabular}
```

```
A 1 ☺
B 2 ☹
C 3 ♥
```

By adding more specifications to the structure, we have a different appearance

```
\begin{tabular}{l | c || r }
  A & 1 & \Smiley \\
\end{tabular}
```

```

B & 2 & \Frowny \\
C & 3 & \Heart \\
\end{tabular}

```

| | | |
|---|---|---|
| A | 1 | ☺ |
| B | 2 | ☹ |
| C | 3 | ♥ |

Adding an `\hline` (horizontal line) gives it a little more polish

```

\begin{tabular}{c | c || c }
\hline
A & 1 & \Smiley \\
B & 2 & \Frowny \\
C & 3 & \Heart \\
\hline
\end{tabular}

```

| | | |
|---|---|---|
| A | 1 | ☺ |
| B | 2 | ☹ |
| C | 3 | ♥ |

```

\begin{tabular}{l | c || r }
\hline
A & 1 & \Smiley \\ \hline
B & 2 & \Frowny \\ \hline
C & 3 & \Heart \\
\hline
\end{tabular}

```

| | | |
|---|---|---|
| A | 1 | ☺ |
| B | 2 | ☹ |
| C | 3 | ♥ |

If you have a lot of text use the p specification for a table:

```

\begin{center}
\begin{tabular}{| l | l | p{5.5in} |}
\hline
Number & Units & Description \\
\hline
\hline
101A & 4 & (Formerly numbered 101B.) Lecture, three hours; discussion, one hour.
      Enforced requisite: course 10 or 12 or 13. Recommended: course 102A. Applied
      regression analysis, with emphasis on general linear model (e.g., multiple
      regression) and generalized linear model (e.g., logistic regression). Special
      attention to modern extensions of regression, including regression diagnostics,
      graphical procedures, and bootstrapping for statistical influence. P/NP or
      letter grading.\\
\hline
101B & 4 & (Formerly numbered 101A.) Lecture, three hours; discussion, one hour.
      Enforced requisite: course 101A. Fundamentals of collecting data, including
      components of experiments, randomization and blocking, completely randomized
      design and ANOVA, multiple comparisons, power and sample size, and block
      designs. P/NP or letter grading.\\
\hline
\end{tabular}
\end{center}

```

| Number | Units | Description |
|--------|-------|--|
| 101A | 4 | (Formerly numbered 101B.) Lecture, three hours; discussion, one hour. Enforced requisite: course 10 or 12 or 13. Recommended: course 102A. Applied regression analysis, with emphasis on general linear model (e.g., multiple regression) and generalized linear model (e.g., logistic regression). Special attention to modern extensions of regression, including regression diagnostics, graphical procedures, and bootstrapping for statistical influence. P/NP or letter grading. |
| 101B | 4 | (Formerly numbered 101A.) Lecture, three hours; discussion, one hour. Enforced requisite: course 101A. Fundamentals of collecting data, including components of experiments, randomization and blocking, completely randomized design and ANOVA, multiple comparisons, power and sample size, and block designs. P/NP or letter grading. |

multicolumn allows a row to span multiple columns, here, the name of the department is spanning 3 columns and is being centered:

