Introduction to LaTeX

Adrian Rohit Dass
Research Coordinator
Institute of Health Policy, Management, & Evaluation
Canadian Centre for Health Economics
University of Toronto

What is LaTeX?

- The term "LaTeX" itself refers to a document preparation system.

  - It does *not* refer to a particular editing program

- It is most often used for technical or scientific documents but it can be used for almost any form of publishing.

- It is widely used in academia

Why should we bother?

- Allows authors to focus on content rather than appearance (font sizes & styles, colours, etc.)
- Documents produced in LaTeX will look identical on a PC or Mac (in comparison to Microsoft Word).
- Equation editing, numbering, referencing, etc is handled much better in LaTeX than Microsoft Word. Equations also look better in LaTeX documents, as well as Tables for descriptives, regression results, etc.
- It's free!
  - However, the editor you use to compile LaTeX code to document may/may not be free. In this lecture, we focus on the free editors Texshop/Texworks.

Where to get LaTeX/Editor?

- On a PC, I recommend MiKTeX:
  - http://miktex.org/
  - This will give you LaTeX and the LaTeX editor *Texworks*

- On a Mac, you can download from the MacTeX website:
  - https://tug.org/mactex/
  - This will give you LaTeX, the LaTeX editors *Texworks* and *Texshop*, as well as a few additional LaTeX editors

Starting off

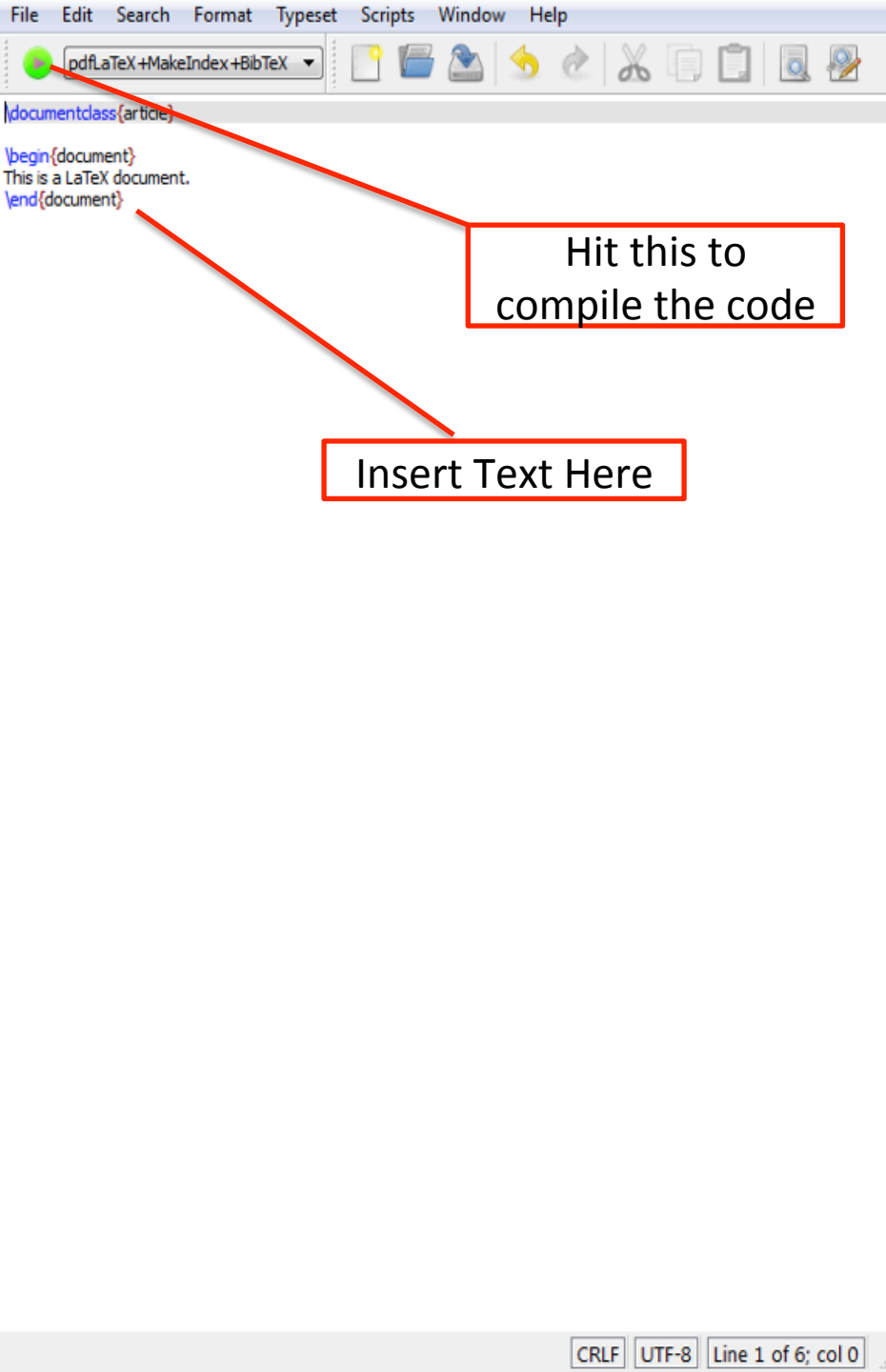- Every LaTeX document **MUST** contain the following three lines of code:

