Introduction to LATEX

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Motivation

Encouragement

The ideal situation occurs when the things we regard as beautiful are also regarded by other people as useful ~ Donald Knuth

Goal

Making your Math look good

Disclaimer

This is just an introduction to the basics of typesetting in Maths.

Getting Started

- LaTex is a typesetting system suitable for producing scientific and mathematical documents

  i. LaTex enables authors to typeset and print their work

  ii. LaTex is pronounced as “Lay-Tech”

  iii. TeX is the typesetting engine used by LaTeX

LaTex Pros and Cons

Advantages

- Math is displayed nicely and easy to edit
- Required in post-graduate courses
- Good for writing research articles

Cons

- There is a steep learning curve

> ⚠ **Warning**
>
> *Be prepared to give up along the way but don't quit the learning process.*

Installation

- For installation on your own machine you should consult the following links:
  - MikTEX website: https://miktex.org/download
  - TeXWorks Website: http://www.tug.org/texworks/
  - TeXStudio Website: https://www.texstudio.org/

LaTeX Editors

General Editors

- Sublime Text Editor
- Notepad++

LaTeX Editors

- TeXStudio
- TeXmaker
- TeXWorks

Browser Editors

- Overleaf
- Authorea

> **Important**
>
> *The advantage of browser editors is that it allows multiple users to collaborate on a single document*

> **Note**
>
> Every student to create an account at **Overleaf**. We will use this for our demonstrations in this class.

Structure

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

- The area between `\documentclass{...}` and `\begin{document}` is called the **preamble**. It normally contains the commands that affect the entire document.

- After the preamble the text of your document is enclosed between two commands which identify the beginning and the end of the actual document.

Document Class

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

```
\documentclass[11pt,twoside,a4paper]{article}
```

- LaTeX needs to know the **type of document** the author wants to create.
- `class` specifies the type of document to be created.
- The `options` parameter customizes the behaviour of the document class

Document Classes

- `article`: For articles in scientific journals, presentations, short reports etc
- `IEEEtran`: For articles with the IEEE transaction format
- `proc`: A cass for proceedings based on the article class
- `minimal`: It only sets a page size and a base font. Used for debugging purposes
- `report`: For longer reports containing several chapters, small books, **thesis**
- `book`: For real books
- `beamer`: For writing presentations
- `letter`: For writing letters
- `slides`: For slides

Common Option for Document Class

- `10pt,11pt,12pt`: Sets the size of the main font in the document
- `a4paper, letterpaper`: Defines the paper size. Other options are `a5paper,b5paper,executivepaper,legalpaper`
- `titlepage, notitlepage`: Specifies whether a new page should be started after the document title or not
- `onecolumn, twocolumn`: Instructs LaTeX to typeset the document in one or two columns
- `twoside, oneside`: Specifies whether double or single sided output should be generated.

Cont'd

- `landscape`: Changes the layout of the document to print in landscape mode

Packages

```
1  \usepackage[options]{package}
2
3  \documentclass[11pt, a4paper]{report}
4
5  \usepackage{color}
6
7  \begin{document}
8  ...
9  ...
10 \end{document}
```

- A comprehensive list of packages and documentation can be found http://www.ctan.org/

- You can enhance the caabilities of LaTeX using packages
- These packages are defined in the preamble section of the document.
- `package` is the name of the package
- `Options` are a list of keywords that trigger special features in the package
- **Options are not always necessary**

Some useful packages

- `\usepackage{amsmath}` most important for math environments
- `\usepackage{graphicx}` essential for inserting figures
- `\usepackage[a4paper]{geometry}` adjust margins of pages
- `\usepackage{hyperref}` makes citations clickable in pdf document

> **Note**
>
> Since we are in Mathematics, we will explore several packages that make our typsetting easier.

Title Page

```
\title{Title Here}
\author{Mutua Kilai \\
Department of Pure and Applied Sciences\\
Kirinyaga University \\
\texttt{samkmutua@gmail.com}}
\date{\today}
\maketitle
```

- The double backslash `\\` is the command for a forced line break
- The `\texttt` command formats the email address using a mono-spaced font
- The `\today` command is used to insert the current date
- To omit the date simply leave the braces empty

Abstract

```
1 \documentclass{article}
2 \begin{document}
3 \begin{abstract}
4 Here is whereto have your abstract
5 \end{abstract}
6 \end{document}
```

- Appears at the top of the main body of the document but before the other sections.
- Available for the `article` and `report` classess but not the book class.

