Title of the Paper

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Abstract

The beginning of the abstract. The middle. How do you like it so far? Almost done. Done.

Contents

Chapter 1

First Steps

1.1 One Line Equations

Garbage text for format purposes. Here is math mode: $\alpha^{\Gamma_3} + \beta_\gamma^{12}$. To enter math mode inside text, simply type a dollar sign. Type another dollar sign to exit math mode.

Some people might have latex environments where it will replace a α with the Greek letter alpha. Note that if you type α it might replace it with what a real alpha, while if I type α, the user defined shortcut, it does not replace.

Here's how to do an equation. Once you type beginequation (with the slash in front of it) you've automatically entered math mode. Now if you type anything, say uppercase Lambda or lowercase epsilon or even some of our user-defined shortcuts, they will be properly formatted:

$$\frac{\Lambda'(s)}{\Lambda(s)} = s + \epsilon \int_a^b 3x^2 e^{2\pi i x} dx. \tag{1.1}$$

In the above, frac (with a slash before it) gives a fraction; it puts the first thing in curly brackets as the numerator, and the second as the denominator. To do Greek letters, type slash letter (for example, slash epsilon), while an integral is slash int, a sum is slash sum, and so on.

I've made a shortcut for equations: be for begin equation and ee for end equation. It looks as follows

$$\frac{\Lambda'(s)}{\Lambda(s)} = \epsilon \int_a^b 3x^2 e^{2\pi i x} dx. \tag{1.2}$$

1.2 Labelling Equations

What if I want to keep track of the equation number, so that I can refer to it in the text? For example, consider

$$\frac{\Lambda'(s)}{\Lambda(s)} = \epsilon \int_a^b 3x^2 e^{2\pi i x} dx. \tag{1.3}$$

Note the label. I can choose anything (as long as there are no numbers, just letters) for the name. I choose to label all equations with eq followed by a descriptive name; lemmas I start lem followed by a descriptive name, and so on.

To refer to the equation, I merely have to write 1.3; however, it's better to write Equation 1.3 or (1.3).

Whenever you add equations, you have to compile Latex twice to get the references correct.

1.3 Multi-Line Equations: Eqnarray

What if your equation is more than one line? You might want to use eqnarray instead of equation. The slashnonumberslashslash is a carriage return without numbering that line; personally, I like to wait to the last line to number something. Here's an example:

$$\begin{aligned} \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x)g(s) + f(x-t) - g(s)f(x) \\ \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x-t) \end{aligned} \tag{1.4}$$

Again, if I don't want to type begin eqnarray I can use the shortcut:

$$\begin{aligned} \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x)g(s) + f(x-t) - g(s)f(x) \\ \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x-t) \end{aligned} \tag{1.5}$$

Here, I've chosen to use bea to stand for begin equation array. You can define your shortcuts almost freely (you can't use numbers in a shortcut definition).

The formatting is done by the ampersand signs, $\&$. (Note: if you have a special symbol which you want to display in Latex, you put a slash before it. Thus, to print a percent-sign in math mode is $\%$, or to print a pound sign is $\#$.) The eqnarray environment has two ampersands per line, and centers the lines on what is between the ampersands.

Usually, one does not repeat the left hand side. Thus, it is more natural to write

$$\begin{aligned} \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x)g(s) + f(x-t) - g(s)f(x) \\ &= f(x-t) \end{aligned} \tag{1.6}$$

Here's a somewhat lengthier example:

$$\begin{aligned} \frac{1}{m}\sum_{p}^{m^\sigma} p^{-\frac{1}{2}} &\leq \frac{1}{m}(\sum_{p}^{m^\sigma}\frac{1}{p})^{\frac{1}{2}}(\sum_{p}^{m^\sigma} 1)^{\frac{1}{2}} \\ &\leq \frac{1}{m}(\log\log m^\sigma + A)^{\frac{1}{2}}(Li(x) + O(x^{\frac{1}{2}}\log x))^{\frac{1}{2}} \\ &\ll \frac{1}{m}(\log\log m)^{\frac{1}{2}}(\frac{2m^\sigma}{\log m})^{\frac{1}{2}} \\ &\ll m^{\frac{1}{2}\sigma - 1}\left(\frac{\log\log m}{\log m}\right)^{\frac{1}{2}}. \end{aligned} \tag{1.7}$$

In the above, I have used a user defined command, slash foh. That is a shortcut I've created to write $\frac{1}{2}$. If there is something you use many times, you should have a shortcut for it.

