TITLE OF THE PAPER

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ABSTRACT. The point of these notes is to give a quick introduction to some of the standard commands of LaTeX; for more information see any reference book. Thus we concentrate on a few key things that will allow you to handle most situations. For the most part, we have tried to have the text describe the commands; though of course we cannot do this everywhere. You should view both the .tex code and the output (either .pdf or .dvi) simultaneously.

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1. First Steps

LaTeX is a cross between a word processor and a programming language. The purpose is to allow one to write articles with lots of mathematical symbols and equations easily. The default is to be in non-mathematical mode; we discuss how to enter mathematical mode below. The first few lines of the code describe the formatting (font size is 12 for this, this is an article not a report or book, which packages we need (some are needed for including graphics, some for standard definitions of common symbols or expressions), short cut commands, how we want theorems, lemmas and the like to look, and so on). For now, you can keep these settings and just modify the text below.

1.1. **General Mathematics.**

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. Many of the symbols for everyday mathematics is as you would expect: you start with a slash and then end with the command. Thus lowercase Greek letters are slash letter, such as slash alpha, slash beta, slash gamma: α, β, γ. Uppercase Greek letters (when they exist) are slash Gamma, slash Delta and so on: Γ, Δ. Sums, products and integrals are slash sum, slash prod and slash int: $\sum$, $\prod$, $\int$. Less than and equal to is slash le: $\le$; similarly greater than or equal to is slash ge: $\ge$. Being an element of is slash in: $\in$; not an element of is slash not slash in: $\not\in$. Subset is slash subset $\subset$, and so forth. Note many of these are exactly as you'd expect: $a \in A \subset B$ and $c \not\in B$. Not equal to is slash neq and not divide is slash neq |: $4 \neq 5$ and $4 \nmid 5$.

Other common symbols like infinity are slash infty: ∞, the section sign is slash S: $\S$, union is slash cup: $\cup$, and intersection is slash cap: $\cap$. To do math blackboard is slash mathbb { letter }; thus the integers and rationals are $\mathbb{Z}$ and $\mathbb{Q}$. We can put arrows over things by slash overrightarrow { text }: $\overrightarrow{v}$. For the other direction it is overleftarrow, to underline it is overline, for a hat (like the Fourier transform) it is widehat: $\widehat{f}$. To have a square root it is slash sqrt { text }: $\sqrt{4x+1}$; if we want an nth root it is slash sqrt [n] { text }: $\sqrt[n]{4x+1}$.

For multivariable calculus, we could write $\overrightarrow{v}$ for the vector v, or we could use our shortcut command $\overrightarrow{v}$. If we want a cross product, we could write $\overrightarrow{v} \times \overrightarrow{w}$. If we want a specific vector, we can do $\langle 1, 2, 3, 4, 5 \rangle$.

Certain symbols (dollar signs, percent sign, pound sign, ambersand sign) are used in tex to mean other things: if we want these in texts we put a slash before them: $, %, #, &, {, }, $\backslash$. The slash backslash gives a back slash. For example, the percent sign is used for comments that you do not want the tex compiler to read; anything on the line with the percent is commented out and not displayed.

Many standard functions have shortcuts to make them look good: for example, \cos, \sin, \tan, \log and so on: $\cos$, $\sin$, $\tan$, $\log$. Compare how things look with and without the \: $\cos(\log(x)+1)$ versus $cos(log(x)+1$; without the \it italicizes. In fact, in math mode any text is automatically italiziced. We discuss later how to handle text in math mode.

To do superscripts use a carot (shift-six) and to do subscripts use underscore (shift-minus sign). Thus x-squared is x^2 and integrating f(x) from a to b is $\int_a^b f(x)dx$. If you have more than one character as the superscript or subscript, you must surround it by left and }s: compare x_{i+j}^2 to x_i^2+j. Sometimes, to be safe, one surrounds both subscripts and superscripts with braces.

If there are frequently used expressions, it is worthwhile to define shortcuts. Instead of typing \alpha to get an alpha, I can type \ga, because I have defined that to be a Greek alpha: α. Similarly for not divide it is \notdiv (as a shortcut for \nmid): $4 \nmid 5$ versus $4 \nmid 5$. The way we do shortcuts is earlier in the document, we do \newcommand { \shortcut name } { command }. Thus for example the shortcut for greek lowercase alpha is \newcommand { \ga } { \alpha }.