Sections

```
1  \documentclass{article}
2  \begin{document}
3  \section{Introduction}
4  Some text here
5  \section{Objectives}
6  \subsection{Specific Objectives}
7  \subsubsection{Research Questions}
8  \end{document}
```

- Sections can be used to help structure a document to make it more readable
- Think of these like chapters or section headings
- Text placed in the brackets will appear as headings on the document
- Sections are also useful when creating a contents page

Table of Contents, List of Figures, List of Tables

- Once you have your sections set correctly you can include them in the table of contents in your work.

- To do this simply insert the following command where you would like your table of contents to be:

```
1 \tableofcontents
```

- You are also able to include a list of figures or tables that you have specified in the document in a similar way using the following commands.

```
1 \listoffigures
2 \listoftables
```

Lists

Bulleted List

```
\begin{itemize}
\item Item 1
\item Item 2
\end{itemize}
```

Description List

```
\begin{description}
\item[First] Item I
\item[Second] Item 2
\end{description}
```

Numbered List

```
\begin{enumerate}
\item Item 1
\item Item 2
\end{enumerate}
```

Nested Lists

```
\begin{enumerate}
\item Item I
\begin{enumerate}
\item Nested Item 1
\item Nested Item 2
\end{enumerate}
\item Item 2
\end{enumerate}
```

Labels and Referencing

```
1 \section{Hello}
2 \label{sec:hello}
3 Hello
4 \section{Referencing}
5 Now we can refer to section \ref{sec:hello}
```

- You can label and reference your sections and pretty much your object in your document using the `\label` command
- You can give a page reference in a similar way by using the `\pageref{marker}` command
- **Tables, Figures, Equations** are referenced in the same manner.

Tables

```
\begin{tabular}[pos]{table spec}
...table here...
\end{tabular}
```

- The `table spec` argument tells LaTeX the alignment to be used in each column and the vertical lines to insert
- The optional parameter `pos` can be used to specify the vertical position of the table relative to the baseline of the surrounding text

Creating a Simple Table in LaTeX

```
\begin{center}
\begin{tabular}{ c c c }
 1 & 2 & 3 \\
 4 & 5 & 6 \\
 7 & 8 & 9
\end{tabular}
\end{center}
```

- The `tabular` environment is the default LaTeX method to create tables.
- You must specify a parameter here we use `{c c c}` which tells LaTeX there are three columns and the text inside each one of them must be centered.

Positioning Tables

- `h` will place the table *here* approximately
- `t` Positioning the table at the *top* of the page
- `b` Position the table at the *bottom* of the page
- `p` puts the table in a special page for tables only
- `!` overide internal LaTeX parameters
- `H` place the table at this precise location, pretty much like `h!`
- `\centering` Centres the table relative to the float container element

Captions, Labels and References in Tables

```
\documentclass{article}
\begin{document}
Table \ref{table:1} is an example of a referenced \LaTeX{} element.

\begin{table}[h!]
\centering
\begin{tabular}{||c c c c||}
 \hline
 Col1 & Col2 & Col2 & Col3 \\ [0.5ex]
 \hline\hline
 1 & 6 & 87837 & 787 \\
 2 & 7 & 78 & 5415 \\
 3 & 545 & 778 & 7507 \\
 4 & 545 & 18744 & 7560 \\
 5 & 88 & 788 & 6344 \\ [1ex]
 \hline
\end{tabular}
\caption{Table to test captions and labels.}
\label{table:1}
```

Cont'd

- `\caption{}` gives the caption of the table
- `\label{}` If you need to reference the table within your document set a label with this command
- `\ref{table:1}` This code will be replaced by the number corresponding to the referenced table.

> **Important**
>
> *For ease of creating Latex Tables, use this online generator* https://www.tablesgenerator.com/

- **All Tables in Academia have to be in APA style**. We use the `booktabs` package to facilitate this.

Mathematical Expressions

Introduction

- LaTeX's features for typesetting mathematics make it a compeling choice for writing technical documents.
- This lecture shows the most basic commands needed to get started with writing maths using LaTeX
- Writing basic equations in LaTeX is straightforward, for example

```
1 \begin{document}
2 Consider the equation \(x^2 + y^2 = z^2\)
3 \end{document}
```

Consider the equation $x^2 + y^2 = z^2$

Mathematical Modes

- LaTeX allows two writing modes for mathematical expressions:

  i. `inline math mode`: Used to write formulas that are part of paragraph

  ii. `display math mode`: Used to write expressions thatare not part of a paragraph and are therefore put on separate lines

Inline Math Mode

- You can use any of these delimiters to typeset your math in inline mode:

  a. `\(...\)`

  b. `$...$`

  c. `\begin{math}...\end{math}`

- They all work and the choice is a matter of taste.

```
\begin{document}
Equation \(E=mc^2\)

Instead use $E=mc^2$

Another option can be

\begin{math}E=mc^2\end{math}
\end{document}
```

