

# Econ 101: Principles of Microeconomics

## *Project*

Due Date

Part 1 - 10/31/2021

Part 2 - 11/28/2021

**Yisroel Cahn**

## Introduction

The purpose of this project is to

1. Teach you how to use the typesetting system  $\text{\LaTeX}$ .
2. Teach you how to search for and cite economics papers.
3. Give you a brief introduction to the minimum wage literature.

## Project Grading

This project is composed of two parts. Part 1 is worth 20% of the project grade and is graded for completion. Part 2 is worth 80% of the project grade and its grading is specified in Part 2.

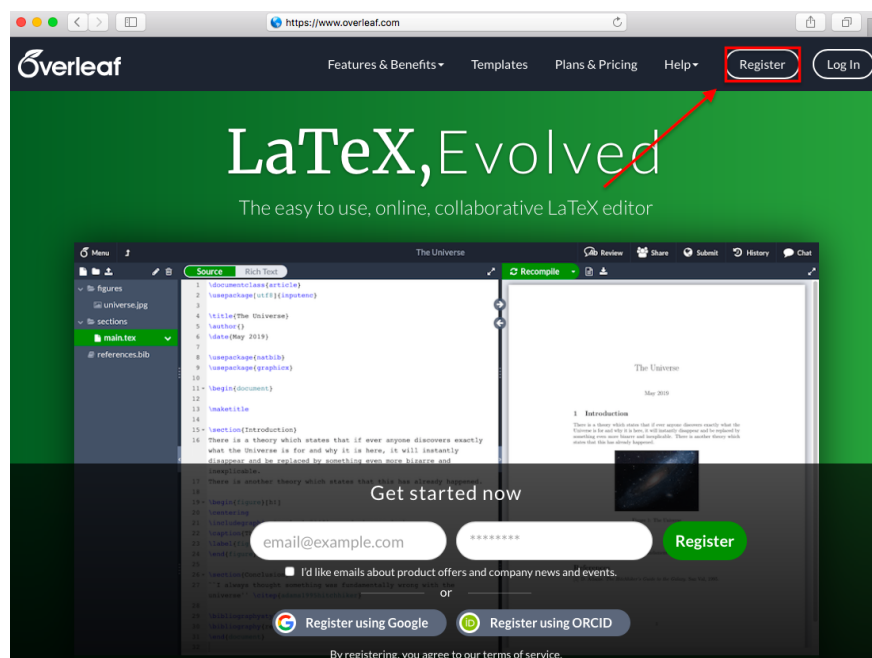
## Part 1

### What is $\text{\LaTeX}$ ?

Latex<sup>1</sup> is a typesetting tool used to make high-quality, professional looking documents. It was created by Leslie Lamport in the early 1980s and has many advantages over other typesetting options like, for example, Microsoft Word. Its easy to change formatting and interface that allows the user to write equations effortlessly are some reasons it is so commonly used in science, mathematics, and economics.

### Getting Started

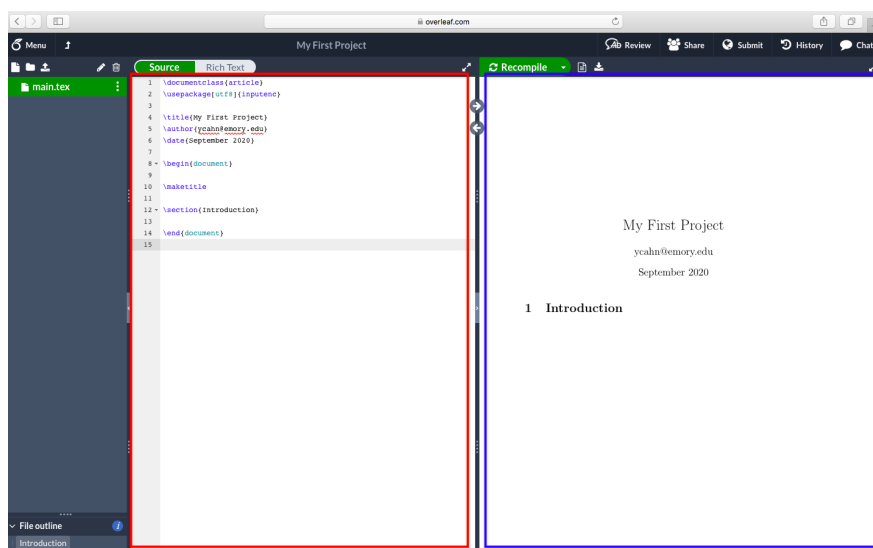
While there are many  $\text{\LaTeX}$  editors, I recommended you use Overleaf for this project. Start by going to <https://www.overleaf.com> and click register (see figure below).



Use an email address and make up a password (see figure below).

<sup>1</sup>Latex is stylized as  $\text{\LaTeX}$  and pronounced “Lay-tek” because the characters ‘T’ ‘E’, and ‘X’ in Latex are meant to be the Greek letters tau, epsilon, and chi, respectively. How pretentious and awesome is that!

Click “Create First Project” and choose “Blank Project”.<sup>2</sup> When prompted, name the project “My First Project”. Your screen should look like this:



Source code (what you write to make your document) is typed into the red box, it is compiled (turned into language the computer understands so it can make your document), and produces the PDF on the right in the blue box. Take a look at the figures below

<sup>2</sup>Overleaf has many different templates for presentations, resumes, and more, but for now we are just writing a simple article. Overleaf also allows you to collaborate with others, much like a Google doc.

```
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{My First Project}
5 \author{ycahn@emory.edu}
6 \date{September 2020}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Introduction}
13
14 \end{document}
15
16
17
```

This area before the document starts is called the preamble

```
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{My First Project}
5 \author{ycahn@emory.edu}
6 \date{September 2020}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Introduction}
13
14 \end{document}
15
16
17
```

This line in the preamble says what kind of document it is. In this case, the document is an article.

```
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{My First Project}
5 \author{ycahn@emory.edu}
6 \date{September 2020}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Introduction}
13
14 \end{document}
15
16
17
```

This line adds a package which enables the document to have additional features. We will add more packages later.

```
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{My First Project}
5 \author{ycahn@emory.edu}
6 \date{September 2020}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Introduction}
13
14 \end{document}
15
16
17
```

These lines define features of the document's title.

```
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{My First Project}
5 \author{ycahn@emory.edu}
6 \date{September 2020}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Introduction}
13
14 \end{document}
15
16
17
```

This line starts the document.

This line ends the document.

```
1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{My First Project}
5 \author{ycahn@emory.edu}
6 \date{September 2020}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Introduction}
13
14 \end{document}
15
16
17
```

Now that we are finally inside the document, we start by putting the title which we already defined the features for in the preamble.

```

1 \documentclass{article}
2 \usepackage[utf8]{inputenc}
3
4 \title{My First Project}
5 \author{ycahn@emory.edu}
6 \date{September 2020}
7
8 \begin{document}
9
10 \maketitle
11
12 \section{Introduction}
13
14 \end{document}
15
16
17

```

This is a section in the document, which we call introduction.

