LaTeX Document Preparation

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Objectives

- Basics of document preparation
  - Create a document!
  - Explore document layout
  - Create an equation
  - Insert a figure & a table
  - BibTex and references
  - Explore formatting and basic markup tools
- Merging LaTeX with R
  - Basic example
  - Figure and table control
  - Code chunk options
- Beamer for presentations

What is LaTeX?

LAH-TEK or *LAY-TEK*

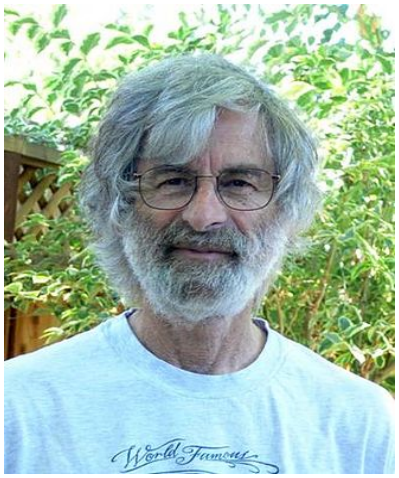
A typesetting and cross-referencing program for document preparation, presentations, and complex graphics.

Typesetting: the art and process of the design and printing of text. Typesetting consists largely of the following:

- fitting text and illustrations to a desired page extent
- place text and illustrations effectively and appropriately
- ensure the layout is uniform and predictable
- produce a final document ready for print.

To achieve these objectives some considerations include (but are not limited to): font selection; paragraph and character styles; and spacing between characters, lines, and objects.

History of LaTeX



TeX system developed by Donald Knuth (late 1970s). TeX came from the capital letters τ, ϵ, and χ; tex is derived from Greek meaning skill, art, technique.

LaTeX, developed by Leslie Lamport in the 1980s, incorporates TeX with built in macros for easy of use.

Why use LaTeX?
Pros and Cons

Pros

1. State of the art typesetting
2. Templates often offered by journals, conferences, etc. for formatting ease
3. Complete control over the document
4. Automation & cross-referencing
5. Ease and aesthetics of mathematical equations
6. Bibliography compilation and citations
7. "Large and active user-base with help forums; Free"

Cons

1. Difficult to learn (relative to other programs)
2. Not a WSIWG wordprocessor (e.g., Word)
3. Difficult when sharing/editing with co-authors

Why use LaTeX?

$$\gamma_{Y_t,Y_{t-k}} = \begin{cases} t^2\sigma_e^2 & k = 0 \\ 0 & k \geq 1 \end{cases}$$

In this example we see that the expected value is free of t, but the variance varies with t, and the covariance varies with t when k=0 (because the variance varies with t). As a result, this process is not stationary.

(b)
$W_t = \nabla Y_t = (\theta_0 + te_t) - (\theta_0 + (t-1)e_{t-1})$

$E(W_t) = \theta_0 - \theta_0 = 0$; because e_t is a white noise process with an expected value of 0.

$var(W_t) = var(\theta_0 + te_t) - (\theta_0 + (t-1)e_{t-1}) = var(te_t - (t-1)e_{t-1})$

$= t^2 var(e_t) + (t-1)^2 var(e_{t-1}) - 2(t^2 - t))cov(e_t, e_{t-1})$

$= t^2\sigma_e^2 + (t^2 - 2t + 1)\sigma_e^2 - (2t^2 - 2t) * 0$

$= \sigma_e^2(2t^2 - 2t + 1)$

Variance is therefore, not free of t.

$$cov(W_t, W_{t-1}) = cov(\theta_0 + te_t - \theta_0 + (t-1)e_{t-1}, \theta_0 + (t-k)e_{t-k} - \theta_0 + (t-k-1)e_{t-k-1})$$

