

A Short Course in \LaTeX

Inseikai Tohoku Bootcamp, Tohoku University

Quang-Thanh Tran

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2.1 Learn \LaTeX or a Related Program

One of your first professional choices will be what typesetting software to use. I strongly endorse \LaTeX (or \TeX , or Scientific Word, whichever one you handle best). \LaTeX makes plain text look beautiful and, because it “understands” the structure of mathematical expressions, it has immeasurable benefits for the writing of proofs. Moreover, as it is

so widely used (in mathematics, it has truly become the typesetter’s \LaTeX), you will find it very convenient when collaborating with coauthors around the world.⁶

If you do not know how to use these software programs, ask one of your younger classmates to teach you. (Knowledge about computers goes from the young to the old.)

These programs will give you considerable freedom in developing your own style. When submitting a paper to a journal, however, respect its guidelines—and do not get carried away.⁷ To emphasize certain aspects of your paper, such as important terminology or, on a rare occasion, when explaining a critical fact or a central conclusion, you should certainly exploit typographical choices you have (such as italics). But if *everything IS emphasized, NOTHING IS!*

Also, use a spellchecker.

Figure: From Thomson’s *A Guide for the Young Economist*

Installing L^AT_EX

- What is L^AT_EX?
 - Text Editor for researchers.
 - Type in a source code – render a document in PDF.
- Why L^AT_EX?
 - It's **free**, light, indestructible.
 - It handles long documents well
 - It supports math & graphs (with **TikZ**), citations, cross-referencing.
- Install a distribution package
 - Windows: use **MikTeX**
 - Mac: use **MacTeX**. Homebrew: use `brew install -cask mactex`
- Install a TeX editor
 - **Texifier**: \$40 (perpetual), very fast, WYSIWYG, Grammarly-enabled
 - **TeXstudio**: free, okay fast, not WYSIWYW, PDF is navigatable.
 - **Obsidian** or **Vscode**: free, fast, handy if you want vanilla L^AT_EX.
 - **Overleaf**: free, online, not fast, support 2-author collaboration.

The Basics

Structures

• Preambles

- Define the document class and customized commands

```
\documentclass[11pt,a4paper]{article}
```

- Declare packages to use `\usepackage{amsmath}`

- Declare title, authors, etc. `\author{}`, `\title{}`

• Content

- Make title by typing `\maketitle`, ToC by `\tableofcontents`.

- Special characters such as `_`, `%`, `$` and commands start with `\`

- The whole content must be nested between `\begin{document}` and `\end{document}`. To make new page `\newpage`.

- Use `\section{<name>}`, `\subsection{<name>}`, `\subsubsection{<name>}` for automatic sectioning.

- use `%` to make comments. (which are not rendered)

• Bibliography

- "Author(year)" – use `\citet{}`, for "(Author,year)" – use `\citep{}`

- to print bibliography, use `\bibliography{file.bib}` at the end.

Math

• Basics

- inline: nested between `$ $` or `\[\]`, for example:
`$y_i = x^{-1}_i + a^2$` produces $y_i = x_i^{-1} + a^2$
- single: nested between `\begin{equation}` and `\end{equation}`
- alignable: nested between `\begin{align}` and `\end{align}`
- lines are separated by `\\`, aligned by putting `&` at the alignment.
- Putting a `*` at the commands `\begin{align*}` – `\end{align*}`, all maths will be unnumbered. Use `\nonumber` to turn it off individually.

• Syntax:

- fractions: `\frac{a}{b}` $\rightarrow \frac{a}{b}$
- superscript: `a^b` $\rightarrow a^b$, subscript: `a_b` $\rightarrow a_b$
- Greeks: `\gamma` $\rightarrow \gamma$, `\Gamma` $\rightarrow \Gamma$
- For more commands, check: [L^AT_EX Mathematical Symbols](#)

• Referencing

- to label an equation, use `\label{eq_foc}`
- to reference that equation, use `\eqref{eq_foc}`
- you can label sections or theorems and reference them with `\ref{sec}`

Figures

To add a figure

- Make sure the figure is in the same path as the .tex file.
- Use the following code

```
\begin{figure}[ht]
\centering
\includegraphics[scale=0.5]{figure.png}
\caption{A Figure of a Cat.}
\label{fig:cat}
\end{figure}
```
- Options:
`\includegraphics[width=0.5\textwidth,right]{figure}`
- Positioning: [h] *here*, [t] *top*, [b] *bottom*, [H] *here!* (need float)

Tables

Tables are extremely easy

```
\begin{table}[ht]
\centering
\begin{tabular}{ c | c | c } ◀ 3 columns, centered, with | between
\toprule
variable & value & meaning \\
\midrule
 $\alpha$  & 0.3 & capital share \\
r & 1.05 & interest rate \\
\bottomrule
\end{tabular} \caption{Regression result}
\label{tab:result}
\end{table}
```


Rendered: (I disabled the | between columns)

variable	value	meaning
α	0.3	capital share
r	1.05	interest rate

Table: Parameters

You can convert results in R, Stata, and Python to copy-paste in \LaTeX (just search it on Google)