To do fractions, type \frac { numerator } { denominator }: $\frac{12}{34}$. If you have the ratio of two one-digit numbers, you do not need the braces: $\frac12$; however, compare $\frac{1}{12}$ to $\frac{1}{1}2$. These are common errors in tex (forgetting braces; the same also happens often with exponents or subscripts); that is why often it is best to include the braces. Remember every { must be paired with a }.

There are many different text enviroments; for webpages a good one to do is slash texttt {insert text here }, which would appear as

`http://www.math.brown.edu/ sjmiller`.

Notice when we do this that the tilde is not displayed; to have it display use $slash sim$: thus we would write

`http://www.math.brown.edu/~sjmiller`.

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.

1.2. **One Line Equations.** Here's how to do an equation. Once you type \begin { equation }, you've automatically entered math mode. Now if you type anything, say \Lambda or \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 \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 \letter (for example, \epsilon), while an integral is \int, a sum is \sum, and so on.

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

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

If you have a blank line between the text and the equation, it sometimes inserts space, and indents the next text as it is a new paragraph; if there is no blank line, it sometimes keeps them closer, and does not indent the following text.

For example, let us compare the following to the earlier examples (where we had blank lines). Thus we follow this text with
$$\frac{\Lambda'(s)}{\Lambda(s)} \ = \ s + \epsilon \int_a^b 3x^2 e^{2\pi i x} dx. \tag{1.3}$$
As there is no carriage return, this text is part of the same paragraph, and is thus not indented.

As long as we are discussing equations, let us consider the case when we have more involved expressions, for example, we might have
$$(\frac{\sin(x^2+3x)}{x} + \frac{4}{e^x})^2. \tag{1.4}$$
Note how the left and right parentheses are too short. There are two ways to fix this. One way is to use \Big (and \Big) (and Bigg if you need a bigger parentheses). A better way is to use \left (and \right); this automatically adjusts the size of the parentheses. Unlike the Big or Bigg commands, if you have a \left (you must match it with a \right). Thus
$$\left(\frac{\sin(x^2+3x)}{x} + \frac{4}{e^x}\right)^2. \tag{1.5}$$

1.3. **Labeling 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
$$\frac{\Lambda'(s)}{\Lambda(s)} = \epsilon \int_a^b 3x^2 e^{2\pi i x} dx. \tag{1.6}$$
The way we label an equation is, after the \begin { equation }, we write \label { label-name }.

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 \ref { eqname }; for example for the previous equation it would be 1.6; however, it's better to write Equation 1.6 or (1.6). The difference between \ref and \eqref is that \eqref automatically puts parentheses around the equation number.

Whenever you add equations, you have to compile Latex twice to get the references correct. The advantage of using equation labels is that, if we add additional equations before the equation we want to refer to, the equation number of our equation changes; by using labels these are automatically updated.

For example, consider the following.
$$g(x) = \int_0^\infty f(x,y)dy. \tag{1.7}$$
We can refer to this and say by (1.7) of §1.3 we have.... You can label equations (or sections, theorems and so on) any way you want, though it is nice to have a standard

method. I prefer to label equations by eq colon name, theorems by thm colon name, sections by sec colon name, sub-sections by subsec colon name, and so on.

1.4. **Multi-Line Equations: Eqnarray.**

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

$$\begin{aligned} \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x)g(s)+f(x-t)-g(s)f(x) \\ \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x-t). \qquad (1.8) \end{aligned}$$

Again, if I don't want to type begin eqnarray I can use the shortcut (that I defined above):

$$\begin{aligned} \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x)g(s)+f(x-t)-g(s)f(x) \\ \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x-t). \qquad (1.9) \end{aligned}$$

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 \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

$$\begin{aligned} \frac{\Lambda'(t)}{\Lambda(t+1)} &= f(x)g(s)+f(x-t)-g(s)f(x) \\ &= f(x-t). \qquad (1.10) \end{aligned}$$