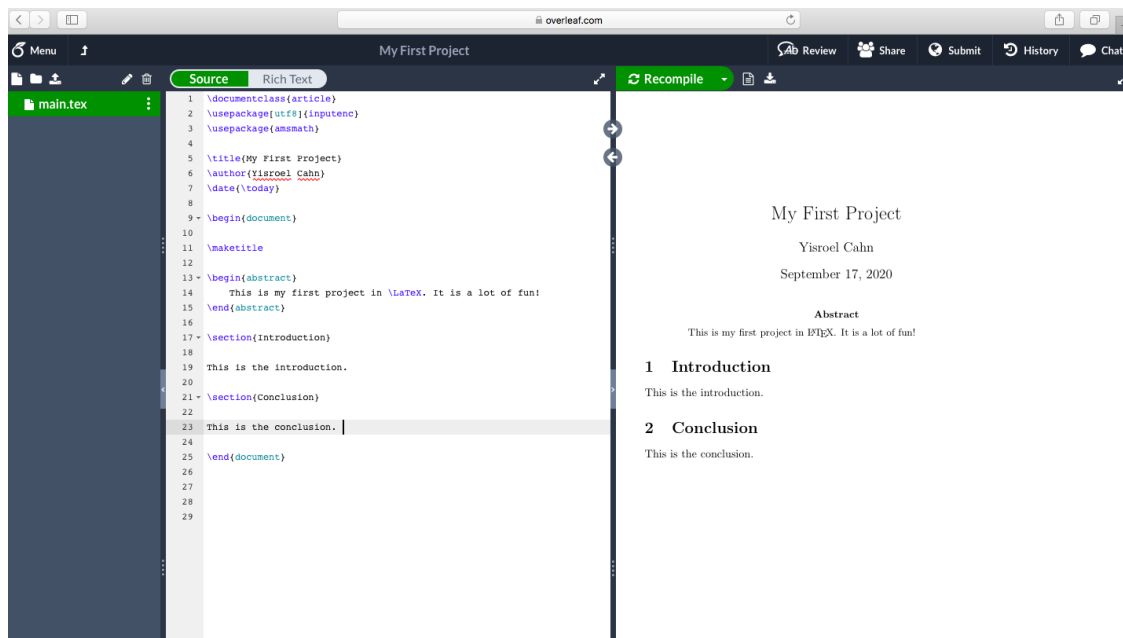
Let's start by doing a couple of things: change your name from you email address to your actual name, change the date to `\today`, add `\usepackage{amsmath}` in the preamble under `\usepackage[utf8]{inputenc}`, add

```
\begin{abstract}
```

This is my first project in `\LaTeX`. It is a lot of fun!

```
\end{abstract}
```

under `\maketitle`, type “This is the introduction.” in the introduction section, and add a section called “Conclusion” (by writing `\section{Conclusion}` after the introcution section) with the word “This is the conclusion.” in it. After you press `ctrl+s` or hit “Recompile,” your screen should look like this



## Basic Commands and Math Mode

Commands in Latex are done using the backslash button (`\`). Create a section in between the introduction and the conclusion called “Basic Commands and Math Mode.” Then type

The word `\textit{hello}` is italicized. And now, the word `\textbf{hello}` is in bold.

Notice that things inside the `{}` are the arguments of the command. A common command is to begin and end an object. For example, type

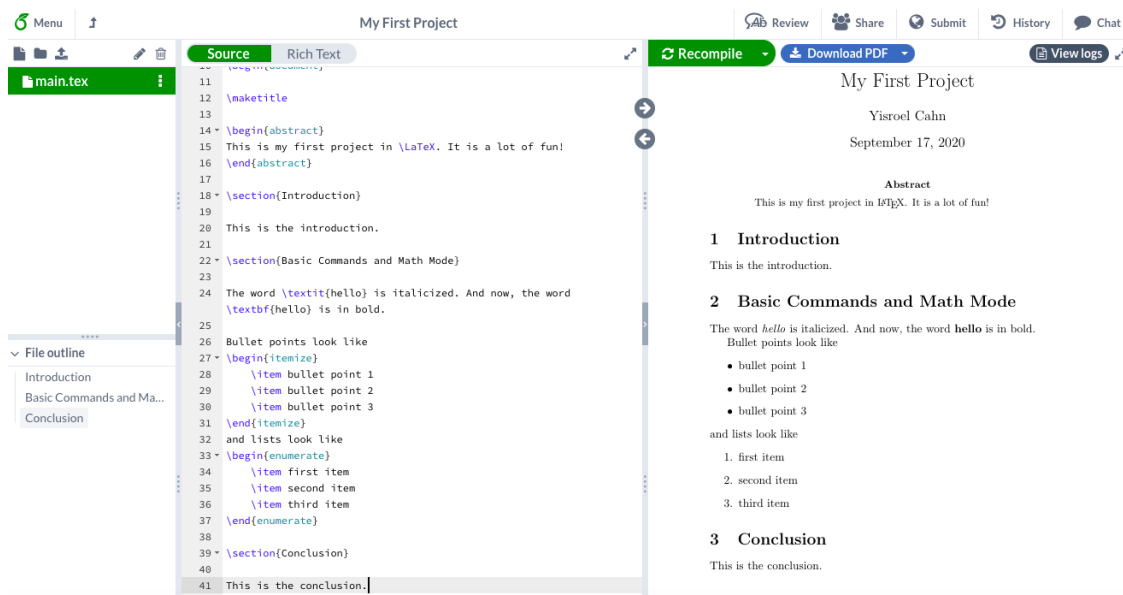
Bullet points look like

```
\begin{itemize}
  \item bullet point 1
  \item bullet point 2
  \item bullet point 3
\end{itemize}
```

and lists look like

```
\begin{enumerate}
  \item first item
  \item second item
  \item third item
\end{enumerate}
```