\documentclass{article}

\begin{document}

\end{document}

- Text for the document, equations, figures, tables, etc etc go between \begin{document} and \end{document}
- Packages to be used go between \documentclass{article} and \begin{document} (more on this later)
- Anything after \end{document} will be ignored
- Broadly speaking, anything in curly brackets {} represents required information, and anything in square [] brackets represents optional information
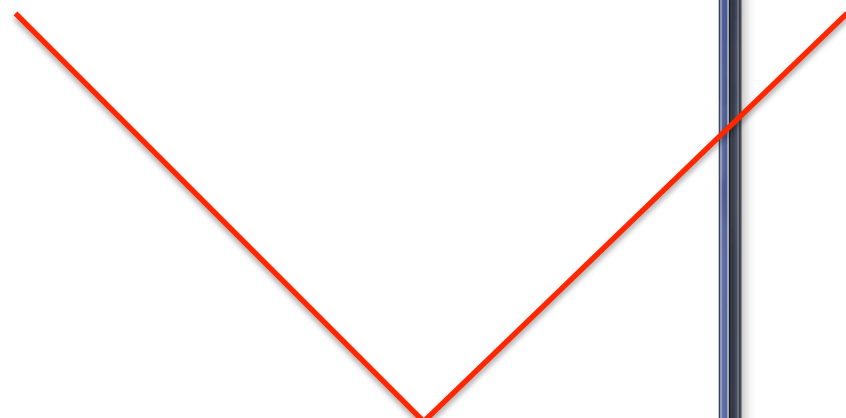
File   Edit   Search   Format   Typeset   Scripts   Window   Help

pdfLaTeX+MakeIndex+BibTeX ▾

```latex
\documentclass{article}

\begin{document}
This is a LaTeX document.
\end{document}
```

Hit this to
compile the code

Insert Text Here

CRLF   UTF-8   Line 1 of 6; col 0

pdfLaTeX+MakeIndex+BibTeX

```
\documentclass{article}

\begin{document}
This is a LaTeX document.
\end{document}
```

This is a LaTeX document.