Here's a somewhat lengthier example:

$$\begin{aligned} \frac{1}{m}\sum_p^{m^\sigma} p^{-\frac{1}{2}} &\le \frac{1}{m}(\sum_p^{m^\sigma}\frac{1}{p})^{\frac{1}{2}}(\sum_p^{m^\sigma}1)^{\frac{1}{2}} \\ &\le \frac{1}{m}(\log\log m^\sigma + A)^{\frac{1}{2}}(Li(x)+O(x^{\frac{1}{2}}\log x))^{\frac{1}{2}} \\ &\ll \frac{1}{m}(\log\log m)^{\frac{1}{2}}(\frac{2m^\sigma}{\log m})^{\frac{1}{2}} \\ &\ll m^{\frac{1}{2}\sigma-1}(\frac{\log\log m}{\log m})^{\frac{1}{2}}. \qquad (1.11) \end{aligned}$$

In the above, I have used a user defined command, \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.

Note several things look wrong in the above equation. The parentheses are wrong-sized, and the mathematical function Li (the logarithmic integral

$$Li(x) = \int_2^x \frac{dt}{\log t}, \tag{1.12}$$

which estimates the number of primes at most x) is italicized. To remove the italization we write inside math mode { \rm text not to be italicized }:

$$\begin{aligned} \frac{1}{m}\sum_p^{m^\sigma} p^{-\frac{1}{2}} &\leq \frac{1}{m}\left(\sum_p^{m^\sigma}\frac{1}{p}\right)^{\frac{1}{2}}\left(\sum_p^{m^\sigma}1\right)^{\frac{1}{2}} \\ &\leq \frac{1}{m}\left(\log\log m^\sigma + A\right)^{\frac{1}{2}}\left(\mathrm{Li}(x) + O\left(x^{\frac{1}{2}}\log x\right)\right)^{\frac{1}{2}} \\ &\ll \frac{1}{m}(\log\log m)^{\frac{1}{2}}\left(\frac{2m^\sigma}{\log m}\right)^{\frac{1}{2}} \\ &\ll m^{\frac{1}{2}\sigma-1}\left(\frac{\log\log m}{\log m}\right)^{\frac{1}{2}}. \end{aligned} \tag{1.13}$$

Finally, instead of eqnarray one often uses align:

$$\begin{aligned} f(x,y) &= (x+y)^3 \\ &= x^3 + 3x^2y + 3xy^2 + y^3. \end{aligned} \tag{1.14}$$

Note it spaces things slightly differently than eqnarray:

$$\begin{aligned} f(x,y) &= (x+y)^3 \\ &= x^3 + 3x^2y + 3xy^2 + y^3. \end{aligned} \tag{1.15}$$

If you want to use align and add additional spaces, one can do \space:

$$\begin{aligned} f(x,y) \ &= \ (x+y)^3 \\ &= \ x^3 + 3x^2y + 3xy^2 + y^3. \end{aligned} \tag{1.16}$$

1.5. **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. With the way our file is set up, we start a lemma with \begin { lem }, and end it with \end { lem }.

Lemma 1.1. *Let* $\hat{\phi}(\xi) = \int_0^\infty \phi(x)e^{2\pi i x}dx$. *Then* $\hat{\phi}_r(\xi) = \frac{1}{r}\hat{\phi}(\xi/r)$.

Proposition 1.2. *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

$$3x + 2y = 4z, \tag{1.17}$$

which completes the proof. □

Notice the proof environment above. We start with \begin { proof }, follow it with the proof (which can contain equations), and then end with \end proof. The nice thing is this automatically italicizes the word proof, and ends with a box (which stands for QED, that which was to be shown, the symbol often used to indicate the end of the proof). It is important that the end proof be on the same line as the last text, or there will be extra spacing.

Proof: Here we do it without using the proof environment. This follows immediately from the well known relation

$$3x + 2y = 4z, \tag{1.18}$$

which completes the proof. □

The following is a new lemma, and what is inside the [] gives the lemma a name.

Lemma 1.3 (Value of $\zeta(2)$)**.** *Let $\zeta(s)$ denote the Riemann Zeta Function. Then*

$$\zeta(2) = \frac{\pi^2}{6}. \tag{1.19}$$

You can label lemmas just like you would equations:

Theorem 1.4. *[The Implicit Equation] Let $x, y, z \in \mathbb{C}$. Then*

$$x^y + y^z + z^x = -1 \tag{1.20}$$

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

$$x^y + y^z + z^x = -1 \tag{1.21}$$

By Theorem 1.5, we see that the desired expression equals -1. Note that you often have to compile twice before the labels are correct.