in the same section. Your screen should look like this



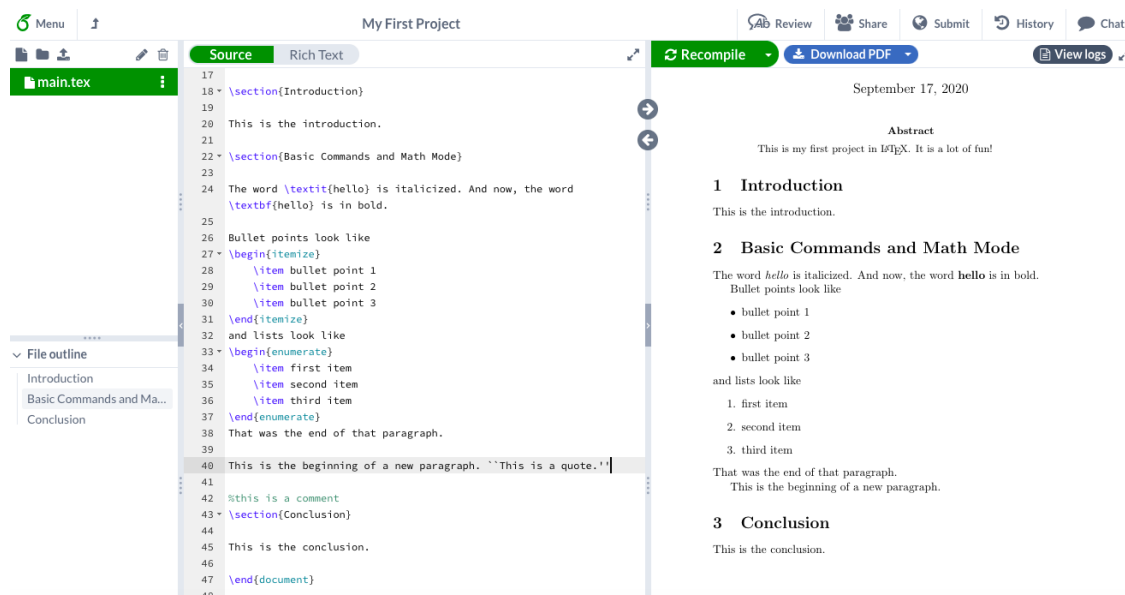
If you want to write something in the source code to explain what you are doing (for someone else who might look at your source code or for yourself for future reference so you don't forget), you can write a comment. Comment by using the `%`. For example write `"%this is a comment"` above `"\section{Conclusion}"`. New paragraphs are started by leaving a space between paragraphs in the source code. Continuing from where we left off, add

```
...
  \item third item
\end{enumerate}
```

That was the end of that paragraph.

This is the beginning of a new paragraph.

Quotations are done using two back-ticks and two apostrophes (``'') and single quotations are done with one back-tick and apostrophe (''). Add ``This is a quote.'' to the end of the last paragraph. Your screen should look like



Latex has a separate mode for entering math equations. To enter math mode in-line use  $and exit in-line math mode also with  $. To enter and exit math mode on a new line use \[ \]. Add  $5+3=8$  to the end of the last paragraph of Section 2 and$$

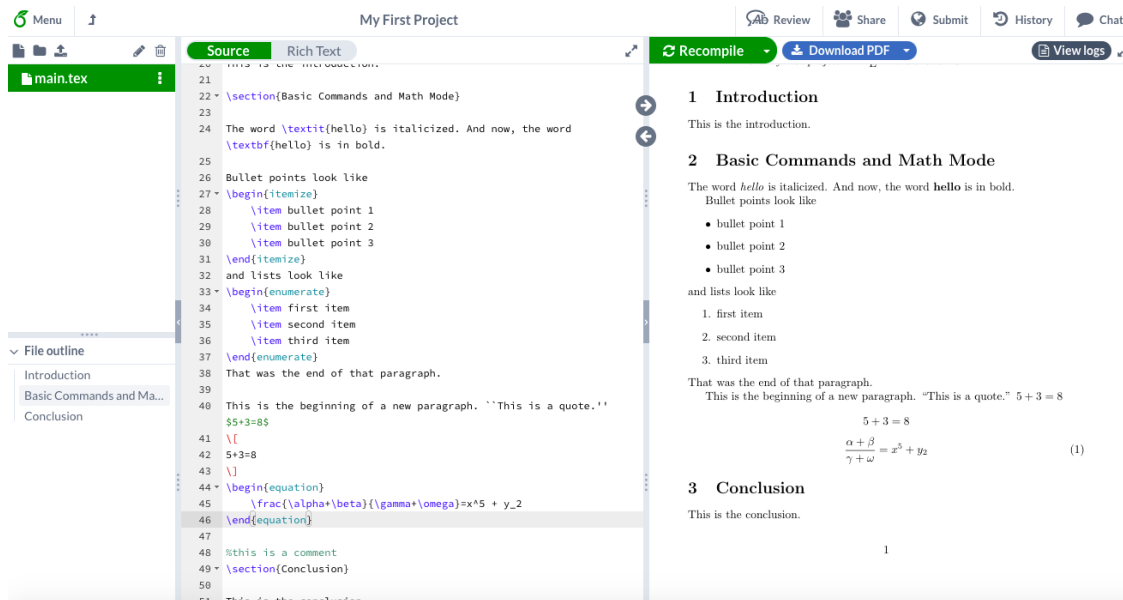
```
\[
5+3=8
\]
```

right after. To write an equation, some math symbols, superscripts, subscripts, and fractions, type for example

```
\begin{equation}
\frac{\alpha+\beta}{\gamma+\omega}=x^5 + y_2
\end{equation}
```

Your screen should look like





`\frac` is how to write fractions in math mode with the first argument in `{}` being the numerator and the second argument in the second `{}` being the denominator. Try typing

$$\frac{1}{2} + \left(\frac{\alpha}{2}\right)^2 = \frac{2 + \alpha^2}{4}$$

in the same section and note that in order to make the parenthesis larger, you need to write “`\left(`” and “`\right)`” so that the parentheses becomes as large as what is in-between them.

Next, in the same section, try typing

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

by googling how to do the plus-minus sign and square root sign in LaTeX.

To produce aligned equations like

$$\begin{aligned} y &= 6 + 7 \\ &= (3 + 3) + (4 + 3) \\ &= (3 + 2 + 1) + (2 + 2 + 3) \end{aligned}$$

type

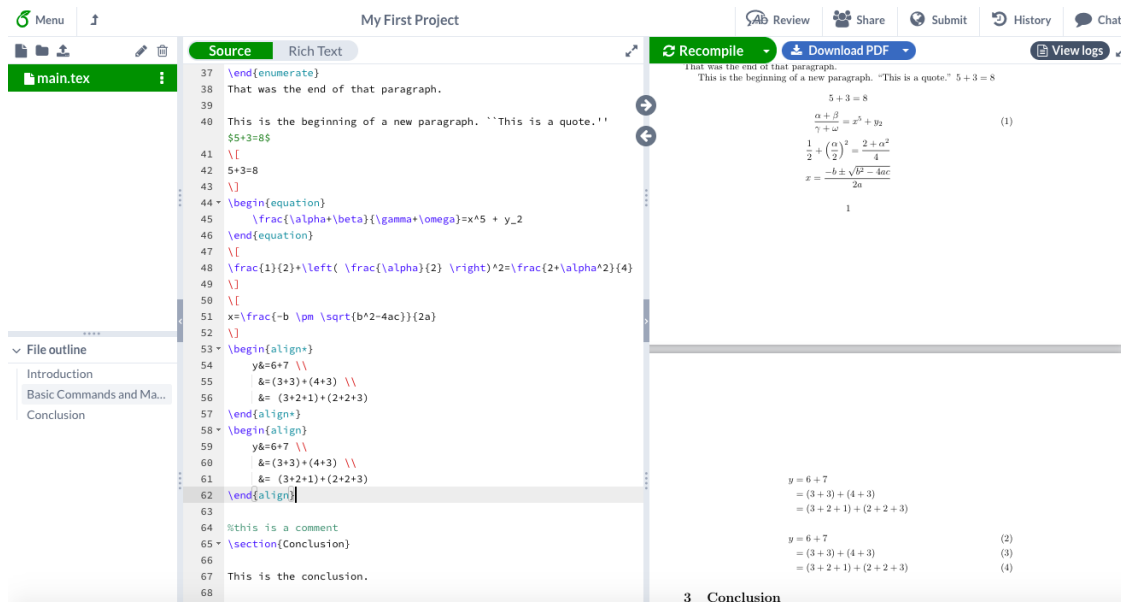
```
\begin{align*}
y&=6+7 \\
&=(3+3)+(4+3) \\
&= (3+2+1)+(2+2+3)
\end{align*}
```

in the same section, and note that `\\` starts a new line and `&` is where the equation aligns. Add

```
\begin{align}
y&=6+7 \\
&=(3+3)+(4+3) \\
&= (3+2+1)+(2+2+3)
\end{align}
```

in the same section and note that it puts equations numbers after each line.

