

# A Short Course in $\text{\LaTeX}$

Inseikai Tohoku Bootcamp, Tohoku University

Quang-Thanh Tran

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## Installing $\text{\LaTeX}$

- What is  $\text{\LaTeX}$ ?
  - Text Editor for researchers.
  - Type in a source code – render a document in PDF.
- Why  $\text{\LaTeX}$ ?
  - 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  $\text{\LaTeX}$ .
  - **Overleaf**: free, online, not fast, support 2-author collaboration.

## 2.1 Learn $\text{\LaTeX}$ or a Related Program

One of your first professional choices will be what typesetting software to use. I strongly endorse  $\text{\LaTeX}$  (or  $\text{\TeX}$ , or Scientific Word, whichever one you handle best).  $\text{\LaTeX}$  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  $\text{\LaTeX}$ ), you will find it very convenient when collaborating with coauthors around the world.<sup>6</sup>

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.<sup>7</sup> 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*

## 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<sup>A</sup>T<sub>E</sub>X 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}`

## 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}
```

## 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)

Rendered: (I disabled the | between columns)

variable	value	meaning
$\alpha$	0.3	capital share
r	1.05	interest rate

### Table: Parameters

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

## Exercises

- Try it yourself by rendering the code uploaded [here](https://github.com/thanhqtran/tohoku_bootcamp/tree/main) on your computer. You can find it at the boot camp's site [https://github.com/thanhqtran/tohoku\\_bootcamp/tree/main](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  $\text{\LaTeX}$  after you finish solving with pen and paper.
- You can use [this template](#), it has everything you need.

## Example

**caption** `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.}
```

**prepend / noprepnd**  
The effect of this option is altered with the package option `prependcaption` or the `prepend / noprepnd` option for the `todo` command.  
The options `prepend` and `noprepnd` 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[noprepnd, caption={Short note with noprepnd}]{A very long and tedious note that cannot be on one line in the list of todos.}
```

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

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

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

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

## 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>

## TikZ

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

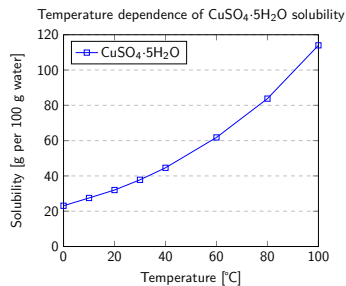
- Preamble:  

```
\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

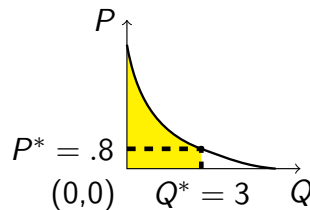
- Preamble:  
`\usepackage{pgfplots}`  
`\usepackage{pgfplotstable}`  
`\usepackage{filecontents}`
- For guidance, see:  
[https://www.overleaf.com/learn/latex/Pgfplots\\_package](https://www.overleaf.com/learn/latex/Pgfplots_package)

Example:



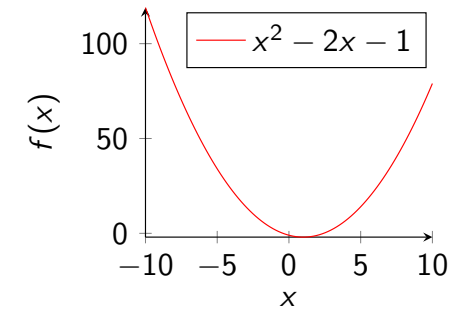
## Example 2

```
\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}
```



## Example 1

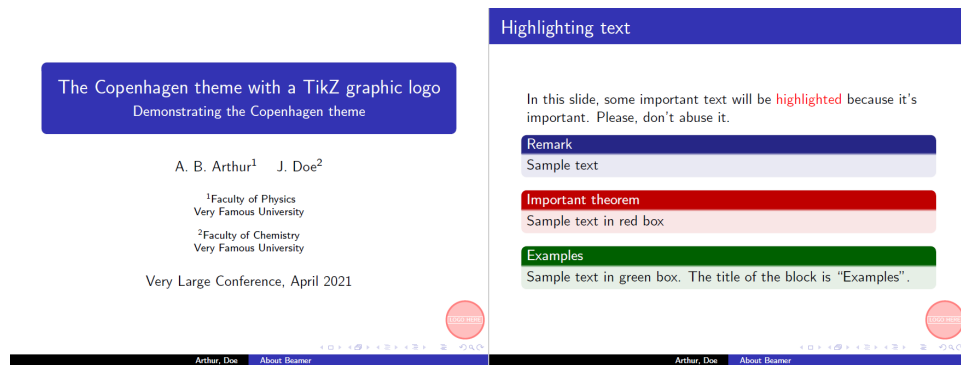
```
\begin{tikzpicture}
\begin{axis}[
axis lines = left,
xlabel = x,
ylabel = f(x),
]
\addplot [
domain=-10:10,
samples=100,
color=red,
]
{ $ x^2 - 2*x - 1 $ };
\addlegendentry{ $ x^2
- 2x - 1 $ }
\end{axis}
\end{tikzpicture}
```



## Syntax

- Your 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



## 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](https://www.stat.berkeley.edu/~paciorek/computingTips/Latex_template_creating_CV_.html)

Christopher J. Paciorek

Current: Duke Mail Stop, Durham, NC 27828-0805  
Department of Statistics, Box 1017, Durham, NC 27828-1017  
Email: cpaciorek@stat.duke.edu  
Website: www.stat.duke.edu/~paciorek

Previous: University of Wisconsin-Madison, Department of Statistics, 480 Lincoln Drive, Madison, WI 53706-1308

Education: Carnegie Mellon University, Pittsburgh, Pennsylvania USA  
Ph.D. Graduate, Statistics, December 2005 (dissertation: *Bayesian methods for large datasets*)

Research: Bayesian methods, spatial statistics, semiparametric regression, statistical methods for large datasets, machine learning

Employment: Carnegie Mellon University, Pittsburgh, Pennsylvania USA  
Postdoctoral Fellow, December 2005 – September 2006 (supported by National Science Foundation Grant DMS-0531139)

• *Bayesian Methods for Large Datasets* (with David Blei, John D. Lafferty, and Michael I. Jordan)  
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Duke University, Durham, North Carolina USA  
M.S. Thesis, May 2006  
Carnegie Mellon University, Pittsburgh, Pennsylvania USA  
M.S. Thesis, May 2005

Research: National Science Foundation Graduate Research Fellowship, 2006  
Carnegie Mellon University, Pittsburgh, Pennsylvania USA  
Graduate Student, September 2003 – December 2005 (supported by National Science Foundation Grant DMS-0531139)

Employment: Carnegie Mellon University, Pittsburgh, Pennsylvania USA  
August, 1999 – present  
Graduate Student, September 2003 – December 2005 (supported by National Science Foundation Grant DMS-0531139)

Research: Carnegie Mellon University, Pittsburgh, Pennsylvania USA  
August, 1999 – present  
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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](https://docs.google.com/viewer?url=https://raw.githubusercontent.com/thanhqtran/tohoku_bootcamp/main/summer2023/math/summer_math.pdf)

## 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=myref.bib -o mydoc.docx`