1.4 Lemmas, Propositions, Theorems and Corollaries

Now let's add a lemma. Below is how one would write it. Notice all the English text is italicized. We'll follow the lemma immediately with a proposition.

Lemma 1.4.1. *Let* $\hat{\phi}(\xi) = \int_R \phi(x)e^{2\pi ix}dx$. *Then* $\hat{\phi}_r(\xi) = \frac{1}{r}\hat{\phi}(\xi/r)$.

Proposition 1.4.2. *If* $f \in \mathcal{C}^3$ *and* $f'(0) = 0,\ f''(0) > 0$ *then* 0 *is a local minimum.*

Proof: this follows immediately from the well known relation

$$3x + 2y = 4z \tag{1.8}$$

The following is a new lemma, and the [] give the lemma a name.

Lemma 1.4.3 (Value of $\zeta(2)$). *Let $\zeta(s)$ denote the Riemann Zeta Function. Then*

$$\zeta(2) = \frac{\pi^2}{6}. \tag{1.9}$$

You can label lemmas just like you would equations:

Theorem 1.4.4. *[The Implicit Equation] Let $x, y, z \in \mathbb{C}$. Then*

$$x^y + y^z + z^x = -1 \tag{1.10}$$

If you view the file, you will notice that the name of the above is italicized. It is better to put the name first, then the label:

Theorem 1.4.5 (The Implicit Equation). *Let $x, y, z \in \mathbb{C}$. Then*

$$x^y + y^z + z^x = -1 \tag{1.11}$$

By Lemma 1.4.5, we see that the desired expression equals -1. Note that you often have to compile twice before the labels are correct.

Corollary 1.4.6. $x = y = z = 1$ *is not a solution*

Corollary 1.4.7 (Hensel's Observation). $x = y = -1,\ z = 1$ *is a solution*

more garbage text to just switch

$$\Lambda(s) = \frac{4z}{g(s)} \tag{1.12}$$

1.5 Using Subsections

If we wanted, we could put subsections in a section.

1.5.1 Pythagoras

If a section is very long, we might want to have sub-sections in the sections. The commands are exactly what you think.

Lemma 1.5.1 (Lengths of Sides). *The sum of the lengths of any two sides of a triangle are greater than the third length.*

1.5.2 Garbage

Here is another subsection.
Here is some more garbage text.
And here is some more.
Note the double slash above forces a carriage return.

1.5.3 New Pages

We are now going to force a new page. The next subsection will start on a new page.

1.5.4 Prime Number Theorem

Below is the Prime Number Theorem. If we assume the Riemann Hypothesis we can take $\alpha = \frac{1}{2} + \epsilon$.

$$\pi(x) = \frac{x}{\log x} \; + \; O(x^{\alpha}) \tag{1.13}$$

We have now come to the end of the first chapter – it will automatically start the next chapter on a new page.

I like to put a lot of percent signs between chapters (and a few carriage returns) to make editing easier.

1.6 Matrices and Shortcuts

If you have symbols you use many times, it is often convenient to define a shortcut. For example, I have defined slash foh to be $\frac{1}{2}$ (stands for fraction: one half).

Let's do some more detailed examples. To do a 5×5 matrix type

$$A = \left(\begin{array}{ccrcc} 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 & 15 \\ 16 & 17 & 18 & 19 & 20 \\ 16 & 17 & 188 & 19 & 20 \\ 121 & 122 & 123 & 124 & 125 \end{array}\right) \tag{1.14}$$

Some important points to note: the $(\cdots)$ draw the left and right parentheses around the matrix, automatically adjusting to the proper size. Then we have a slash begin array, followed by five cs in curly braces. This gives a 5×5 matrix, with each element centered. If instead of cs we used ls, it would left-justify (and rs would right justify). For example,

$$A = \left(\begin{array}{rrrrr} 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 & 15 \\ 16 & 17 & 18 & 19 & 20 \\ 121 & 122 & 123 & 124 & 125 \end{array}\right) \tag{1.15}$$

