Basic LaTeX Walkthrough

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Before doing anything, try typesetting this TeX document. What that means is, it'll turn all of this code into a PDF that hopefully looks the way you want it to look. In MiKTeX the shortcut is control+t.

Plain Text Anyway, this is how you type plain text. Nothing fancy, right? There are a few things to note. First, it will only render one space. So if you use a lot of spaces, most of the spaces will disappear when you typeset. Similarly, if you enter a lot of empty lines between two paragraphs, it will just start a new paragraph without a line between them. (Try it!)

If you want to **bold** something, you'll use the `\textbf{}` command. To *emphasize* something, use the `\emph{}` command. (There is a `\textit{}` command to italicize, but if you're trying to emphasize something, use `\emph{}` instead.) To underline text, use `\underline{}`.

We can break up the document into different sections and subsections with `\section{}` and `\subsection{}` commands. They'll automatically be numbered for you unless you put an asterisk at the end, like `\section*{}`. We can also title paragraphs with `\paragraph{}`, as seen above. I'll start a new section right now.

1 Math

1.1 In-Line

We can put math directly into a paragraph, which is called **in-line** math. To do so, enter a dollar sign \$, then type in your math, then enter another \$ as soon as you want to use text again. For instance, `$y=x^2$` will output as $y = x^2$. If you don't like using the dollar signs, you can use `\(y=x^2\)`, which will look exactly the same: $y = x^2$.

1.2 Display Environment

For larger equations, you'll want to use **displayed** math. It will display the math on a new line below the paragraph you were just writing. This is also good if you want to show a short string of (in)equalities. To do so, use the form `\[y=x^2\]` and you'll get

$$y = x^2$$

1.3 Common Commands

- For a times symbol $\times$, use `\times`. For a dot product symbol $\cdot$, use `\cdot`.
- If you're in-line, write fractions as `a/b`. If you're in display mode, you can write fractions with `\frac{a}{b}` to get

  $$\frac{a}{b}.$$

  If you try the latter in-line, you'll get tiny fractions that are difficult to read, e.g. $\frac{a}{b}$, whereas a/b is less cramped.
- Use `_` for subscripts and `^` for superscripts. For instance, `$x_1^2$` will give you x_1^2. If you want an entire expression in the subscript or

superscript (or generally for any command), put the entire expression in `{}`. For instance, `$x_1^{2y-5}$` will render as x_1^{2y-5}.

- Write square roots with `\sqrt{}`. For instance, `$\sqrt{-1}=i$` will output as $\sqrt{-1} = i$.

- Write strict inequalities with `<` and `>`, non-strict with `\leq` and `\geq`. Note that you can express "not greater than" by prefacing it with `\not`, for instance `$5 \not > 6$` will output as $5 \not> 6$. (I think you can put `\not` on pretty much anything, although there is a special command `\neq` for $\neq$.)

- Most Greek letters are straightforward. `\delta` will give you a δ, and `\Delta` will give you a Δ.

- For fancier letters, you'll usually use either the `\mathbb{}` or `\mathcal{}` commands. For instance, `\mathbb{R}` gives you the fancy real number symbol $\mathbb{R}$.

- Subsets and supersets are `\subset` and `\superset`, respectively. Add `eq` at the end to make them non-strict, e.g. $A \subseteq B$. To take an arbitrary element from a set, use `\in`, so $x \in X$. Unions are given with `\cup` and intersections are given with `\cap`, for instance,

$$(A \cup B)^c = A^c \cap B^c.$$

  The empty set is simply `\emptyset`.

- Use `\{ ... \}` for curly brackets.

- For a partial derivative, use `\partial`, e.g. $\partial z/\partial y$.

- For limits, use `\lim` with a subscript explaining what the limit is doing.

For instance, `\lim_{x \rightarrow \infty}` will output as

$$\lim_{x \rightarrow \infty}$$

If you try putting the limit in-line, it'll look kinda weird.

