# LaTeX Workshop

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# Plan for the Workshop

1. Introduction. →
2. Why bother learning LaTeX? →
3. Challenges and downsides. →
4. Basic structure of a LaTeX document and compiling. →
5. Bibliographies. →
6. Article-style document: Formatting, figures, tables, bibliographies, equations (accompanying template).

# Introduction

# What is LaTeX?

LaTeX is a typesetting language that allows you to produce publication-ready documents.

# Goal for this Workshop

Give you a jump start into working with LaTeX.

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- Good template.
- Basic idea of the structure of LaTeX documents.

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## Key to learning LaTeX

- Good template.
- Basic idea of the structure of LaTeX documents.
- Google should be your bff.
- Willingness to suffer a bit in the beginning.

# Friendly Warning

If your dissertation is due in 2 weeks, do not start typesetting it in LaTeX now!

# Why bother learning LaTeX

# Just a few reasons why you should be using LaTeX

- Free, open source.

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- Free, open source.
- Beautiful typesetting.
- Inserting and updating tables/figures from `R` or Stata.
- Inserting/updating bibliographies.
- Math typesetting and formal presentation (game trees, diagrams).

# LaTeX—The quiz!

# The Quiz: LaTeX or Word?

The positioning of a specific armed non-state actor along the two dimensions might vary considerably across space and time. For example, certain cartels in Mexico might have a higher capacity and willingness to bend the rules of the game and project control into their areas of influence than others. Therefore, it should be noted that this theoretical approach is action-based and tied to a spatio-temporal unit, as opposed to specific actor identities. It is the nature of the predominant security challenge that a government faces in a specific spatio-temporal unit, rather than the identity of the violent non-state actor, that is thought to influence its welfare spending. Suppose for example, that rebel group $g$ has some territorial control at time $t$ in the subnational area $i_1$, but not in area $i_2$. Therefore, I expect to see group $g$ conducting guerrilla-style attacks in area $i_1$ and terrorist-style attacks in area $i_2$, both at time $t$. Consequently, in the next period $t + 1$, we should see higher levels of subnational welfare spending in area $i_1$ than in area $i_2$, even though the governments of both areas face the same opponent $g$.

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## INTRODUCTORY STATISTICS LECTURE

*Segment on Hypothesis Testing*

- Segment: three 50 minute class sessions (like IR 211 class).
- Segment after the midterm, i.e. second third of the class, when students are familiar with basic concepts such as sample, population, standard error, t-test, p-values, etc.
- Learning objective:
  - What is hypothesis testing and why is relevant?
  - How does it help us to understand statistical relationships?
  - How is it done (focus on one sample and two sample tests)?
  - What are some of the fallacies with regard to hypothesis testing?
- I assume that most students are PoliSci or IR majors.
- All mathematical examples for practicing hypothesis tests in class will be presented as cases that are either directly relevant to political science or IR, or present interesting real-world scenarios.

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# The Quiz: LaTeX or Word?

| | *Dependent Variable:* | | | | |
|---|---|---|---|---|---|
| | Naval Tonnage Index | | | | |
| | (1) | (2) | (3) | (4) | (5) |
| *Naval Tonnage Index*$_{i,t-1}$ | | 0.971*** | 0.970*** | 0.970*** | 0.971*** |
| | | (0.004) | (0.004) | (0.004) | (0.004) |
| *Competition*$_{i,t-1}$ | 2.247*** | 0.146*** | 0.126*** | 0.120*** | 0.147*** |
| | (0.077) | (0.020) | (0.024) | (0.024) | (0.019) |
| *Democracy*$_{i,t-1}$ | | | -0.002* | -0.002** | |
| | | | (0.001) | (0.001) | |
| *GDP*$_{i,t-1}$ | | | | 1.597*** | 1.617*** |
| | | | | (0.268) | (0.260) |
| Observations | 4,226 | 4,226 | 4,051 | 4,051 | 4,226 |
| $R^2$ | 0.169 | 0.955 | 0.956 | 0.956 | 0.956 |
| *Note:* | | | | | *p<0.1; **p<0.05; ***p<0.01 |

Figure: Markowitz, J. and C. Fariss: Power, Proximity, and Democracy: Geopolitical Competition in the International System. In *Journal of Peace Research* (Forthcoming).