Latex Code and PDF Side by Side

Latex Files

- After hitting compile, 6 files will be created in the directory/location you chose to save to:

Intro.aux   Intro.log   Intro.out   Intro.pdf   Intro.synctex.gz   Intro.tex
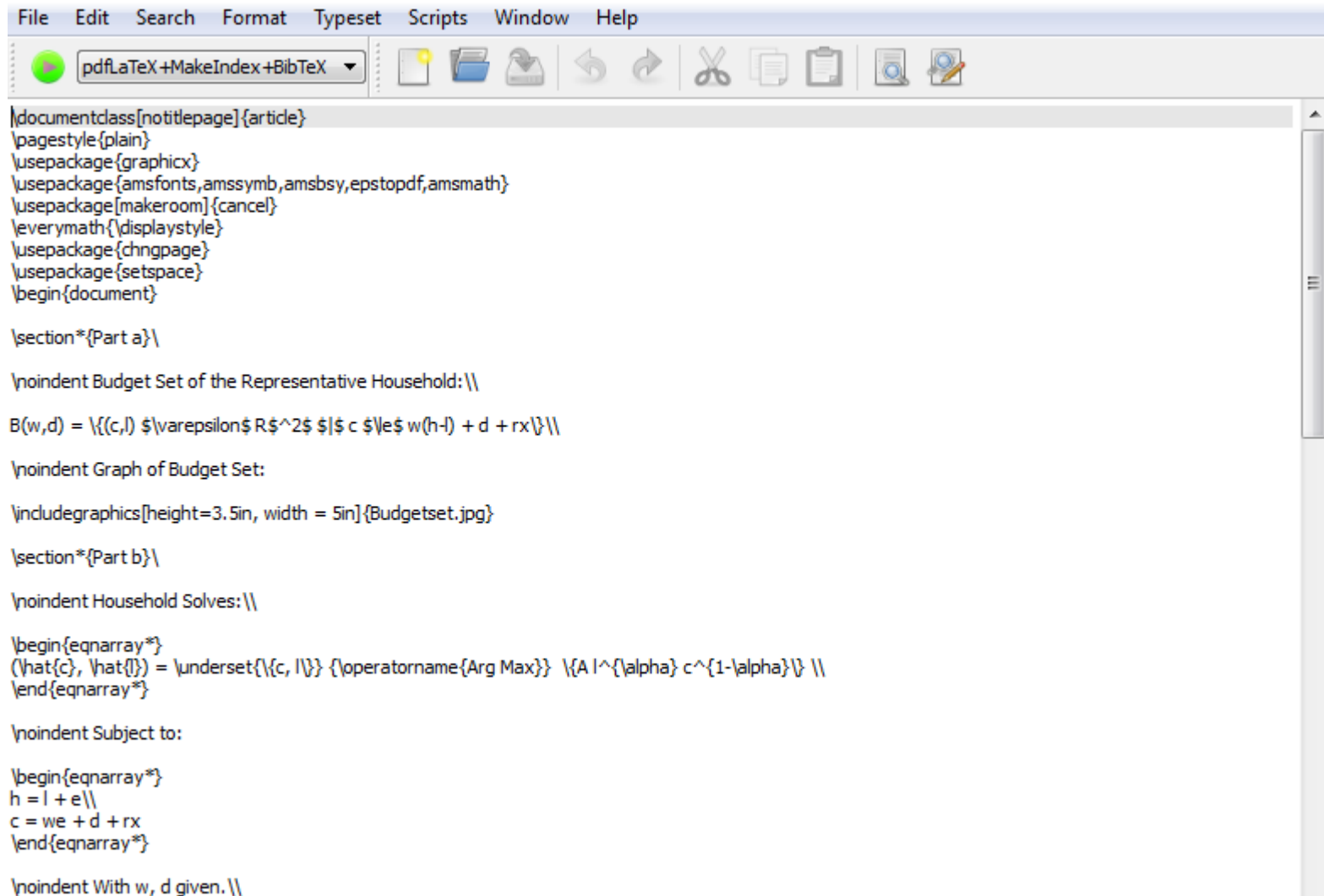
- The .pdf file is the LaTeX document you created, which you can view in any pdf viewer (adobe, preview, web browser, etc.)
- The .tex file contains the LaTeX code we created. To edit the file later on, double click on the .tex file
- You shouldn't need to touch the remaining 4 files.
- It's usually a good idea to save your .tex file in a folder. More on this later.

