



AALBORG UNIVERSITY

DENMARK

P1 PROJECT
MATHEMATICS-ECONOMICS

L^AT_EX Template

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Abstract:

This document serves as a L ^A T _E X project template for first year students at Aalborg University, Dept. of Mathematics.

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1 | First Example

This is an example chapter with content. Aside from `\chapter`, there are several levels available to use for partitioning your body text:

- `part`
- `chapter`
- `section`
- `subsection`
- `subsubsection`
- `paragraph`
- `subparagraph`

Each level is a subsection of the above level. Titles are added automatically to the table of contents. See more at https://en.wikibooks.org/wiki/LaTeX/Document_Structure#Sectioning_commands.

1.1 Environments

In \LaTeX , you are going to be using many different kinds of *environments*. These are scopes denoted with `\begin{...}` and `\end{...}`, enclosing special content such as lists, figures, equations, etc. Table 1.1 lists some commonly used environments.

Environment	Function
<code>document</code>	Document contents
<code>table</code>	Floating table such as this one
<code>figure</code>	Floating figure
<code>equation</code>	Numbered equation
<code>align</code>	Aligned, multiple equations
<code>itemize</code>	Bulleted list
<code>enumerate</code>	Numbered list
<code>description</code>	Descriptive list

Table 1.1: Common \LaTeX environments and their function

1.1.1 Lists

There are three essential list structures: `itemize`, `enumerate`, and `description`. The `itemize` variant produces a simple bullet list. Each item in the list are prepended by the `\item` command.

```
\begin{itemize}
  \item First item
  \item Second item
  \item Third item
\end{itemize}
```

- First item
- Second item
- Third item

The `enumerate` variant uses the same syntax for items as `itemize`, but produces a numbered list.

```
\begin{enumerate}
  \item First item
  \item Second item
  \item Third item
\end{enumerate}
```

1. First item
2. Second item
3. Third item

Finally, the `description` list in which `\item` is given an item name as an optional argument, and the contents of the line is a description of that item. This produces a list where the item names are typeset in bold followed by their descriptions as normal text.

```
\begin{description}
  \item[First item] Description of first item
  \item[Second item] Description of second item
  \item[Third item] Description of third item
\end{description}
```

First item Description of first item

Second item Description of second item

Third item Description of third item

1.1.2 Equations

One of the main reasons why people use \LaTeX is the beautiful math typesetting. There are several different math environments to suit your needs, and most come in a numbered and unnumbered variants. For example, the code

```
\begin{equation}
  \label{eq:1}
  e^{i\pi} - 1 = 0
\end{equation}
```

produces the output

$$e^{i\pi} + 1 = 0, \tag{1.1}$$

and since it was given a label, it can be referenced with the command `\eqref{eq:1}`, which produces a clickable reference in parentheses, (1.1). If instead of `equation` you put `equation*`, the equation does not get a number. Equivalently, you can use `\[...\]`, so the code `\[e^{i\pi} + 1 = 0 \]` produces

$$e^{i\pi} + 1 = 0.$$

If you need multiple, aligned equations, e.g. for step-by-step calculations, use the `align` environment, which aligns the contents at `&` characters. For example,

```
\begin{align*}
  (x + y)^2 &= x^2 + xy + yx + y^2 \\
            &= x^2 + y^2 + 2xy
\end{align*}
```

produces

$$\begin{aligned} (x + y)^2 &= x^2 + xy + yx + y^2 \\ &= x^2 + y^2 + 2xy. \end{aligned}$$

The double backslash denotes a line break. Note the asterisk; like with `equation`, `align` has both a numbered and unnumbered version. The numbered version has a separate number for each line.

For rendering inline math, e.g. $\cos^2 \theta + \sin^2 \theta = 1$, use `\(...\)`. Alternatively, you can also use `$...$`, but `\(...\)` has improved spacing and error messages.

See <https://en.wikibooks.org/wiki/LaTeX/Mathematics> for a good reference of symbols and commands.

1.1.3 Floats

Figures in \LaTeX are input as so-called *floats* using the `figure` environment. A floating object cannot be broken over a page, so the figure will be repositioned depending on the available space on the page. The syntax is as follows:

```
\begin{figure}[placement]
  \centering
  \includegraphics[options]{path/to/image}
  \caption{The figure caption}
  \label{fig:label}
\end{figure}
```

The optional argument `placement` can be either of `h` (here), `t` (top of page), `b` (bottom of page), or `p` (put on special page with only floats). The `\centering` command is there to center the image. Among the options available for `\includegraphics`, the most important one for you will probably be `width`. To make the image take up half the page (within margins), use `width=0.5\textwidth`. All figures should have a caption, which is set with the `\caption` command, and the `\label` lets us reference it (for example, `Figure \ref{fig:me}` becomes Figure 1.1).



Figure 1.1: A picture of me responding to emails from my students

For more info, see https://en.wikibooks.org/wiki/LaTeX/Floats,_Figures_and_Captions.

2 | Second Example

Here is another example, citing [Rosen, 2013] and [Edwards and Penney, 2014]. When you cite a resource, that resource is automatically added to the literature list, and in the PDF file the citations become clickable links pointing to that list.

2.1 Custom Environments and Commands

While \LaTeX provides commands for many different purposes, you will often find yourself defining your own. For this template, I have included some examples of custom environments and commands in the preamble (`preamble.tex`).

Such commands can save you a lot of typing when working on a long, modular document such as a semester project. For instance, instead of typing `\mathbb{N}` every time you want the symbol for the set of natural numbers, define a shorter command, like `\N`. The syntax for defining commands is as follows:

```
\newcommand{name}[num]{definition}
```

where `name` is the command name, e.g. `\N`, `num` is the number of arguments the command takes (omit the square brackets if the command takes no arguments), and `definition` is the output of the command, e.g. `\mathbb{N}`.

2.1.1 Definitions, Theorems, Proofs

In a mathematics project, you are going to be including mathematical definitions, propositions, lemmas, theorems, etc. The `amsthm` package provides a simple way to define such environments:

```
\newtheorem{name}{Printed output}[numberby]
```

A few examples are included in the preamble. See <https://en.wikibooks.org/wiki/LaTeX/Theorems> for more information.

Theorem 2.1 (Example of Theorem). $\sqrt{2}$ is irrational.

Proof. Suppose $\sqrt{2} \in \mathbb{Q}$ and let $k = \min\{N \in \mathbb{N} : N\sqrt{2} \in \mathbb{N}\}$. But then $k(\sqrt{2} - 1) = k\sqrt{2} - k \in \mathbb{N}$, and $k(\sqrt{2} - 1) < k$, which is a contradiction. Therefore, $\sqrt{2} \notin \mathbb{Q}$. \square

2.1.2 Source and Pseudocode

WIP...

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Bibliography

Edwards, C. H. and Penney, D. E. (2014). *Calculus: Early Transcendentals*. Pearson, 7 edition.

Rosen, K. H. (2013). *Discrete Mathematics and Its Applications*. McGraw-Hill, 7 edition.