# The Quiz: LaTeX or Word?

| | Welfare spending | | | Military spending | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Dummy 25 battle deaths (low) | −0.077 | | | 0.195*** | |
| | (0.298) | | | (0.075) | |
| Dummy 1000 battle deaths (low) | | −0.472 | | | |
| | | (0.389) | | | |
| Insurgency | | | −0.769* | | 0.215** |
| | | | (0.424) | | (0.105) |
| ln GDP p.c. | −0.831*** | −0.827*** | −0.905*** | 0.684*** | 0.689*** |
| | (0.296) | (0.296) | (0.299) | (0.217) | (0.220) |
| Democracy dummy | 2.191*** | 2.169*** | 2.171*** | −0.364** | −0.375** |
| | (0.375) | (0.377) | (0.376) | (0.154) | (0.154) |
| GDP Growth | −0.007 | −0.008 | −0.009 | 0.001 | 0.0003 |
| | (0.007) | (0.007) | (0.007) | (0.002) | (0.002) |
| N | 3,902 | 3,902 | 3,902 | 3,784 | 3,784 |
| Adjusted $R^2$ | 0.041 | 0.042 | 0.043 | 0.062 | 0.061 |

*p < .1; **p < .05; ***p < .01. Two-way linear fixed effects with heteroskedasticity and serial correlation consistent covariance estimates are computed using the `plm` function in `R`.

Figure: Anders, T. *The Relationship Between Violent Conflict and Welfare Spending Revisited* (unpublished manuscript).

# WYSIWYG and WYSIWYM

**what-you-see-is-what-you-get (WYSIWYG)**

Content = presentation. Example: Word.

**what-you-see-is-what-you-mean (WYSIWYM)**

Content $\neq$ presentation. Example: LaTeX.

# Example for Separation of Content and Presentation

If your dissertation is due in 2 weeks, <u>do not</u> start typesetting it in LaTeX now!

```
\begin{center}
If your dissertation is due in 2 weeks,
{\Huge\underline{do not}} start typesetting it in {\LaTeX} now!
\end{center}
```

# Pros and Cons: Separation of Content and Presentation

## Pros

- Reproducibility.
- Stability.
- Unambiguous.
- Once set up, no need to worry about formatting. In fact, you should focus on content over form. LaTeX will do the rest the form for you. $\Longrightarrow$ Templates!

## Cons

- No/few "buttons" to press—need to learn commands.
- Steep learning curve. Can be time intensive.

# Working Directory (WD)

- The WD is a specified path (think folder) on your machine.
- The program will look for and store all data in the WD.
- Unless otherwise specified, LaTeX will use the folder where the main .tex file is stored as WD.
- Store all auxiliary data (graphs, tables, etc.) in the WD.

# Adding graphs to LaTeX files.

```
\begin{figure}[h!]
\begin{center}
\includegraphics[width = 2in]{latex_comic.jpg}
\caption{Source \url{http://bit.ly/25VwZaG}.}
\label{comic_fig}
\end{center}
\end{figure}
```

# Integration of tables is one of the main perks!

- `R` packages such as `stargazer` or `xtable` will output beautifully formatted (regression) tables as a .tex file.
- `estout` package for Stata.
- Save the .tex file directly to you WD, then import the file into your LaTeX document.

# \input{} command

The following table (stargazer output) is imported by the following line:

```
\input{tab_simple.tex}
```

Disclaimer: In reality, to import the table into the beamer class, I use a wrapper:

```
\resizebox{\linewidth}{!}{\input{tab_simple.tex}}.
```