A note on syntax colouring

- By default, Texshop adds colour to the syntax, which makes writing LaTeX code considerably easier
  - But TexShop is only available on a Mac
- By default, Texworks does not add colour to syntax, but this can be changed
  - In Texworks, go to Format → Syntax Colouring →LaTeX or ConTeXt (different forms of colouring, ConTeXt is closer to the default colouring on Texshop for Mac).

Texworks Without Syntax Colouring

File   Edit   Search   Format   Typeset   Scripts   Window   Help

pdfLaTeX+MakeIndex+BibTeX ▼

```
\documentclass[notitlepage]{article}
\pagestyle{plain}
\usepackage{graphicx}
\usepackage{amsfonts,amssymb,amsbsy,epstopdf,amsmath}
\usepackage[makeroom]{cancel}
\everymath{\displaystyle}
\usepackage{chngpage}
\usepackage{setspace}
\begin{document}

\section*{Part a}\

\noindent Budget Set of the Representative Household:\\

B(w,d) = \{(c,l) $\varepsilon$ R$^2$ $|$ c $\le$ w(h-l) + d + rx\}\\

\noindent Graph of Budget Set:

\includegraphics[height=3.5in, width = 5in]{Budgetset.jpg}

\section*{Part b}\

\noindent Household Solves:\\

\begin{eqnarray*}
(\hat{c}, \hat{l}) = \underset{\{c, l\}} {\operatorname{Arg Max}}  \{A l^{\alpha} c^{1-\alpha}\} \\
\end{eqnarray*}

\noindent Subject to:

\begin{eqnarray*}
h = l + e\\
c = we + d + rx
\end{eqnarray*}

\noindent With w, d given.\\
```
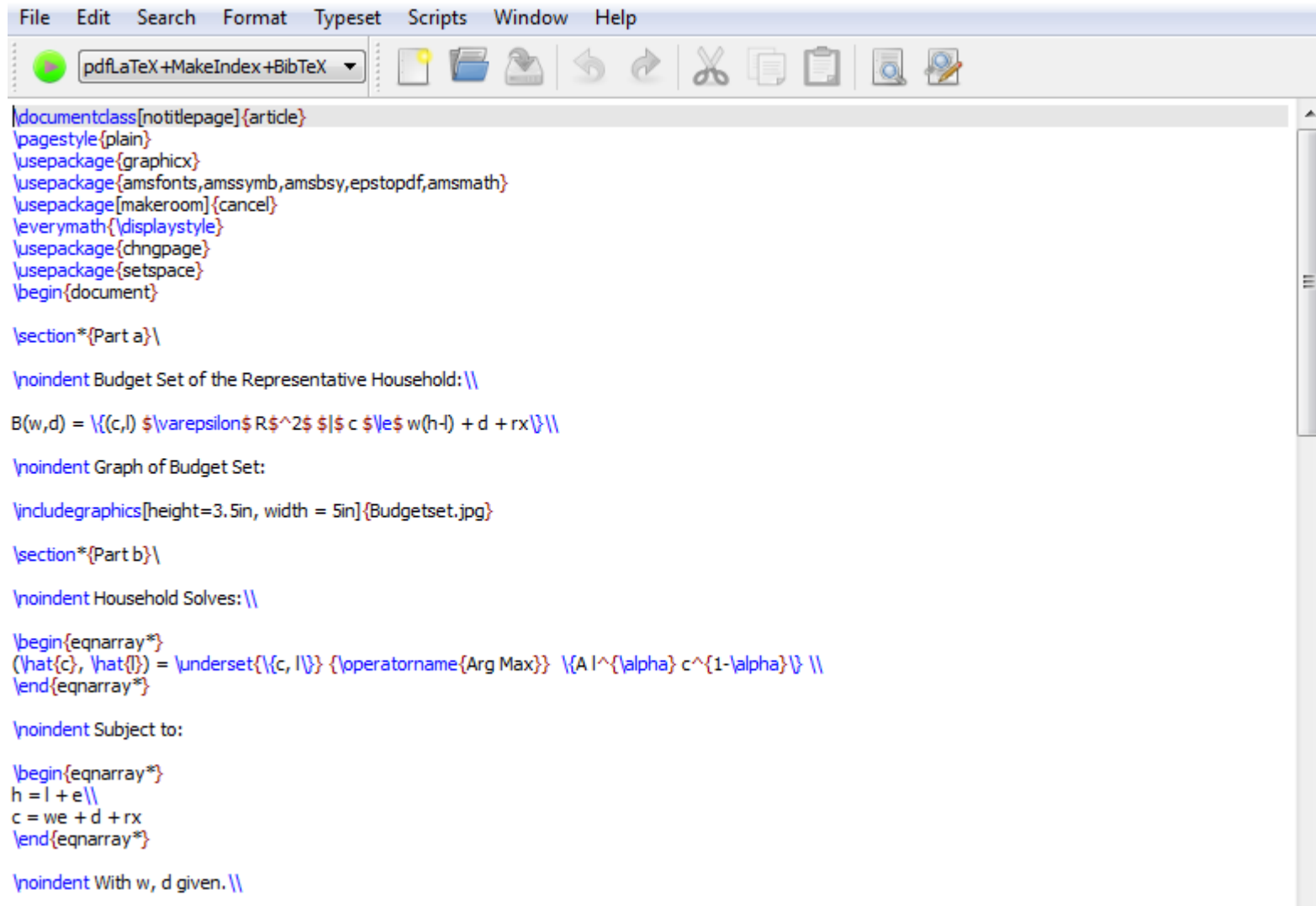
Texworks With Syntax Colouring