Your screen should look like



## Referencing

Make a new section before the conclusion called referencing. In it, create two subsections by typing

```
\subsection{Cross-Referencing}
```

```
\subsection{Bibliography}
```

Next to reference the section “Referencing”, type `\label{sec:Referencing}` after the section, like

```
\section{Referencing} \label{sec:Referencing}
```

Under the subsection “Cross-Referencing” type

You can reference a section if it is labeled by typing `\ref{sec:Referencing}`

(whatever is inside the label) and you can reference an equation like this

```
\begin{equation} \label{eq:Euler}
```

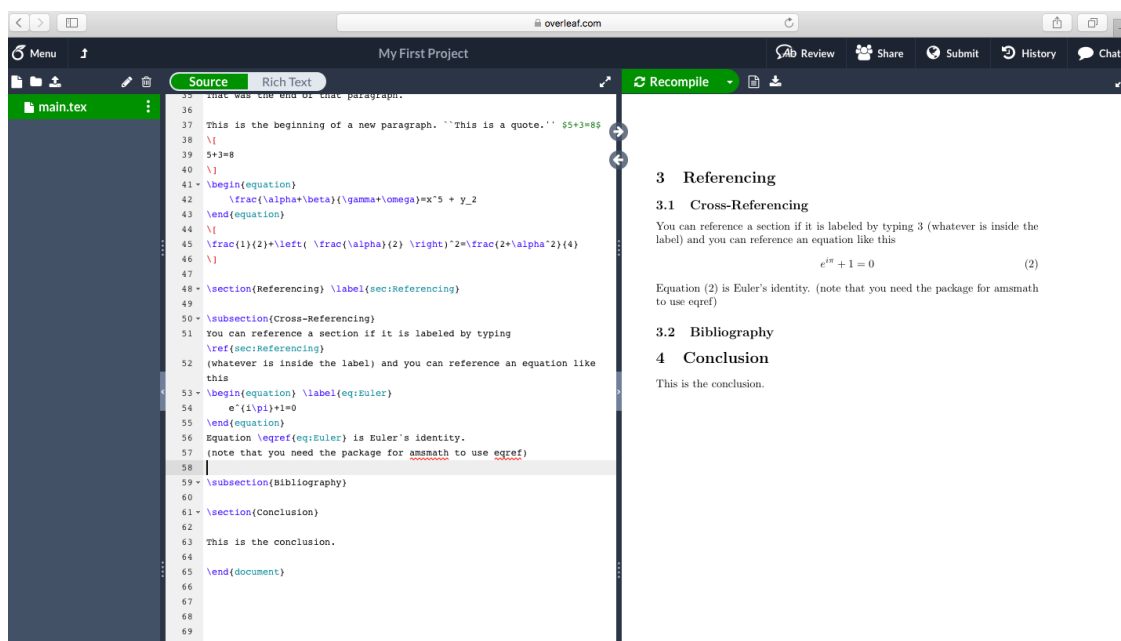
$$e^{i\pi} + 1 = 0$$

```
\end{equation}
```

Equation `\eqref{eq:Euler}` is Euler’s identity.

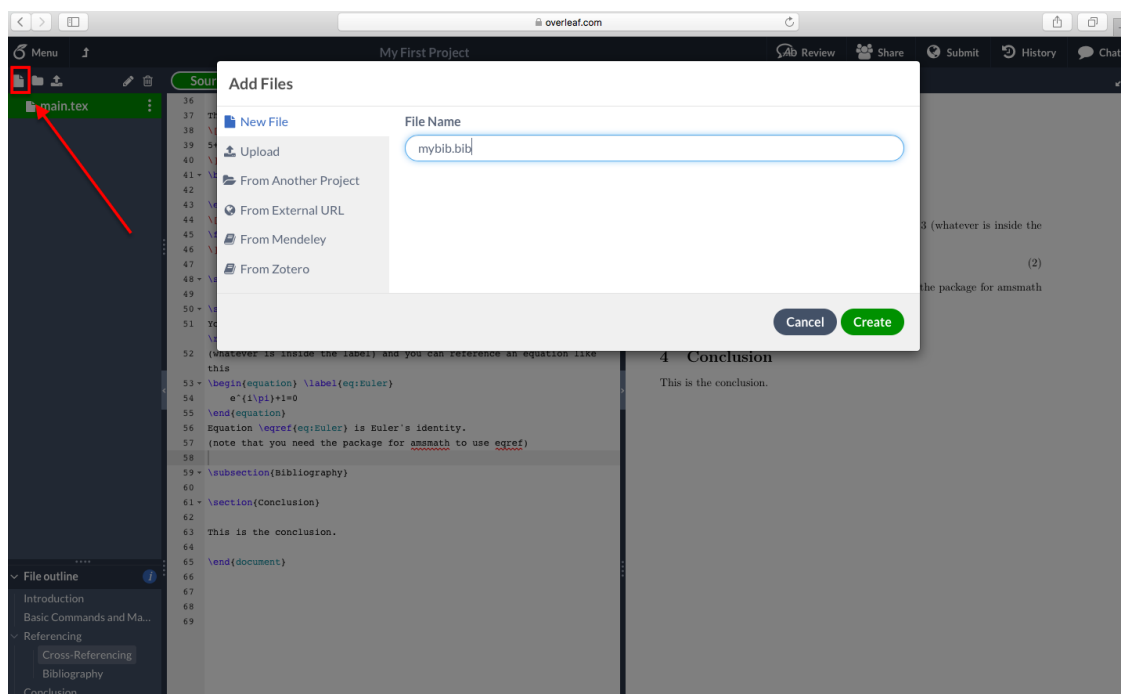
(note that you need the package for `amsmath` to use `eqref`)

Your screen should look like



Cross-referencing in this way is extremely useful. While writing a paper, you will be moving around sections, equations, figures, and tables (which we will talk about shortly) and having to manually change each cross-reference would be a nightmare!

Now we are going to add a bibliography. Click the page button and create a bibliography file called “my-bib.bib” (as shown in the figure below).