Latex allows you to define shortcuts that are functions of up to nine arguments with ease. Thus, I can have shortcut definitions for 2×2 and 3×3 matrices. To use my shortcuts (the newcommands at the top), one just types

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \tag{1.16}$$

or

$$B = \begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}. \tag{1.17}$$

If you want determinants, you can do

$$\det(A) = \begin{vmatrix} a & b \\ c & d \end{vmatrix}, \quad \det(B) = \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}. \tag{1.18}$$

Two remarks on the above equation. First, slash det gives a nice determinant. For functions like det, sin, cos, if you don't put a slash before them, Latex interprets them as text (letters). Thus, compare $\det(A), cos(A), \cos(A), \sin(A), \log(A)$ to $det(A), cos(A), sin(A), log(A)$.

Second, a slash followed by a space gives a space. Latex ignores (for the most part) spaces. In the above, the slash space slash space slash space gives three spaces (ie, helps format).

Finally, here are some other shortcuts I've created that you might find useful. Feel free to make your own!

$$\Lambda(n) = \begin{cases} \log p & \text{if } p \text{ is a prime power} \\ 0 & \text{otherwise} \end{cases} \tag{1.19}$$

$$\mu(n) = \begin{cases} 1 & \text{if } n = 1 \\ (-1)^r & \text{if } n \text{ is the product of } r \text{ distinct primes} \\ 0 & \text{if } n \text{ is divisible by the square of a prime} \end{cases} \tag{1.20}$$

For the Legendre / Jacobi symbol with modulus p, simple use $\left(\frac{x}{p}\right)$.

The standard sets of numbers encountered are the natural numbers $\mathbb{N}$, the integers $\mathbb{Z}$, the reals $\mathbb{R}$, and the complex numbers $\mathbb{C}$.

If we want to do vectors, we just do $\overrightarrow{v}$; set operations are $x \in A \cup B \cap C \subset D = G \oplus H$.

Sometimes we prefer to write

$$x = \bigcup_{i=1}^{\infty} A_i \quad instead of \quad x \in \cup_{i=1}^{\infty} A_i. \tag{1.21}$$

Note the above has the text in emphasis mode. To avoid this, use either mbox or text (text is better):

$$x = \bigcup_{i=1}^{\infty} A_i \quad \text{instead of} \quad x \in \cup_{i=1}^{\infty} A_i. \tag{1.22}$$

Here it is with text instead of mbox.

$$x = \bigcup_{i=1}^{\infty} A_i \quad \text{instead of} \quad x \in \cup_{i=1}^{\infty} A_i. \tag{1.23}$$

To do a unit vector, one can write $\widehat{i}, \widehat{j}, \widehat{k}$. We also have $\prod_{i=1}^{5} \sum_{j=1}^{8} a_{ij}$.

Chapter 2

Environments I

2.1 Shortcut Environments

To do an equation, recall we need slash begin curly brackets equation curly brackets. Thus, we write

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6} = \frac{8}{3}\left(\int_0^1 \frac{1}{1+x^2} dx \right)^2. \tag{2.1}$$

If you have a lot of equations or arrays of equations, you don't want to keep typing begin equation and end equation.

We've created some shortcuts: slash be will be begin equation; slash ee will end the equation; bea and eea will begin and end arrays of equations.

Thus,

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6} = \frac{8}{3}\left(\int_0^1 \frac{1}{1+x^2} dx \right)^2 \tag{2.2}$$

does it as an equation, and

$$\begin{aligned} \sum_{n=1}^{\infty} \frac{1}{n^2} &= \frac{\pi^2}{6} \\ &= \frac{8}{3}\left(\int_0^1 \frac{1}{1+x^2} dx \right)^2 \qquad (2.3) \end{aligned}$$

does it as an array of equations.

Other useful commands: **this will put any text in bold** while *this will emphasize or italicize text* and this will underline.

2.2 Enumeration, Itemizing, and General Latex and Linux Commands

We will use the shortcuts for the enumeration environment. First, the long form.