pdfLaTeX+MakeIndex+BibTeX ▼

```
\documentclass[notitlepage]{article}
\pagestyle{plain}
\usepackage{graphicx}
\usepackage{amsfonts,amssymb,amsbsy,epstopdf,amsmath}
\usepackage[makeroom]{cancel}
\everymath{\displaystyle}
\usepackage{chngpage}
\usepackage{setspace}
\begin{document}

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\noindent Graph of Budget Set:

\includegraphics[height=3.5in, width = 5in]{Budgetset.jpg}

\section*{Part b}\

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\begin{eqnarray*}
(\hat{c}, \hat{l}) = \underset{\{c, l\}} {\operatorname{Arg Max}}  \{A l^{\alpha} c^{1-\alpha}\} \\
\end{eqnarray*}

\noindent Subject to:

\begin{eqnarray*}
h = l + e\\
c = we + d + rx
\end{eqnarray*}

\noindent With w, d given.\\
```

Change Font Size Entire Document

- The default text size in LaTeX is 10. You can change this at the very top of the document in the document class

\documentclass[10pt]{article}

- If size 10 is okay for you, you don't need the [10 pt] after document class

- You can change the size to 11 or 12, but nothing beyond 12

Packages

By default, we can't do a lot with LaTeX unless we specify 'packages' as well. These packages go in the premable (after \documentclass{article}, before \begin{document}).
Examples
To insert images, \usepackage{graphicx}
To write equations, \usepackage{amsmath}
To change margins, \usepackage{geometry}

Most, if not all, packages are included in the installer on a Mac (hence the large size). Most packages will be missing in the windows installer, but missing packages can either be installed later on as the code runs for the first time.

Text Modifications

- Italicizing Text

\emph{text}

- Bolding Text

\textbf{text}

- Underlining Text

\underline{text}

Double-spacing

- If you need to double space, you can use the following commands:

\begin{spacing}{2}

…

\end{spacing}

The \begin{spacing}{2} piece should be placed just after \begin{document} (or the section you want double-spaced). The \end{spacing} should be place just before \end{document} (or at the end of the section you want double spaced). Please be sure to include the \end{spacing} line, otherwise you will get an error.