In the new file type

```
@article{atkinson,
Author = {Atkinson, Anthony B. and Bourguignon, Francois},
```

```

ISSN = {00346527},
Journal = {Review of Economic Studies},
Keywords = {Welfare Theory--General 0240},
Number = {2},
Pages = {183 - 201},
Title = {The Comparison of Multi-Dimensioned Distributions of Economic Status.},
Volume = {49},
Year = {1982},
}

```

Hit `cntrl+s` and click on `main.tex` to go back to the main file. In the preamble, add `\usepackage[style=apa]{biblatex}` and right underneath add `\addbibresource{mybib.bib}`. The first line that we added to the preamble imports the package for bibliography with APA style references and the second line we imported our bib file into main.

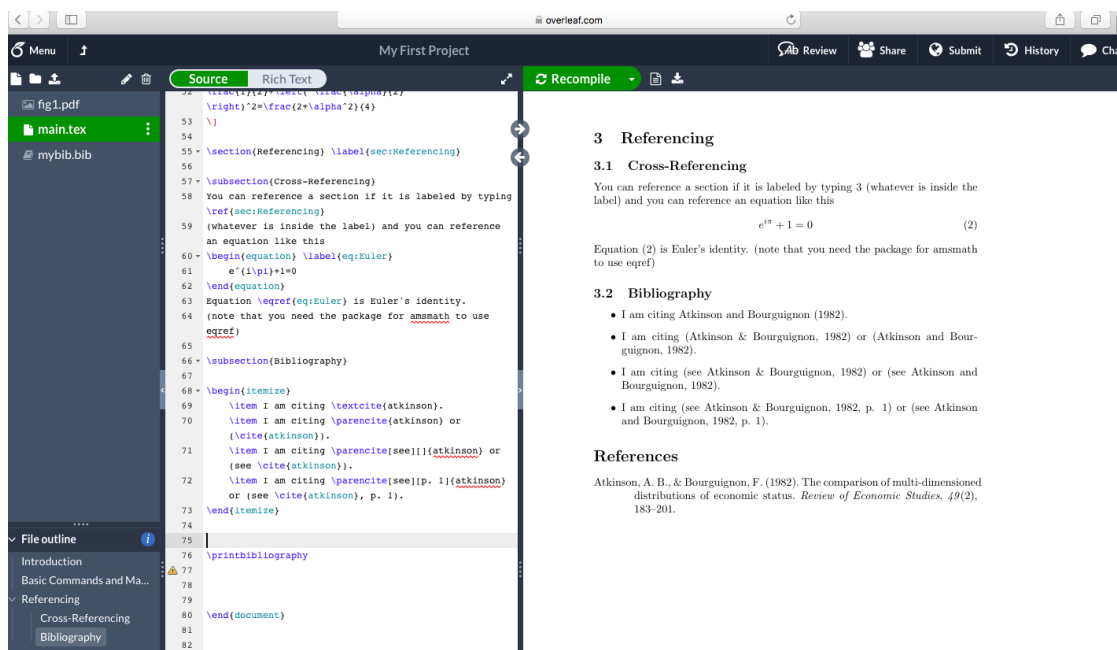
Now under the subsection bibliography type

```

\begin{itemize}
  \item I am citing \textcite{atkinson}.
  \item I am citing \parencite{atkinson} or (\cite{atkinson}).
  \item I am citing \parencite[see][]{atkinson} or (see \cite{atkinson}).
  \item I am citing \parencite[see][p. 1]{atkinson} or (see \cite{atkinson}, p. 1).
\end{itemize}

```

and add `\printbibliography` right before `\end{document}` at the end of the document. See figure below



Add `\usepackage{hyperref}` to the end of the preamble to make references hyperlinks. The referencing style can easily be changed. Try changing the style to `m1a` or `phys` by changing `\usepackage[style=apa]{biblatex}` to `\usepackage[style=m1a]{biblatex}` or `\usepackage[style=pys]{biblatex}` (you do not need to do this, it is just to show you that the referencing style can be changed easily).

Now, we are going to find articles through a database and export the citation. Go to <https://guides.libraries.emory.edu/az.php> or google “Emory library database” and click the first link. These are all

the databases Emory has access to, many of them are in fields other than economics. For economics, we will use Econlit. Click ‘E’, find Econlit, and log in using your Emory account (see figure below).

The screenshot shows a list of databases. The entry for 'EconLit with Full Text' is highlighted with a red rectangular box. A red arrow points upwards from the bottom of the box to the 'EconLit with Full Text' entry. The entry for 'EconLit with Full Text' includes the title, a link icon, the alternative name 'EBSCO', and a description of its content.

<b>EBSCOhost Espanol</b> <a href="#">↗</a>	
<b>Alternative Name(s) &amp; Keywords:</b> EBSCO	
Spanish-language interface to EBSCOhost databases.	
<a href="#">more...</a>	
<b>EBSEES (European bibliography of Slavic and East European studies)</b> <a href="#">↗</a>	
Contains the data of two former EBSEES databases, one for 1991-2000, the other for 2001-2006.	
<b>EconLit with Full Text</b> <a href="#">↗</a>	
<b>Alternative Name(s) &amp; Keywords:</b> EBSCO	
Access a wide variety of economics-related literature. Includes indexes of journals, books, and dissertations, and covers both economic theory and application.	
<b>Economist Archive (1843-2011)</b> <a href="#">↗</a>	
Access back issues of the economic and political focused magazine. Offers multidisciplinary primary sources for researching and teaching the 19th and 20th centuries.	
<b>Economist Intelligence Unit (EIU)</b> <a href="#">↗</a>	
Access to country and industry analysis, forecasts, data, country profiles, as well as coverage of global business and political news. Emory subscribes to the Country Reports and Country Commerce collections.	
<b>Economist.com</b> <a href="#">↗</a>	
Desktop access to The Economist magazine's weekly print edition and additional content, including special reports, unique to the Economist.com website.	
<a href="#">more...</a>	

Search “The Measurement and Decomposition of Multi-dimensional Inequality”. The article seems to have been used in a book, but the you can access the original by click “PDF Full Text” (see figure below).

