

One of the technical aspects of this course will be to learn some basic elements of working with LaTeX. LaTeX is a markup language for documents that can handle mathematical code, styles, citations and bibliographies, graphs and more. But working with the code language does take some practice. We are going to start by setting up an account on Overleaf, a free website for working with LaTeX that can compile your documents for you and convert them into pdfs. Each assignment will build on previous assignments to add more functionality to your document.

## 1. Writing Mathematical Equations

### Objective

Learn how to:

1. Write mathematical equations using LaTeX.
2. Format and align equations for readability.
3. Use advanced mathematical structures like summations, matrices, integrals, and derivatives.

### Steps

#### 1. Set Up the Document

Start with this LaTeX template:

```
\documentclass[12pt]{article}
\usepackage[utf8]{inputenc}
\usepackage{amsmath} % For advanced math typesetting
\usepackage{amssymb} % For additional symbols

\title{Working with Mathematical Equations in LaTeX}
\author{Your Name}
\date{\today}

\begin{document}

\maketitle

\section{Introduction}
Mathematical equations are an essential part of data science and analytics. This document
demonstrates key types of equations and their formatting in LaTeX.

\section{Summations}
The summation of a sequence of numbers can be written as:
\[
S = \sum_{i=1}^n a_i
\]

\section{Matrices}
Matrices are a fundamental concept in linear algebra:
\[
A = \begin{bmatrix}
a_{11} & a_{12} & a_{13} \\
\end{bmatrix}
\]
```

```
a_{21} & a_{22} & a_{23} \\
a_{31} & a_{32} & a_{33} \\
\end{bmatrix}
\]
```

```
\section{Integrals and Derivatives}
Examples of an integral and a derivative:
```

```
\[
F(x) = \int_a^b f(x) \, dx
\]
\[
f'(x) = \frac{d}{dx} (x^2 + 3x + 5)
\]
```

```
\section{Aligned Equations}
Align multiple equations for better readability:
```

```
\begin{align*}
y &= mx + c \\
z &= e^x + \ln(x)
\end{align*}
```

```
\section{Conclusion}
```

Write a short paragraph explaining how these equations could be used in your data science projects.

```
\end{document}
```

## 2. Modify the Equations

- Add a summation with different limits and variables.
- Replace the matrix with one that has dimensions  $2 \times 2$ .
- Modify the integral to include a specific function (e.g.,  $f(x)=x^2$ ).
- Add at least one new aligned equation.

## 3. Reference for LaTeX Math Symbols and Structures

- **LaTeX Math Symbols Cheat Sheet:** <https://ctan.org/pkg/latex-math-symbols>
- **Detexify** (Search for symbols by drawing them): <https://detexify.kirelabs.org/>
- **Overleaf Mathematics Guide:** [https://www.overleaf.com/learn/latex/mathematical\\_expressions](https://www.overleaf.com/learn/latex/mathematical_expressions)

4. Include a paragraph about where equations like these are encountered in data science.

5. **Submission:** Once the document has been customized to your satisfaction, submit the pdf in the dropbox for the assignment in Blackboard.

If you've used the Equation Editor in Word, it is also responsive to LaTeX codes, so you may already be familiar with some of the syntax you need, and learning LaTeX will make the Equation Editor in Word easier to use.