Display Math Mode

- Use one of these constructions to typeset maths in display mode:

  i. `\[\]`

  ii. `\begin{displaymath}...\end{displaymath}`

  iii. `begin{equation}...\end{equation}`

Cont'd

- Display math mode has two versions which produce numbered or unnumbered equations.

```
# numbered equations
\begin{equation}\label{eqn1}
y = mx +c
\end{equation}

Equation \ref{eqn1} shows
```

$$y = mx + c$$

```
# unnumbered equations

\begin{equation*}
y = mx +c
\end{equation*}
```

$$y = mx + c$$

Guide for Math Symbols

- For list of `Greek Letters` see here

Matrices

amsmath matrix environments

- The `amsmath` package provides commands to typeset matrices with different delimiters.

- Once you have loaded `\usepackage{amsmath}` in your preamble, you can use the following environments in your math environments

plain

```
\begin{matrix}
1 & 2 & 3\\
a & b & c
\end{matrix}
```

$$\begin{matrix}
1 & 2 & 3\\
a & b & c
\end{matrix}$$

Cont'd

Parentheses: round brackets

```
\begin{pmatrix}
1 & 2 & 3\\
a & b & c
\end{pmatrix}
```

$$\begin{pmatrix} 1 & 2 & 3 \\ a & b & c \end{pmatrix}$$

Brackets: square brackets

```
\begin{bmatrix}
1 & 2 & 3\\
a & b & c
\end{bmatrix}
```

$$\begin{bmatrix} 1 & 2 & 3 \\ a & b & c \end{bmatrix}$$

Brackets: curly brackets

```
\begin{Bmatrix}
1 & 2 & 3\\
a & b & c
\end{Bmatrix}
```

$$\begin{Bmatrix} 1 & 2 & 3 \\ a & b & c \end{Bmatrix}$$

pipes

```
\begin{vmatrix}
1 & 2 & 3\\
a & b & c
\end{vmatrix}
```

$$\begin{vmatrix}
1 & 2 & 3\\
a & b & c
\end{vmatrix}$$

Inline Matrices

```
\documentclass{article}
\usepackage{amsmath}
\begin{document}
\noindent Trying to typeset an inline matrix here:
 $\begin{pmatrix}
  a & b\\
  c & d
\end{pmatrix}$,
but it looks too big, so let's try
$\big(\begin{smallmatrix}
  a & b\\
  c & d
\end{smallmatrix}\big)$
instead.
\end{document}
```

Trying to typeset an inline matrix here: $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ but it looks too big, so let's try $\big(\begin{smallmatrix} a & b \\ c & d \end{smallmatrix}\big)$ instead.

Subscripts and superscripts

Introduction

- The use of superscripts and subscripts is very common in mathematical expressions involving exponents, indexes and in some special operators.

- This section explains how to write superscripts and subscripts in simple expressions, integrals, summations etc

Definite Integrals

```
$$\int\limits_0^1 x^2 + y^2 dx$$
```

$$\int\limits_0^1 x^2 + y^2 dx$$

Note

> **Note**
>
> - By convention, superscripts and subscripts in LaTeX are created using the characters ^ and _ respectively.

Operators using subscripts and superscripts

- Some mathematical operators may require subscripts and superscripts.

- The most frequent cases are those of the integral `\int` and summation `\sum` operators whose bounds are typset precisely with superscripts and subscripts.

```
$$ \sum_{i=1}^{\infty} \frac{1}{n^s}
= \prod_p \frac{1}{1 - p^{-s}} $$
```

$$\sum_{i=1}^{\infty} \frac{1}{n^s} = \prod_p \frac{1}{1 - p^{-s}}$$

More Examples

Intersection

```
\cap_{i=1}^n
```

$$\bigcap_{i=1}^{n}$$

union

```
\cup_{i=1}^n
```

$$\bigcup_{i=1}^{n}$$

double subscript

```
a_{n_i}
```

$$a_{n_i}$$

Fractions and Binomials

- This section explains how to typset binomials and fractions

```
The binomial coefficient, \(\binom{n}{k}\), is defined by the expression:
\[
    \binom{n}{k} = \frac{n!}{k!(n-k)!}
\]
```

The binomial coefficient, $\binom{n}{k}$, is defined by the expression:

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

- In LaTeX ensure you load the `amsmath package` in the document preamble

Displaying Fractions

- The visual appearance of fractions will change depending on whether they appear inline, or as part of paragraph or stand alone.

```
Fractions can be used inline within the paragraph text, for
example $\frac{1}{2}$, or displayed on their own line,
such as this:
$$\frac{1}{2}$$
```