Search Results: 1 - 2 of 2

1.  **The Measurement and Decomposition of Multi-dimensional Inequality**    
 Maasoumi, Esfandiar; The Economic Theory of Income **Inequality**, 2013, pp. 447-53, Elgar Research Collection. International Library of Critical Writings in Economics, vol. 279. Cheltenham, U.K. and Northampton, Mass.: Elgar  
**Subjects:** Personal Income, Wealth, and Their Distributions ; Equity, Justice, Inequality, and Other Normative Criteria and Measurement

2.  **The Measurement and Decomposition of Multi-dimensional Inequality**    
 Academic Journal  
 Maasoumi, Esfandiar; *Econometrica*, July 1986, v. 54, iss. 4, pp. 991-97  
**Subjects:** Welfare Theory--General ; Social Choice--General  
 [PDF Full Text](#)

Now, click on the article's name, click "export" on the right (to export) the citation, click "Citations in BibTeX format", and click "save". Your screen should look like this

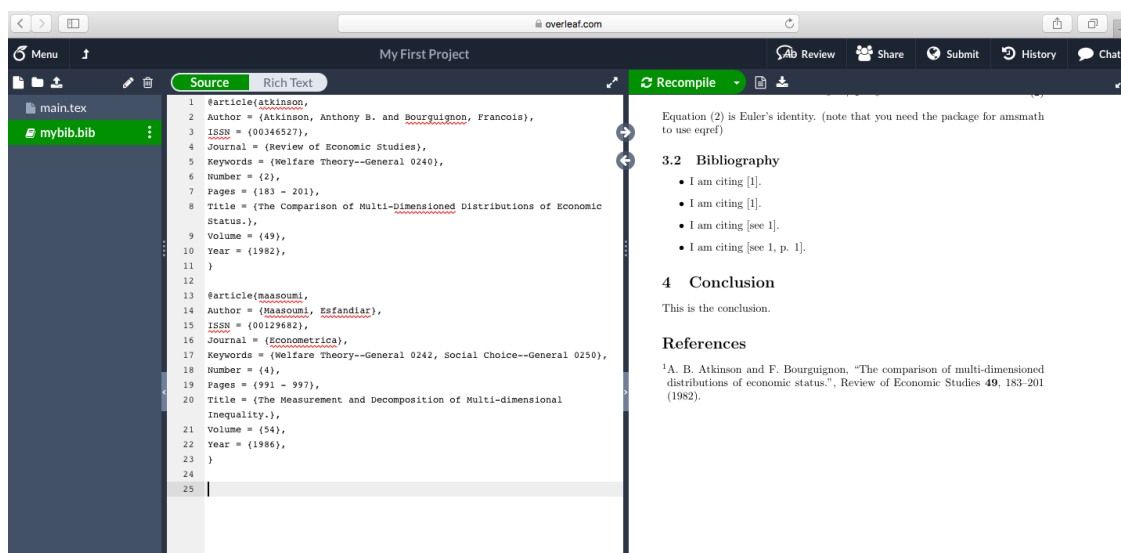
EBSCO Publishing Citation Format: BibTex:

#### References

```
@article{019393319860701,
  Author = {Maasoumi, Esfandiar},
  ISSN = {00129682},
  Journal = {Econometrica},
  Keywords = {Welfare Theory--General 0242, Social Choice--General 0250},
  Number = {4},
  Pages = {991 - 997},
  Title = {The Measurement and Decomposition of Multi-dimensional Inequality.},
  Volume = {54},
  URL = {https://login.proxy.library.emory.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eoh&AN=0193933&site=ehost-live&scope=site},
  Year = {1986},
}
```

[◀ Back](#)

Copy and paste the citation into your "mybib.bib" file in overleaf. Delete the URL line and change the numbers on the first line to "maasouni" (that is how we reference the citation in main), as shown below



Notice that the citation does not show up in references. The citation will only show up if it is called in the text. To make the citation appear in references type `\nocite{maasoumi}` above `\printbibliography`. And, `\nocite{*}` will show all citations in `mybib.bib`.

## Tricks of the Trade

If you google a title of an article you want to read, it is very likely you don't have access to it. Instead of going through the process of login into eJournals on Emory's library website, you can simply do the following:

(1) On your browser go to 'www.google.com' (or whatever other website you want) and add it to your favorites.

(2) Then 'edit' this new favorite link and change

'www.google.com' to 'javascript:void(location.href="http://proxy.library.emory.edu/login?url="+location.href)'

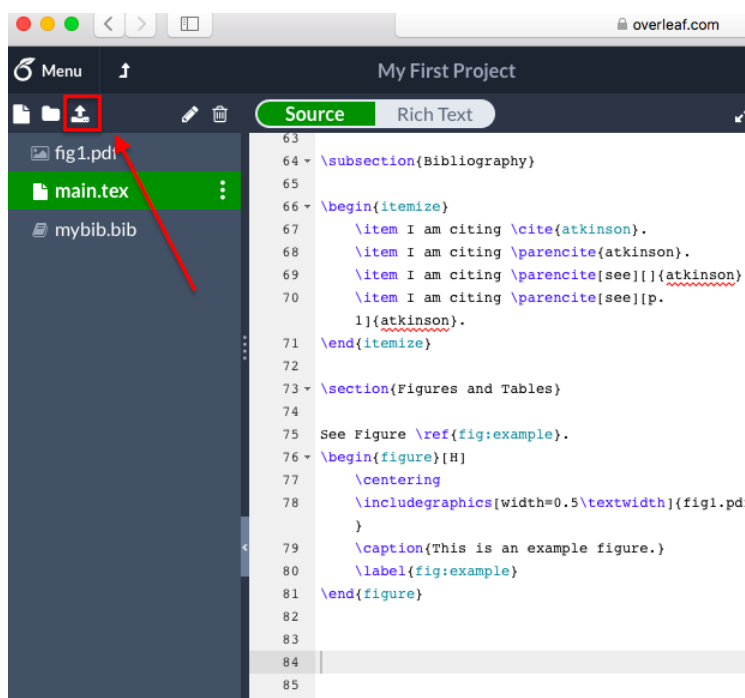
(without the ' ' of course).

Next time you find an article you're interested in, while on the publisher website, click on the favorite link you created in (1) and (2) and you will be directed to Emory verification page. Input your Emory username and password and very likely you will now be able to download the PDF version of the article you are looking for.

This works even for articles not in economics and is useful if you use google scholar instead of the Emory database when searching for articles. I thank professor David Jacho-Chavez for showing this trick to me.

## Figures and Tables

After downloading example.pdf from Canvas, upload it to your project by click the upload button in Overleaf. See the figure below

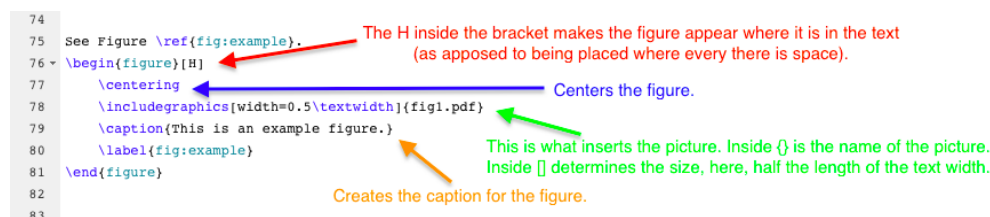


Add `\usepackage{graphicx}` and `\usepackage{float}` to the preamble. Add a section called “Tables and Figures” before the conclusion section. In the new section type

See Figure `\ref{fig:example}`.

```
\begin{figure}[H]
  \centering
  \includegraphics[width=0.5\textwidth]{example.pdf}
  \caption{This is an example figure.}
  \label{fig:example}
\end{figure}
```

Let’s break down what is going on. See the figure below



Next let’s make a table. In the same section type

This is a table

```
\begin{table}[H]
  \centering
  \begin{tabular}{1 1}
    1 & 2 \\
    3 & 4
  \end{tabular}
  \caption{My first table.}
```

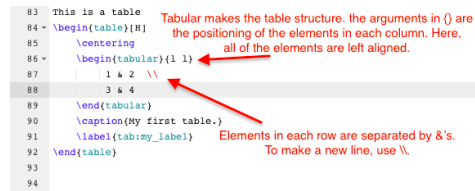


```

\label{tab:my_label}
\end{table}

```

The output should be



```

83 This is a table
84 \begin{table}[H]
85 \centering
86 \begin{tabular}{l l}
87 1 & 2 \\
88 3 & 4
89 \end{tabular}
90 \caption{My first table.}
91 \label{tab:my_label}
92 \end{table}
93
94

```

Tabular makes the table structure, the arguments in {} are the positioning of the elements in each column. Here, all of the elements are left aligned.

