



L^AT_EX WORKSHOP

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1 What is LaTeX?

LaTeX is a free typesetting program and is an extension of the original program Tex written by Donald Knuth and released in 1978.

What is typesetting program?

To prepare a document:

1. The text is entered into the computer.
2. The input text is formatted into lines, paragraphs and pages.
3. The output text is displayed on the computer screen.
4. The final output is printed.

In most word processors all these operations are integrated into a single application package. But a typesetting program like TEX is concerned only with the second stage above. So to typeset a document using TEX, we type the text of the document and the necessary formatting commands in a text editor and then compile it. After that the document can be viewed using a previewer or printed using a printer driver.

TEX is a programming language, so that by learning this language, people can write code for additional features. In fact LATEX itself is such a (large) collection of extra features.

2 Why LaTeX?

So, why all this trouble? Why not simply use a word processor? The answer lies in the motivation behind TEX. Donald Knuth says that his aim in creating TEX is to beautifully typeset technical documents especially those containing a lot of Mathematics. It is very difficult (sometimes even impossible) to produce complex mathematical formulas using a word processor. Again, even for ordinary text, if you want your document to look really beautiful then LATEX is the natural choice.

3 LaTeX Installation

Installing MiKTeX

MiKTeX is a free TeX distribution for Windows systems. The current version is MiKTeX 2.9. The survey starts at the [MiKTeX website](#). In the menu, click on [MiKTeX 2.9](#) and scroll down to download the MiKTeX 2.9 Net Installer. This is the installation file that will be used to download the MiKTeX distribution. Run the file once it is downloaded. The installation wizard of MiKTeX will now pop up.

First, agree with the copying conditions and click next. In the following window, click 'Download MiKTeX' to download the distribution to a directory on your computer. Again, click next. Next you will be prompted whether you want install Basic or Complete MiKTeX. I recommend you to download the complete distribution, since it will save a lot of time in the future. Note that the complete package is quite large (1.2 GB) and it takes a while to install. So you'll need a steady internet connection and enough space on your hard-disk. The next thing you have to choose is the source where the package will be downloaded from. Search for a source that is located in your country, or nearby. After you click next you'll have to choose a directory where MiKTeX will be installed. This was the last step, the downloading will now begin. Note that this installation will take a while.

Once its finished, navigate to the directory where you've installed MiKTeX. There are a lot, really a lot, of files here. However, there is only one .exe file. Run this file (called setup-2.9.3959.exe for this version). This time, the real installation of MiKTeX will take place. This process will again be quite lengthy.

Installing the Editor

In order to actually compile LaTeX documents, we need an editor. For windows, the most used editors are probably [TeXnicCenter](#) and [Texmaker](#). I might add an overview of all editors in the future, but that is not where this tutorial is about. Personally, I like Texmaker the most, so let's install that editor right away!

On the Texmaker website, go to the download section to download Texmaker for Windows. The current version is 2.2.1. We're going to download the Executable file (.exe). When the downloading is complete, don't run the installation wizard! Wait for the MiKTeX installation to be completed. This way, Texmaker will automatically

configure the settings for you. Once you're ready to install Texmaker, agree to the GPL license by clicking 'I Agree' and choose a directory to install the editor. Done! Wow, that was fast.

4 What To Do After Installation?

When we finish the installation and open the text editor, we need to think about the *Document Structure*, which includes:

- 1 Global structure
- 2 Preamble
 - 2.1 Document classes
 - 2.2 Packages
- 3 Top matter
- 4 The main body of text
- 5 Bibliography and references
- 6 Glossary and Index

5 Global Structure

When LaTeX processes an input file, it expects it to follow a certain structure. Thus every input file must contain the commands

```
\documentclass{...}  
\begin{document}  
...  
\end{document}
```

The area between

`\documentclass{...}` and `\begin{document}`

is called the preamble. It normally contains commands that affect the entire document.

After the preamble, the text of our document is enclosed between two commands which identify the beginning and end of the actual document:

```
\begin{document}  
...  
\end{document}
```

6 Preamble

6.1 Document Classes

In order to start typing, we first need to decide which document class is more suitable based on our purposes under the command

```
\documentclass[options]{class}
```

6.1.1 Small Example

Let us first give a very short example in LATEX.

```
\documentclass{article}  
\begin{document}  
\emph{This is my first document in \LaTeX}.  
\end{document}
```

Then the output is

This is my first document in L^AT_EX.