Fractions can be used inline within the paragraph text, for example $\frac{1}{2}$, or displayed on their own line, such as this:

$$\frac{1}{2}$$

Aligning Equations with amsmath

- The `amsmath` package provides a handful of options for displaying equations.
- You can choose the layout that better suits your document.

```
\begin{equation} \label{eq1}
\begin{split}
A & = \frac{\pi r^2}{2} \\
 & = \frac{1}{2} \pi r^2
\end{split}
\end{equation}
```

$$
\begin{aligned}
A &= \frac{\pi r^2}{2} \\
&= \frac{1}{2} \pi r^2
\end{aligned}
$$

Writing a Single Equation

- To display a single equation you have to use the `equation*` or `equation` environment depending on whether you want the equation to be numbered or not.

- Additionally you might add label for future reference within the document

```
\begin{equation} \label{eu_eqn}
e^{\pi i} + 1 = 0
\end{equation}

The beautiful equation \ref{eu_eqn} is known as the Euler equation.
```

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

Displaying Long Equations

- For equations longer than a line use the `multiline` environment.
- Insert a double backslash to set a point for the equation to be broken.
- The first part will be aligned to the left and the second part will be displayed in the next line and aligned left

```
\begin{multline*}
p(x) = 3x^6 + 14x^5y + 590x^4y^2 + 19x^3y^3\\
- 12x^2y^4 - 12xy^5 + 2y^6 - a^3b^3
\end{multline*}
```

$$p(x) = 3x^6 + 14x^5y + 590x^4y^2 + 19x^3y^3 \\ - 12x^2y^4 - 12xy^5 + 2y^6 - a^3b^3$$

Aligning Several Equations

- If there are several equations that you need to align vertically the `align` environment will do it.

```
\begin{align*}
2x - 5y &=  8 \\
3x + 9y &=  -12
\end{align*}
```

$$2x - 5y = 8$$
$$3x + 9y = -12$$

Operators

Trigonometric Functions

- Characters in mathematical mode are usually shown in italics but sometimes certain function name require different formatting which can be accomplished by using operators defined in LaTeX

- Trigonometrical functions, logarithms, and others can be written in a document by means of some special commands.

```
Examples of mathematical operators:
$$\sin(a + b) = \sin a \cos b + \cos b \sin a$$
```

$$\sin(a + b) = \sin a \cos b + \cos b \sin a$$

Operators in different Context

- Some operators can take parameters that are handled in a special way for instance `limits`

```
1 Testing notation for limits
2 $$\lim_{h \to 0 } \frac{f(x+h)-f(x)}{h}$$
3 This operator changes when used alongside
4 text $\lim_{h \to 0} (x-h)$.
```

Testing notation for limits

$$\lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$$

This operator changes when used alongside text $\lim_{h \to 0}(x-h)$.

Spacing in math mode

- Adjusting LaTeX default math mode spacing can be useful in certain situations

```
Assume we have the next sets
$$S = \{ z \in \mathbb{C}\, |\, |z| < 1 \} \quad \textrm{and} \quad S_2=\partial{S}$$
```

Assume we have the next sets

$$S = \{z \in \mathbb{C} \,|\, |z| < 1\} \quad \textrm{and} \quad S_2 = \partial S$$

Spaces

- The example below contains a complete list of spaces inserted using various commands

```
Spaces in mathematical mode.

\begin{align*}
f(x) &= x^2\! +3x\! +2 \\
f(x) &= x^2+3x+2 \\
f(x) &= x^2\, +3x\, +2 \\
f(x) &= x^2\: +3x\: +2 \\
f(x) &= x^2\; +3x\; +2 \\
f(x) &= x^2\ +3x\ +2 \\
f(x) &= x^2\quad +3x\quad +2 \\
f(x) &= x^2\qquad +3x\qquad +2
\end{align*}
```

Output

Spaces in mathematical mode.

$$f(x) = x^2 + 3x + 2$$

$$f(x) = x^2 + 3x + 2$$

$$f(x) = x^2 \ + 3x \ + 2$$

$$f(x) = x^2 \ + 3x \ + 2$$

$$f(x) = x^2 \ + 3x \ + 2$$

$$f(x) = x^2 \ + 3x \ + 2$$

$$f(x) = x^2 \quad + 3x \quad + 2$$

$$f(x) = x^2 \qquad + 3x \qquad + 2$$

Intregrals

- Integrals expressions can be added using the `\int_{lower}^{upper}` command
- Note that integral expression may seems a little different in inline and display math mode

```
1  Integral $\int_{a}^{b} x^2 \,dx$ inside text
```