# This is what the stargazer looks like

```
% Table created by stargazer v.5.1 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harvard.edu
% Date and time: Wed, Apr 13, 2016 - 12:31:07
\begin{tabular}{@{\extracolsep{5pt}}lcccc}
\\[-1.8ex]\hline
\hline \\[-1.8ex]
 & \multicolumn{4}{c}{\textit{Dependent variable:}} \\
\cline{2-5}
\\[-1.8ex] & \multicolumn{3}{c}{internet} & life\_exp \\
\\[-1.8ex] & (1) & (2) & (3) & (4)\\
\hline \\[-1.8ex]
 polity & 0.255$^{***}$ & 0.084$^{***}$ &  &  \\
  & (0.023) & (0.020) &  &  \\
  &  &  &  &  \\
 pop &  &  & 0.000 &  \\
  &  &  & (0.000) &  \\
  &  &  &  &  \\
 gdppc &  &  & 0.001$^{***}$ &  & 0.0005$^{***}$ \\
  &  &  & (0.00002) &  & (0.00001) \\
  &  &  &  &  \\
 life\_exp &  &  &  & 1.101$^{***}$ &  \\
  &  &  &  & (0.031) &  \\
  &  &  &  &  \\
 Constant & 15.002$^{***}$ & 5.955$^{***}$ & $-$60.212$^{***}$ & 62.576$^{***}$ \\
  & (0.401) & (0.408) & (2.098) & (0.160) \\
  &  &  &  &  \\
\hline \\[-1.8ex]
Observations & 3,126 & 3,003 & 3,376 & 4,111 \\
R$^{2}$ & 0.039 & 0.384 & 0.276 & 0.334 \\
Adjusted R$^{2}$ & 0.038 & 0.383 & 0.276 & 0.334 \\
Residual Std. Error & 22.391 (df = 3124) & 17.953 (df = 2999) & 18.534 (df = 3374) & 8.625 (df = 4109) \\
F Statistic & 125.913$^{***}$ (df = 1; 3124) & 622.987$^{***}$ (df = 3; 2999) & 1,285.932$^{***}$ (df = 1; 3374) & 2,063.299$^{***}$ (df = 1; 4109) \\
\hline
\hline \\[-1.8ex]
\textit{Note:}  & \multicolumn{4}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
\end{tabular}
```

# stargazer output with LaTeX typesetting

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | internet | | | life_exp |
| | (1) | (2) | (3) | (4) |
| polity | 0.255*** | 0.084*** | | |
| | (0.023) | (0.020) | | |
| pop | | 0.000 | | |
| | | (0.000) | | |
| gdppc | | 0.001*** | | 0.0005*** |
| | | (0.00002) | | (0.00001) |
| life_exp | | | 1.101*** | |
| | | | (0.031) | |
| Constant | 15.002*** | 5.955*** | −60.212*** | 62.576*** |
| | (0.401) | (0.408) | (2.098) | (0.160) |
| Observations | 3,126 | 3,003 | 3,376 | 4,111 |
| $R^2$ | 0.039 | 0.384 | 0.276 | 0.334 |
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| F Statistic | 125.913*** (df = 1; 3124) | 622.987*** (df = 3; 2999) | 1,285.932*** (df = 1; 3374) | 2,063.299*** (df = 1; 4109) |
| *Note:* | | | | *p<0.1; **p<0.05; ***p<0.01 |

# Fancier stargazer output

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Internet Users | | | Life Expectancy |
| | (1) | (2) | (3) | (4) |
| Polity Score | 0.2553*** | 0.0842*** | | |
| | (0.0228) | (0.0202) | | |
| Population | | 0.0000 | | |
| | | (0.0000) | | |
| GDP p.c. | | 0.0010*** | | 0.0005*** |
| | | (0.00002) | | (0.00001) |
| Life Expectancy | | | 1.1005*** | |
| | | | (0.0307) | |
| Constant | 15.0024*** | 5.9550*** | −60.2123*** | 62.5757*** |
| | (0.4005) | (0.4082) | (2.0975) | (0.1602) |
| Observations | 3,126 | 3,003 | 3,376 | 4,111 |
| $R^2$ | 0.0387 | 0.3839 | 0.2760 | 0.3343 |
| Adjusted $R^2$ | 0.0384 | 0.3833 | 0.2757 | 0.3341 |
| Residual Std. Error | 22.3914 (df = 3124) | 17.9527 (df = 2999) | 18.5340 (df = 3374) | 8.6253 (df = 4109) |
| *Note:* | | | | *p<0.1; **p<0.05; ***p<0.01 |