$$= cov(te_t - (t-1)e_{t-1}, (t-k)e_{t-k} - (t-k-1)e_{t-k-1})$$

$$= cov(te_t, (t-k)e_{t-k}) - cov(te_t, (t-k-1)e_{t-k-1}) - cov((t-1)e_{t-1},$$

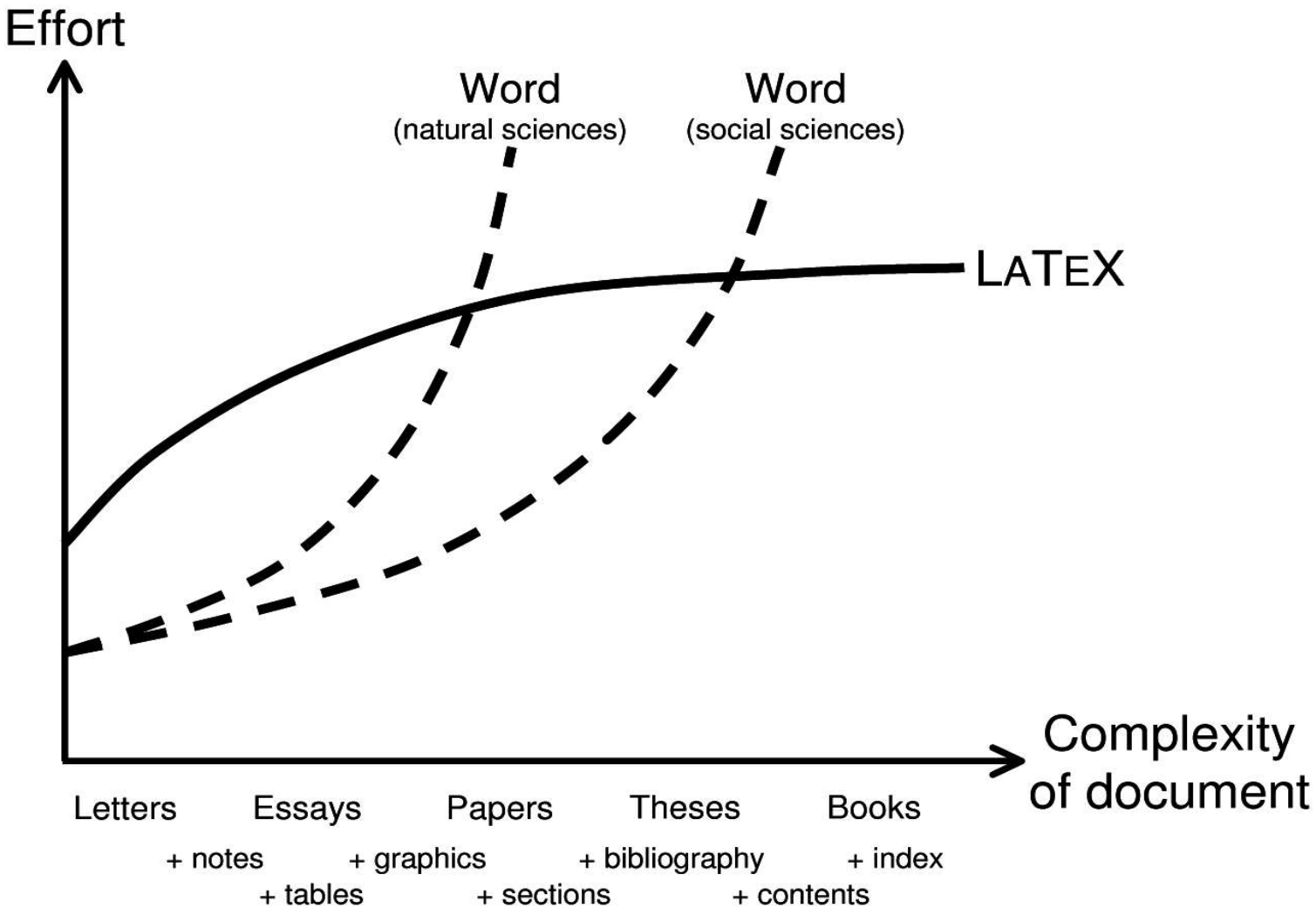
$$(t-k)e_{t-k}) + cov((t-1)e_{t-1}, (t-k-1)e_{t-k-1})$$

$$= t(t-k)cov(e_t, e_{t-k}) - t(t-k-1)cov(e_t, e_{t-k-1}) - (t-1)(t-k)cov(e_{t-1}, e_{t-k})$$

$$+(t-1)(t-k-1)cov(e_{t-1}, e_{t-k-1})$$

$$\gamma_{W_t} = \begin{cases} \sigma_e^2(2t^2 - 2t + 1) & k = 0 \\ -\sigma_e^2(t^2 - t) & k = 1 \\ 0 & k>1 \end{cases}$$

Why use LaTeX?