Integral $\int_a^b x^2 \,dx$ inside text

Multiple Integrals

- To obtain double/triple/multiple integrals and cyclic integrals you must use `amsmath`

```
\begin{gather*}
    \iint_V \mu(u,v) \,du\,dv
\\
    \iiint_V \mu(u,v,w) \,du\,dv\,dw
\\
    \iiiint_V \mu(t,u,v,w) \,dt\,du\,dv\,dw
\\
    \idotsint_V \mu(u_1,\dots,u_k) \,du_1 \dots du_k
\end{gather*}
```

Output

$$\iint_V \mu(u, v)\, du\, dv$$

$$\iiint_V \mu(u, v, w)\, du\, dv\, dw$$

$$\iiiint_V \mu(t, u, v, w)\, dt\, du\, dv\, dw$$

$$\int \cdots \int_V \mu(u_1, \ldots, u_k)\, du_1 \ldots du_k$$

Inserting Images

- In this section we explain how to include images in the most common formats how to shrink, enlarge and rotate them.

- A simple example is given in the code below

```
\documentclass{article}
\usepackage{graphicx}
\graphicspath{ {./images/} }

\begin{document}
The universe is immense and it seems to be homogeneous,
in a large scale, everywhere we look at.

\includegraphics{universe}

There's a picture of a galaxy above
\end{document}
```

Changing image size

- You can specify length, height etc we can pass those contents in the following format:

```
1 \includegraphics[width=5cm, height=4cm]{logo}
```

Positioning

- The positioning is same as the one for tables:

```
\begin{figure}[h]
\includegraphics[width=8cm]{Plot}
\end{figure}
```

- Sample include:

  i. `h` place the float here

  ii. `t` Position at the *top* of the page

  iii. `b` position at the *bottom* of the page

  iv. `!` override internal LaTeX parameters

Wrapping text around figures

- It’s also possible to wrap the text around a figure.
- When the document contains small pictures this makes it look better

```
\begin{wrapfigure}{r}{0.25\textwidth} %this figure will be at the right
    \centering
    \includegraphics[width=0.25\textwidth]{mesh}
\end{wrapfigure}

There are several ways to plot a function of two variables,
depending on the information you are interested in. For
instance, if you want to see the mesh of a function so it
easier to see the derivative you can use a plot like the
one on the left.
```

- For the commands to work you have to import the `wrapfig` package in the document preamble.

Position parameters

- `r R` right side of the text
- `l L` left side of the text
- `i I` inside edge near the binding (*two side document*)
- `o O` outside edge-far from the binding

> **Important**
>
> *The upper version allows the figure to float. The lowercase version means **exactly here***

Captions in Figures

```
\begin{figure}[h]
\caption{Example of a parametric plot ($\sin (x), \cos(x), x$)}
\centering
\includegraphics[width=0.5\textwidth]{spiral}
\end{figure}
```

Labels and Cross References

- Figures, just as many other elements in a LATEX document (equations, tables, plots, etc) can be referenced within the text.

```
\begin{figure}[h]
    \centering
    \includegraphics[width=0.25\textwidth]{mesh}
    \caption{a nice plot}
    \label{fig:mesh1}
\end{figure}
```

As you can see in the figure `\ref{fig:mesh1}`, the function grows near 0. Also, in the page `\pageref{fig:mesh1}` is the same example.

Theorems and Proofs

Introduction

- Mathematical documents include elements that require special formatting and numberings such as:

  i. Theorems

  ii. Definitions

  iii. Propositions

  iv. Remarks

  v. Corollaries

  vi. lemmas

Theorems

- Numbered environments in LaTeX can be defined by means of the command `\newtheorem` which takes two arguments:

```
1 \newtheorem{theorem}{Theorem}
```

- The first one is the name of the environment that is defined

- The second one is the word that will be printed in boldface font at the beginning of the environment

Example

```
\documentclass{article}
\usepackage[english]{babel}
\newtheorem{theorem}{Theorem}
\begin{document}

\section{Introduction}
Theorems can easily be defined:

\begin{theorem}
Let \(f\) be a function whose derivative exists in every point, then \(f\)
is a continuous function.
\end{theorem}
\end{document}
```