# Professional typesetting of math symbols

```
\begin{equation*}
\begin{split}
\frac{\partial EU_{ns_p}}{\partial s}&=A(v)f\gamma-S'(s)\leq0\\
\frac{\partial^2 EU_{ns_p}}{\partial s^2}&=-S''(s)<0
\end{split}
\end{equation*}
```

$$\frac{\partial EU_{ns_p}}{\partial s} = A(v)f\gamma - S'(s) \leq 0$$
$$\frac{\partial^2 EU_{ns_p}}{\partial s^2} = -S''(s) < 0$$

# Professional typesetting of regression equations

```
\begin{equation*}
\text{exp}_{i,t} = \beta_1\text{conflict}_{i,t-1} +
\beta_2\text{coca}_{i,t-1} +
\beta_3\text{conflict}_{i,t-1} \times \text{coca}_{i,t-1}
+ c_i + \delta_t + \epsilon_{i,t}
\end{equation*}
```

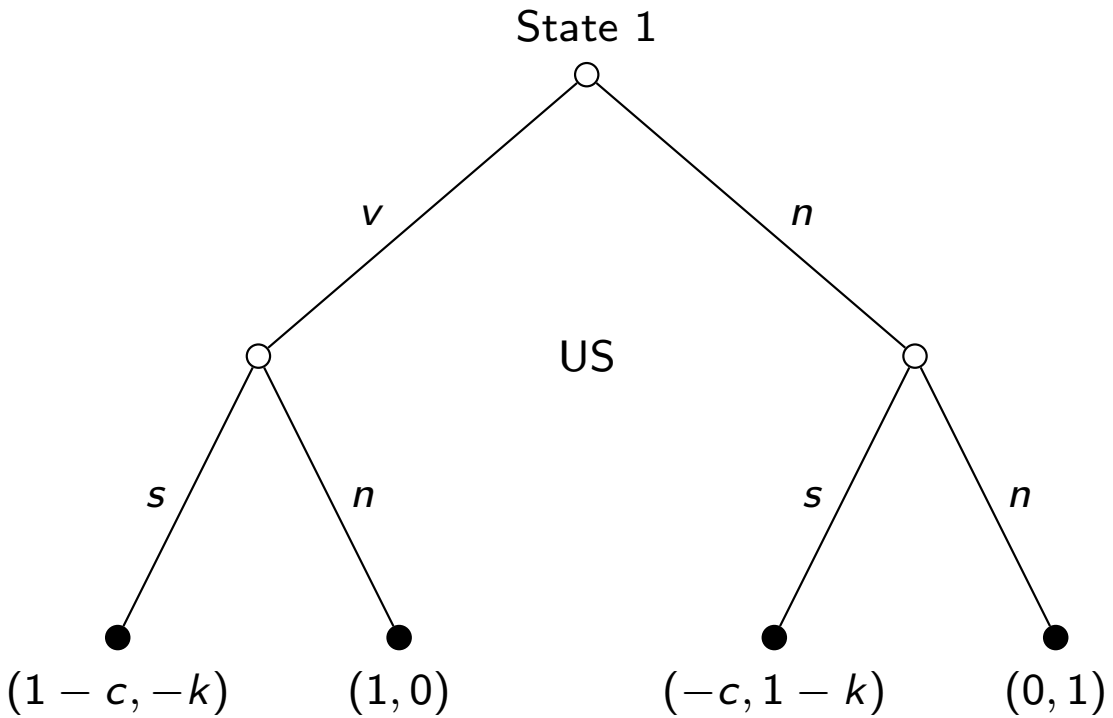
$$\text{exp}_{i,t} = \beta_1\text{conflict}_{i,t-1} + \beta_2\text{coca}_{i,t-1} + \beta_3\text{conflict}_{i,t-1} \times \text{coca}_{i,t-1} + c_i + \delta_t + \epsilon_{i,t}$$