6.1.2 Different Document Classes

- [article](#) For articles in scientific journals, presentations, short reports, program documentation, invitations, ...
- [IEEEtran](#) For articles with the IEEE Transactions format.
- [proc](#) A class for proceedings based on the article class.
- [report](#) For longer reports containing several chapters, small books, thesis, ...
- [book](#) For real books.

- [slides](#) For slides. The class uses big sans serif letters.
- [memoir](#) For changing sensibly the output of the document. It is based on the book class, but you can create any kind of document with it [1]
- [letter](#) For writing letters.
- [beamer](#) For writing presentations (see LaTeX/Presentations).

6.1.3 Document Class Options

Some of the options are `{10pt, 11pt, 12pt}`, `{a4paper, letterpaper,... }`, `{twocolumn}`, and `{landscape}`. For the rest of other options, we refer to https://en.wikibooks.org/wiki/LaTeX/Document_Structure.

6.2 Packages

If you want to include graphics, colored text or source code from a file into your document, you need to enhance the capabilities of LaTeX. Such enhancements are called packages. The command is:

```
\usepackage[options]{package}
```

You can pass several options to a package, each separated by a comma.

```
\usepackage[option1,option2,option3]{"package_name"}
```

Some examples of packages:

```
\usepackage{color}
\usepackage{mathrsfs,amsmath}
\usepackage{footnote}
\usepackage{hyperref}
\hypersetup{
    colorlinks=true,
    citecolor=gray
}
```

```

\begin{ver\textsc\textscbatim}
\usepackage[top=1in, bottom=1.25in, left=1.25in,
             right=1.25in]{geometry}
\usepackage{tcolorbox}
\definecolor{myviolet}{rgb}{0.73,0.56,0.64}
\definecolor{mygray}{rgb}{0.73,0.56,0.64}
\newtcolorbox{mybox1}{
    arc=0pt,
    boxrule=0pt,
    colback=myviolet,
    width=.8\textwidth,
    colupper=white,
    fontupper=\bfseries
}

```

6.3 Page Style

The standard page styles are invoked in LATEX by means of the command:

```
\pagestyle{"style"}
```

And its position is in the preamble.

- **plain:** Just a plain page number.
- **empty:** Produces empty heads and feet - no page numbers.
- **headings:** Puts running headings on each page. The document style specifies what goes in the headings.
- **myheadings:** You specify what is to go in the heading or commands.

```
\thispagestyle{empty}
```

It suppresses the original defined style for the particular page.
Its position is at the begin of the page.

7 Top Matter

At the beginning of most documents there will be information about the document itself, such as the title and date, and also information about the authors, such as name, address, email etc. All of this type of information within LaTeX is collectively referred to as *top matter*. Top matter could be defined in the Preamble or at the beginning of “*begin{document}*”.

```
\title{LATEX WORKSHOP}
\author{Sepideh Mosaferi}\
  University of Maryland,\
  College Park,\
  MD 20742, USA\
\texttt{smosafer@umd.edu}}
\date{\today}
\maketitle
```

8 Table of Contents

A table of contents is a special list which contains the section numbers and corresponding headings as given in the standard form of the sectioning commands, together with the page numbers on which they begin.

Its position is after the “*begin{document}*”, where we would like the table of contents be. The appropriate command is:

```
\tableofcontents
```

[1]

9 Main Body of Text

After the set of preparation, we could start the body of text. We can type our texts, theorems, and put graphs, etc. We can define suitable sections, subsections, etc.

```
chapter{Introduction}
This chapter's content...ref

section{Structure}
This section's content...

subsection{Top Matter}
This subsection's content...

subsubsection{Article Information}
This subsubsection's content...
```

9.1 Some Details

Here we provide some more details useful for the main body of text.

9.1.1 Figures and Tables Environments

Floating figures are created by putting commands in a figure environment. The contents of the figure environment always remains in one chunk, floating to produce good page breaks. The following commands put the graphic from figure.eps inside a floating figure:

```
\begin{figure}
\centering
\includegraphics{figure.pdf} %define the format of figure
\caption{Give A Title To The Figure.}
\label{fig} %Give a label to the figure for calling it or referring to it.
\end{figure}
```

The environment *tabular* is the basic tool for creating the tables. Some examples:

Example1

```

\begin{table}[ht]
\centering
\caption{Dual-System (Two-Sample) Table}
\begin{tabular}{c c c }
\hline\hline
& \multicolumn{2}{r}{Second Sample} \\ \cline{2-3}
& 1 & 0 \\ \hline
First Sample & & \\
1 &  $x_{11}$  &  $x_{10}$  \\
0 &  $x_{01}$  &  $x_{00}=?$  \\ \hline
\end{tabular}
\end{table}

