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 LaTeN), 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 spellchequer.

Figure: From Thomson's A Guide for the Young Economist

Installing LaTeX

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

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: LaTeX 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

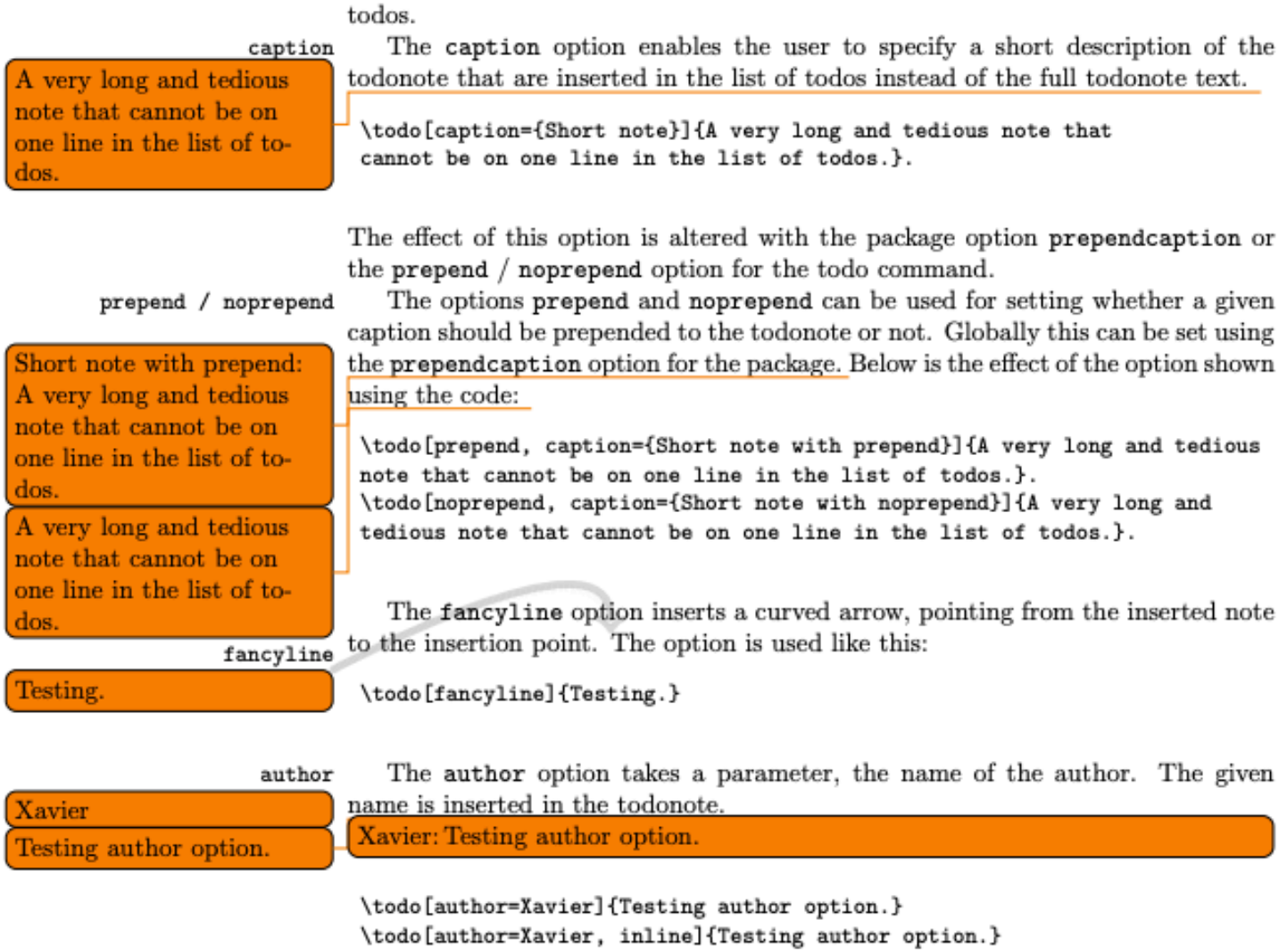
optional Exercise 6: Tables and Figures
optional Exercise 7: Bibliography
optional Additional Exercises: `\newcommand`

- 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.

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.}.
```

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

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.}.
```

`fancyline`

Testing.

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`

Xavier

Testing author option.

Xavier: Testing author option.