Section Heading

- To create a heading:

\section{*section name*}

- To create a sub-heading:

\subsection{*section name*}

Section Headings are automatically numbered as 1, 2, 3...
Subsection headings are automatically numbered as
1.1,1.2...,2.1,2.2,...

To have a section unnumbered, place an asterisk after
section (e.g \section*{} or \subsection*{}

Section Heading (Example)

LaTeX Code

→

Output

\section{Introduction}

\subsection{Canada}

Some text about Canada here…

\subsection{United States}

Some text about the United States here…

\section{Data}

The Data for our study comes from…

---

1 Introduction

1.1 Canada

Some text about Canada here…

1.2 United States

Some text about the United States here…

2 Data

The Data for our study comes from…

Indenting

- LaTeX will automatically indent a new paragraph
- It usually gets the indenting right, but there will be times when it will indent when you don't want it to, or vice versa
- To indent, use \indent
- To take back an indent, use \noindent

To Move to The Next Line

- Putting a "\\" at the end of the line will move you to the next line.
  - Note that this doesn't leave any space between the lines
- You can also use \vspace{xx pt}, which will create a vertical space between two elements (lines, equations, figures, etc. etc.). You may specify how big you want the space in the curly brackets (pt is used for reference, you can use cm or in as well).

The use of '$' in LaTeX

If we want a Greek letter, fraction, or any sort of math symbol in the body of our text, we must surround the term with $ $.

Examples

My favorite Greek letter is α.

My favorite Greek letter is α.

The probability I will attend class is p, where 0 $\le$ p $\le$ 1.

The probability I will attend class is p, where $0 \le p \le 1$.

Superscripts and Subscripts

- For just one Superscript

x^2 produces x^2

- For more than one superscript, place the superscripts in curly brackets

x^{21} produces x^{21}, but x^21 produces x^21

- Same Story for subscripts

x_i produces x_i

x_{it} produces x_{it}, but x_it produces x_it

Working with Greek Letters

- The basic structure is *greeklettername*. Some Examples

α is $\$\backslash alpha\$$

β is $\$\backslash beta\$$

δ is $\$\backslash delta\$$

ψ is $\$\backslash psi\$$

ρ is $\$\backslash rho\$$

θ is $\$\backslash theta\$$

ε is $\$\backslash epsilon\$$

Working with Fractions

- The basic structure is

\frac{*numerator*}{*denominator*}

Example:

$$

\frac{\alpha + \beta}{x+1}

$$
Produces

$$\frac{\alpha + \beta}{x + 1}$$

Hats, Tildes, Dots, etc

- To put a "hat" over a character:

  $\hat{}$

- To put a tilde (~) over a character:

  $\tilde{}$

- To put a dot over a character:

  $\dot{}$

- To put a bar over a character:

  $\bar{}$

Special Characters

There are certain characters that take on special functions in LaTeX. A good example is '%', which is used to insert a comment into the LaTeX code. '&' is used in arrays/tables, and '$' is generally used for inserting greek letters/math symbols into the body text. If you'd like these characters in your body text, you can usually just put a backslash before it.

Examples:

$ is \$

& is \&

_ is _

% is \%

is \#

Working with Equations

- For equations, I recommend the align command (you will need to have \usepackage{amsmath} in preamble)
- For one equation:

\begin{align}
\psi = \beta + \alpha + [\rho + \delta - 1]
\end{align}

Note that we don't use '$' or '$$' when in an equation environment

- For two equations that you would like aligned, with both equations numbered:

\begin{align}
\psi =& \beta + \alpha + [\rho + \delta - 1]\\
\psi =& \beta + \alpha
\end{align}

The '&' sign is put where we want the equations aligned. In this case, they will be aligned at the equal sign

