

Introduction to L^AT_EX

BIOST 561

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¹Borrowing heavily from Katie Wilson and Ken Rice

First things first...

Is it **Lah-Tech** or **Lay-Tech** ?

What is L^AT_EX?

- “A document preparation system for high-quality typesetting”
- It is *not* a word processor like Microsoft Word

Why use L^AT_EX?

- Formatting is clean, uniform, professional
- Math formulas look great and they're easy to include
- Good for large documents (e.g., dissertations, textbooks)
- Handles citations easily

Why not use L^AT_EX?

- Have to remember lots of commands
- Need to compile before you can see the document
- Making comments, tracking edits not as straightforward
- Some applied journals prefer Word

How to get L^AT_EX

Everything you need is on Box.

But, for your own computers:

- Get a T_EX distribution
- Get a T_EX editor (my favorite is texmaker)
- Or, compile using the department servers

Basic Structure

1. Specify type (“class”) of document: `article`, `beamer`
2. (Optional preamble)
3. Begin document
4. (Insert your text here)
5. End document

An example....

Example 1:

```
\documentclass{article}  
\begin{document}  
This is a sentence.  
\end{document}
```

Compiling

1. Save your code as `filename.tex`
2. Compile
 - Open in T_EX editor, “Build” / “Typeset”
 - Use department servers: `pdflatex filename.tex`
 - Errors displayed on console and in `.log` file
3. Open `.pdf` (other files created, but you can ignore)

Example 2:

```
\documentclass{article}
%Start of preamble
\title{Example Document}
\author{Kelsey] %there is an error here
\date{November 2, 2017}
%End of preamble
\begin{document}
\maketitle
This is a sentence.
\end{document}
```

L^AT_EX Commands

- Start with a backslash, usually contain letters only
- End with a space, number, or non-letter
- Required parameters (if applicable) specified within { } after command
- Optional parameters (if applicable) specified within [] after command

Example: `\maketitle`

Text Commands

- `\underline`: underline
- `\textit`: *italicize*
- `\textbf`: **bold**
- `\texttt`: typewriter
- `\\`: line break
- `\:` add a space
- `\LaTeX`: writes \LaTeX
- `\clearpage`: inserts page break at current position
- `\par`: start new paragraph
- `\today`: today's date November 2, 2017

Font Size

tiny scriptsize footnotesize small normalsize large **Large**

LARGE huge Huge

Special Characters

Symbols with special meaning in \LaTeX :

\$ % ^ & _ { } ~ \

Need to put backslash in front of them:

\# \\$ \% \^ \& _ \{ \} \~ \textbackslash

Math Symbols

Many built in commands:

- `\beta`: β
- `\hat{p}`: \hat{p}
- `\sum_{i=1}^n`: $\sum_{i=1}^n$
- `\sim`: \sim
- `\approx`: \approx

Typing Math

- Inline: $\hat{\beta} = (\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{y}$

- `\(...\)`
- `$... $`

- Display mode:

$$\hat{\beta} = (\mathbf{X}^T \mathbf{X})^{-1} \mathbf{X}^T \mathbf{y}$$

- `$$... $$`
- `\[... \]`
- `equation`, `eqnarray`, `align` environments
- Comparison here²

²<https://tex.stackexchange.com/questions/40492/what-are-the-differences-between-align-equation-and-displaymath>

```

\begin{align}
E(\hat{\beta})
&= E \left[ (X^{\top} X)^{-1} X^{\top} y \right] \\
&= (X^{\top} X)^{-1} X^{\top} E \left[ y \right] \\
&= (X^{\top} X)^{-1} X^{\top} X \beta \\
&= \beta
\end{align}

```

$$E(\hat{\beta}) = E \left[(X^{\top} X)^{-1} X^{\top} y \right] \quad (1)$$

$$= (X^{\top} X)^{-1} X^{\top} E[y] \quad (2)$$

$$= (X^{\top} X)^{-1} X^{\top} X \beta$$

$$= \beta \quad (3)$$


```

\[\left( \begin{array}{cc}
a & b \\
d & e \\
\end{array} \right) \]

```

$$\left(\begin{array}{cc} a & b \\ d & e \end{array} \right)$$

```

\[\begin{bmatrix}
a & b \\
d & e \\
\end{bmatrix}
\]

```

$$\begin{bmatrix} a & b \\ d & e \end{bmatrix}$$

```

\[ I(x<10) = \left\{ \begin{array}{l}
1 & \text{\mbox{if } $x < 10$}; \\
0 & \text{\mbox{if } $x \geq 10$}. \end{array} \right. \]

```

$$I(x < 10) = \begin{cases} 1 & \text{if } x < 10; \\ 0 & \text{if } x \geq 10. \end{cases}$$



