Guide to using LaTeX

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1 What is LaTeX, and why use it?

LaTeX (pronounced *LAH-tekh* or *LAY-tekh*) is a language and document preparation system for typesetting. LaTeX is widely used in several academic disciplines where authors frequently typeset mathematical expressions such as in mathematics, economics, and physics. For instance, LaTeX makes it relatively easy to write even complicated equations like the one below (taken from one of my actual research papers in grad school):

$$
\begin{aligned}
\Delta \ln(K_r) = \delta_0 \;+\; & \underbrace{\delta_1 \sum_{g=\{q,qf\}} \left(\hat{\theta}_{gr} - \bar{\hat{\theta}}_g \right) \Delta \ln(p_{gr})}_{\text{quinoa regional tastes wealth effect}} \;+\; \underbrace{\delta_2 \sum_{g\backslash\{q,qf\}} \left(\hat{\theta}_{gr} - \bar{\hat{\theta}}_g \right) \Delta \ln(p_{gr})}_{\text{non-quinoa regional tastes wealth effect}} \\
+\; & \underbrace{\delta_3 \sum_{g} \left[\bar{\hat{\theta}}_g + z_g \left(\mathbf{p}_r, \frac{y_r}{P_r^*}, \mathbf{Z}_r \right) \right] \Delta \ln(p_{gr}) \;+\; \delta_4 \sum_{g} \left(J_{gr} - \bar{J}_r \right) \Delta \ln(p_{gr})}_{\text{standard wealth effect}} \\
+\; & \underbrace{\delta_5 \Delta \ln(y_r)}_{\text{factor income effect}} \;+\; \underbrace{\delta_6 \sum_{g} s_{gr} J_{gr} \Delta \ln(s_{gr})}_{\text{reallocation effect}} \;+\; \zeta_r
\end{aligned}
$$

Unlike programs such as Microsoft Word where "what you see is what you get" (WYSI-WYG), LaTeX is written like computer code and compiled into a final document where the program automatically typesets the contents. Because LaTeX automatically typesets your content into a final document, it is sometimes called a program where "what you *want* is what you get" (WYWIWYG).

Who should use LaTeX? That depends on what you need to do. If you expect to pursue an academic career in a field that uses a lot of math, it is definitely worth learning. If you never want to take a derivative again after this course, you probably don't need it. However, once you learn how to use LaTeX, it is a very flexible language. You can use it to write problem set solutions, articles, essays, letters, and even books. This document itself is written in LaTeX.

2 Getting started: choose a LaTeX editor

To use LaTeX, you will need to download and install an application that will allow you to compose and compile your documents. There are many different options, each with different strengths and weaknesses. For the purposes of someone just starting out using LaTeX, I suggest using either TeXShop (Mac) or texworks (Windows and Mac). I use and am most

familiar with TeXShop, but the fundamentals covered in this document should apply to both these applications.

You can download TeXShop at `http://pages.uoregon.edu/koch/texshop/index.html` and can download texworks at `https://code.google.com/p/texworks/`. (If you are reading this document as a PDF on a computer, note that these urls are click-able. This is just one of the many cool things you can do with LaTeX.)

Once you have a LaTeX editing application installed on your computer, you are ready to start composing documents. The basic file-type you will use is the .tex file-type. A .tex file is basically a blank slate where you will write your LaTeX "code." Once you've finished writing your .tex file, you will compile it to create a PDF file of your output. In the process of compiling, your editor application will create several necessary auxiliary files. So, for each unique document you create, there will be six different files (of different types) in the same folder. You should only ever need to open the .tex file or the .pdf file.

3   Setting up your .tex file

The most difficult part of learning to use LaTeX is making sure your .tex file is set up the right way. In practice, once you have written one document in LaTeX, you will just copy-and-paste it to a new .tex file and replace the contents. That way, you will not need to re-write all the "preamble" material all over again. But for your first .tex file, there are several things you need to understand.