Corollary 1.6. $x = y = z = 1$ *is not a solution to the Implicit Equation from Theorem 1.4.*

Corollary 1.7 (Bob's Observation)**.** $x = y = -1,\ z = 1$ *is a solution to the Implicit Equation from Theorem 1.4.*

Remark 1.8 (Seldon's Remark)**.** *Here is how you do a remark; notice that the remark is italicized.*

1.6. **Using Subsubsections.** If we wanted, we could put subsubsections in a section. Again, \section is section, \subsection is a subsection, \subsubsection is a subsubsection; you then put the name between braces.

1.6.1. *Pythagoras.* If a subsection is very long, we might want to have sub-subsections in the subsections. The commands are exactly what you think.

Lemma 1.9 (Lengths of Sides)**.** *The sum of the lengths of any two sides of a triangle are greater than the third length.*

1.6.2. *Garbage.* Here is another subsubsection.

Here is some more garbage text.
And here is some more.

Note the double \above forces a carriage return. More gobbledegook follows here, such as the quick brown fox and one bright day in the middle of the night.
If you start a paragraph with \noindent then there is no indentation.

1.6.3. *New Pages.* We are now going to force a new page. The next subsubsection will start on a new page. We do this by \newpage.

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

$$\pi(x) \;=\; \frac{x}{\log x} \;+\; O(x^{\alpha}) \tag{1.22}$$

In the next subsection we discuss tables. We add a slash newpage command below to start it on a new page.

Family	**Median $\widetilde{\mu}$**	**Mean μ**	**StDev σ_μ**	**log(conductor)**	**Number**
1: [0,1,1,1,T]	1.28	1.33	0.26	[3.93, 9.66]	7
2: [1,0,0,1,T]	1.39	1.40	0.29	[4.66, 9.94]	11
3: [1,0,0,2,T]	1.40	1.41	0.33	[5.37, 9.97]	11
4: [1,0,0,-1,T]	1.50	1.42	0.37	[4.70, 9.98]	20
5: [1,0,0,-2,T]	1.40	1.48	0.32	[4.95, 9.85]	11
6: [1,0,0,T,0]	1.35	1.37	0.30	[4.74, 9.97]	44
7: [1,0,1,-2,T]	1.25	1.34	0.42	[4.04, 9.46]	10
8: [1,0,2,1,T]	1.40	1.41	0.33	[5.37, 9.97]	11
9: [1,0,-1,1,T]	1.39	1.32	0.25	[7.45, 9.96]	9
10: [1,0,-2,1,T]	1.34	1.34	0.42	[3.26, 9.56]	9
11: [1,1,-2,1,T]	1.21	1.19	0.41	[5.73, 9.92]	6
12: [1,1,-3,1,T]	1.32	1.32	0.32	[5.04, 9.98]	11
13: [1,-2,0,T,0]	1.31	1.29	0.37	[4.73, 9.91]	39
14: [-1,1,-3,1,T]	1.45	1.45	0.31	[5.76, 9.92]	10
All Curves	1.35	1.36	0.33	[3.26, 9.98]	209
Distinct Curves	1.35	1.36	0.33	[3.26, 9.98]	196

TABLE 1. First normalized zero above the central point for 14 one-parameter families of elliptic curves of rank 0 over $\mathbb{Q}$ (smaller conductors)

1.7. **Tables.** We give an example of how to insert tables into a document. In Tables 1 and 2 we provide some information from investigations of families of elliptic curves. Note the structure of how we do a table. We start with a slash begin {table} (and end with a slash end {table}). We then have the center command (which is ended later). The next line is slash begin {tabular}, followed by combinations of vertical lines and the letters l, c, r. The letters stand for left, center and right, and refer to how the text in that column is justified. The | give vertical lines. Horizontal lines are inserted by the command slash hline. Note the different entries are surrounded by ampersand signs &, and the rows are ended with slash slash. If you want a table entry to be in math mode, simply surround it with dollar signs (see Table 2).