- Use `\sum` for sums. You'll usually want to try to use sums in the display environment because they can be bulky, for instance

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}.$$

- Write integrals with `\int` with sub and superscripts for the limit. You'll want to put these in the display environment most of the time as well:

$$\int_{-\infty}^{\infty} \frac{1}{\pi(1+x^2)}\, dx = 1.$$

- Sometimes you'll want really big parentheses. For instance,

$$(\sum_{i=1}^{n} i)^2$$

just looks weird. In this case, put `\left` before the left parenthesis and `\right` before the right parenthesis:

$$\left(\sum_{i=1}^{n} i\right)^2$$

- If you want to display a dollar sign or a percentage or some other symbol that's used as code, try putting a \ before it. Then we can display \$ and \& and \% and so forth.

1.4 Matrices

Matrices are where things can get a little bit messy, if nothing else because matrices can be really big. Here's a simple 3×3 matrix.

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$$

In this case, we began a matrix **environment** which has a specific syntax for inputing matrices. When done inputting, you end the environment so things return to normal. Use `pmatrix` if you prefer your matrices in parenthesis, and use `vmatrix` for determinants. Also note that `\\` typically will start a new line in any environment.

1.5 Lots of Math

If we have a large collection of equations, we might want to write each equation as its own line. Furthermore, we might want each equation to be numbered. Do so with the `gather` environment.

$$y = mx + b \tag{1}$$

$$l = w \times h \tag{2}$$

$$x = -b \pm \frac{\sqrt{b^2 - 4ac}}{2a} \tag{3}$$

Sometimes we might have a long chain of (in)equalities and we can't fit them all on one line. In that case, use the `align` environment. For example,

$$\begin{aligned} P(D) &= P(D|C)P(C) + P(D|N)P(N) \\ &= (0.90)(0.02) + (0.20)(0.98) \\ &= 0.214. \end{aligned}$$

Each line is aligned by your placement of the &. We might also want to take the previous `gather` environment and align everything by the equality signs:

$$y = mx + b \tag{4}$$

$$l = w \times h \tag{5}$$

$$x = -b \pm \frac{\sqrt{b^2 - 4ac}}{2a} \tag{6}$$

1.6 New Commands

Typing `\mathbb{R}` for $\mathbb{R}$ over and over again gets old very quickly. What we can do is create a new command that allows us to just type, say, `\R` instead. If you look in the preamble in this file, you'll see a handful of new commands I've made for this purpose.

2 Lists

There are two types of lists: bullet lists using the `itemize` environment, and enumerated lists using the `enumerated` environment. Create a bullet list as follows:

- Every time you use `\item`, you will create a new bullet point.
- See?

Or we might want to make a numbered list instead:

1. Sometimes it would make more sense to number the lists.
2. Like this.

We have to get a little fancy to have an alphabetized list, but it's not too bad:

(a) We just had to add that little label tag that changed the type of "enumeration."

(b) I bolded it too just to illustrate that such a thing is possible.

One thing I don't like about lists by default is that they appear to be too spread out for my tastes. If we begin the list with `\itemsep=-.5em`, then the spacing between each item is reduced:

(A) I think this looks a lot better.
(B) It's much more compact.

3 Proofs

Use the `proof` environment for proofs. Place your QED symbol with `\qedhere` if you don't like where it defaults to. Here's an example.

Let $F(K, L) = AK^{\alpha}L^{1-\alpha}$ be a Cobb-Douglas production function. I claim that this function has constant returns to scale.

Proof. Multiply both capital K and labor L by some constant λ. Then we have

$$\begin{aligned} F(zK, zL) &= A(zK)^{\alpha}(zL)^{1-\alpha} \\ &= Az^{\alpha}K^{\alpha}z^{1-\alpha}L^{1-\alpha} \\ &= zAK^{\alpha}L^{1-\alpha} \\ &= zF(K, L). \end{aligned}$$

□

4 Quotations

Use the `quote` environment for shorter quotes (no indent):

> "The first principle is that you must not fool yourself and you are the easiest person to fool." — Richard Feynman

And use the `quotation` environment for longer quotes:

> "Dr. Scholl makes foot products, right? And he's a doctor, which means he went to school for a long time. But it doesn't take a lot to figure out that stepping on a cushion would be more comfortable. That fucker wasted lots of time at school. 'Cuz I would have bought that shit from a Mr. Scholl."
>
> — Mitch Hedberg

5 Other Stuff