Exercises

- Try it yourself by rendering the code uploaded [here](#) on your computer. You can find it at the boot camp's site
https://github.com/thanhqtran/tohoku_bootcamp/tree/main
 - Exercises: See <https://guides.nyu.edu/LaTeX/exercises>
 Today, do
 - Exercise 4: Creating Sections and Referencing Equation
 - Exercise 5: Creating Matrix Equations
- optional Exercise 6: Tables and Figures
- optional Exercise 7: Bibliography
- optional Additional Exercises: `\newcommand`
- For this class, I encourage you to type everything in \LaTeX after you finish solving with pen and paper.
 - You can use [this template](#), it has everything you need.

Notes

todonotes

- Put this in preamble: `\usepackage{todonotes}`
- To comment, type: `\todo{content}` after some words. This option will push the comment to the paper margin.
- You can change color or insert drop shadow
`\todo[color=green!40, shadow]{content}` or `noshadow`
- If you want an inline comment, type `\todo[inline, inlinewidth=5cm]{content}`
- To add author, add `\todo[author=John]{content}`
- Documentation: <https://ftp.kddilabs.jp/CTAN/macros/latex/contrib/todonotes/todonotes.pdf>

Example

todos.

caption

A very long and tedious note that cannot be on one line in the list of todos.

The `caption` option enables the user to specify a short description of the `todonote` that are inserted in the list of todos instead of the full `todonote` text.

```
\todo[caption={Short note}]{A very long and tedious note that cannot be on one line in the list of todos.}
```

The effect of this option is altered with the package option `prependcaption` or the `prepend` / `noprepend` option for the `todo` command.

prepend / noprepend

Short note with prepend:
A very long and tedious note that cannot be on one line in the list of todos.

A very long and tedious note that cannot be on one line in the list of todos.

The options `prepend` and `noprepend` can be used for setting whether a given caption should be prepended to the `todonote` or not. Globally this can be set using the `prependcaption` option for the package. Below is the effect of the option shown using the code:

```
\todo[prepend, caption={Short note with prepend}]{A very long and tedious note that cannot be on one line in the list of todos.}.
\todo[noprepend, caption={Short note with noprepend}]{A very long and tedious note that cannot be on one line in the list of todos.}.
```

The `fancyline` option inserts a curved arrow, pointing from the inserted note to the insertion point. The option is used like this:

fancyline

Testing.

```
\todo[fancyline]{Testing.}
```

author

Xavier

Testing author option.

The `author` option takes a parameter, the name of the author. The given name is inserted in the `todonote`.

```
Xavier: Testing author option.
```

```
\todo[author=Xavier]{Testing author option.}
\todo[author=Xavier, inline]{Testing author option.}
```

Plots

TikZ

You can plot directly or import data from an outside file to make plots!

- Preamble:

```
\usepackage{tikz}
\usepackage{tikzscale}
\usetikzlibrary{arrows,calc, automata, patterns,
positioning, shapes.geometric,
decorations.pathreplacing,decorations.markings}
```

- For more tikz plots related to economics, see:

<https://web.archive.org/web/20221023220457/https://sites.google.com/site/kochiuyu/Tikz>

- If you want to know why we prefer to plot directly (or export an image to .pdf or .svg), try to zoom in a vector image vs a normal image (raster). The raster images become blurred or pixelated, while the vector image does not lose any sharpness or quality.

pgfplot

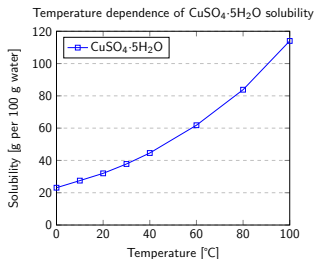
- Preamble:

```
\usepackage{pgfplots}
\usepackage{pgfplotstable}
\usepackage{filecontents}
```

- For guidance, see:

https://www.overleaf.com/learn/latex/Pgfplots_package

Example:

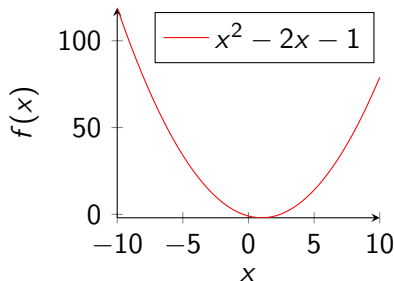


Example 1

```

\begin{tikzpicture}
\begin{axis}[
axis lines = left,
xlabel = x,
ylabel = f(x),
]
\addplot [
domain=-10:10,
samples=100,
color=red,
]
{ $ x^2 - 2*x - 1 $ };
\addlegendentry{ $ x^2 - 2x - 1 $ }
\end{axis}
\end{tikzpicture}