The '\\' indicates that we are moving on to the next equation

Working with Equations (Continued)

LaTeX Code

\begin{align} \label{kformula}

k_{t+1} = \frac{ \beta \alpha A k_{t}^\alpha (1 - l_{t})^{1 - \alpha}}{(1+n)}
\end{align}

$$k_{t+1} = \frac{\beta \alpha A k_t^\alpha (1 - l_t)^{1-\alpha}}{(1+n)} \tag{1}$$

Note the \label{} after align. If we label an equation, we can refer to it later on in the text using \eqref{}, using the label instead of the equation number. This means we can move equations around without having to worry about updating the equation numbers in the text.

Inserting an Image

- To insert an image into your document, make sure the image is in the same directory as your .tex file. You also need the graphics package, \usepackage{graphicx}, loaded and enabled.

```
\begin{figure}[h]
 \centering
  \includegraphics[height=xx in, width = xx in]{name of picture}
  \caption{This is a picture}
\end{figure}
```

Dimensions of picture. Note inches specified here, but you can use cm and other units of measurement as well.

Name of picture file goes here. You can leave off the file extension (.jpg, .png, etc etc)

Inserting an Image

```
\begin{figure}[h]
 \centering
  \includegraphics[height=2.5 in, width = 5 in]{Photo}
   \caption{Chicago Skyline}
\end{figure}
```


Figure 1: Chicago Skyline

Making a Table

\begin{table}[h]
\begin{tabular}{l | c | c | c}
Variable & Patient 1 & Patient 2 & Patient 3\\
\end{tabular}
\end{table}

These put vertical separators between columns. Delete to remove – they are optional

'&' is used to separate column entries. I.E. if you have 4 columns, you should expect 4-1=3 '&' signs per line

The l, c, c, c defines the alignment for a particular column. The code above specifies that the first column be left aligned, and the others be centered

The '\\' indicates a new row entry. You must specify this when moving to the next row of the table.

Making a Table (Example)

LaTeX Code

```
\begin{table}[h]
\begin{tabular}{l | c | c | c}
Variable & Patient 1 & Patient 2 & Patient 3\\
\hline
Age & 33 & 45 & 65\\
Height & 150 cm & 180 cm & 120 cm\\
\end{tabular}
\end{table}
```

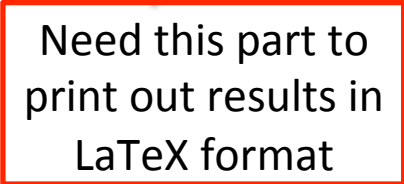| Variable	Patient 1	Patient 2	Patient 3
Age	33	45	65
Height	150 cm	180 cm	120 cm

What about regression results?

- Some software packages (including STATA) have built in commands to covert regression results into LaTeX code. We can then copy and paste the output into a LaTeX editor.
- For STATA, I recommend estout:
  - http://repec.org/bocode/e/estout/
- To install, type this command into STATA:

ssc install estout, replace

Example

sysuse auto2

regress price foreign

eststo r1

regress price foreign headroom

eststo r2

regress price foreign headroom mpg

eststo r3

regress price foreign headroom mpg length

eststo r4

estout r1 r2 r3 r4, style(tex) cells(b(fmt(3)star) se(par))starlevels(* 0.10 ** 0.05 *** 0.01) stats (N r2)

Need this part to print out results in LaTeX format

Stata Output

```
foreign   &   312.259  &   577.812  &   1714.109** &   2644.847***\\
          & (754.449)  & (787.566)  & (712.795)  & (757.800)  \\
headroom  &           &   491.575  &  -186.567  &  -520.396  \\
          &           & (428.405)  & (391.567)  & (392.500)  \\
mpg       &           &           &  -303.820***&  -139.692* \\
          &           &           &  (59.530)  &  (81.770)  \\
length    &           &           &           &   69.695***\\
          &           &           &           &  (24.963)  \\
_cons     & 6072.423***&  4522.071***&  12684.649***&  -3186.254  \\
          & (411.363)  & (1412.097)  & (2007.966)  & (5999.225)  \\
N         &   74.000  &   74.000  &   74.000  &   74.000  \\
r2        &    0.002  &    0.021  &    0.286  &    0.359  \\
```