L^AT_EX Environments

- Helpful for formatting entire blocks of text
- Start with `\begin` statement
- End with `\end` statement
- Examples:
 - `array`, `bmatrix`, `align`
 - `itemize`, `enumerate` (bulleted, numbered lists)
 - `table`, `figure`

Tables

- tabular environment
- Specify column alignment (`\left`, `\center`, `\right`)
- Separate columns with `&`, separate rows with `\\`
- Vertical lines with `|`, horizontal lines with `\hline`
- The R packages `xtable` and function `kable` in the `knitr` package can sometimes help

Tables

```
Console //fs2-vip-nfs.nfs.biost.priv/students/grindek/Documents/  
> data(cars)
> (small.cars <- head(cars))
  speed dist
1     4    2
2     4   10
3     7    4
4     7   22
5     8   16
6     9   10
> library(knitr)
warning message:
package 'knitr' was built under R version 3.4.2
> kable(small.cars,format='latex')

\begin{tabular}{r|r}
\hline
speed & dist\\
\hline
4 & 2\\
\hline
4 & 10\\
\hline
7 & 4\\
\hline
7 & 22\\
\hline
8 & 16\\
\hline
9 & 10\\
\hline
\end{tabular}
> |
```

Tables

```
\begin{tabular}{|r|cccr|}\hline&&&\multicolumn{3}{c|}{Survival at 10 years} \\&Total & Events & \% & \multicolumn{2}{c|}{95\% CI} \\ \hlineGroup 1 & 12 & 11 & 90.9 & 75.4 & 100.0 \\Group 2 & 11 & 7 & 66.7 & 44.7 & 99.5 \\ \hline\end{tabular}
```

	Survival at 10 years				
	Total	Events	%	95% CI	
Group 1	12	11	90.9	75.4	100.0
Group 2	11	7	66.7	44.7	99.5

Figures

- Use the `graphicx` package
- Lets you include pdf, png, jpeg, gif
- Include captions with `\caption`
- Label for easy referencing with `\label`
- Cannot be broken over pages (tables, too), so considered to be a “float”
 - If it doesn't fit on current page, will be “floated” to a later one
 - Some control over this (e.g., `[h]` = here, `[t]` = top, `[h!]` = ignore other parameters that might prevent float from being placed here)

Figures

```
\includegraphics[width=0.5\linewidth]{RooHalloween}  
\includegraphics[scale=0.3, angle=90]{RooPuppy}
```




```
My dog was a ‘‘hot" dog for Halloween  
(see Figure \ref{puppy})  
\begin{figure}[h!]  
\centering  
\includegraphics[height=0.3\textheight]{RooHalloween}  
\caption{Adorable puppy dressed as sriracha bottle.}  
\label{puppy}  
\end{figure}
```

My dog was a “hot” dog for Halloween (see Figure 1)



Figure: Adorable puppy dressed as sriracha bottle.

Macros

- Define your own commands instead of typing the same thing over and over again
- Specify in preamble
- Or, store in another file (`preamble.tex`) and load this in with `\include{preamble.tex}`

Example: `\newcommand{\R}{\mathbb{R}}` will produce \mathbb{R} by writing `\R` rather than `\mathbb{R}`

BibT_EX

- Citation tool
- Keep one file with information about all sources (mybib.bib)
- Easy to reference any source in that file, in whatever style is needed (e.g., APA)
- To get information for mybib.bib file: Google Scholar > Cite > BibT_EX

My mybib.bib file contains the following entry:

```
@article{mckeague2015adaptive,  
  title={An adaptive resampling test for detecting the  
  author={McKeague, Ian W and Qian, Min},  
  journal={Journal of the American Statistical Association},  
  volume={110},  
  number={512},  
  pages={1422--1433},  
  year={2015},  
  publisher={Taylor \& Francis}  
}
```

Let's look at an example where we cite this article two different ways:

```
\documentclass{article}
\usepackage{natbib}
\begin{document}
I thought \cite{mckeague2015adaptive} was very
interesting. In fact, it was so interesting that I'm going
to cite it two different ways \citep{mckeague2015adaptive}.
\bibliographystyle{plainnat}
\bibliography{mybib}
\end{document}
```

Beamer

- For making slides like these!
- It's a document class: `\documentclass{beamer}`
- There are many different themes
 - I'm using the default
 - Others here
- Take a look at my slides (and corresponding .tex file) for example

Miscellaneous

- You can define your own class
 - `\documentclass{myclass.cls}`
 - Or, use someone else's class file. I did this for my CV (you can find resume class files online)
 - There's one for UW dissertations: `uwthesis.cls`
- You can use \LaTeX to make posters
- Need help? Ask Google.
- You can do nearly all of this in R Markdown