Numbered theorems, definitions, corollaries and lemmas

- The numbering of the environments can be controlled by means of two additional parameters in the `\newtheorem` command

```
\newtheorem{theorem}{Theorem}[section]
\newtheorem{corollary}{Corollary}[theorem]
\newtheorem{lemma}[theorem]{Lemma}
\begin{document}
\section{Introduction}
Theorems can easily be defined:
\begin{theorem}
Let \(f\) be a function ..
\end{theorem}
\begin{corollary}
There's no right rectangle whose sides measure 3cm, 4cm, and 6cm.
\end{corollary}
\begin{lemma}
Given two line segments whose lengths are \(a\) and \(b\)
\end{lemma}
\end{document}
```

Unnumbered Theorem

- It can be useful to have an unnumbered theorem-like environment to add remarks, comments or examples to a mathematical document.

```
\documentclass{article}
\usepackage[english]{babel}
\usepackage{amsthm}
\newtheorem*{remark}{Remark}
\begin{document}
Unnumbered theorem-like environments are also possible.
\begin{remark}
This statement is true, I guess.
\end{remark}
\end{document}
```

Proofs

- Proofs are the core of mathematical papers and books and it is customary to keep them visually apart from the normal text in the document.

```
\documentclass{article}
\usepackage[english]{babel}
\usepackage{amsthm}
\newtheorem{theorem}{Theorem}[section]
\newtheorem{lemma}[theorem]{Lemma}
\begin{document}
\section{Introduction}
\begin{lemma}
Given two line segments whose lengths are \(a\) and \(b\) respectively there
is a real number \(r\) such that \(b=ra\).
\end{lemma}
\begin{proof}
To prove it by contradiction try and assume that the statement is false,
proceed from there and at some point you will arrive to a contradiction.
\end{proof}
\end{document}
```

Page Numbering

Introduction

- Document page numbers can be typeset using a particular *style* such as:

  i. Arabic numerals

  ii. Roman numerals

- They can also be typeset at a particular *page location* usually within headers and footers.

- The style of page numbers can be changed by the `\pagenumbering` command

- The location of page numbers can be changed using the `fancyhdr` package

Setting the style of page numbers

Examples

```
\begin{document}
\tableofcontents
\newpage
\section{Uppercase Roman}
\pagenumbering{Roman}% Capital 'R': uppercase Roman numerals
\section{Lowercase Roman} % lowercase Roman numerals
\pagenumbering{roman}
\section{Arabic numbers}
\pagenumbering{arabic} % Arabic/Indic page numbers
\section{Lowercase alphabetic}
\pagenumbering{alph} % Lowercase alphabetic page "numbers"
\section{Uppercase alphabetic}
\pagenumbering{Alph} % Uppercase alphabetic page "numbers"
\end{document}
```

Using two styles of page number

- The first few pages of a book/thesis are called the *preliminary pages* and are numbered using **lowercase Roman numerals** with the main pages being numbered using Arabic numerals.

Example

- The following example demostrates:

```
\documentclass{book}
% The emptypage package prevents page numbers and
% headings from appearing on empty pages.
\usepackage{emptypage}
\begin{document}
\frontmatter %Use lowercase Roman numerals for page numbers
\chapter*{Foreword}
\addcontentsline{toc}{chapter}{Foreword}
The Foreword is written by someone who is not the book's author.
\chapter*{Preface}
\addcontentsline{toc}{chapter}{Preface}
The Preface is written by the book's author.
\tableofcontents
\mainmatter % Now Use Arabic numerals for page numbers
\chapter{First Chapter}
This will be an empty chapter...
\section{First section}
Some text would be good.
\chapter{The second chapter}
```

Using Colors in LaTeX

- This section explains how to use the `color` or `xcolor` packages
- `xcolor` is more flexible and supports a large number of color models so is the recommended approach.

```
\documentclass{article}
\usepackage{xcolor}
\begin{document}
This example shows some instances of using the \texttt{xcolor} package to change the color of elements in \La
\begin{itemize}
\color{blue}
\item First item
\item Second item
\end{itemize}
\noindent
{\color{red} \rule{\linewidth}{0.5mm}}
\end{document}
```

References and Citations

> **Important**
>
> *Ensure that you have installed **JabRef** in your PC*

- This section explains how to use `natbib` to format and cite bibliographic sources.