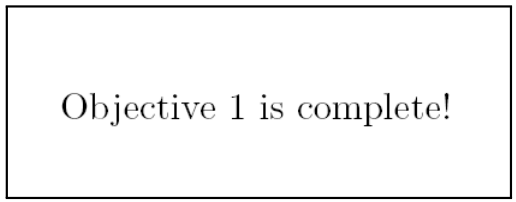
What is LaTeX?

Markup language - converts source text, combined with the markup, into a lovely document (similar to how web pages work).

```
% Create a document!
\documentclass{article}
\begin{document}

Objective 1 is complete!

\end{document}
```



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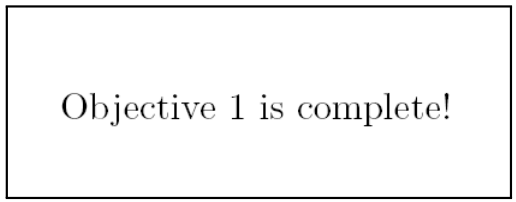


Exercise: Create a simple document.


LATEX
YOUR PAPER MAKES NO GODDAMN SENSE, BUT IT'S THE MOST BEAUTIFUL THING I HAVE EVER LAID EYES ON.

Getting Started

LaTeX is a markup language and document preparation system.

What is markup?

Commands to style and format the document.

New commands can be created and stored in libraries for reuse (similar to R).

Plain text is wrapped within commands, but can be written simply as plain text.

Getting Started

The basic parts of a document: Preamble and/or top matter and the body of the document.

```
\documentclass{article}

\begin{document}
Some text
\end{document}
```

Getting Started

Document classes:

- **article:** for scientific articles, short reports, program documentation (the general class for docs)
- **proc:** for proceedings based on the article class
- **report:** for longer reports containing several chapters, thesis, etc.
- **book:** for books
- **slides:** presentation slides - uses big sans serif letters
- **memoir:**
- **letter:** for letters
- **beamer:** for presentations

Getting Started

Document class options: \documentclass[ ]{article}

- font size
- paper size
- alignment and numbering placement of equations (e.g., left or right aligned)
- column structure
- to have a standalone title page
- landscape or portrait

\documentclass[12pt, letterpaper, landscape]{article}

Preamble

Many options! Some basics:

- specify margins \usepackage[ ]{geometry}
- have document double spaced:
  \usepackage{setspace}
  \doublespacing
- create title info:
  \author{}
  \title{}
  \date{}
- load packages for use throughout document:
  \usepackage[ ]{amsmath, amsfont, color, float, titlesec, ...}

Document layout and settings

\begin{document}

Titles, Chapters, Sections, etc.

- \maketitle
- \part{...}
- \chapter{...}
- \section{...}
- \subsection*{...}

\end{document}

Section formatting

Some section formatting that I commonly use \usepackage{titlesec}:

\titleformat{the command}{styling of header text}{label}{spacing before}{spacing after}

\titleformat{\textbackslash section}{\normalfont\bfseries}{}{0pt}{}
\titleformat{\subsection}{\normalfont\bfseries\itshape}{}{0pt}{}
\titleformat{\subsubsection}{\normalfont \itshape}{}{0pt}{}

Document layout and settings

Preamble	**Body**
\documentclass[11pt, fceqn]{article}	\maketitle
\usepackage[left=2cm,...]{geometry}	\section{...}
\title{...} \author{...}	\subsection{...}

Exercise: Customize a document with above settings.