```

Tab. 1: Dual-System (Two-Sample) Table

	Second Sample	
	1	0
First Sample		
1	x_{11}	x_{10}
0	x_{01}	$x_{00}=?$

Example2

```

\begin{tab\textscle}[ht]
\caption{Sampling Design}
\centering
\begin{tabular}{c c c c c c }
\hline\hline
& $Sample$ & $Prob. of$ & & $Sample$ & $Prob. of$ \\ \hline
$Sample$ & $Elements$ & $Sample$ & $Sample$ & $Elements$ & $Sample$ \\
[0.5ex]
\hline
1 & 1,2,3 & 0.06 & 6 & 1,4,5 & 0.10 \\
2 & 1,2,4 & 0.07 & 7 & 2,3,4 & 0.11 \\
3 & 1,2,5 & 0.08 & 8 & 2,3,5 & 0.12 \\
4 & 1,3,4 & 0.09 & 9 & 2,4,5 & 0.13 \\
5 & 1,3,5 & 0.10 & 10 & 3,4,5 & 0.14
\end{tabular}

```

```
[1ex]
\hline
\end{tabular}
\end{table}
```

Tab. 2: Sampling Design

	<i>Sample</i>	<i>Prob.of</i>		<i>Sample</i>	<i>Prob.of</i>
<i>Sample</i>	<i>Elements</i>	<i>Sample</i>	<i>Sample</i>	<i>Elements</i>	<i>Sample</i>
1	1,2,3	0.06	6	1,4,5	0.10
2	1,2,4	0.07	7	2,3,4	0.11
3	1,2,5	0.08	8	2,3,5	0.12
4	1,3,4	0.09	9	2,4,5	0.13
5	1,3,5	0.10	10	3,4,5	0.14

Example3

```
\begin{table}[ht]
\caption{My Dairy}
\centering
\begin{tabular}{| l | l | l | l |} %left justified columns
\hline
Day & Month & Year & Summary \\\hline
Monday & 03 & 2016 & I study geometry today.\\\hline
Tuesday & 04 & 2016 & I study STAT 740. \\\hline
Wednesday & 05 & 2016 & I go to the library. \\\hline
Thursday & 06 & 2016 & I watch movies.\\
\hline
\end{tabular}
\end{table}
```

Tab. 3: My Dairy

Day	Month	Year	Summary
Monday	03	2016	I study geometry today.
Tuesday	04	2016	I study STAT 740.
Wednesday	05	2016	I go to the library.
Thursday	06	2016	I watch movies.

9.1.2 Typesetting Mathematics and Theorems

Donald Knuth created TEX primarily to typeset Mathematics beautifully. LATEX includes all the capabilities of TEX in Mathematics typesetting, sometimes with easier user interfaces. Then there are packages like *amsmath* which enhance and refine these interfaces. A mathematical expression occurring in running text (called *in-text math*) is produced by enclosing it between dollar signs ($\$...\$$) or $\backslash\text{begin}\{\text{math}\} \dots \backslash\text{end}\{\text{math}\}$. For example in order to have a simple formula of circle $(x-2)^2 + (y-2)^2 = 25$, we need to type:

For example in order to have a simple formula
of circle $\$(x-2)^2+(y-2)^2=25\$$, OR
 $\backslash\text{begin}\{\text{math}\}$
 $(x-2)^2+(y-2)^2=25$
 $\backslash\text{end}\{\text{math}\}$

If we want to type formula outside of a text, we have different options:

- I. double dollar signs ... double dollar signs
- II. $\backslash\text{begin}\{\text{equation}^*\} \dots \backslash\text{end}\{\text{equation}^*\}$
- III. $\backslash\text{begin}\{\text{equation}\} \dots \backslash\text{end}\{\text{equation}\}$

I. double dollar signs ... double dollar signs ($\$...\$$)

$$\lim_{n \rightarrow \infty} Pr(C_1 \leq \frac{\xi_1^n - n/2}{\sqrt{n/4}} \leq C_2) = \frac{1}{\sqrt{2\pi}} \int_{C_1}^{C_2} e^{-\frac{z^2}{2}} dz$$