It is very important that you put the table label in the correct spot!. After the slash end tabular, you may insert a caption. This is done with the command: slash caption {, followed by all the captioning text you want, then ended with }. Immediately after the caption comes the label, which is of the form slash label {label name}. **AFTER you have added the label, then you end the centering, and then you end the table.**

Note the tables do not always appear where you want them to. You can try to force them to be in certain places, but the TeX program puts the tables around where you want, taking into account how much space is available on the pages. Note, for instance, that only this paragraph is between the two tables, but they appear on different pages.

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

Family	**Median**	**Mean**	**Std. Dev.**	**Number**
Rank 2 Curves, Families Rank 0 over $\mathbb{Q}$	1.926	1.936	0.388	701
Rank 2 Curves, Families Rank 2 over $\mathbb{Q}$	1.642	1.610	0.247	64

TABLE 2. First normalized zero above the central point. The first family is the 701 rank 2 curves from the 21 one-parameter families of rank 0 over $\mathbb{Q}$ from Table 3 with $\log(\text{cond}) \in [15, 16]$; the second family is the 64 rank 2 curves from the 21 one-parameter families of rank 2 over $\mathbb{Q}$ from Table 4 with $\log(\text{cond}) \in [15, 16]$.

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

$$A = \left(\begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 & 15 \\ 16 & 17 & 18 & 19 & 20 \\ 16 & 17 & 188 & 19 & 20 \\ 121 & 122 & 123 & 124 & 125 \end{array}\right) \tag{1.23}$$

Some important points to note: the \left and the \right draw the left and right parentheses around the matrix, automatically adjusting to the proper size. Then we have a \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,

$$A = \left(\begin{array}{rrrrr} 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 & 15 \\ 16 & 17 & 18 & 19 & 20 \\ 121 & 122 & 123 & 124 & 125 \end{array}\right) \tag{1.24}$$

Notice we use ampersand signs & between the various elements; this is similar to multi-line equations, where we used the ampersands to center things. We end each line with \\, which is a carriage return.

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

$$A = \left(\begin{array}{cc} a & b \\ c & d \end{array}\right) \tag{1.25}$$

or

$$B = \left(\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array}\right). \tag{1.26}$$

If you want determinants, you can do

$$\det(A) = \left|\begin{array}{cc} a & b \\ c & d \end{array}\right|, \quad \det(B) = \left|\begin{array}{ccc} a & b & c \\ d & e & f \\ g & h & i \end{array}\right|. \tag{1.27}$$

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

Second, a \followed by a space gives a space. Latex ignores (for the most part) spaces. In the above, the \space \space \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!

Here is one to do a two case argument:

$$\Lambda(n) = \begin{cases} \log p & \text{if } p \text{ is a prime power} \\ 0 & \text{otherwise.} \end{cases} \tag{1.28}$$

Here is a way to do a three case argument.

$$\mu(n) = \begin{cases} 1 & \text{if } n = 1 \\ (-1)^r & \text{if } n \text{ is the product of } r \text{ distinct primes} \\ 0 & \text{if } n \text{ is divisible by the square of a prime.} \end{cases} \tag{1.29}$$

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

$$x \ = \ \bigcup_{i=1}^{\infty} A_i \quad instead of \quad x \in \cup_{i=1}^{\infty} A_i. \tag{1.30}$$

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

$$x \ = \ \bigcup_{i=1}^{\infty} A_i \quad \text{instead of} \quad x \in \cup_{i=1}^{\infty} A_i. \tag{1.31}$$

Here it is with text instead of mbox.

$$x \ = \ \bigcup_{i=1}^{\infty} A_i \quad \text{instead of} \quad x \in \cup_{i=1}^{\infty} A_i. \tag{1.32}$$

Here it is using remove emphasis \rm:

$$x \ = \ \bigcup_{i=1}^{\infty} A_i \quad {\rm instead of} \quad x \in \cup_{i=1}^{\infty} A_i. \tag{1.33}$$

Note with the remove emphasis that we have lost the space between instead and of; to add it back we would need a \space.

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

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

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

2. Environments I

2.1. Shortcut Environments. To do an equation, recall we need \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: \be will be begin equation; \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

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

does it as an array of equations.