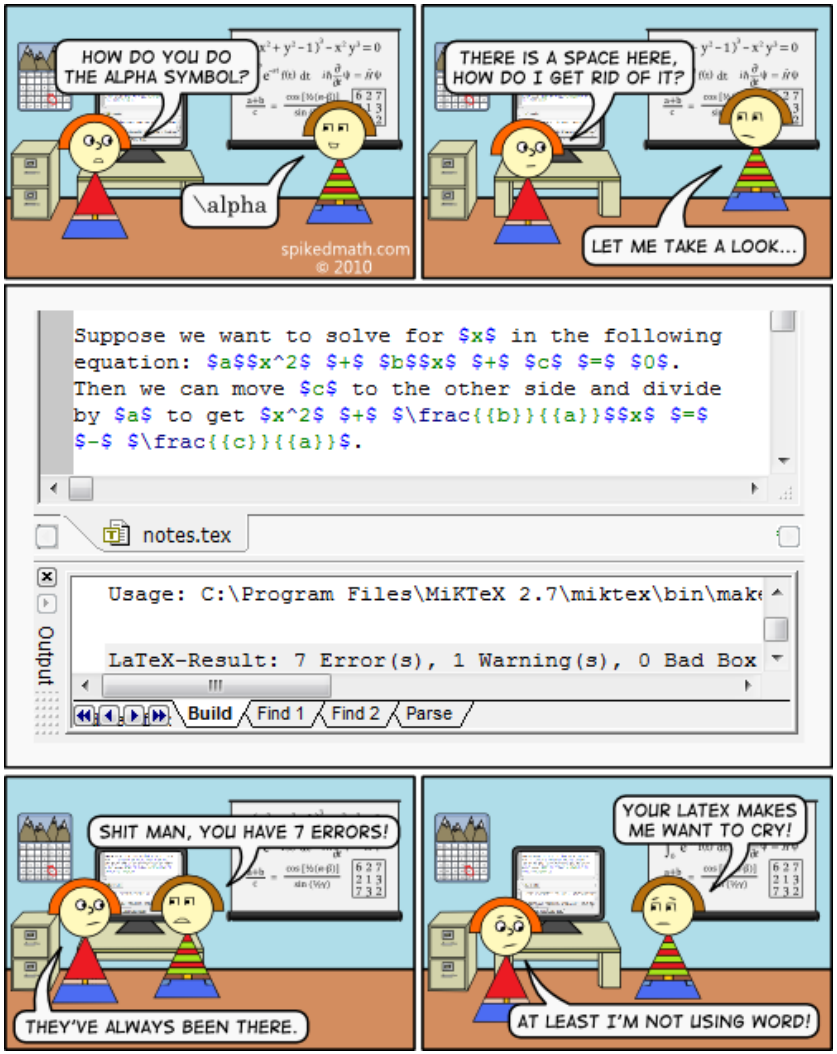
Characters, symbols, and spacing

Special characters: # $ % ^ & _ { } ~ \
These can all be used if preceded by a \ (e.g., \# or \{ \})

Symbols: command for just about any symbol, all begin with \followed by the command name (e.g., $\cup$ \cup, $^\circ$ ^ {circ}, $\triangledown$ \triangledown, etc.)

Spaces: \\ is a carriage return, \hspace{1cm}, \vspace{2in}, \indent, skipped line indicates a new ¶, $\sim$ \\is a forced carriage return , \clearpage starts at the top of a new page

Characters, symbols, and spacing



Equations and Math Mode

Equations

$$CI = \bar{x} \pm z_{\alpha/2} * \left(\frac{s}{\sqrt{n}}\right) = 0.6 \pm 1.65 * \left(\frac{0.230}{\sqrt{14}}\right) = \textbf{[0.4 - 0.8]} \quad (1)$$

```
\begin{equation}

CI = \bar{x} \pm
z_{\alpha/2}*\biggl(\dfrac{s}{\sqrt{n}}\biggr) = 0.6 \pm 1.65
* \biggl(\dfrac{0.230}{\sqrt{14}}\biggr) = \textbf{[0.4 - 0.8]}

\end{equation}
```

Equations and Math Mode

Math mode

$$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i + \epsilon_i$$

```
\[ \hat{Y_{i}} = \hat{\beta_{0}} + \hat{\beta_{1}} X{1} \]
```

Note: no numbering of equations

Equations and Math Mode

Exercise: Create the following equations using the equation markup for one and general math mode for the other, inside the document you've already created.

$$N\beta_0 = \sum_{i=1}^{N} y_i - \beta_1 \sum_{i=1}^{N} x_i \tag{2}$$

$$var(\bar{Y}) = \frac{\gamma_0}{n}[1 + 2\sum_{k=1}^{n-1}(1 - \frac{k}{n})\rho_k]$$

Tables & Figures

- Tables & Figures are automatically numbered in LaTeX
- Tables can be exported directly from R into LaTeX, or created within the document itself
- Figures are imported from a file path name
- If the source file is updated, it is automatically updated in the document when compiled
- Both tables and figures can be 'labeled' to be cross-referenced in the document

Table and Figure environment

```
\usepackage{graphix, float}
```

Tables and figures are created in the *floating* environment for ease of placement. Pagebreaks aren't allowed within this environment - so LaTeX decides where the image is best suited. You can suppress this, however.

