

# A Quick Introduction to L<sup>A</sup>T<sub>E</sub>X

Hao-Che (Howard) Hsu

[www.haochehsu.com](http://www.haochehsu.com)

ECON 142CW  
University of California-Irvine

2020

# Microsoft Word vs L<sup>A</sup>T<sub>E</sub>X

## A comparison

- Same **paragraph** design, same Computer Modern **font** family, same font size 11pt, same **justify** alignment, on **different** typesetting systems:

### Microsoft Word

Firms face a choice between two a a a modes of competition: make their networks incompatible and compete fiercely for market dominance, or make their networks compatible and have mild competition.

### LaTeX

Firms face a choice between two a a a modes of competition: make their networks incompatible and compete fiercely for market dominance, or make their networks compatible and have mild competition.

# Manage Line Height Like a Pro

A fully customize environment

- Four different line heights in a single paragraph:

“A product or service has network effect if its value to a consumer increases in number of its users. For example, with mobile phone services, there are typically discounts for on-net calls, and therefore a user benefits from being in a network with more users, because in that case the user is more likely to be making on-net calls and paying discounted calling fees.”

- The height can be set to as little as 0.01mm or even negative.

# White Space Elimination

## Auto management

- Input (what you typed):

A sentence        with        different        whitespaces .

- Output (what appears on the PDF document):

A sentence with different whitespaces.

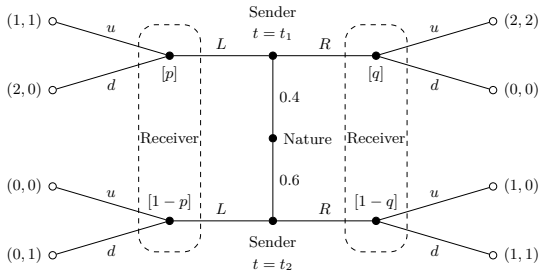
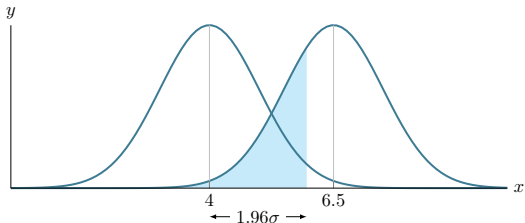
# The Math Environment

The ability to present beautiful equations with super flexible customization

$$\begin{aligned}
 \hat{\beta}_{\text{W2SLS}} - \beta &= \\
 & \left[ \underbrace{\left( \frac{1}{n} \sum_{i=1}^n \frac{x_i z_i'}{\sigma^2(z_i)} \right)}_{\xrightarrow{p} E\left(\frac{x_i z_i'}{\sigma^2(z_i)}\right)} \underbrace{\left( \frac{1}{n} \sum_{i=1}^n \frac{z_i z_i'}{\sigma^2(z_i)} \right)^{-1}}_{\xrightarrow{p} E\left(\frac{z_i z_i'}{\sigma^2(z_i)}\right)^{-1}} \underbrace{\left( \frac{1}{n} \sum_{i=1}^n \frac{z_i x_i'}{\sigma^2(z_i)} \right)}_{\xrightarrow{p} E\left(\frac{z_i x_i'}{\sigma^2(z_i)}\right)} \right]^{-1} \\
 & \left[ \underbrace{\left( \frac{1}{n} \sum_{i=1}^n \frac{x_i z_i'}{\sigma^2(z_i)} \right)}_{\xrightarrow{p} E\left(\frac{x_i z_i'}{\sigma^2(z_i)}\right)} \underbrace{\left( \frac{1}{n} \sum_{i=1}^n \frac{z_i z_i'}{\sigma^2(z_i)} \right)^{-1}}_{\xrightarrow{p} E\left(\frac{z_i z_i'}{\sigma^2(z_i)}\right)^{-1}} \underbrace{\left( \frac{1}{n} \sum_{i=1}^n \frac{z_i (x_i' \beta + e_i)}{\sigma^2(z_i)} \right)}_{\xrightarrow{p} E\left(\frac{z_i (x_i' \beta + e_i)}{\sigma^2(z_i)}\right)} \right] - \beta
 \end{aligned}$$

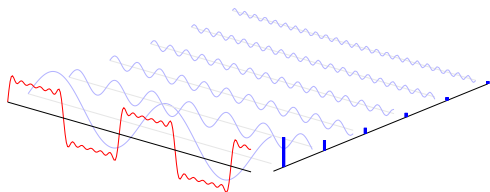
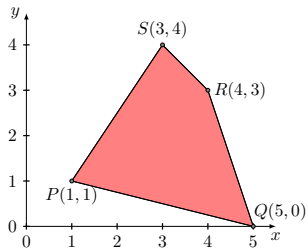
# Draw Graphs with $\text{\LaTeX}$

Using "tikzpicture" (Statistics + Game Theory)



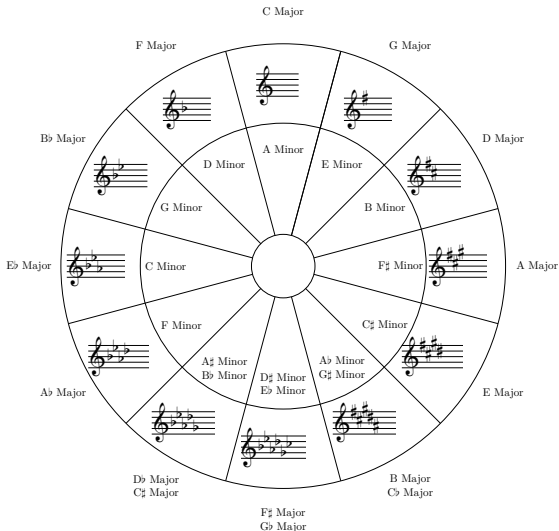
# Draw Graphs with $\text{\LaTeX}$

Using "tikzpicture" (Mathematics)