1. Eduardo Dueñez has been kind enough to give me his .emacs configuration file, which configures the editor to make LaTeX-ing very easy. Save the .emacs file into your home directory. NOTE FOR PEOPLE AT OHIO STATE – this is configured for Princeton, not for OSU. I may need to modify this a bit, and will get back to you.

2. in whatever directory you want to latex, save the files template.tex, template.bbl, YL.EPS. This will give you a tex template with a bibliography section and image. Unfortunately, it's only configured to display the image when run in the windows environment on my machine, so I've commented out the graphics section. The bibliography file should have the same name as your file, except with the extension .bbl instead of .tex.

3. at the unix prompt, move into the directory where you've saved the templates. To edit, type emacs template.tex & (the ampersand makes sure it opens in a new window). To compile is **Control-c-f**. Type xdvi template.dvi & to view your compiled file. If you make changes to the latex source file, just clicking on the xdvi file will (if you've compiled the latex file) automatically update the dvi file. control-c (let go of the two keys) ‘ displays error messages (it's on the same key as the tilde, don't hold down shift).

If instead of numbering I wanted bullets I would do

- General: cd directory changes the directory, ls lists all files and sub-directories in whatever directory you are currently in. Control-x-w saves without exiting; Control-x-c saves with exiting.

You can also use my shortcuts for these environments.

1. ben stands for begin enumerate.
2. een stands for end enumerate.
3. each line starts with slash item.

Itemize is similar.

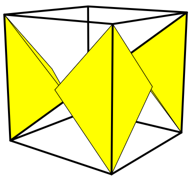
- bi is begin itemize.
- ei is end itemize.
- each line starts with slash item.

Chapter 3

Graphics and Color

3.1 Inserting Graphics

Let's end by inserting a picture (image courtesy of J. Ax and S. Kochen). The image extension should be .eps, and in the same directory as everything.



At least on my home computer, if I try to view the .dvi file I have trouble seeing the picture; I need to convert it to a .ps file and then use ghostview or some such. I'm not sure exactly how to format it in the UNIX environment to add the picture.

3.2 Color

If you have included the color package, you can write in color. Simply use the following:

This is to type in a shade of red. There are three parameters, red green blue, I think. Each is a number between 0 and 1. Note you start with a brace followed by rmfamily then the color specification, and you end with another brace like this.

If we type here, it is in black, the default color.

Now we are in a shade of blue. You can also use **bold test** in a color, as well as math notation, such as $a_i^j x_{ij} = \pi^e$, or whatever you want.

We can also switch colors to pure red or to pure blue or back to black in the middle of a paragraph.

Chapter 4

Environments II

4.1 Lists

Enumerating lists:

1. This is the first item.
2. This is the second item.
3. This is the last item.

4.2 Emphasize and Bolding

If you use **this, then whatever is inside will be in bold**, while if you use *this, everything will be emphasized*, and <u>this will cause the text to be underlined</u>.

I have created a shortcut for textbf, namely **this will bold text as well**.

4.3 Centering Text

One can also center text:

Everything typed in here is centered.
Isn't centering wonderful?
I thought so too.

This is also wonderful.

The two slashes above give a extra carriage return. You can only have one double slash at the end of a line. If you want more, use bigskip.

Many of these shortcut commands are from a tex template that Alex Barnett was kind enough to share with me.

4.4 Refering to Bibliography

The bibliography is included at the end. To refer to items, simply type [RSZ]. Note all the items in the bibliography have two abbreviations, one in brackets, one in curly braces.

What is in brackets is what the computer will print; what is in curly braces is how you refer to it.

Thus, you should type [Ki]

4.5 Font sizes

This is huge.

This is LARGE

This is Large

You guessed it.

This is tiny.

Back to normalsize.

Consider the matrix $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$. Boy does this look bad compiled. How about $A = \left(\begin{smallmatrix} a & b \\ c & d \end{smallmatrix}\right)$. This looks better.

Appendix A

Psychohistorical Dynamics of the Sayshell Republic: An Analysis of the Rise of the Mule

This is the first appendix, works like you would expect.

Appendix B

Random Walks in High Dimensions: Choosing a Universe Interesting for Drunks

This is the second appendix.

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