```

\begin{center}
  \begin{tabular}{| l | l | l | p{14cm} |}
  \hline
    \multicolumn{3}{|c|}{UCLA Department of Statistics} \\
  \hline
    Number & Units & Description \\
  \hline
  \hline
  101A & 4 & (Formerly numbered 101B.) Lecture, three hours; discussion, one hour.
    Enforced requisite: course 10 or 12 or 13. Recommended: course 102A. Applied
    regression analysis, with emphasis on general linear model (e.g., multiple
    regression) and generalized linear model (e.g., logistic regression). Special
    attention to modern extensions of regression, including regression diagnostics,
    graphical procedures, and bootstrapping for statistical influence. P/NP or
    letter grading. \\
  \hline
  101B & 4 & (Formerly numbered 101A.) Lecture, three hours; discussion, one hour.
    Enforced requisite: course 101A. Fundamentals of collecting data, including
    components of experiments, randomization and blocking, completely randomized
    design and ANOVA, multiple comparisons, power and sample size, and block
    designs. P/NP or letter grading. \\
  \hline
  \end{tabular}
\end{center}

```

| UCLA Department of Statistics | | |
|-------------------------------|-------|--|
| Number | Units | Description |
| 101A | 4 | (Formerly numbered 101B.) Lecture, three hours; discussion, one hour. Enforced requisite: course 10 or 12 or 13. Recommended: course 102A. Applied regression analysis, with emphasis on general linear model (e.g., multiple regression) and generalized linear model (e.g., logistic regression). Special attention to modern extensions of regression, including regression diagnostics, graphical procedures, and bootstrapping for statistical influence. P/NP or letter grading. |
| 101B | 4 | (Formerly numbered 101A.) Lecture, three hours; discussion, one hour. Enforced requisite: course 101A. Fundamentals of collecting data, including components of experiments, randomization and blocking, completely randomized design and ANOVA, multiple comparisons, power and sample size, and block designs. P/NP or letter grading. |

The multirow package (not shown) allows a column to span multiple rows.

4 Equation Fundamentals in L^AT_EX

□ Equations, use a double dollar sign to bracket them (non-preferred style) OR use a slash with open and close square brackets (preferred style) OR a begin and end equation

4.1 Using a slash with open and close square brackets

```
\[
\exp(i\theta)=\cos\theta+i\sin\theta\,,\quad
\sinh(\log x)=\frac{1}{2}\left(x-\frac{1}{x}\right).
\]
```

$$\exp(i\theta) = \cos \theta + i \sin \theta, \quad \sinh(\log x) = \frac{1}{2} \left(x - \frac{1}{x} \right).$$

4.2 Using a double dollar sign (not recommended)

```
$$
\lim_{q \rightarrow \infty} \|f(x)\|_q
=\max_x |f(x)|,
$$
```

$$\lim_{q \rightarrow \infty} \|f(x)\|_q = \max_x |f(x)|,$$

4.3 Using an equation environment (generates numbering)

```
\begin{equation}
\begin{matrix}
-2 & 1 & 0 & 0 & \cdots & 0 \\
1 & -2 & 1 & 0 & \cdots & 0 \\
0 & 1 & -2 & 1 & \cdots & 0 \\
0 & 0 & 1 & -2 & \ddots & \vdots \\
\vdots & \vdots & \vdots & \ddots & \ddots & 1 \\
0 & 0 & 0 & \cdots & 1 & -2
\end{matrix}
\end{matrix}
\end{equation}
```

$$\begin{matrix} -2 & 1 & 0 & 0 & \cdots & 0 \\ 1 & -2 & 1 & 0 & \cdots & 0 \\ 0 & 1 & -2 & 1 & \cdots & 0 \\ 0 & 0 & 1 & -2 & \ddots & \vdots \\ \vdots & \vdots & \vdots & \ddots & \ddots & 1 \\ 0 & 0 & 0 & \cdots & 1 & -2 \end{matrix} \tag{i}$$

4.4 Equation arrays (the asterisk suppresses numbering)

```
\begin{eqnarray}
u_\alpha & = & \epsilon^2 \kappa_{xxx} \\
\left( y - \frac{1}{2} y^2 \right), & & \\
\text{label{equ}} & & \\
v & = & \epsilon^3 \kappa_{xxx} y, \\
\text{label{eqv}} & & \end{eqnarray}
```



```

p & = & \epsilon \kappa_{xx} \backslash, .
\label{eqp}
\end{eqnarray}

\begin{eqnarray*}
e^x & = & \sum_{n=0}^{\infty} \frac{x^n}{n!} \\
\quad \text{where } n! & = & \prod_{i=1}^n i \backslash, , \quad \backslash \\
\overline{U_{\alpha}} & = & \bigcap_{\alpha} U_{\alpha} \backslash, .
\end{eqnarray*}

```

$$u_{\alpha} = \epsilon^2 \kappa_{xxx} \left(y - \frac{1}{2} y^2 \right), \quad (2)$$

$$v = \epsilon^3 \kappa_{xxx} y, \quad (3)$$

$$p = \epsilon \kappa_{xx}. \quad (4)$$

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} \quad \text{where } n! = \prod_{i=1}^n i,$$

$$\overline{U_{\alpha}} = \bigcap_{\alpha} U_{\alpha}.$$

4.5 Math packages

If your document requires only a few simple mathematical formulas, plain \LaTeX has most of the tools that you will need. If you are writing a scientific document that contains numerous complicated formulas use the following:

```
- \usepackage{amsmath,amssymb,amsthm}
```

You can read a much better discussion of these packages. If you don't need them, don't load them because loading packages takes time and resources, see tex.stackexchange.com

All of your math symbols can be found online, see the links in Week 2 and also visit the Detexify website.

4.6 \LaTeX symbols

Include math symbols, there are over 14,000 symbols available to users of \LaTeX . Some of them require special packages. For example, to gain access to the emojis or the dots in the matrices, a couple of packages were loaded:

```
- \usepackage{wasysym}
- \usepackage{marvosym}
```

For example, theoretically, you could “write music” using \LaTeX but you would need some specialized packages, here is a start...

♪ ♪ 🎵 . ♫ ♪ ♫ ♪

Some advanced symbol packages will require the downloading and installation of specialize fonts. In other words, if you want to type something like Icelandic magic spells in the original language, it is do-able but you would need a strong understanding of your computer's abilities.

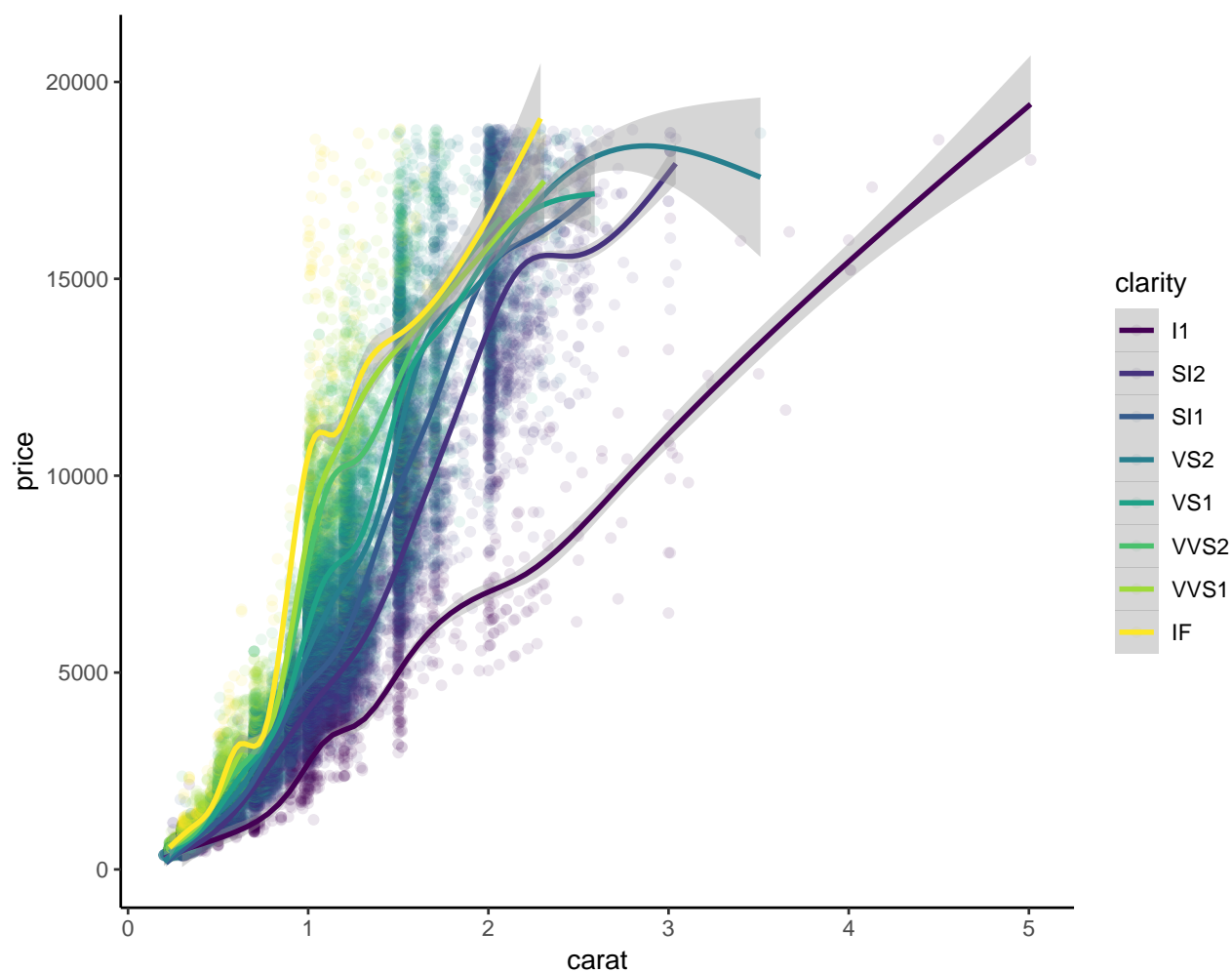


Figure 1: Scatter with GAM smoother

5 Graphics in RMarkdown with \LaTeX

5.1 The package `graphicx`

The package `graphicx` is used for importing and manipulating external graphics files. This is different from generating R graphics using the “chunks”:

```
library(ggplot2)
ggplot(data=diamonds, aes(x=carat, y=price, colour=clarity)) + geom_point(alpha=0.1) +
  geom_smooth() + theme_classic()
```

We control the size of R graphics with chunk options such as `fig.height` and `fig.width`. We use the option `fig.cap=` to generate captions. But what about an external graphic mixed with text? This is easily accomplished using \LaTeX and two packages (`graphicx` and `overpic`):

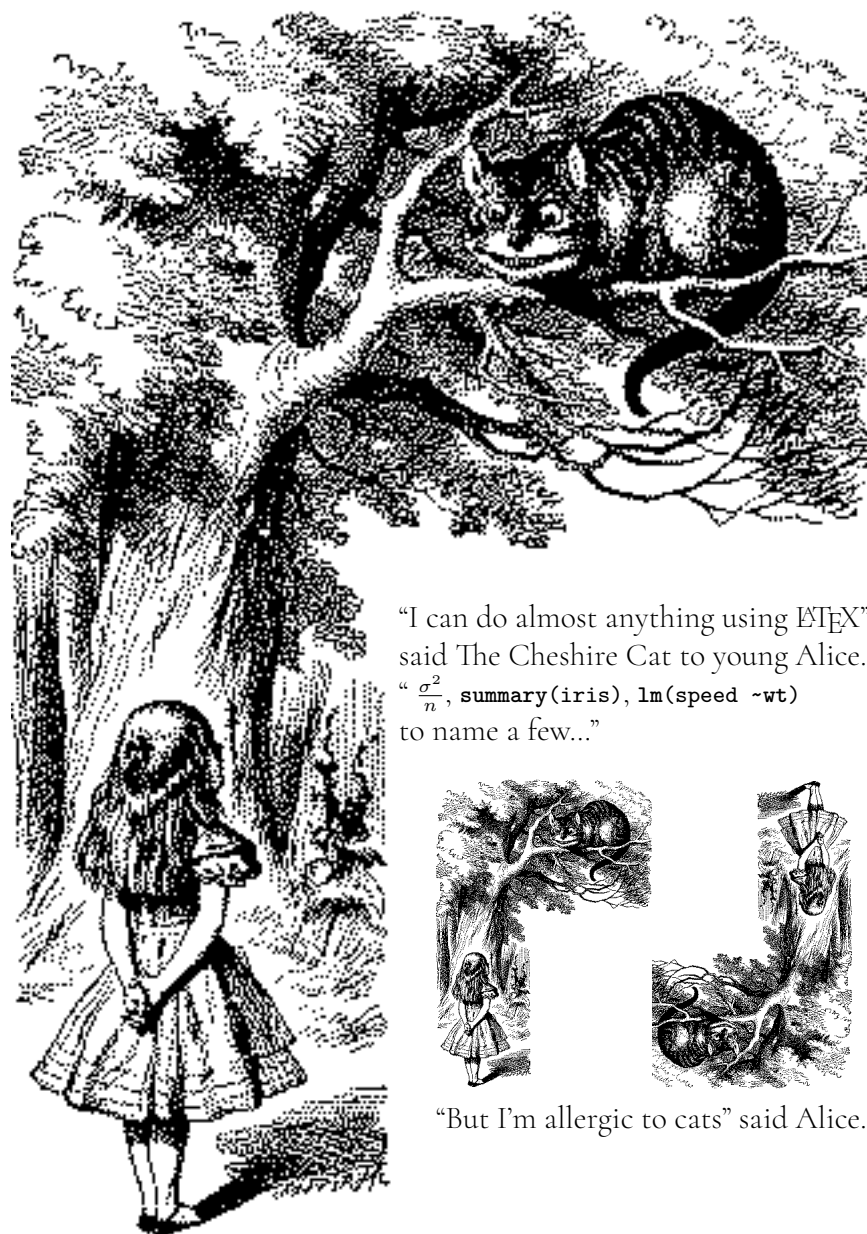


Figure 2: The Cheshire Cat on the subject of \LaTeX

Try to do this without the help of \LaTeX ...

5.2 Using `includegraphics`

First, this line should be in your RMarkdown header:

```
- \usepackage{graphics}
```

During my time in graduate school, a classmate told me that the classic children's book "Alice in Wonderland" by Lewis Carroll explained everything a student needed to know about graduate school. More than 20 years have passed and her insight is still remarkable to me:

- "But I don't want to go among mad people," Alice remarked. "Oh, you can't help that," said the Cat: "we're all mad here. I'm mad. You're mad." "How do you know I'm mad?" said Alice. "You must be," said the Cat, "or you wouldn't have come here."
- "Would you tell me, please, which way I ought to go from here?" "That depends a good deal on where you want to get to," said the Cat. "I don't much care where —" said Alice. "Then it doesn't matter which way you go," said the Cat. "— so long as I get SOMEWHERE," Alice added as an explanation. "Oh, you are sure to do that," said the Cat, "if you only walk long enough."

Do not put spaces in your image names, if you do, you will need to quote the image name. You do not need to specify the extension (e.g., .png, .jpeg) as the most common extensions are recognized by \LaTeX , however, if a graphic has an unusual extension you can declare it as a graphic (advanced, not covered here).

```
\includegraphics{officialseal_200x}
```



Here, we turn and shrink:

```
\includegraphics[angle=90, scale=0.1]{officialseal_200x}
```



If you want to add a caption, you'll need to nest your graphic in a figure environment:

```
\begin{minipage}{\linewidth}
  \begin{minipage}{.4\linewidth}
    \begin{figure}[H]
      \centering
      \caption{The University Seal.}
      \includegraphics[width=\linewidth, angle=270, scale=0.25]{officialseal_200x}
    \end{figure}
  \end{minipage}
  \begin{minipage}{.4\linewidth}
    \begin{figure}[H]
      \includegraphics[width=\linewidth, angle=90, scale=0.25]{officialseal_200x}
      \centering
      \caption{The University Seal.}
    \end{figure}
  \end{minipage}
\end{minipage}
```

Figure 3: The University Seal.



Figure 4: The University Seal.

6 L^AT_EX unrelated to document content (but necessary)

6.1 The geometry package

Use this package to control the page layout, here I am choosing one inch margins on the left and right, and approximately one inch on the top and bottom (but controlling the space allocation of the header and footer). The geometry package can be used for paper orientation and paper size too (e.g., legal, A4, custom size)