# Draw Music Sheet with L<sup>A</sup>T<sub>E</sub>X

Using "musixtex" and "tikzpicture" (create the sharp and flat notations on the five-line staff)





# Auto Numbering and Equation Alignments

Mathematics environment and equation numbering

$$(x + y)^2 = x^2 + 2xy + y^2 \tag{1}$$

$$(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2xz + 2yz \tag{2}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{3}$$

$$\begin{aligned} |x - y| \frac{|x + y|}{(1 + x^2)(1 + y^2)} &\leq |x - y| \frac{|x| + |y|}{(1 + x^2)(1 + y^2)} \\ &= |x - y| \left[ \frac{1}{\frac{1+x^2}{|x|}(1+y^2)} + \frac{1}{(1+x^2)\frac{1+y^2}{|y|}} \right] \\ &\leq |x - y| \left[ \frac{1}{2(1+y^2)} + \frac{1}{(1+x^2)2} \right] \leq |x - y| < \delta = \epsilon. \end{aligned} \tag{4}$$

# The Experience after Years of Usage

## The good and the bad

- Pros:
  1. create large document in small **compressed** file without freezing/lagging
  2. **modularize** editing work-flow, easy to move things around
  3. auto **formatting**, **numbering** and **typesetting**, let you focus on the contents
  4. maximum **compatibility** across desktop OS and typesetting platforms
  5. native **mathematics** environment support
  6. full **customization** in typesetting/editing
  7. it is **free**
- Cons:
  1. medium learning curve (need to learn the syntax)
  2. typing long equation and tables are very tedious (there are supporting tools)
  3. in default, no live viewing (**WYSIWYG**) as you write (requires other packages)
  4. the whole PDF document will not compile if there exist any coding error
  5. can't run on mobile devices (alternative: online **T<sub>E</sub>X** editor)
  6. less graphical interface

# The Typesetting System

It is all about formatting

- $\text{T}_{\text{E}}\text{X}$  is a typesetting language (system), developed by Donald Knuth in 1978.
- $\text{\LaTeX}$  (*lay-tech*) is a set of macros built on top of  $\text{T}_{\text{E}}\text{X}$ .
- Typesetting engines:  $\text{pdfT}_{\text{E}}\text{X}$ (default),  $\text{X}_{\text{E}}\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$ ,  $\text{LuaT}_{\text{E}}\text{X}$ .
- No macro viruses.  $\text{T}_{\text{E}}\text{X}$  documents received by email is anti-viruses.
- Widely used in scientific areas and academia.
- Many software and packages can export results to  $\text{\LaTeX}$  code.  
e.g. STATA, R, Jupyter Notebook.

# TeX Typesetting Engine: X<sub>3</sub>TeX

The ability to change fonts and languages

- Traditional Chinese: 不畏浮雲遮望眼，只緣身在最高層。
- Simplified Chinese: 不畏浮云遮望眼，只缘身在最高层。
- English: *We have no fear of the clouds that may block our sights as we are already at the top of the height.*
- Korean: 우리는 이미 높이가 높을 때 시야를 가리는 구름에 대해 두려워하지 않습니다.
- Japanese: 私たちはすでに高さの一番上にいるので、私たちの視界を遮る可能性のある雲の恐れはありません。
- Hindi: हमें उन बादलों का कोई डर नहीं है जो हमारी जगहें रोक सकते हैं क्योंकि हम पहले से ही ऊंचाई पर हैं।

# The Typesetting Platform

## The choices

- **macOS**
  - macTeX (T<sub>E</sub>X language): <https://tug.org/mactex/>
  - Editor: Texmaker, TeXstudio, LyX, Texpad
- **Windows**
  - MiKTeX (T<sub>E</sub>X language): <https://miktex.org/download>
  - Editor: Texmaker, TeXstudio, LyX, TeXworks, WinEdt
- **Online:** Overleaf (<https://www.overleaf.com>)
  - Register with UCI email to obtain [Overleaf Professional Accounts](#).
- Editor with extensions: Sublime Text, Emacs, Atom, Visual Studio Code, Vim (with L<sup>A</sup>T<sub>E</sub>X-suite), Eclipse (with TeXlipse), Gummi
- L<sup>A</sup>T<sub>E</sub>X Tables Generator: <http://www.tablesgenerator.com>.
- [A Practitioner's Guide to basic LaTeX Setup](#) (click to download)

# Write Paper with T<sub>E</sub>X

Leave everything other than research to L<sup>A</sup>T<sub>E</sub>X

- This **navigable**<sup>1</sup> presentation is created with X<sub>Y</sub>L<sup>A</sup>T<sub>E</sub>X beamer.
- **Download** the **Template.zip** and unarchive.
  - I have prepared a full L<sup>A</sup>T<sub>E</sub>X template for you (also supports X<sub>Y</sub>L<sup>A</sup>T<sub>E</sub>X).
  - Contains a full paper structure and instructions.
  - Includes a reference template (BibT<sub>E</sub>X).
  - Reference/citation format follows *Journal of Political Economy*<sup>2</sup> style.
  - Includes syntax examples.
- Choose a typesetting **platform** (page 12).
- Import **reference** information into `references.bib` (or use BibDesk).
- Edit the template, **fill in** your research contents, title page keywords and look up the [JEL Codes](#).
- **Compile** and produce the paper PDF document.

---

<sup>1</sup>You can try clicking the sections at the top progress bar and the title bar at the bottom left.

<sup>2</sup>Journal of Political Economy (JPE) is one of the “top five” journals in Economics.