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.}
```

TikZ

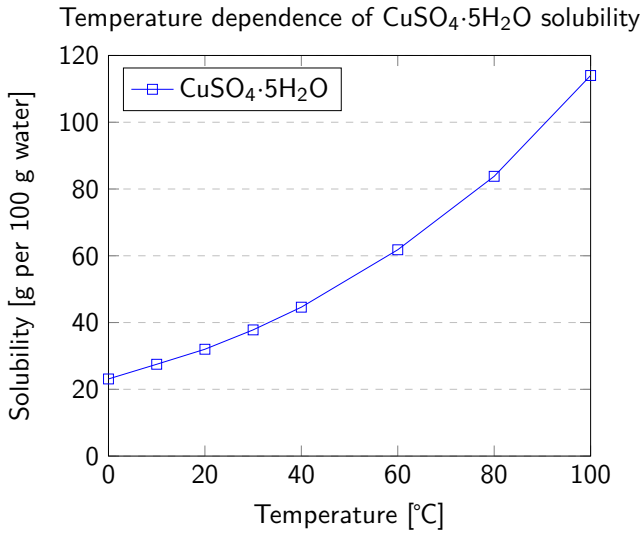
You can plot directly or import data from an outside file to make plots!

- 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

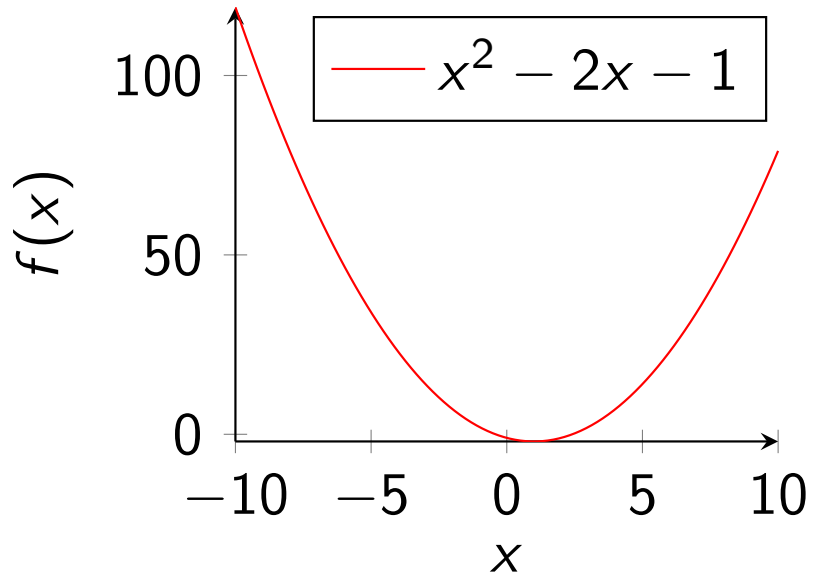
- Preamble:
  ```
  \usepackage{pgfplots}
  \usepackage{pgfplotstable}
  \usepackage{filecontents}
  ```
- For guidance, see:
  https://www.overleaf.com/learn/latex/Pgfplots_package

Example:



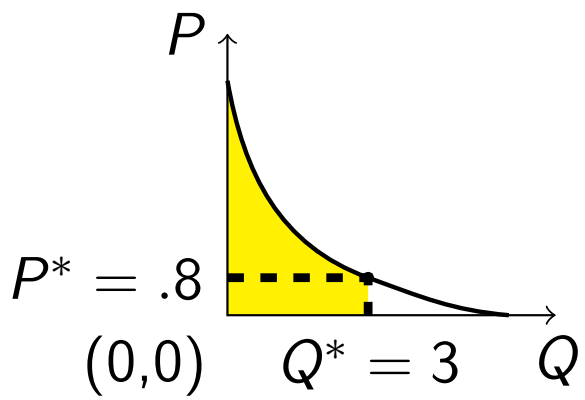
Example 1

```
\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}
```



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. Arthur[1] J. Doe[2]

[1]Faculty of Physics
Very Famous University

[2]Faculty 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

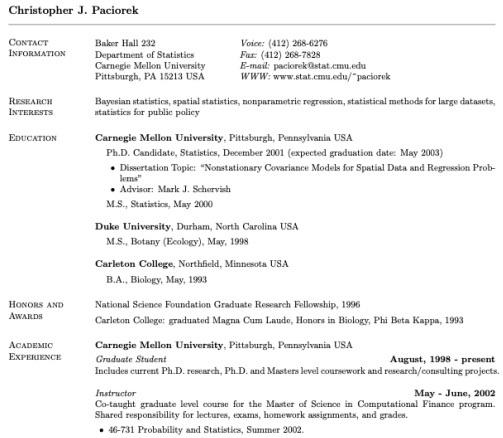
Sample text in red box

Examples

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

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



Christopher J. Paciorek

CONTACT INFORMATION

Baker Hall 232
Department of Statistics
Carnegie Mellon University
Pittsburgh, PA 15213 USA

Voice: (412) 268-6276
Fax: (412) 268-7828
E-mail: paciorek@stat.cmu.edu
WWW: www.stat.cmu.edu/~paciorek

RESEARCH INTERESTS

Bayesian statistics, spatial statistics, nonparametric regression, statistical methods for large datasets, statistics for public policy

EDUCATION

Carnegie Mellon University, Pittsburgh, Pennsylvania USA
Ph.D. Candidate, Statistics, December 2001 (expected graduation date: May 2003)
- Dissertation Topic: "Nonstationary Covariance Models for Spatial Data and Regression Problems"
- Advisor: Mark J. Schervish

M.S., Statistics, May 2000

Duke University, Durham, North Carolina USA
M.S., Botany (Ecology), May, 1998

Carleton College, Northfield, Minnesota USA
B.A., Biology, May, 1993

HONORS AND AWARDS

National Science Foundation Graduate Research Fellowship, 1996
Carleton College: graduated Magna Cum Laude, Honors in Biology, Phi Beta Kappa, 1993

ACADEMIC EXPERIENCE

Carnegie Mellon University, Pittsburgh, Pennsylvania USA
Graduate Student **August, 1998 - present**
Includes current Ph.D. research, Ph.D. and Masters level coursework and research/consulting projects.

Instructor **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.
- 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`

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
   ```