Placements: **[t]**: top; **[b]**: bottom; **[p]**: put on a separate page without text, only with other figures, tables, and floats; **[h]**: put the float approximately at the current position; **[H]** put the float at the current position

Tables - LaTeXcreation

```
\begin{table}[H] \begin{center} \begin{tabular}{c| l| r}
Centered & Left & Right \\
\hline
A & B & C \\
\hline
1 & 2 & 3
\hline
\end{tabular} \end{center} \end{table}
```

Centered	Left	Right
A	B	C
1	2	3

Tables - merging cells

Rank	Fixed Effects				Random Effects	
	Y	M	V	T	Trip	Day
1	x	x	x	x	3038.5	0
2	x	x	x	x	3038.7	0.2
3	x	x	x	x	3041.1	2.6
4	x	x	x	x	3044.0	5.5
5	x	x	x	x	3048.5	10
6	x	x	x	x	3052.2	13.7
7	x	x	x	x	3053.1	14.6
8	x	x	x	x	3061.4	22.9

Table: Some table caption.

Tables - merging cells

This can be done using the \multicolumn command.

\multicolumn{number of columns to merge}{alignment and vertical bars}{Label/Text}

For examples, instead of just separating your column values with an &, you specify the following

\textbf{Rank} & \multicolumn{4}{c}{ \textbf{Fixed Effects}} & \multicolumn{2}{c}{ \textbf{Random Effects}}\\

NOTE: the number of columns must add up to the number defined for your table. In this example, 7 are specified. The line following this command will revert back to the table defaults.

Tables - merging cells

Exercise: Refer back to the table we previously made. Try to merge the header row into one single cell, with a new label.

Merged cells		
A	B	C
1	2	3

Tables - Export from R

In R:

```
library(xtable)

tab=xtable(tab1, caption= 'Correlation matrix', align=c('c',| 'c',|
'c',), digits=3)

print(tab,file="MyTexFile.tex",append=T,table.placement = "H",
caption.placement="top",hline.after=seq(from=-1, to=nrow(tab),
by=1), include.rownames=F)
```

Tables - Export from R

Exercise: Attempt to create a table in R, and export into the document you are working on.

Simple R table creation:

df <- data.frame("Year"=seq(2010,2017), "Site"=LETTERS[1:8], "Value"=rnorm(8,5,2))

Figures - Importing

```
\begin{figure}[H]

\includegraphics[width=8cm, height=6cm]{Barplot.pdf}

\caption{A barplot ...}
\label{fig:barplot}
\end{figure}
```

Figures

Exercise: Insert one or more figures into your document.

```
\begin{figure}[H]
\includegraphics[width=8cm, height=6cm]{Barplot.pdf}
\caption{A barplot . . . }
\label{fig:barplot}
\end{figure}
```

Aligning multiple figures

Controlling placement - can be done when creating figures (e.g., in R) or aligning them in LaTeX. **Columns** are one way to do it in LaTeX.

```
\begin{columns}
\begin{column}{.5\textwidth}
\includegraphics[width=3cm, height=3.5cm]{FigA.png}
\end{column}
\begin{column}{.5\textwidth}
\includegraphics[width=3cm, height=3.5cm]{FigB.png}
\end{column}
\end{columns}
```

Multiple figures

```
\begin{figure}[H]
\flushleft
\subfloat{}
{\includegraphics[width=.3\textwidth, height=5cm]{FigA.png}}
\subfloat{}
{\includegraphics[width=.3\textwidth, height=5cm]{FigB.png}}
\subfloat{}
{\includegraphics[width=.3\textwidth, height=5cm]{FigC.png}}
\subfloat{}
{\includegraphics[width=.3\textwidth, height=5cm]{FigD.png}}
\subfloat{}
{\includegraphics[width=.3\textwidth, height=5cm]{FigE.png}}
\subfloat{}
{\includegraphics[width=.3\textwidth, height=5cm]{FigF.png}}
\caption{A series of plots.}
\label{fig:series}
\end{figure}
```

Tables & Figures

Referencing tables and figures within the text

```
\begin{figure}[H]

\includegraphics[width=8cm, height=6cm]{Barplot.pdf}

\caption{A barplot . . . }
\label{fig:barplot}
\end{figure}

The results of this study are shown in Figure \ref{fig:barplot}.
```

What appears is:

The results of this study are shown in Figure 1.

Cross-referencing

Exercise: Reference a table and figure in your document within the text, using cross-referencing.