Elements in each row are separated by &'s. To make a new line, use \\.

```

1 2
3 4

```

Table 1: My first table.

## 5 Conclusion

This is the conclusion.

To get the gist of it, add the following two tables

This is another table

```

\begin{table}[H]
\centering
\begin{tabular}{l c r} \hline \hline
left & center & right \\ \hline
1 & 22 & 333 \\
4444 & 55555 & 66666666 \\
777 & 88 & 9999 \\ \hline
\end{tabular}
\caption{My second table.}
\label{tab:two}
\end{table}

```

and

This is another table

```

\begin{table}[H]
\centering
\begin{tabular}{|l|l|l|l|} \hline
 $\alpha$  &  $\beta$  &  $\gamma$  \\ \hline
123 & 353 & 94837 \\
45734 & 54557 & 66 \\
67783 & 37 & 1899 \\ \hline
\end{tabular}
\caption{My third table.}
\label{tab:three}
\end{table}

```

Last, add this table

Name	Age	Height	Weight
Adam	20	5'9"	165 lb
Benjamin	24	5'5"	152 lb
Carla	19	5'3"	127 lb
Deborah	27	5'6"	141 lb

## Tikz

Tikz is a package in latex for drawing figures. Add `\usepackage{tikz}` to the preamble. A good website with lots of economics figures to tweak is <https://sites.google.com/site/kochiuyu/Tikz>.

Make a new section above the conclusion section called “Tikz”. In the new section, type

Figure `\ref{fig:tikz}` is a figure using the Tikz package.

```
\begin{figure}[H]
  \centering
  \begin{tikzpicture}[scale=0.3]
    \draw (5,0) -- (-5, 0);
  \end{tikzpicture}
  \caption{My first Tikz figure}
  \label{fig:tikz}
\end{figure}
```

This draws a line from coordinates (5,0) to (-5,0) and the picture’s size is “0.3”.

Now type

Figure `\ref{fig:tikz2}` is a figure using the Tikz package.

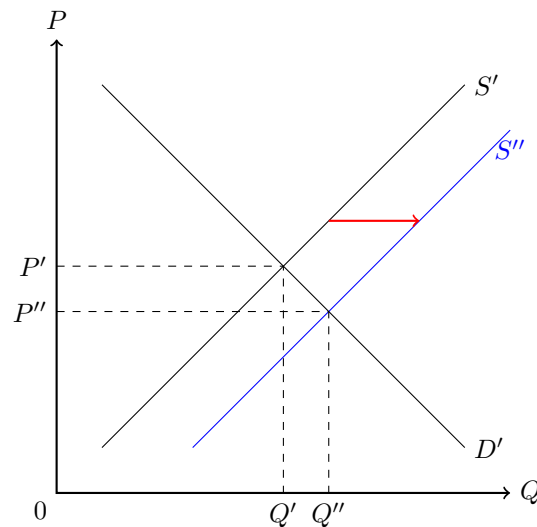
```
\begin{figure}[H]
  \centering
  \begin{tikzpicture}[scale=0.3]
    \draw (5,0) -- (-5, 0);
    \draw[>-] (0,0) -- (5,5);
    \draw[red, dashed] (-1,0) -- (-1,7);
    \node [left] at (-2,3.5) {$W_1$};
    \filldraw [blue] (0,0) circle (4pt);
  \end{tikzpicture}
  \caption{My second Tikz figure}
  \label{fig:tikz2}
\end{figure}
```

and

Figure `\ref{fig:tikz3}` is a figure using the Tikz package.

```
\begin{figure}[H]
  \centering
  \begin{tikzpicture}[scale=0.6]
    \draw[thick,<->] (0,10) node[above]{$P$}--(0,0)--(10,0) node[right]{$Q$};
    \node [below left] at (0,0) {$0$};
    \node [below] at (5,0) {$Q^*$};
    \node [left] at (0,5) {$P^*$};
    \draw(1,1)--(9,9) node[right]{\texttt{Supply}};
    \draw(1,9)--(9,1) node[right]{\texttt{Demand}};
    \draw[dashed] (0,5)--(5,5)--(5,0);
  \end{tikzpicture}
  \caption{My third Tikz figure.}
  \label{fig:tikz3}
\end{figure}
```

Add this figure to the section



note that  $P^{\prime}$  produces  $P''$ .

## Beamer

To make slides using latex, the document type is called beamer. This is beyond the scope of this introduction, but interested readers should look at [https://www.overleaf.com/learn/latex/Free\\_online\\_introduction\\_to\\_LaTeX\\_\(part\\_3\)](https://www.overleaf.com/learn/latex/Free_online_introduction_to_LaTeX_(part_3)).

## Note on Errors

Don't panic! Errors happen. It is usually a misspelling. Recompile often and fix errors as soon as they pop up. It is much easier to fix one error than to try to fix several.

## Google

Now that you know the basics, if there is anything new you want to do just Google it! Getting good at Latex takes a little while and you will be Googling a lot of things in the beginning, but as you get better, using Latex will be really efficient.

## You are done!

You just made your first document in L<sup>A</sup>T<sub>E</sub>X! Click "Download PDF" (as shown in the figure below), and submit in on Canvas.

## Word of Advice

Don't go crazy with Latex. It is useful in some settings and not the best choice in others. Undergrads tend to get carried away and write even their shopping lists with Latex. Unless it is an academic project that uses a sufficient amount of mathematical notation, Latex is likely not the best choice.

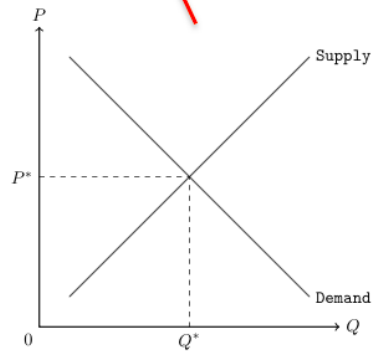


Figure 4: My third Tikz figure.

## 6 Conclusion

This is the conclusion.

## References

- Atkinson, A. B., & Bourguignon, F. (1982). The comparison of multi-dimensioned distributions of economic status. *Review of Economic Studies*, 49(2), 183–201.
- Maasoumi, E. (1986). The measurement and decomposition of multi-dimensional inequality. *Econometrica*, 54(4), 991–997.