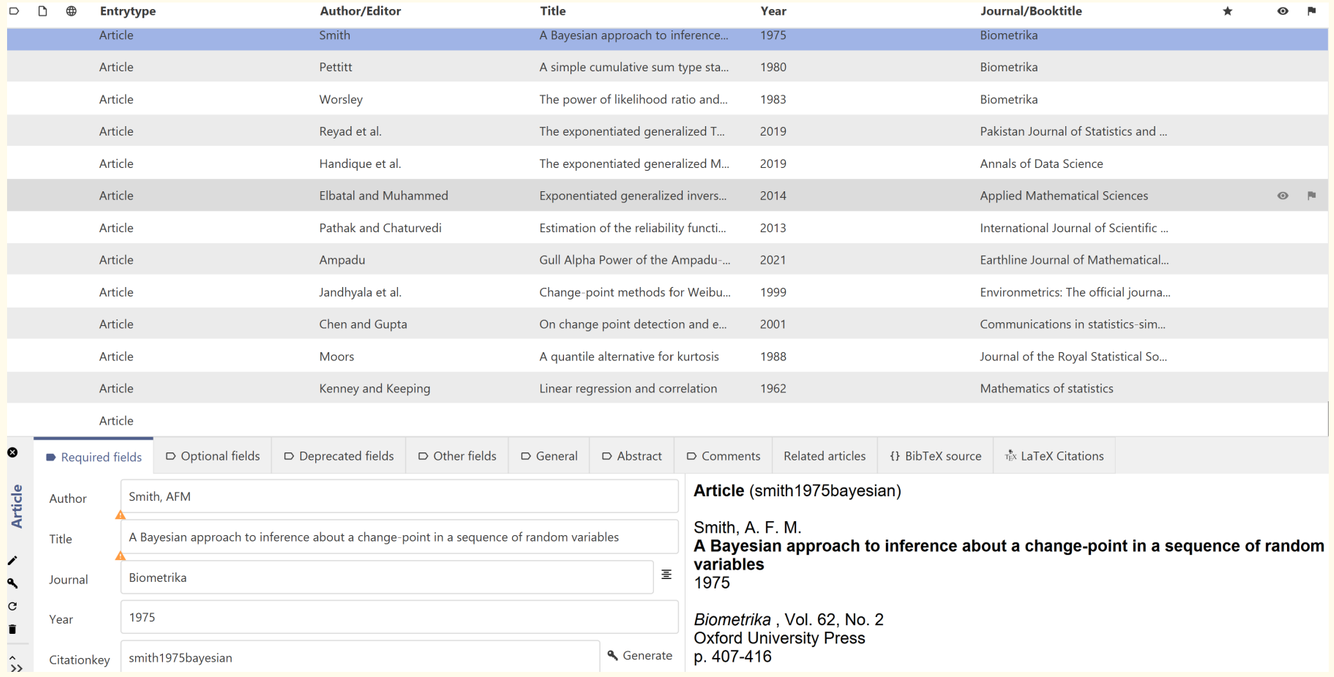
Example

```
\usepackage{natbib}
\title{Bibliography management: \texttt{natbib} package}
\author{Sam}
\date {April 2024}
\begin{document}
\maketitle
This document is an example of \texttt{natbib} package using in bibliography
management. Three items are cited: \textit{The \LaTeX\ Companion} book
\cite{latexcompanion}, the Einstein journal paper \cite{einstein}, and the
Donald Knuth's website \cite{knuthwebsite}. The \LaTeX\ related items are
\cite{latexcompanion,knuthwebsite}.
\bibliography{sample}
\bibliographystyle{apa}
\end{document}
```

How to create the `sample.bib` file

- For ease of use the `bib` file is created from JabRef and saved in the same workspace as your `tex` file.

- A sample looks like:



Entrytype	Author/Editor	Title	Year	Journal/Booktitle
Article	Smith	A Bayesian approach to inference...	1975	Biometrika
Article	Pettitt	A simple cumulative sum type sta...	1980	Biometrika
Article	Worsley	The power of likelihood ratio and...	1983	Biometrika
Article	Reyad et al.	The exponentiated generalized T...	2019	Pakistan Journal of Statistics and ...
Article	Handique et al.	The exponentiated generalized M...	2019	Annals of Data Science
Article	Elbatal and Muhammed	Exponentiated generalized invers...	2014	Applied Mathematical Sciences
Article	Pathak and Chaturvedi	Estimation of the reliability functi...	2013	International Journal of Scientific ...
Article	Ampadu	Gull Alpha Power of the Ampadu-...	2021	Earthline Journal of Mathematical...
Article	Jandhyala et al.	Change-point methods for Weibu...	1999	Environmetrics: The official journa...
Article	Chen and Gupta	On change point detection and e...	2001	Communications in statistics-sim...
Article	Moors	A quantile alternative for kurtosis	1988	Journal of the Royal Statistical So...
Article	Kenney and Keeping	Linear regression and correlation	1962	Mathematics of statistics
Article				

Required fields | Optional fields | Deprecated fields | Other fields | General | Abstract | Comments | Related articles | {} BibTeX source | TEX LaTeX Citations

