

# MATH 112 Sample Project Template - University of Oregon

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May 2, 2014

## 1 Introduction

The rest of this document introduces some things that a MATH 112 student might need in my class for their projects. It is not mandatory that projects are typed, but I believe that in some disciplines, learning  $\text{\LaTeX}$  is a useful skill.

I started with the default template provided by writelatex.com and I edited it for my own needs. I kept only the basic skills needed for my class' project and added a few examples.

## 2 Some $\text{\LaTeX}$ Examples

### 2.1 How to Include Figures

First you have to upload the image file (.jpeg, .png, or .pdf) from your computer to writeLaTeX using the upload link the project menu. Then use the includegraphics command to include it in your document. Use the figure environment and the caption command to add a number and a caption to your figure. See the code for Figure 1 in this section for an example.



Figure 1: This frog was uploaded to writeLaTeX via the project menu.

### 2.2 How to Make Tables

Use the table and tabular commands for basic tables — see Table 1, for example.

Item	Quantity
Widgets	42
Gadgets	13

Table 1: An example table.

## 2.3 How to Write Mathematics

L<sup>A</sup>T<sub>E</sub>X is great at typesetting mathematics. This is one of its most useful features. The syntax used in the source document can be confusing at first but the output that it produces is quite beautiful.

In order to type math, one must use “math mode.” The simplest way to use math mode is to use the  $\$$  character in the input. Anything between two  $\$$  symbols will be typeset as inline-mathematics such as  $a^2 + b^2 = c^2$  or  $f(\theta) = 150 + 100 \sin(\theta)$ . Another way to use math mode is with  $\backslash[$  and  $\backslash]$ . Things that are between those will be typeset as displayed-mathematics, meaning that they will go on their own line. A few examples are demonstrated below.

Let  $f(x) = ax^2 + bx + c$  be any second-degree polynomial. Then the  $x$ -coordinates of the  $x$ -intercepts of  $y = f(x)$  are given by

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

There may be one, two, or zero such values of  $x$ .

In math mode, underscores are used for subscripts and carets are used for superscripts.

$$F_1 + F_2 = x^3$$

However, the default behavior is for the compiler to assume that the text of your superscripts and subscripts are only one character long. To fix this, put braces ( $\{$  and  $\}$ ) around your subscript. Look at the difference in the code used to produce  $x^2_4$  and  $x^{2_4}$ .

There are commands for all of the greek letters such as  $\theta$ ,  $\phi$ , and  $\alpha$ . However, you need to be in math mode to use them. Also, there are special commands for important functions. Typing  $\sin(x)$  is acceptable but it doesn't look very good and it is much better to use  $\sin(x)$ . Check the code to see the difference. Some examples are shown below:

$$\sin^2(\theta) + \cos^2(\theta) = 1$$

$$\tan(\theta) = \frac{b}{a}$$

$$\log(ab) = \log(a) + \log(b)$$

$$\ln(a/b) = \ln(a) - \ln(b)$$

$$\log_b(x^p) = p \log_b(x)$$

One often comes up with the need to write a string of equalities (or whatever) that are stacked vertically. This is done with the align environment as demonstrated here. If  $f(x) = x^2 + 2x - 3$  and  $g(x) = 6x - 5$  then

$$\begin{aligned} (f \circ g)(x) &= (6x - 5)^2 + 2(6x - 5) - 3 \\ &= 36x^2 - 60x + 25 + 12x - 10 - 4 \\ &= 36x^2 - 48x + 11. \end{aligned}$$

Compare that with

$$(f \circ g)(x) = (6x - 5)^2 + 2(6x - 5) - 3 = 36x^2 - 60x + 25 + 12x - 10 - 4 = 36x^2 - 48x + 11.$$

which is produced using very similar input.

## 2.4 How to Make Sections and Subsections

Use section and subsection commands to organize your document.  $\text{\LaTeX}$  handles all the formatting and numbering automatically. Use `ref` and `label` commands for cross-references. Indeed, this functionality is one of the nicest benefits of  $\text{\LaTeX}$ . You can move things around and the compiler will handle all of the numbering and labeling for you. The code shows some examples of creating, labelling, and referencing sections.

## 2.5 How to Make Lists

You can make lists with automatic numbering . . .

1. Like this,
2. and like this.
3. and you can make sub-lists if you want.
  - (a) item.
  - (b) another item.
  - (c) last one.

. . . or bullet points . . .

- Like this,
- and like this.

. . . or with words and descriptions . . .

**Word** Definition

**Concept** Explanation

**Idea** Text

## 2.6 How to Graph Functions

In short, don't do it. It's not that it's unreasonably difficult, it's just frustrating to learn.  $\text{\LaTeX}$  definitely has the capabilities to make very nice graphs and many other useful images. However, in the beginning, it's better not to get ahead of ourselves.

For now, one option is to create an image somewhere else, turn it into a usable image file, and use the `includegraphics` command to import it as a figure. Or, specifically with the projects in my class, if you are asked to sketch a graph then you are welcome to *sketch* it. If you want to leave space for sketch in the output, use the `vspace` command.

Yay vertical space!