## Part 2

### What is the effect of a policy?

Suppose the government implements a policy. How do we know the effect of that policy on some outcome of interest? For example, suppose a state increases its minimum wage. How do we know what the effect of that increase in minimum wage is on employment?

Naively, one might look at the employment before and after the minimum wage increase and compare the two. However, employment might have gone up on its own due to other factors? In that case, it is possible minimum wage reduced jobs but by observing employment before and after would lead you to the conclusion that minimum wage increases jobs.

As we learned, if the assumptions of a perfectly competitive market hold, individuals are acting rationally, and the minimum wage is binding (there are people working at a wage below the new minimum wage), then there should be a decrease in employment. However, these assumptions likely do not hold in most of the cases we might be interested in—particularly the assumption of a perfectly competitive market. While we could try relaxing some assumptions and see what results follow, we would still have to rely on some other *a priori* assumptions, which may not be *a priori* in the true meaning of the word (i.e. self-evident). Indeed, there might be no such thing as true self-evident assumptions in economics. That is why empirical economics is important. We would like to deduce strong, compelling *a posteriori* evidence of the effect of the policy with observational data that does not follow from “*a priori*” assumptions.

To be sure, the theoretical model is still important. The theoretical model allows us to say **how** the policy is effecting a particular outcome. Once we know how the policy works, we can answer more nuanced questions like, if a small minimum wage increase does not reduce employment, then what is the optimal minimum wage level before it does start to reduce employment? As you can see, empirical and theoretical work are not substitutes, but complements.

In the next section we will discuss one possible method for parsing out the causal effect of a policy. Note that much of the technical details have been removed for exposition.

### Difference-in-differences

You will have undoubtedly heard of the famous expression “correlation does not equal causation.” To demonstrate this idea, consider the case where murders and ice cream sales are positively correlate—that is, when murders increase, so do ice cream sales. Confusing correlation with causation, one might think ice cream sales cause murders. The easily implemented policy prescription would be to reduce ice cream sales in order to reduce murders. Of course, this is silly and there are likely other factors at work, possibly causing both ice cream sales and murders. If we were only interested in predicting murders, using ice cream sales would be perfectly acceptable. But, economics is generally interested in policy and causation, not prediction like, for example, facial recognition (or finance for that matter).

John Stuart Mill postulated five methods for inductively determining causation (see [https://en.wikipedia.org/wiki/Mill%27s\\_Methods](https://en.wikipedia.org/wiki/Mill%27s_Methods)). All of these methods determine the *ceteris paribus* effect of changing something. Note the “Method of Difference.” If the only difference between a control and a treatment group is one thing, A, and the only difference in outcome is one thing, w, then we say A caused w.<sup>3</sup>

Consider Table 1. Let  $y$  be the outcome of interest (employment), “Before” is the period before the policy was implemented (period before a minimum wage increase), “After” is the period after the policy was

---

<sup>3</sup>Modern economics and causal inference don’t use the verbal arguments of “Mills Methods” but rather formal mathematical arguments based on probabilistic models. Curious readers should see the first chapter of <http://fitelson.org/woodward/haavelmo.pdf>. Trygve Haavelmo won a Nobel Prize for formalizing economic models in terms of probabilistic models. If parameters in a causal model are “identified,” then the *ceteris paribus* of the policy can be determined. The “Rubin potential outcome framework” is a commonly used type of probabilistic model in applied microeconomics.

implemented, treatment is a group that gets the minimum wage increase in the “After” period (state that implemented a minimum wage increase), and control is a group that does not get a minimum wage increase in the “After” period (state that did not implement a minimum wage increase). So,  $y_{c,b}$  is the employment in the control state before the policy was implemented. Then,  $y_{(c,b)} - y_{(c,a)}$  is how much employment changes in the control state (without minimum wage),  $y_{(t,b)} - y_{(t,a)}$  is how much employment changes in the treatment group, and hence  $(y_{(c,b)} - y_{(c,a)}) - (y_{(t,b)} - y_{(t,a)})$  is the effect of employment due to the only difference between the control and treatment groups—minimum wage.

	Before	After	Difference
Control	$y_{(c,b)}$	$y_{(c,a)}$	$y_{(c,b)} - y_{(c,a)}$
Treatment	$y_{(t,b)}$	$y_{(t,a)}$	$y_{(t,b)} - y_{(t,a)}$
			$(y_{(c,b)} - y_{(c,a)}) - (y_{(t,b)} - y_{(t,a)})$

Table 1: Difference-in-differences

## Minimum Wage Literature

Please read <https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.35.1.3>. The Journal of Economic Perspectives publishes nontechnical opinion pieces and is an excellent place for undergraduate students to see the forefront of economic research without being bogged down by technical details.

Additionally, please read this short literature review I wrote: <https://izzy-cahn.github.io/website/documents/litreview.pdf>.

You will need to reference Card and Kruger (1994): <https://davidcard.berkeley.edu/papers/njmin-aer.pdf>. You do not need to read it.

## Writing Resources

Here is a nice guide for writing economics paper for undergraduates: [Link]. You can just skim through it, but I recommend reading sections 18a, 19, 20, 21, and 23.

## Mock Paper

For Part 2 of this project, write a short paper (2-4 pages is fine) using Latex. Pretend you are writing the Card and Kruger (1994) paper now. The paper should includes:

1. An abstract, introduction, and conclusion section (10%)
2. A literature review section which summarizes the minimum wage controversy (45%)
3. A reference section using APA referencing (10%)
4. A “Model of Perfect Competition” section with a supply and demand figure with a price floor representing minimum wage drawn with Tikz and explained (20%)
5. A data section briefly describing the data used in Card and Kruger (1994) (5%)
6. A results section with the table of Figure below explained. So, what you need to do is put the numbers in from Figure into a table like Table 1 above. Ignore the numbers in parenthesis in Figure, they are the standard errors. (10%)

Most empirical microeconomics papers follow a similar structure. The paper should be structured: abstract, introduction, literature review, data, model (generally this section would be empirical strategy), results, (there would generally be a section here on robustness checks that address any concerns a reader might have so that the results of the paper are compelling), conclusion, references.

TABLE 3—AVERAGE EMPLOYMENT PER IN NEW JERSEY M			
Variable	Stores by state		
	PA (i)	NJ (ii)	Difference, NJ – PA (iii)
1. FTE employment before, all available observations	23.33 (1.35)	20.44 (0.51)	– 2.89 (1.44)
2. FTE employment after, all available observations	21.17 (0.94)	21.03 (0.52)	– 0.14 (1.07)
3. Change in mean FTE employment	– 2.16 (1.25)	0.59 (0.54)	2.76 (1.36)

Figure 1: Table 3 in Card and Kruger (1994) showing the difference-in-differences results

## Example

Here is an example of Part 2: <https://izzy-cahn.github.io/website/documents/example.pdf>.