Article

Author: Smith, AFM

Title: A Bayesian approach to inference about a change-point in a sequence of random variables

Journal: Biometrika

Year: 1975

Citationkey: smith1975bayesian | Generate

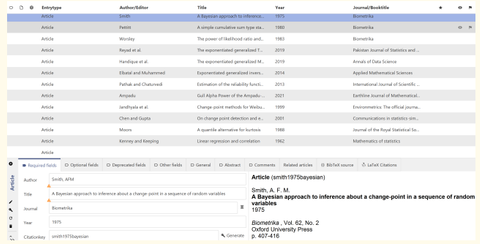
Article (smith1975bayesian)

Smith, A. F. M.
A Bayesian approach to inference about a change-point in a sequence of random variables
1975

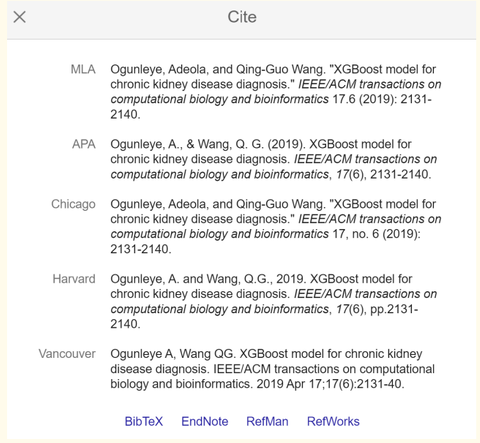
Biometrika , Vol. 62, No. 2
Oxford University Press
p. 407-416

Ease to use

- From `Google Scholar` search the article you want to cite



- Select `cite`

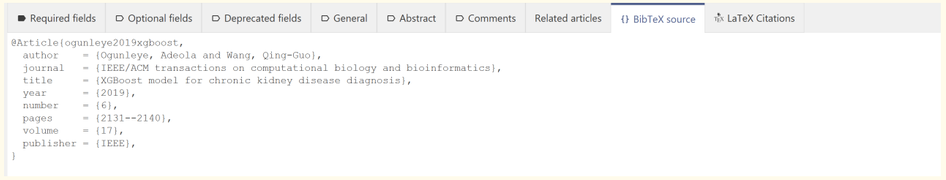


Cont'd

- Select `BibTeX` since we are using JabRef

```
@article{ogunleye2019xgboost,
  title={XGBoost model for chronic kidney disease diagnosis},
  author={Ogunleye, Adeola and Wang, Qing-Guo},
  journal={IEEE/ACM transactions on computational biology and bioinformatics},
  volume={17},
  number={6},
  pages={2131--2140},
  year={2019},
  publisher={IEEE}
}
```

- Copy the whole items and paste in approporiate JabRef Section under the field `BibTeX source`



- You can then use the `\cite{key}` in LaTeX and the Reference will be included

Standard Entry Types

- `article`: Article from magazine or journal
- `book`: published book
- `booklet`: A work that is printed but has no publisher or sponsoring institution
- `conference`: An article in a conference proceedings
- `inbook`: A part of a book (section, chapter and so on)
- `incollection`: A part of a book having its own title

Cont'd

- `inproceedings`: An article in a conference proceedings
- `manual`: Technical documentation
- `masterthesis`: A Masters Thesis

Cont'd

- `misc`: Anything that does not fit any other type
- `phdthesis`: A PHD thesis
- `proceedings`: The same as conference
- `techreport`: Report published by institution
- `unpublished`: Document not formally published with author and title

Environment

- An environment starts with `\begin{name}` and ends with the name `\end{name}`

```
\begin{name}
Your content here...
...goes here...
\end{name}
```

Defining a new environment

- To define a new environment use the `\newenvironment` command which has the general form

```
1 \newenvironment{name}[numarg][optarg_default]{begin_def}{end_def}
```

i. `name` is the name of this user-defined argument

ii. `numarg` is the number of arguments

iii. `optarg_defauly` makes the first argument optional and provides a default value

iv. `begin_def` is LaTeX code executed when the environment starts (opens)

v. `end_def` is LaTeX code executed when the environment ends (closes)

Example

```
\documentclass{article}
\newenvironment{boxed}
    {\begin{center}
    \begin{tabular}{|p{0.9\textwidth}|}
    \hline\\
    }
    {
    \\\\\hline
    \end{tabular}
    \end{center}
    }
\begin{document}
Now we can use the \texttt{boxed} environment in our document:
\begin{boxed}
This text is formatted within the \texttt{boxed} environment.
\end{boxed}
\end{document}
```

Remark

- The end of the LaTeX short introduction.
- Practice, practice and you will be a pro