# Professional math typesetting

## Basic list of math symbols in LaTeX

`http://web.ift.uib.no/Teori/KURS/WRK/TeX/symALL.html`

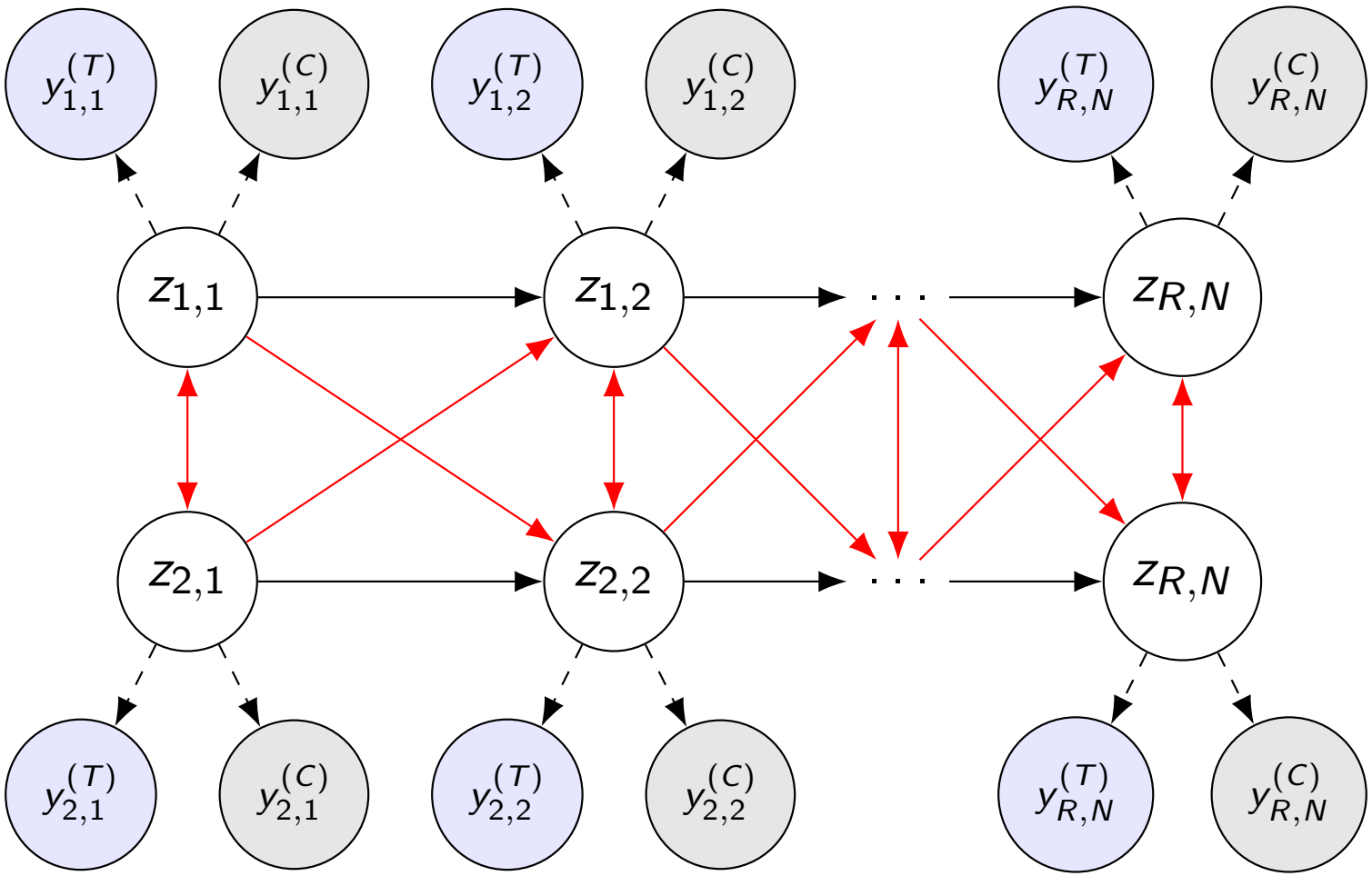
# Game trees with `tikz` package



# Game trees with tikz package

```
\usetikzlibrary{calc}
  \tikzset{
    solid node/.style={circle,draw,inner sep=1.5,fill=black},
    hollow node/.style={circle,draw,inner sep=1.5}
}
\begin{tikzpicture}[scale=1.2,font=\scriptsize]
    \tikzstyle{level 1}=[level distance=15mm,sibling distance=35mm]
    \tikzstyle{level 2}=[level distance=15mm,sibling distance=15mm]
  \node(0)[hollow node,label=above:{State 1}]{}
    child{node(1)[hollow node]{}
      child{node[solid node,label=below:{$(1-c,-k)$}]{} edge from parent node[left]{$s$}}
      child{node[solid node,label=below:{$(1,0)$}]{} edge from parent node[right]{$n$}}
      edge from parent node[left,xshift=-3]{$v$}
    }
    child{node(2)[hollow node]{}
      child{node[solid node,label=below:{$(-c,1-k)$}]{} edge from parent node[left]{$s$}}
      child{node[solid node,label=below:{$(0,1)$}]{} edge from parent node[right]{$n$}}
      edge from parent node[right,xshift=3]{$n$}
};
  \node at ($(1)!.5!(2)$) {US};
\end{tikzpicture}
```

# Diagrams with `tikz` package



# Diagrams with tikz package

```
\tikzstyle{hv}=[circle,draw]
\tikzstyle{ovt}=[hv,fill=blue!10]
\tikzstyle{ovc}=[hv,fill=black!10]
\tikzstyle{a}=[-{Latex[length=2mm,width=1.5mm]}]
\tikzstyle{ao}=[a,dashed]
\tikzstyle{across}=[a,red]
\tikzstyle{d}=[above]
\tikzstyle{both}=[{Latex[length=2mm,width=1.5mm]}-{Latex[length=2mm,width=1.5mm]},red]
\begin{tikzpicture}[every node/.style={scale=1}]
  \node (z11) at (-3,2) [hv] {\(z_{1,1}\)};