LaTeX Output

Table 1: The Determinants of the Price of a Car

Variable	Model (1)	Model (2)	Model (3)	Model (4)
foreign	312.259	577.812	1714.109**	2644.847***
	(754.449)	(787.566)	(712.795)	(757.800)
headroom		491.575	-186.567	-520.396
		(428.405)	(391.567)	(392.500)
mpg			-303.820***	-139.692*
			(59.530)	(81.770)
length				69.695***
				(24.963)
_cons	6072.423***	4522.071***	12684.649***	-3186.254
	(411.363)	(1412.097)	(2007.966)	(5999.225)
N	74.000	74.000	74.000	74.000
r2	0.002	0.021	0.286	0.359

LaTeX Code for Table

```
\begin{table}[h]
\centering
\caption{The Determinants of the Price of a Car}
\begin{tabular}{l c c c c}
\hline
Variable & Model (1) & Model (2) & Model (3) & Model (4)\\
\hline
\hline
foreign   &   312.259  &   577.812  &  1714.109** &  2644.847***\\

        &  (754.449)  &  (787.566)  &  (712.795)  &  (757.800)  \\

headroom   &          &   491.575  &  -186.567  &  -520.396  \\

        &          &  (428.405)  &  (391.567)  &  (392.500)  \\

mpg      &        &          &  -303.820***&  -139.692*  \\

        &        &        &   (59.530)  &  (81.770)  \\

length    &        &        &          &   69.695***\\

        &        &        &          &  (24.963)  \\

\_cons    &  6072.423***&   4522.071***&  12684.649***&  -3186.254  \\

        &  (411.363)  &  (1412.097)  &  (2007.966)  &  (5999.225)  \\
        \hline

N       &   74.000  &   74.000  &   74.000  &   74.000  \\

r2      &   0.002  &   0.021  &   0.286  &   0.359  \\

\hline
\hline
\end{tabular}
\end{table}
```

The Geometry Package

- By default, the left margin in a LaTeX document is quite a bit indented inward to allow for margin comments

- When making a LaTeX document, this indenting may/may not be desirable

- The geometry package allows us to modify the margin, header, and footer size. The defaults in geometry are actually quite sufficient for making LaTeX documents. In this case, you don't need to specify anything, just have the following included in the preamble:

\usepackage{geometry}

Default LaTeX page layout

Default with Geometry Package

The Geometry Package (Continued)

- If you'd like to change the margins for the entire document, then in the preamble:

\usepackage[top=xx cm, bottom=xx cm, left=xx cm, right= xx cm]{geometry}

- If you'd like to change the margins for a specific page:

\newgeometry{bottom=xx cm, top=xx cm, left=xx cm, right=xxcm}

Page Content

\restoregeometry

- Note that we need the restoregeometry at the end, otherwise the new dimensions will carry forward in the document

LaTeX Tips

- Be careful of curly brackets, {}
  - These are used as a part of commands, and so having one stray can cause you all kind of errors
  - The same is not true for square brackets, []. An extra one lying around wont cause you any issues
- Use Syntax coloring!
  - I emphasized this at the beginning, but syntax colouring can really make things easier
- When it doubt, Google it
  - Because LaTeX is free, there is a large community of users who have likely encountered the same problem you are experiencing. You can find solutions to virtually all LaTeX problems via Google.

LaTeX Resources

- For Math:

http://en.wikibooks.org/wiki/LaTeX/Mathematics

- For Images:

http://en.wikibooks.org/wiki/LaTeX/Floats,_Figures_and_Captions

- For Tables:

http://en.wikibooks.org/wiki/LaTeX/Tables