II. $\backslash\text{begin}\{\text{equation}^*\} \dots \backslash\text{end}\{\text{equation}^*\}$

$$\lim_{n \rightarrow \infty} Pr(C_1 \leq \frac{\xi_1^n - n/2}{\sqrt{n/4}} \leq C_2) = \frac{1}{\sqrt{2\pi}} \int_{C_1}^{C_2} e^{-\frac{z^2}{2}} dz$$

III. $\backslash\text{begin}\{\text{equation}\} \dots \backslash\text{end}\{\text{equation}\}$

$$\lim_{n \rightarrow \infty} Pr(C_1 \leq \frac{\xi_1^n - n/2}{\sqrt{n/4}} \leq C_2) = \frac{1}{\sqrt{2\pi}} \int_{C_1}^{C_2} e^{-\frac{z^2}{2}} dz \quad (1)$$

ref **More On Mathematics**: Multiline and group of equations

```
\begin{multline*}
\lim_{n \rightarrow \infty} \Pr(C_1 \leq \frac{\xi_n}{\sqrt{n}} \leq C_2) = \lim_{n \rightarrow \infty} \Pr(C_1 \leq
\frac{2\nu_1^n - n}{\sqrt{n}} \leq C_2) \\
= \frac{1}{\sqrt{2\pi}} \int_{C_1}^{C_2} e^{-\frac{z^2}{2}} dz
\end{multline*}
```

$$\lim_{n \rightarrow \infty} \Pr(C_1 \leq \frac{\xi_n}{\sqrt{n}} \leq C_2) = \lim_{n \rightarrow \infty} \Pr(C_1 \leq \frac{2\nu_1^n - n}{\sqrt{n}} \leq C_2) \\ = \frac{1}{\sqrt{2\pi}} \int_{C_1}^{C_2} e^{-\frac{z^2}{2}} dz$$

```
\begin{equation*}
\begin{split}
\lim_{n \rightarrow \infty} \Pr(C_1 \leq \frac{\xi_n}{\sqrt{n}} \leq C_2) &= \lim_{n \rightarrow \infty} \Pr(C_1 \leq \frac{2\nu_1^n - n}{\sqrt{n}} \leq C_2) \\
&= \frac{1}{\sqrt{2\pi}} \int_{C_1}^{C_2} e^{-\frac{z^2}{2}} dz
\end{split}
\end{equation*}
```

$$\lim_{n \rightarrow \infty} \Pr(C_1 \leq \frac{\xi_n}{\sqrt{n}} \leq C_2) = \lim_{n \rightarrow \infty} \Pr(C_1 \leq \frac{2\nu_1^n - n}{\sqrt{n}} \leq C_2) \\ = \frac{1}{\sqrt{2\pi}} \int_{C_1}^{C_2} e^{-\frac{z^2}{2}} dz$$

```
\begin{gather*}
(a,b)+(c,d)=(a+c,b+d) \\ (a,b)(c,d)=(ac-bd,ad+bc)
\end{gather*}
```

$$(a,b) + (c,d) = (a+c, b+d)$$

$$(a,b)(c,d) = (ac - bd, ad + bc)$$

Theorem 9.1. Poisson Limit Theorem. *If $\lim_{n \rightarrow \infty} np_n = \lambda > 0$, then the probability that the number of occurrences of 1 in a sequence of n trials is equal to k has the following limit*

$$\lim_{n \rightarrow \infty} Pr(\xi^n = k) = \frac{\lambda^k}{k!} e^{-\lambda}, k = 0, 1, \dots$$

Proof.

$$\begin{aligned} Pr(\xi^n = k) &= \frac{n!}{k!(n-k)!} p_n^k (1-p_n)^{n-k} \\ &= \frac{n(n-1)\dots(n-k+1)}{k!} p_n^k \exp((n-k)\ln(1-p_n)) \end{aligned}$$

Here k is fixed but $n \rightarrow \infty$. Therefore,

$$\lim_{n \rightarrow \infty} (n-k)\ln(1-p_n) = -\lim_{n \rightarrow \infty} (n-k)p_n = -\lim_{n \rightarrow \infty} np_n \left(1 - \frac{k}{n}\right) = -\lambda.$$

Furthermore,

$$\lim_{n \rightarrow \infty} n(n-1)\dots(n-k+1)p_n^k = \lim_{n \rightarrow \infty} (np_n)^k = \lim_{n \rightarrow \infty} (np_n)^k = \lambda^k.$$

Thus,

$$\lim_{n \rightarrow \infty} Pr(\nu^n = k) = \frac{\lambda^k}{k!} e^{-\lambda}.$$

□

For the Theorem, we need to write the following command in the preamble.