  \node (z12) at (0,2) [hv] {\(z_{1,2}\)};
  \node (z1n) at (4,2) [hv] {\(z_{R,N}\)};
  \node (y11t) at (-3.75,3.5) [ovt] {\scriptsize\(y^{(T)}_{1,1}\)};
  \node (y11c) at (-2.25,3.5) [ovc] {\scriptsize\(y^{(C)}_{1,1}\)};
  \node (y12t) at (-0.75,3.5) [ovt] {\scriptsize\(y^{(T)}_{1,2}\)};
  \node (y12c) at (0.75,3.5) [ovc] {\scriptsize\(y^{(C)}_{1,2}\)};
  \node (y1nt) at (3.25,3.5) [ovt] {\scriptsize\(y^{(T)}_{R,N}\)};
  \node (y1nc) at (4.75,3.5) [ovc] {\scriptsize\(y^{(C)}_{R,N}\)};
  \node (z1dots) at (2,2) {\ldots};
  \draw[a] (z11) -- (z12);
  \draw[a] (z12) -- (z1dots);
  \draw[a] (z1dots) -- (z1n);
  \draw[ao] (z11) -- (y11t);
  \draw[ao] (z11) -- (y11c);
  \draw[ao] (z12) -- (y12t);
  ...
\end{tikzpicture}
```

# Challenges

# Steep Learning Curve

## The key to learning LaTeX

- Learning by doing
- Trial and error
- Google
- PATIENCE

# Co-Authoring

Reproducibility is one of the main advantages of LaTeX. But co-authoring can be tricky with a basic LaTeX distribution.

## Challenges toward collaboration

- Co-authors that don't know LaTeX.
- Special packages, fonts, etc.
- Limited tracking of changes.
- Limited commenting abilities (except % or ).

# Tools for collaboration

## Online platform `https://www.overleaf.com`

Limited free version, many templates.

## `todonotes` package

Adds margin and in-text comments.

# Journal submission

- Some journals will not accept LaTeX files for final manuscript submission.
- There are software tools for converting LaTeX to Word, but it is a pain.
- Especially frustrating for: Tables, bibliographies, equations. Hence, all the reasons why you would want to use LaTeX in the first place.