```

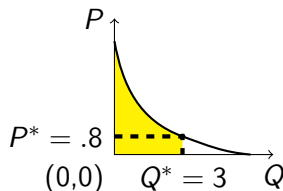


Example 2

```

\begin{tikzpicture}
\path [fill=yellow] (0,0) - (0,5) to
[out=-80, in=160
(3,.8) - (3,0) - (0,0);
\draw [<->] (0,6) node [left] { $ P $ } -
(0,0)
node [below left] {(0,0)} - (7,0) node
[below] { $ Q $ };
\draw [ultra thick, dashed] (0,.8) node
[left] { $ P^*=.8 $ } - (3,.8)
- (3,0) node [below] { $ Q^*=3 $ };
\draw [fill] (3,.8) circle [radius=.1];
\draw [thick] (0,5) to [out=-80, in=160]
(3,.8) to
[out=-20, in=175] (6,0);
\end{tikzpicture}

```



Slides

Syntax

- You document will be `\documentclass{beamer}`
- You can use various themes. `\usetheme{}`. This presentation uses CambridgeUS
- To create a new slide, use
`\begin{frame}`
`\frametitle{Title}`
content
`\end{frame}`
- To highlight important text
`\begin{block}`
content
`\end{block}`
you can use `alertblock` instead of `block`

Beamer example

The Copenhagen theme with a TikZ graphic logo
Demonstrating the Copenhagen theme

A. B. Arthur¹ J. Doe²

¹Faculty of Physics
Very Famous University

²Faculty of Chemistry
Very Famous University

Very Large Conference, April 2021

Highlighting text

In this slide, some important text will be **highlighted** because it's important. Please, don't abuse it.

Remark

Sample text

Important theorem

Sample text in red box

Examples

Sample text in green box. The title of the block is "Examples".

Arthur. Doe

About Beamer

Arthur. Doe

About Beamer

CV

Make professional CV

- Shopping for templates here
<https://www.latextemplates.com/cat/curricula-vitae>
- But for academics, consider this one
https://www.stat.berkeley.edu/~paciorek/computingTips/Latex_template_creating_CV_.html

Example

Christopher J. Paciorek

CONTACT INFORMATION	<p>Baker Hall 232 Department of Statistics Carnegie Mellon University Pittsburgh, PA 15213 USA</p>	<p>Voice: (412) 268-6276 Fax: (412) 268-7828 E-mail: paciorek@stat.cmu.edu WWW: www.stat.cmu.edu/~paciorek</p>
RESEARCH INTERESTS	Bayesian statistics, spatial statistics, nonparametric regression, statistical methods for large datasets, statistics for public policy	
EDUCATION	<p>Carnegie Mellon University, Pittsburgh, Pennsylvania USA</p> <p>Ph.D. Candidate, Statistics, December 2001 (expected graduation date: May 2003)</p> <ul style="list-style-type: none"> Dissertation Topic: "Nonstationary Covariance Models for Spatial Data and Regression Problems" Advisor: Mark J. Schervish <p>M.S., Statistics, May 2000</p> <p>Duke University, Durham, North Carolina USA</p> <p>M.S., Botany (Ecology), May, 1998</p> <p>Carleton College, Northfield, Minnesota USA</p> <p>B.A., Biology, May, 1993</p>	
HONORS AND AWARDS	<p>National Science Foundation Graduate Research Fellowship, 1996</p> <p>Carleton College: graduated Magna Cum Laude, Honors in Biology, Phi Beta Kappa, 1993</p>	
ACADEMIC EXPERIENCE	<p>Carnegie Mellon University, Pittsburgh, Pennsylvania USA</p> <p><i>Graduate Student</i> August, 1998 - present Includes current Ph.D. research, Ph.D. and Masters level coursework and research/consulting projects.</p> <p><i>Instructor</i> May - June, 2002 Co-taught graduate level course for the Master of Science in Computational Finance program. Shared responsibility for lectures, exams, homework assignments, and grades.</p> <ul style="list-style-type: none"> 46-731 Probability and Statistics, Summer 2002. 	

Figure: <https://www.stat.berkeley.edu/~paciorek/files/cv/paciorek-cv.pdf>

Host CV online

- 1 Make a Git account, then a public repo. `user/repo/`
- 2 Upload the CV in pdf format, say `cv.pdf` at branch `main`
- 3 Copy the permanent link to the file
`https://raw.githubusercontent.com/user/repo/main/cv.pdf`
- 4 Add google doc preview before the link
`https://docs.google.com/viewer?url=https://raw.githubusercontent.com/user/repo/main/cv.pdf`

Try: `https://docs.google.com/viewer?url=https://raw.githubusercontent.com/thanhqtran/tohoku_bootcamp/main/summer2023/math/summer_math.pdf`

Pandoc

Convert .tex to .docx

① Install pandoc: <https://pandoc.org/installing.html>

② Go to command center/ terminal and type

```
pandoc mydoc.tex -o mydoc.docx
```

③ To convert with citations

```
pandoc mydoc.tex -bibliography=myref.bib -o mydoc.docx
```

④ You can turn on cross-referencing

```
pandoc mydoc.tex -filter pandoc-crossref -bibliography=my
```