```
- \usepackage{geometry}
- \geometry{left=1in,top=0.875in,right=1in,bottom=0.875in,
headheight=0.25in,headsep=0.125in, footskip=0.125in,portrait,twoside=true}
```

The options headheight, headsep, footskip are only needed if one is using headers (as in this document, see the information on the fancyhdr package)

6.2 The fancyhdr package

The package fancyhdr allows control of the header and footer completely. This makes it possible for users to perform tasks such as inserting page numbers using `\thepage` and adding dynamic dates using `\today`. The header will contain something like the following which structures the header and footer on each page except the first:

```
- \usepackage{fancyhdr}
- \pagestyle{fancy}
- \rhead{Right top}
- \chead{\today}
- \lhead{Left top}
- \rfoot{Right bottom}
- \cfoot{\thepage}
- \lfoot{Left bottom}
- \renewcommand{\headrulewidth}{1pt}
- \renewcommand{\footrulewidth}{1pt}
```

The `- \renewcommand{\headrulewidth}{1pt}` and `- \renewcommand{\footrulewidth}{1pt}` control the thickness of the rule between the text and header and footer. A `renewcommand` simply redefines existing L^AT_EX defaults. An understanding of `renewcommand` is useful for more advanced applications.

6.3 Using Color with the xcolor package

The xcolor package allows driver independent access to several kinds of color tints, shades, tones, and color mixing. The following package should be in a header and the options allow the declaration of color using names such as “blue”. The table option allows coloring within L^AT_EX tables:

```
- \usepackage[usenames,dvipsnames,svgnames,table]{xcolor}
```

An example of the application of color in text:

```
\textit{\textcolor{red}{And He said to them, “Cast the net on the right-hand side of
the boat and you will find a catch.”}},\So\they\cast,\and\then\they\were\not\able\
to\haul\it\in\because\of\the\great\number\of\fish.}
```

And He said to them, “Cast the net on the right-hand side of the boat and you will find a catch.”, So they cast, and then they were not able to haul it in because of the great number of fish.

6.3.1 The basic colors

Just call them by name at the appropriate place:

black, blue, brown, cyan, darkgray, gray, green, lightgray, lime, magenta, olive, orange, pink, purple, red, teal, violet, white, yellow

6.3.2 The 68 dvips colors

dvips is a computer program that converts the Device Independent file format (DVI) output of \LaTeX into printable or presentable form. A list of recognized dvips colors:

Apricot Aquamarine } Bittersweet
 Black Blue BlueGreen
 BlueViolet BrickRed Brown
 BurntOrange CadetBlue CarnationPink
 Cerulean CornflowerBlue Cyan
 Dandelion DarkOrchid Emerald
 ForestGreen Fuchsia Goldenrod
 Gray Green GreenYellow
 JungleGreen Lavender LimeGreen
 Magenta Mahogany Maroon
 MelonMidnightBlue Mulberry
 NavyBlue OliveGreen Orange
 OrangeRed Orchid Peach
 Periwinkle PineGreen Plum
 ProcessBlue Purple RawSienna
 Red RedOrange RedViolet
 Rhodamine RoyalBlue RoyalPurple
 RubineRed Salmon SeaGreen
 Sepia SkyBlue SpringGreen
 Tan TealBlue Thistle
 Turquoise Violet VioletRed
 White WildStrawberry Yellow
 YellowGreen YellowOrange

The black background is accomplished with

```
\colorbox{black}{\textcolor{GreenYellow}{GreenYellow}}
```

but that method only works if you have few words. Large colored spaces are possible but are more advanced.

6.3.3 Defining your own colors

```
\color{red!20}{This is 20 percent red and 80 percent white}\par
\color{red!30}{This is 40 percent red and 60 percent white}\par
\color{red!30!black!70}{This is 50 percent red and 50 percent black}\par
\color{red!30!white!30!blue}{You can read about color mixing in the xcolor
  documentation}
\color{black}
```

This is 20 percent red and 80 percent white

This is 40 percent red and 60 percent white

This is 50 percent red and 50 percent black

You can read about color mixing in the xcolor documentation

☐ Resizing (text, code, graphics) can be convoluted in RMarkdown, L^AT_EX allows better control.

6.4 Changing Fonts and Font Size

6.4.1 Font size

If you want to change a font size temporarily, there are a set of commands, for example:

```
\Huge This is Huge \newline
\huge This is huge \newline
\LARGE This is LARGE \newline
\Large This is Large \newline
\large This is large \newline
\normalsize This is the default called normalsize \newline
\small This is small \newline
\footnotesize This is footnotesize \newline
\scriptsize This is scriptsize \newline
\tiny This is tiny \newline
```

This is Huge

This is huge

This is LARGE

This is Large

This is large

This is the default called normalsize

This is small

This is footnotesize

This is scriptsize

This is tiny

If you change your text, you will need to issue a “normalsize” to return your text to the default font size for the document (or use some bracketing)

6.4.2 Font Style

This document is using the package fontspec to select a user installed font, this particular document is using something called Cormorant Garamond Light. The quotes and letter combinations (e.g., two letter f together) will be handled by TeX and the font is going to 1.2 times larger than normal. If you use fontspec, you will need to specify the bold and italic fonts (you don’t need to do that if you aren’t using fontspec), this appears in the header of this RMarkdown document:

```
- \usepackage{fontspec}
- \setmainfont[Ligatures=TeX,Scale=1.2, BoldFont={CormorantGaramond-Bold}, ItalicFont
  ={CormorantGaramond-LightItalic}, BoldItalicFont={CormorantGaramond-BoldItalic}]{
  CormorantGaramond-Light}
```

Additionally, I can include other fonts if I’m using them less frequently. It’s easiest to define the font first with the newfontfamily command found in fontspec and then use it as its own environment:

First, the definition goes in the header, I'm using fonts that are available on my Mac, these could be seen using the Font Book app on a Mac (there is something comparable in Windows):

```
- \newfontfamily\comic[Scale=2]{ComicSansMS}
- \newfontfamily\curse[Scale=2]{Apple-Chancery}
- \newfontfamily\chinese[Scale=2]{STHeitiSC-Light}
- \newfontfamily\korean[Scale=2]{JCKg}
```

Then they can be invoked using the new font names as environments:

```
\begin{comic}
This is ComicSansMS
\end{comic}
\par
\begin{curse}
And this is Apple-Chancery
\end{curse}
\par
\begin{chinese}
(they aren't showing up here but will show up in print)
\end{chinese}
\par
\begin{korean}
(they aren't showing up here but will show up in print)
\end{korean}
```

This is ComicSansMS

And this is Apple-Chancery

美国 一 二 三 四 五 六 七 八 九 十 劉惠蓮

어떻게 지내세요?

I used Google Translate for the Chinese characters and found a Korean phrase book online and copied and pasted the glyphs into RMarkdown. They will show up when processed but aren't showing up when I try to reveal the unprocessed version for this document (sorry...)

6.4.3 Line Spacing

The package `setspace` can handle all of your needs and it is the recommended way to change spacing. You can set a document-wide spacing in the header, or locally, for example:

```
\begin{doublespace}
This is \\ double \\ line spacing.
\end{doublespace}
\begin{spacing}{1.5}
This is \\ one and a half \\ line spacing.
\end{spacing}
```

This is

double

line spacing.

This is
one and a half
line spacing.

☐ Pagination and Page Numbering

To break a page at any point, just add a

`\newpage`

Page numbering will be automatic. To suppress ALL page numbering, add this to your header:

- `\usepackage{gobble}`

To suppress only the first page of page numbering you can add this to the to the specific page:

`\thispagestyle{empty}`

☐ L^AT_EX plus package enumitem does a better job of creating lists.

It involves a little more typing but a whole lot more powerful. Try to write this quickly in Markdown:

7 Example: This is a section header same as a pound sign in RMarkdown

7.1 This is a subsection same as a double pound sign

7.1.1 This is a subsubsection same as a triple

1. This is an enumerated list item 1
 - This is a sublist within my enumerated list, first bullet
 - This is a sublist within my enumerated list, second bullet
 - This is a sublist within my enumerated list, third bullet
2. Back to the enumerated list item 2
 - (a) This is a sublist within my enumerated list, item
 - (b) This is a sublist within my enumerated list, item
 - (c) This is a sublist within my enumerated list, item
3. Back to the enumerated list item 3
 - (a) This is a sublist within my enumerated list, item
 - i. This is a subsublist within my enumerated list, item
 - ii. This is a subsublist within my enumerated list, item
 - A. This becomes something like an infinity mirror or something
 - B. Alice down the rabbit hole maybe
 - iii. This is a subsublist within my enumerated list, item
 - (b) This is a sublist within my enumerated list, item
 - (c) This is a sublist within my enumerated list, item

We put the following line in the R Markdown header to make enumitem available for use.

