R07: LaTeX

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Introduction to LaTeX in Quarto

- Quarto allows LaTeX syntax for math expressions.
- Supports inline math, display equations, and complex formatting.
- Useful for scientific writing, presentations, and reports.

- What is LaTeX?
  - It is a form of coding within qmd files (and many other types of files) that helps us write equations in an easily readable format

Open a new qmd file

- You can follow along in the file
- Source vs. Visual: Source is often easier when using LaTeX, but it works in Visual
- LaTeX is written in the text portion of a qmd, NOT the code portion
- We use $'s to tell our Quarto doc where we are writing LaTeX code

Inline Math

- To include inline math, wrap your LaTeX code in `$...$`
- Example: $a^2 + b^2 = c^2$ is written as `$a^2 + b^2 = c^2$`
- This is great for brief equations within text

Display Equations

- For equations that should be centered on their own line, use `$$...$$`.
- Example: We can make an equation with a new line using `$$E = mc^2$$`

$$E = mc^2$$

- This makes the equation stand out

Symbols and Greek Letters

- Quarto LaTeX can include Greek letters and other symbols

Greek letters

- mu (μ): `\mu`
- sigma (σ): `\sigma`
- beta (β): `\beta`
- lambda (λ): `\lambda`

Math symbols

- Greater than ($>$): `>`
- Greater than or equal to ($\geq$): `\geq`
- Not equal to ($\neq$): `\neq`
- Multiplication
  - $\cdot$ from `\cdot`
  - $\times$ from `\times`

- Other Greek letters and math symbols

Subscripts and Superscripts in LaTeX

- To create **subscripts**, use _ (underscore).
  - Example: `$x_1$`, `$y_{ij}$` render as x_1, y_{ij}
- To create **superscripts**, use ^ (caret).
  - Example: `$x^2$`, `$e^{5i}$` render as x^2, e^{i5i}
- Use `{}` for multiple characters in subscripts or superscripts

LaTeX:

```
$$x_i^2 + y_j^3$$
```

Output in html:

$$x_i^2 + y_j^3$$

```
$\sum_{i=1}^n x_i^2$
```

$\sum_{i=1}^n x_i^2$

```
$$\sum_{i=1}^n x_i^2$$
```

$$\sum_{i=1}^n x_i^2$$

Fractions in LaTeX

- To create fractions, use the `\frac{numerator}{denominator}` command

LaTeX:

```
$$\frac{a}{b}$$
```

Output in html:

$$\frac{a}{b}$$

```
$$\frac{\sqrt{a^2 + b^2}}{c}$$
```

$$\frac{\sqrt{a^2 + b^2}}{c}$$

```
$$\frac{\sum_{i=1}^n x_i}{n}$$
```

$$\frac{\sum_{i=1}^n x_i}{n}$$

- Fractions can be used in both inline and display modes.

Text within LaTeX

- LaTeX allows you to insert text within mathematical expressions using `\text{...}`.
- This is useful for labeling variables or adding context to equations

LaTeX:

```
$$y = mx + \text{intercept}$$
```

Output:

$$y = mx + \text{intercept}$$

LaTeX:

```
$$P(A) = \frac{\text{Number of favorable outcomes}}
{\text{Total outcomes}}$$
```

Output:

$$P(A) = \frac{\text{Number of favorable outcomes}}{\text{Total outcomes}}$$

Aligning Equations

- To align multiple equations, use the `align` environment

LaTeX:

```
$$
\begin{align}
x + y &= 10 \\
x - 3y &= 6
\end{align}
$$
```

Output in html:

$$
\begin{aligned}
x + y &= 10 \\
x - 3y &= 6
\end{aligned}
$$

What you might use in Homework 5

LaTeX:

```
$$SE = \frac{\sigma}{\sqrt{n}}$$
```

```
$$z = \frac{x - \mu}{\sigma}$$
```

Output in html:

$$SE = \frac{\sigma}{\sqrt{n}}$$

$$z = \frac{x - \mu}{\sigma}$$

Practical Uses of LaTeX in Quarto

- Writing technical documents with lots of math
- Formatting statistics for reports and papers
- Presenting mathematical concepts in presentations like this one

Resources

- Quarto Documentation
- LaTeX Math Symbols
- List of Greek letters and math symbols
- Ariel's guide from my previous course