3.1   Document classes

LaTeX can be used to create several different kinds of documents, referred to as document classes. The most common class (and the one you will use 90% of the time) is the "article" class. Others you may use include "book," "report," and "letter." Finally, there is also the "beamer" class for creating PowerPoint-esqe presentations. This document does not cover beamer presentations, but the basics do not differ significantly from other LaTeX documents.

At the top of your .tex file, the first line should read (including the backslash):

```
\documentclass[12pt]{article}
```

The "documentclass" command defines what kind of document you are writing, (in this case, article), and "12pt" tells the editor how large your normal text size should be in the document. For the most part, your documents should be either 11 or 12 pt. Smaller sizes become very difficult to read. (This document is in 12pt font.)

Under the "documentclass" line, you will include other options in your preamble. After those options, you will write a line to "begin" your document. At the very end of your document, you will write another line that ends the document. Only the content between those two lines will be typeset when you compile the documents. For instance:

```
\documentclass[12pt]{article}
```

```
<Your preamble options go here>
```

```
\begin{document}
```

```
<Your content goes here>
```

```
\end{document}
```

3.2 Packages

For almost anything you want to do with LaTeX, you are going to need to use some "packages" that tell your compiler how to compile certain things like math variables or click-able links. To use a package, you simply include the following line in your LaTeXpreamble:

```
\usepackage{packagename}
```

Usually, you only really need a few packages in any given document. But since there is no cost to including many packages in your preamble, so you will probably develop a pretty long preamble over time as you keep copying and pasting your preamble from .tex file to .tex file. The packages below should be a bare minimum for any of your documents:

- amsfonts

- amsmath

- amssymb

- amstext

- graphicx

- hyperref

4 Creating content

Most of your time using LaTeX will be spent creating content (such as the answers to your problem sets). The basics of creating content are straightforward, but there are several critical details that often trip up new users. This section tries to preemptively address these details.

4.1 Writing body text

Writing text in the body of your LaTeX document is one of the easiest things to do. Just like any other word processor, you simply write sentences in your text editor. Unlike a program such as Microsoft Word, there is no need to indent paragraphs in your text editor. Simply hit the return key twice to separate paragraphs and LaTeX will automatically indent them when it compiles your document. However, putting larger vertical spaces in between paragraphs in your .tex file will not create vertical space in your final document. (Remember, LaTeX is not WYSIWYG.) If you really want to start messing around with blank spaces in your document, look up commands like `\vspace{}`.

There are a few idiosyncrasies about writing in LaTeX that I try to address briefly here:

- **Quotation marks:** the regular quotation mark key on your keyboard will *always* show up as right-hand-side quotation marks in LaTeX. For instance, see how weird "this" looks? Instead, you can type two left-hand-side marks (in the upper-left-hand side of your keyboard) to get something that looks better, like "this."

- **Boldface, underlining, and italics:** to create text that is bold, underlined, or italicized, use the commands `\textbf{}`, `\underline{}`, and `\emph{}` respectively. Then just write the text you want to be bolded/underlined/italicized inside the braces.

- **Line breaks, page breaks, and white space:** in addition to hitting the return button twice, you can also start a new line of text by typing two backslashes right next to each other: `\\`. To force a page break where LaTeX would not normally put it, you can type `\pagebreak`. Finally, the tilde key in the upper-left-hand side of your keyboard will give you a small amount of white space, similar to a tab in MS Word. Just type ∼ to mess around with adding this white space.

- **Centering text:** if you want to center your text, just write the following two lines in your document with the text you want centered in between them: `\begin{center}`, `\end{center}`.

- **Important symbols:** several common symbols you may want to use in your document are actually key components of LaTeX code. For instance, the dollar sign ($) toggles the math typesetting mode, and the percentage sign (%) toggles comments that will not be compiled into the final document. The ampersand (&) is another tricky symbol in LaTeX. If you want to use any of these symbols in your text like you normally would in MS Word, simply put a backslash in front of them: e.g. `\$`.