```
- \usepackage{enumitem}
```

and then this is the \LaTeX code that is the document. You also have the option of using Roman numerals (or any kind of numbers for that matter).

```
\section{Example: This is a section header same as a pound sign in RMarkdown}
  \subsection{This is a subsection same as a double pound sign}
    \subsubsection{This is a subsubsection same as a triple}
    \begin{enumerate}[itemsep=0pt, topsep=0pt]
      \item{This is an enumerated list item 1}
      \begin{itemize}[itemsep=0pt, topsep=0pt]
        \item{This is a sublist within my enumerated list, first bullet}
        \item{This is a sublist within my enumerated list, second bullet}
        \item{This is a sublist within my enumerated list, third bullet}
      \end{itemize}
      \item{Back to the enumerated list item 2}
      \begin{enumerate}[itemsep=0pt, topsep=0pt]
        \item{This is a sublist within my enumerated list, item}
        \item{This is a sublist within my enumerated list, item}
        \item{This is a sublist within my enumerated list, item}
      \end{enumerate}
      \item{Back to the enumerated list item 3}
      \begin{enumerate}[itemsep=0pt]
        \item{This is a sublist within my enumerated list, item}
        \begin{enumerate}[itemsep=0pt, topsep=0pt]
          \item{This is a subsublist within my enumerated list, item}
          \item{This is a subsublist within my enumerated list, item}
          \begin{enumerate}[itemsep=0pt, topsep=0pt]
            \item{This becomes something like an infinity mirror or something}
            \item{Alice down the rabbit hole maybe}
          \end{enumerate}
        \end{enumerate}
        \item{This is a subsublist within my enumerated list, item}
      \end{enumerate}
      \item{This is a sublist within my enumerated list, item}
      \item{This is a sublist within my enumerated list, item}
    \end{enumerate}
```

8 Modifying The Output Portion of the YAML header

In the YAML header (this is a human readable data storage language) there is a place where output from the RMarkdown is controlled, at minimum, a user typically sees HTML or PDF output, for example:

| | |
|-----------------------|----------------------|
| title: "Untitled" | title: "Untitled" |
| author: "Vivian Lew" | author: "Vivian Lew" |
| date: "10/9/2017" | date: "1/13/2017" |
| output: html_document | output: pdf_document |

For this particular document, the output has several added options.

```
output:
  pdf_document:
    latex_engine: xelatex
    toc: true
    toc_depth: 3
    number_sections: true
```

xelatex is a T_EX typesetting engine which uses Unicode (an international standard which accommodates many languages) and supports modern font technologies. If you plan on changing your fonts, you will need to change the latex_engine to xelatex or something comparable.

toc controls whther a table of contents will be produced (options are true/false)

the toc_depth controls the levels

and sections can be numbered

9 An Example Header

```
title: 'A Title'
author: "Your Name"
date: "10-9-2017"
header-includes:
- \usepackage{geometry}
- \geometry{left=1in,top=0.75in,right=1in,bottom=.75in,textheight=8.5in, headheight
  =0.25in,headsep=0.125in, footskip=0.25in, portrait, twoside=true}
- \usepackage{amsmath,amssymb,amsthm}
- \usepackage{enumitem}
- \usepackage[usenames,dvipsnames,svgnames,table]{xcolor}
- \usepackage{graphicx}
- \usepackage{setspace}
output:
  pdf_document:
    latex_engine: xelatex
    toc: true
    toc_depth: 2
    number_sections: true
```