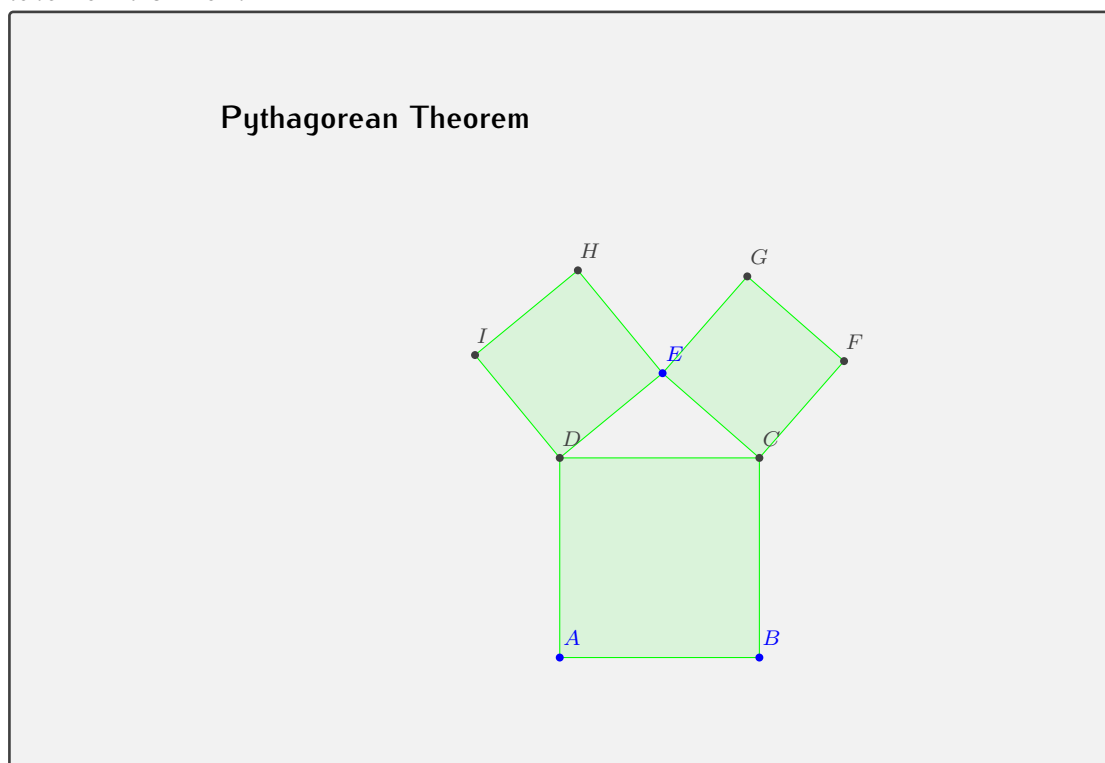
`\newtheorem{thm}{Theorem}[section]`

Then in the text, we need to use `\begin{thm}...\end{thm}` to write the theorem, and `\begin{proof} ... \end{proof}` to prove the theorem.

9.1.3 GeoGebra and MathType: Mathematical Software with Built-in LaTeX Code



GeoGebra is an interactive geometry, algebra, statistics and calculus application, intended for learning and teaching mathematics and science from primary school to university level. It has this feature that we can produce complex graphs and convert the graph to the latex source code within the program and compile it in the latex environment.



In GeoGebra we can draw any graphs that we are interested in, then we can click on *File < Export < Graphics View as PGF/TikZ < Format < LaTeX* to generate the LaTeX code and insert it into our document.

At the begin, it is difficult for beginners to type formulas directly into the latex. One solution is using MathType. In MathType, we can type formulas very similar to the word and generate the LaTeX codes within MathType and copy it into our tex-editor.



MathType is a software application created by Design Science that allows the creation of mathematical notation for inclusion in desktop and web applications. From the convert equations, we can select *MathJax:LaTeX* to convert the formulas. Note that some of the features of LaTeX might not work freely.

9.1.4 Footnotes and Marginal Notes

Footnotes are generated with the command

```
\footnote{footnote text}
```

which comes immediately after the word requiring an explanation in a footnote. As an example: Capture-Recapture for estimating the true population after the census contains the information of Census, as a capture and PES¹ as a recapture.

```
PES\footnote{Post-Enumeration Survey:
A probability survey which has been conducted after the
census time} as a recapture.
```

The `\marginpar` command generates a marginal note. This command typesets the text given as an argument in the margin, the first line at the same height as the line in the main text where the `\marginpar{Text}` command occurs.