4.2 Typesetting math

Math typesetting is one of the primary reasons (if not *the* primary reason) that LaTeX is so popular. In general, math type-setting is toggled by the dollar sign: `$`. To put an equation

in your body text, such as this: $2 + 2/4 = 2.5$, just put one dollar sign on either end of the math expression. My code for the equation above looks like this: `$2+2/4=2.5$`.

To set an equation centered outside your body text, use double dollar signs. For the equation below, my code looks like this: `$$2+2/4=2.5$$`.

$$2 + 2/4 = 2.5$$

When you don't know how to get a certain symbol in LaTeX, just Google it. Here are some common things you might use:

- Exponents/superscripts: use the `^` symbol on the 6 key: `x^a`: x^a

- Subscripts: use the underscore _ symbol: `x_a`: x_a

- Multi-character subscripts and superscripts: put the expression you want in brackets, such as `x^{a+b}`, `x_{a,b}`: x^{a+b}, $x_{a,b}$

- Using both subscripts and superscripts, put subscripts first: `x_{a,b}^{c+d}`: $x_{a,b}^{c+d}$

- Square roots, use the command `\sqrt{x}`: $\sqrt{x}$

- Summation signs and integration signs, use `\sum` and `\int`, respectively: $\sum$, $\int$

- Fractions, either use `\frac{a}{b}` or `{{a}\over{b}}`: $\frac{a}{b}$

- Primes, use an apostrophe, such as `f'(x)` or `f''(x)`: $f'(x)$, $f''(x)$

- The partial derivative symbol, use `\partial`: ∂

- Less than or equal to (or greater than or equal to), use `\leq`, `\geq`: $\leq$, $\geq$

- Automatically sized parentheses, etc., use `\left(`, `\right)`, and variations,
  `$$\left[\left({{\left({{a}\over{b}}+c\right)-d}\over{e+f}}\right)-{{g}\over{h}}\right]$$`:

$$\left[\left(\frac{\left(\frac{a}{b}+c\right)-d}{e+f}\right)-\frac{g}{h}\right]$$

- Greek letters, just add a backslash, e.g. `\theta`: θ

- Multi-line equations or systems of equations, use the `\begin{align*}` command. Search online for more details if you are interested in using the align* environment.

4.3   Organizing your document into sections

It is quite easy to organize your document into numbered sections using the `\section{}`, `\subsection{}`, and `\subsubsection{}` commands. The result is exactly what you see in this document.

4.4 Using lists or bullet points

There are two primary environments you will likely use to create lists in LaTeX: itemize and enumerate. They both work the same way. For a list of bullet points, first, you write `\begin{itemize}`, then you create a new item with `\item`, and conclude the environment with `\end{itemize}`. The same works for a numbered list where you replace "itemize" with "enumerate". You can also stack these environments within each other to create nestled lists. For instance:

1. Number 1
   (a) Letter a
   (b) Letter b
2. Number 2

The code for the above list is:

```
\begin{enumerate}
\item Number 1
\begin{enumerate}
\item Letter a
\item Letter b
\end{enumerate}
\item Number 2
\end{enumerate}
```

5 Troubleshooting

The most common problems when writing documents in LaTeX have to do with pairing dollar signs or brackets. If your document will not compile, double check to make sure you have the right number of dollar signs before and after all your mathematical expressions. Similarly, make sure you have the same number of left-hand brackets { as right-hand brackets }.

Usually, your LaTeX compiler will tell you where your errors are by line number in your .tex file. Even if you cannot figure out what the error is from the error message, it should hopefully tell you where to look.

Finally, it is a reality good idea to compile your document often as you are writing it. That way, if you do make an error, you have a pretty good idea of where the error is.

6 Additional resources

When you have a question about LaTeX, Google is your friend. Just type the question you have and chances are someone else has already asked it (and answered it) before. For a great reference resource, try the LaTeX WikiBook at `http://en.wikibooks.org/wiki/LaTeX`. It is the best place to start for most of your questions.