Other useful commands: \textbf } text you want in bold {: **this will put any text in bold**; \emph { text you want emphasized }: *this will emphasize or italicize text*; \underline { text to underline }: <u>this will underline</u>.

2.2. Enumeration, Itemizing, and General Latex and Linux Commands. We will use the shortcuts for the enumeration environment. First, the long form. We start with \begin { enumerate }. This starts the enumeration (ie, a list of items with each item numbered). Each item in the enumerated list starts with \item. To have sub-items we use \subitem; however, there are no bullet points or marks here; we can add a bullet with •. We end with \end { enumerate }.

(1) in whatever directory you want to latex, save the files template.tex, yl.eps.
    This will give you a tex template with the image yl.eps.
    • Not the $ \bullet $ gives a bullet point.
(2) The following commands work in many unix environments: 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 we wanted bullets, we just change enumerate to itemize. Here \subitem also does not give bullet points. Instead of using bullets we could use diamonds, \diamond.

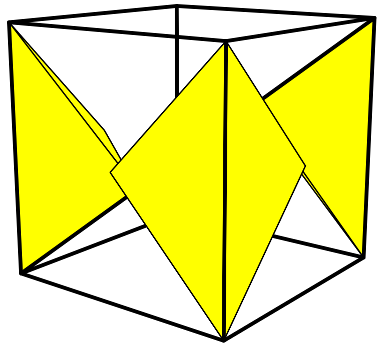

FIGURE 1. The infamously famous yl image.

- To open a file for editing using emacs, type emacs filename &; the ampersand opens the file in a new window.
  - ♣ Control-x-w saves without exiting;
  - ◇ Control-x-c saves with exiting.
- General: We list some general commands:
  - ◇ cd directory changes the directory,
  - ◇ ls lists all files and sub-directories in current directory.

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 \item.

Itemize is similar.

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

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. We display it in Figure 1

On some systems, 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.

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.

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.

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 (which is what is displayed in the bibliography), and one in curly braces (the shortcut name); I often have the two the same..

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

Thus, to refer to the book by Khinchin you should type \Kh: [Kh]. We can also refer to the appendices, such as see Appendix A or see §A.

4.5. Font sizes. We describe some different font sizes:

- This is huge.
- This is LARGE
- This is Large
- You guessed it.
- This is tiny.
- Back to normalsize.

Notice in the above how the bullet size changes; the reason is that we start off in normal size, but when we type \huge we enter huge mode; we are in huge mode until we type \LARGE, when we enter LARGE mode. Thus the bullet points are adjusted.

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.

5. DOCUMENT CLASS AND GLOBAL FORMATTING

First off, you can adjust the margins of your document. Below are the commands used in this document – by playing with the numbers you can obtain the margins you want. We have used the verbatim command (slash begin {verbatim}) so that the TeX program will not convert our commands (ie, so it will just display them).

```
\addtolength{\textwidth}{2cm} \addtolength{\hoffset}{-1cm}
\addtolength{\marginparwidth}{-1cm} \addtolength{\textheight}{2cm}
\addtolength{\voffset}{-1cm}
```

You can also make the document double spaced easily. For example, type

```
\baselinestretch}{2}
```

at the beginning of the document and your document will be double spaced. If you use a number between 1 and 2, you get something between single and double spaced.

We have used the document class amsart (AMS article) and a font size of 12: this is evidenced by the command (at the start of the file)

```
\documentclass[12pt,reqno]{amsart}
```

The reqno means right equation numbers.

We have also used (in the beginning)

```
\subjclass[2000]{ (primary),  (secondary).}

\keywords{How to use TeX}
```

This inserts the subject classification numbers and keywords. The subject classifications can be found online at

`http://www.ams.org/msc/`.

Finally, we remark that an article class of amsart is not the only choice: one can also use article, report, book, ... More on these can be found online.

6. FURTHER READING

There are numerous sources online for additional TeX help. See for example

`http://www.giss.nasa.gov/tools/latex/`

or

`http://www.stat.washington.edu/software/latex/`

or all the sites referenced at

`http://coulomb.ecn.purdue.edu/ bulsara/LaTeX/latex.html`

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

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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