# Other Challenges

- Limited spell-checking options. Depends on editor.
- Debugging is part of the process.
  - Check for typos.
  - Read error message of compiler.
  - Google error message.
  - Trial and error.

# Some misconceptions

## No word counts

Many compilers don't have a build in function, but there is external programs (e.g. `http://app.uio.no/ifi/texcount/`) and ShareLaTeX also has a word count option.

## Tables in LaTeX suck

Programming tables from scratch is no fun! But, there are tools such as the `stargazer` and `estout` packages, plug-ins for Excel, and online tools (`http://www.tablesgenerator.com`).

# Structure and compiling

# Basic Structure

## Preamble

Document type, basic settings, packages. Not printed.

## Title section

Title, date, author information.

## Main Body

Document content including title wrapped by

`\being{document} ... \end{document}.`

# Preamble

```
\documentclass[11pt,letterpaper,oneside]{article} %Change basic font size and paper size here.
\usepackage{setspace, graphicx, fullpage, fancyhdr, amssymb, amsmath, epsfig, natbib, array, multirow, hyperref, tabularx, lscape,
booktabs, sidecap, subfig, longtable, enumitem}

\hypersetup{
   bookmarks=false,        % show bookmarks bar?
   unicode=false,          % non-Latin characters in Acrobat?s bookmarks
   pdftoolbar=true,        % show Acrobat?s toolbar?
   pdfmenubar=true,        % show Acrobat?s menu?
   pdffitwindow=false,     % window fit to page when opened
   pdfstartview={FitH},    % fits the width of the page to the window
   pdftitle={},    % title
   pdfauthor={},     % author
   pdfsubject={Subject},   % subject of the document
   pdfcreator={Creator},   % creator of the document
   pdfproducer={Producer}, % producer of the document
   pdfkeywords={keywords}, % list of keywords
   pdfnewwindow=true,      % links in new window
   colorlinks=true,        % false: boxed links; true: colored links
   linkcolor=blue,         % color of internal links
   linkbordercolor={0 0 0},  %border color
   citebordercolor={0 0 0},
   citecolor=blue,         % color of links to bibliography
   filecolor=black,      % color of file links
   urlcolor=blue,          % color of external links
}
```

Most important parameter is `documentclass{}`

- article
- resume
- beamer
- letter

Packages and hypersetup differ.

# Compiling a document

Workflow might differ for each editor. Example TeXShop:

1. Running LaTeX first time will produce general text.
2. Running BibTeX to create bibliography (if necessary).
3. Running LaTeX second time will product internal links, table of contents, and references.

Some editors like Overleaf will compile everything at once.

# LaTeX commands and special characters

All LaTeX commands start with a \. Example: `\begin{}`

## Characters with special meaning

- { and }: Used in functions and for delineation.
- %: Comment (nothing that follows will be printed).
- $: In-line math.
- &: Alignment character (tables and math).

To use any of these symbols in text, we need to use an escape character. For example, to print % & $, we need to type:

```
\% \& \$
```

# Miscellaneous Notes

- Using `section{}`, `subsection{}`, and `subsubsection{}`, LaTeX automatically creates a structure that pdf readers will understand.

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- `section*{}`, `subsection*{}`, and `subsubsection*{}` are the non-numbered equivalents.
- Size of headings will automatically be chosen by LaTeX.
- White space typically does not matter.

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# Bibliographies

# Basic structure

## Bibliographic data base, e.g. sample_bib.bib.

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@article{fearonlaitin2003,
Author = {James D. Fearon and David D. Laitin},
Journal = {American Political Science Review},
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# Moving on...

Any questions before we move on to part II?

# LaTeX Lingo

## Distribution

Collection of TeX-related software. Examples: MiKTeX, TeX Live.

## Editor

Creation of documents. Examples: TeXworks, TeXShop.

## Format

Different TeX-based languages. Examples: LaTeX, plain TeX.

## Packages

Add ons to basic systems. Examples graphicx, natbib.