As an example:

```
\marginpar{\scriptsize Know More Than Others.}.
```

Know
More
Than
Others.

¹ Post-Enumeration Survey: A probability survey which has been conducted after the census time

10 Glossary and Index

Glossary should be Index and usually are in books, dissertations, etc.

Glossary is an alphabetical list of terms or words found in or relating to a specific subject, text, or dialect, with explanations; a brief dictionary:

```
\makeglossary      in the preamble
\glossary{glossary-entry}{page number} in the text
```

Index is an alphabetical list of names, subjects, etc., with references to the places where they occur.

```
\makeindex      in the preamble
\index{index entry}{page number} in the text
```

11 Bibliography and References

There are variety of ways for bibliography. Here we cover two common ways:

- **thebibliography** environment usually inserted at the end of the main document
- **Bibtex** usually created outside of the main document and called at the end of main document ². Based upon the class that we are in, we can receive **References** title for papers and articles and **Bibliography** title for books.

11.1 thebibliography

The related commands are:

```
\begin{thebibliography}{ widest-label }
\bibitem{ key1 }
\bibitem{ key2 }
\end{thebibliography}
```

² Remark: Please pay attention there are variety ways for classifying references and putting them in the text. Another way is

where *key1* and *key2* (as an example) can be used as a key words for citation within the text.

```
\begin{thebibliography}{ widest-label }
\bibitem{Alho} Alho, J. M. (1990). Logistic Regression in
Capture-Recapture Models. {\it Biometrics}, {\bf 46}, 623-635.
\end{thebibliography}
```

If we want to cite the references within the text, we can use `\cite{.}` or `\citep{.}`.

11.2 Bibtex

We can produce a separate file of references with LaTeX BibTeX and saved it with the extension of and call it in the main document by its name with

If we use the above commands, for compiling we need to run

```
pdflatex -> bibtex -> pdflatex -> pdflatex
```

Based upon the publication (book, journal, etc.), there are variety of templates that one of them is given as follows and a more complete list of it can be found at https://en.wikibooks.org/wiki/LaTeX/Bibliography_Management.

```
@book{goossens93,
  author    = "Michel Goossens and Frank Mittelbach
              and Alexander Samarin",
  title     = "The LaTeX Companion",
  year      = "1993",
  publisher = "Addison-Wesley",
  address   = "Reading, Massachusetts"
}
```

A complete list of citation is as follows:

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[2]

Citation command	Output
<code>\cite{goossens93}</code>	[1]
<code>\citet{goossens93}</code>	Goossens et al. (1993)
<code>\citep{goossens93}</code>	(Goossens et al., (1993))
<code>\citet{*}{goossens93}</code>	Goossens, Mittlebach, and Samarin (1993)
<code>\citep{*}{goossens93}</code>	(Goossens, Mittlebach, and Samarin, 1993)
<code>\citeauthor{goossens93}</code>	Goossens et al.
<code>\citeauthor{*}{goossens93}</code>	Goossens, Mittlebach, and Samarin
<code>\citeyear{goossens93}</code>	1993
<code>\citeyearpar{goossens93}</code>	(1993)
<code>\citealt{goossens93}</code>	Goossens et al. 1993
<code>\citealp{goossens93}</code>	Goossens et al., 1993

All graduate students at University of Maryland, College Park who are seeking a doctoral degree should accomplish a dissertation. They need to prepare their theses based on the format provided by the UMD and submit their them to the Graduate School [DRUM \(Digital Repository at the University of Maryland\)](https://ireap.umd.edu/sites/default/files/documents/theses/LatexTemplateFiles-2015.zip) after the defence. UMD has been provided a LaTeX package under the address of <https://ireap.umd.edu/sites/default/files/documents/theses/LatexTemplateFiles-2015.zip> which could be easily downloaded. This package contains variety of files that we explain thoroughly in the workshop. We recommend graduate students to check these websites as well for getting more related information:

1. [thesis-and-dissertation-filing](#)
2. [thesis-templates](#)

References

- [1] Kirk Wolter. *Introduction to variance estimation*. Springer Science & Business Media, 2007.
- [2] Tal Yarkoni, Russell A. Poldrack, Thomas E. Nichols, David C. Van Essen, and Tor D. Wager. Large-scale automated synthesis of human functional neuroimaging data. *Nature Methods*, 8:665–670, 2011.