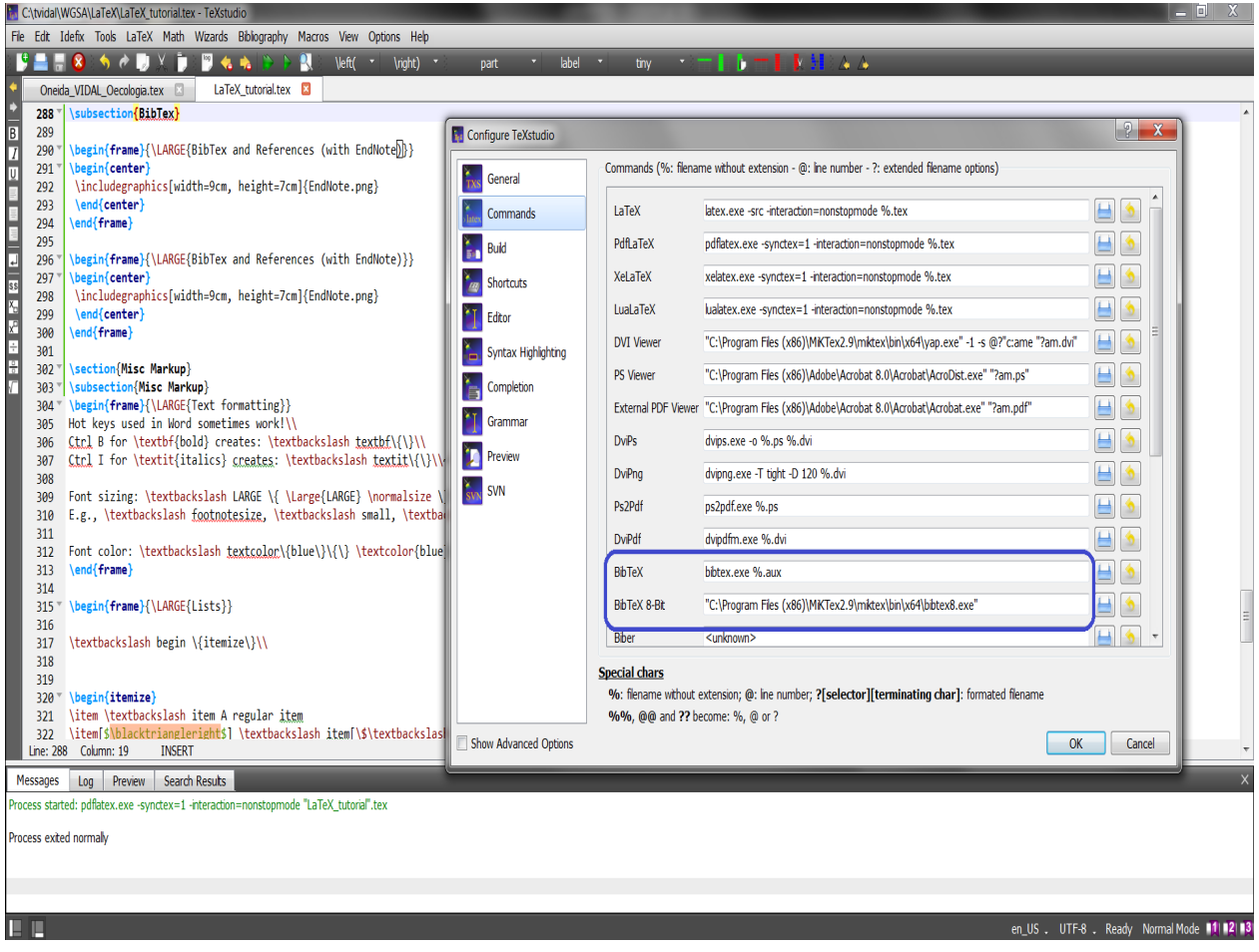
Objectives

- Create a document! ✓
- Explore document layout ✓
- Create an equation ✓
- Insert a figure & a table ✓
- BibTex and References
- Explore formatting and basic markup tools
- Sweave
- Beamer

BibTex and References

- Maintain a list of references (text editor or Mendeley?)
- Export references as .BibTex format (i.e., .bib file)
- Configure LaTeX for BibTex (should be a one time thing)
- Cite references in .tex file using label (from .bib file)
- Reference .bib in LaTeX file

BibTex and References



BibTex and References

. . . Identification of reliable indicators (i.e., quantifiable metrics responsive to change) of ecosystem dynamics as they relate to the state space \citep{walker_2004} is an important area of research because the transition to a new basin of attraction may represent a unidirectional shift into an alternate, long-term stable state, a condition commonly referred to as a regime shift \citep{may_1977, lluch_belda_1989, scheffer_2001, kuehn_2011, drake_2013}.

