EXAMPLE OF A LaTeX DOCUMENT

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1. Introduction

The goal of this document is to illustrates some of the ways to use LaTeX. For this, please compare the .tex source with the .pdf outcome. We recommend that you make a copy of this file and play with it, to see how the different options work.

2. Formulas and math symbols

Use single dollar signs for an equation embedded in text, such as when asserting that the circumference of a circle of radius r is $2\pi r$. Use double dollar signs for an un-numbered displayed equation:

$$1 + \ldots + n = \sum_{k=1}^{n} k.$$

We also have

$$\int_0^\infty re^{-r^2} dr = \frac{1}{2} e^{-r^2} \Big|_0^\infty ,$$

and

$$\prod_{\text{primes } p} \frac{1}{1 - \frac{1}{p^s}} = \sum_{\text{positive integers } n} \frac{1}{n^s}.$$

Inside a formula, use \text{prime} to write "prime" and not "$prime$". The latter is p times r times i times m times e.

LaTeX puts a slightly bigger space after a period, e.g. after the word "e.g."; use \ to force a regular-sized space, e.g. here.

Check the source to see how to skip a line or adjust spaces.

If your text contains the dollar sign, percent sign, or curly brackets, use backslash, e.g., in \$10, or \%10, or \{ here \}.

Use quotation marks "like here" and not "like here".

Here are some fonts. Blackboardbold: $\mathbb{N}$, $\mathbb{Q}$, $\mathbb{R}$, $\mathbb{C}$. Calligraphic: $\mathcal{A}$, $\mathcal{B}$, $\mathcal{C}$. Fraktur: $\mathfrak{f}$, $\mathfrak{g}$, $\mathfrak{h}$. Also see `cheeseorfont.com`.

Challenge: explain in what sense $(e^{t\frac{\partial}{\partial x}} f)(x) = f(x + t)$.

3. Labels, cross references, and citations

Use the \label command to put labels on sections, formulas, or theorem-like environments. You can later refer to these items using the \ref command. For example, check the LaTeX source of this file to see how we now refer to Theorem 1 in Section 4. *Warning*: For cross-references to come out right after a recent source changes, run the latex program twice.

To label equations or formulas, use the "equation" environment, such as here

$$a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0 \tag{3.1}$$

or here

$$\lim_{x\to\infty} f(x) = 1, \qquad \text{or} \qquad f(x) \xrightarrow[x\to\infty]{} 1. \tag{3.2}$$

See the LaTeX source of this file to see how we refer to Equation (3.1) with the round brackets.

In your essays, record every source. Within a collection, record the title and author in your bibliography item. Within a book, give the section or page number in the body of your text We can refer to Gardiner's article [1]. Or we can refer to Gardiner's article [2, pp. 955–966][1]. Or we can just refer to Gardiner's article, on pages 955–966 of The Princeton Companion to Mathematics [2]. And now we cite a journal paper [6].

For more advice on LaTeX we recommend the following sources: [3, 4, 5], or simply "google". Google is great! Try, e.g., to search "latex font size".

4. Theorem-like environments

In this section we present some theorem-like environments. We enumerate them consecutively ("Theorem 1, Example 2, Definition 3 ..."), to make it easier for the reader to navigate.

Theorem 1. *Consider a quadratic equation $ax^2 + bx + c = 0$, where $a, b, c \in \mathbb{R}$ and $a \neq 0$. The solutions to this equation are*

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

Proof. Because $a \neq 0$, we divide through by a and get

$$x^2 + \frac{b}{a}x + \frac{c}{a} = 0.$$

The solution to this equation are the same as those of the original equation. Completing the square, we re-write this equation as

$$\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2} + \frac{c}{a} = 0.$$

Adding $\dfrac{b^2 - 4ac}{4a^2}$ and taking square roots, we get

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

which yields the required formula. □

Example 2. One of the two solutions to the equation $x^2 - x - 1 = 0$ is the golden ratio, $x = \frac{1+\sqrt{5}}{2}$.

We recommend to *emphasize* or put in **boldface** any new term that is being defined or introduced, such as here:

Definition 3. A *square root* of α is a number whose square is equal to α.

[1] Notice how we cite references.

Remark. Theorem-like environments can also come without numbers.

5. Lists

A thumb-rule for writing:

(1) Tell the reader what you're going to say.
(2) Say it.
(3) Tell the reader what you just said.

Use

- "enumerate" for a numbered list;
- "itemize" for an un-numbered list;
  - you can indent lists,
  - such as here.

6. Cases; matrices

The *characteristic polynomial* of the 3×3 matrix

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

is $\lambda \mapsto \det(\lambda I - T)$. And the following text is produced with the "cases" environment:

$$|x| := \begin{cases} x & x \geq 0 \\ -x & x < 0 \end{cases}$$

Conclusion

We hope that you find this document helpful. If you have suggestions for improvement, please let us know.

References

[1] A. Gardiner, *The art of problem solving*, in: T. Gowers (Ed.), *The Princeton Companion to Mathematics*, Princeton University Press, 2008, pp. 955–966.

[2] T. Gowers (Ed.), *The Princeton Companion to Mathematics*, Princeton University Press, 2008.

[3] Leslie Lamport, *LaTeX: A Document Preparation System*. Addison Wesley, Massachusetts, 2nd Edition, 1994.

[4] Tobias Oetiker, Hubert Partl, Irene Hyna, and Elisabeth Schlegl, *The Not So Short Introduction to LaTeX2E*, `http://tobi.oetiker.ch/lshort/lshort.pdf`.

[5] Scott Pakin, *The Comprehensive LaTeX symbol list*, `http://www.ctan.org/tex-archive/info/symbols/comprehensive/symbols-a4.pdf`

[6] J. J. Price, *Learning Mathematics through Writing: Some Guidelines*, The College Mathematics Journal, vol. 20, No. 5 (1989), pp. 393–401.

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