\bibliographystyle{ecology}
\bibliography{oneida}

BibTex and References

There are different reference packages. I use natbib most often. Below are some customizations allowed with that package. You might want to explore some other packages, depending on your preferences.

```
\documentclass[article]
\usepackage[round]{natbib}

\begin{document}

...
\bibliographystyle{apalike}
\bibliography{References}
\end{document}
```

BibTex and References

Some options:

\usepackage[square,numbers]natbib
\usepackage[super]natbib
\usepackage[curly,numbers, super]natbib

\bibliographystyle{plain}
\bibliographystyle{unsrt}

Inline citations

some text \cite{maunder2004standardizing}. = some text Maunder (2004).
some text \citep{maunder2004standardizing}. = some text (Maunder, 2004).
some text \citealp{maunder2004standardizing}. = some text Maunder, 2004.
some text \citealt{maunder2004standardizing}. = some text Maunder 2004.
some text \citeauthor{maunder2004standardizing}. = some text Maunder.
some text \citeyear{maunder2004standardizing}. = some text 2004.

Text formatting

Hot keys used in Word sometimes work!
Ctrl B for **bold** creates: \textbf{}
Ctrl I for *italics* creates: \textit{}

Font sizing: \LARGE { LARGE }
E.g., \footnotesize, \small, \normalsize, \Large, \Huge

Font color: \textcolor{blue}{} Blue Text

Lists

\begin {itemize}

- \item A regular item
- \item[$\blacktriangleright$] A fancy item

\end {itemize}

\begin {enumerate}

1. \item One item
2. \item Two items

\end {enumerate}

Misc Markup

Exercise: Create lists, and nested lists with special text formatting.

\begin {itemize}

- \item A regular item
- \item[$\blacktriangleright$] A fancy item

\end {itemize}

Font sizing: \LARGE { LARGE }
E.g., \footnotesize, \small, \normalsize, \Large, \Huge

Font color: \textcolor{blue}{} Blue Text

Packages & Google

- Just like R, there are many tools for LaTeXthat can be found in specific packages.
- Usually I find this out from Google searches
- But, it *usually* doesn't hurt to include several packages in a template
- Errors can sometimes be cryptic...
- You can create new commands - similar to creating functions in R \newcommand{ . . . }
- Some packages I frequently use: \usepackage{amsmath, amssymb, amsfonts, cite, amsthm, mathtools, color, float, lineno, subfig, enumitem, verbatim, framed, textcmds, libertine}

References

Some potentially useful references:

All things LaTeX: http://en.wikibooks.org/wiki/LaTeX

Document class options:
http://www.nada.kth.se/~carsten/latex/class.html

Symbols:
http://www.andy-roberts.net/res/writing/latex/symbols.pdf

knitr/Sweave

knitr

Elegant, flexible and fast dynamic report generation with R

Beamer

```
\documentclass[xcolor=dvipsnames]{beamer}

\usetheme{Singapore}
\usepackage{color, graphicx, tikz, verbatim}

\title{\Huge{\textbf{\LaTeX\\ Document Preparation}}}
\author{\textbf{\large{Tiffany Cunningham}}}
\date{\today}

\begin{document}

\begin{frame}
\titlepage
%end{frame}
```

Beamer customization

There are several standard themes that you can easily call to modify the appearance of your presentations. Here are a few:

`http://deic.uab.es/~iblanes/beamer_gallery/`

Some themes:

- Bergen
- boxes
- Dresden
- Malmoe

Some color themes:

- albatross
- crane
- lily

Beamer customization

```
\usetheme{Singapore}
\usecolortheme{lily}

# Or define your own color scheme
%\usecolortheme[RGB={194,91,91}]{structure}

# Remove navigation symbols
\setbeamertemplate{navigation symbols}{}
```

Beamer customization

There is really endless customization you can do. If you like animation... you might be stuck with PowerPoint, otherwise, this might offer a nice alternative.

Can also make posters... I'll leave it here. The basics are pretty straightforward. Google will help you with the rest.


THE END IS NEAR
THIS WILL NEVER END
YOUR OPTIMISM DISGUSTS ME.
©HILARY B. PRICE 11-13-2016
rhymeswithorange.com
Dist. by King Features