Math in \LaTeX

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1 General Information

Special Characters: \# \$ \% \& \{ \} \_ \^ \_. The first seven can be generated with \ followed by the character.

Quotation marks: ‘‘\ldots’’ yields “...”.

Dashes: – (hyphen -), –– (range –), and — (dash —).

Spaces between words don’t matter a bit. Forced hyphenation can be done this way: hyphenation.

\texttt{Emphasized Text} = Emphasized Text
\textbf{Bold Text} = Bold Text
\texttt{Typewriter Text} = Typewriter Text

To prevent line breaks between certain words, use a ~ in place of a space: Mr. Johns, Figure 7 (Mr.~Johns, Figure~7).

To print long text on a single line, surround it by an \mbox: \mbox{This text will appear on one line.}

Footnotes\footnote{This is a footnote.} can be printed using \footnote{This is a footnote}.

Comments are done by \% characters.

Vertical space can be specified by \vspace{0.25in}

Verbatim text can be done with \verb+Text! or the verbatim environment
\begin{verbatim} ... \end{verbatim}.

\footnote{This is a footnote.}
Lists types: itemize, enumerate, and description.

\begin{itemize}
  \item \begin{description}
    \item[Name1] Description of the Name1 object.
    \item[Name2] Description of the Name2 object.
  \end{description}
  \item \begin{enumerate}
    \item item1
    \item item2
  \end{enumerate}
\end{itemize}

- **Name1** Description of the Name1 object.
- **Name2** Description of the Name2 object.

- 1. item1
- 2. item2

## 2 Types of Math Environments

Formulas in the middle of text: \((2x=4)\) or $2x=4$. This appears as follows: \(2x = 4\) or \(2x = 4\). \texttt{\begin{math} \end{math}} also works the same.

The displaymath environment offsets equations for emphasis:

\begin{displaymath}
2x=4
\end{displaymath}

\(2x = 4\)

The commands \[ \] are shortcuts to the displaymath environment.

The equation environment does the same, but numbers the equation:

\begin{equation}
2x=4
\label{simpleequation}
\end{equation}

\(2x = 4\) (1)

To refer to Equation 1 (Equation~\ref{simpleequation}), use a cross-reference. Note that this takes multiple passes of \LaTeX. In figures, the label command must go after the caption command.
3 Typical Math Constructs

Exponentiation: \(x^2 = x^2, x^{2y} = x^{2y}, x^{4^{y}} = x^{4^y}\).

Subscripts: \(x_2 = x_2, x^{y_2} = x^{y_2}\).

Fractions: \(\frac{n}{2+m} = n/(2 + m), \frac{y+z/2}{y^2+1} = \frac{y + z/2}{y^2 + 1}\)

Ellipsis: \(\ldots = \ldots\)

Roots: \(\sqrt{x+y} = \sqrt{x+y}, \sqrt[n]{x+y} = \sqrt[n]{x+y}\)

Greek letters: \(\alpha = \alpha, \beta = \beta, \delta = \delta, \Delta = \Delta, \theta = \theta, \pi = \pi, \ldots\)

Common operators:

\begin{verbatim}
\times \div \pm \bullet
\cap \cup \subset \supset
\lor \land \lnot \in
\leq \geq \neq \equiv
\infty \forall \exists \emptyset
\leftarrow \Leftarrow \leftrightarrow \Leftrightarrow
\end{verbatim}

3.1 Functions

\begin{verbatim}
\sum \prod \int
\bigcup \bigcap \oint
\end{verbatim}

\[\sum_{i=0}^{n} x_i = \int_{0}^{1} f\] These functions all work similar to the following example:

This expression will look this way \(\sum_{i=0}^{n} x_i = f_0^1 f\) when in the text but this way \(\sum_{i=0}^{n} x_i = f_0^1 f\)
when in displaymath mode.

Common math functions:
\[ \log \cos \sin \tan \]
\[ \arccos \arcsin \cosh \sinh \]
\[ \lim \ln \max \min \]

log cos sin tan
arccos arcsin cosh sinh
lim ln max min

Example with limits:
\[ \lim_{n \rightarrow \infty} x = 0 \]

\[ \lim_{n \rightarrow \infty} x = 0 \]

Picky things about functions:

- To typeset \{a \mid a>0\}, try \{a \mid a > 0\}. The point is to use \mid instead of \|. The latter has spacing problems.
- To typeset \( f: X \rightarrow Y \), try \( f: X \rightarrow Y \). Use \colon instead of \(:\) to get the correct spacing.
- To typeset multi-character names in math mode, use \textit. For example, doesn’t \textit{difference} = 1 look better than \textit{difference} = 1? The commands \textstyle (for in-text math) and \displaystyle (for displaymath mode) can be used to make plain text in an equation: \[
\textstyle \text{Let} x=1.\]

\[
\text{Let} x=1.\]

Notice the extra space by \,! You can also use \texttt{mbox} to make plain text.

You can define your own function in the following manner:
\[
\newcommand{\SumToX}{2}{\ensuremath{\sum_{#1=1}^{#2}}} \\
\newcommand{\QuadraticFormula}{3}{\ensuremath{\frac{-#2 \pm \sqrt{#2^2 - 4 \times #1 \times #3}}{2 \times #1}}} \\
\sqrt{#2^2 - 4 \times #1 \times #3} \times #1}^{#3}\}
\]

Then we can use the new commands in our document: $\SumToX{i}{N}x_i = \sum_{i=1}^{N} x_i$.

\[
\text{Let } x=1.\]

\[
\text{Let } x=1.\]

\[
\text{Let } x=1.\]

Notice the extra space by \,! You can also use \texttt{mbox} to make plain text.
3.2 Arrays

Note that the `\texttt{tabular}` environment is very similar to the `\texttt{array}` environment, except it is for regular text.

\[
\begin{array}{cl|r}
Name1 & Name2 & Name3 \\ \hline
a & xy & 12 \\ a+b & x+y & 5 \\ a+b+c & x/y & 100
\end{array}
\]

Delimiters are often used in combination with arrays. The delimiters automatically scale to encompass the arrays. Use the commands `\texttt{left}` or `\texttt{right}` before a delimiter to specify the left or right side. Common delimiters:

( ) [ ] \\
\{ \} \| \\
\lfloor \rfloor \lceil \rceil

An example:

\[
\left( \begin{array}{c}
\left[ \begin{array}{cc} x_1 & x_2 \\ x_3 & x_4 \end{array} \right]
\end{array} \right) \]

The argument \texttt{t} aligns the top line of the second array with the center of the first. The argument \texttt{b} would align the bottom line with the center.

\[
X = \left[ \begin{array}{c}
\textstyle a_1 \\ \ldots \\ a_n \end{array} \right] - \left[ \begin{array}{cc}
x-y & x+y \\ xy & x/y \end{array} \right] \]
\[
X = \begin{bmatrix}
a_1 \\
\ldots \\
a_n
\end{bmatrix} - x - y \quad x + y \\
x y \quad x/y
\]

You can make an invisible delimiter with a “.” as follows:

\[
\begin{cases}
y & \text{if } y > 0 \\
0 & \text{otherwise}
\end{cases}
\]

3.3 Equation Arrays

Equation arrays allow you to create an aligned series of equations. Each equation can either be numbered (using \texttt{eqnarray}) or unnumbered (using \texttt{eqnarray*}). A \texttt{\nonumber} command on a line tells \LaTeX to not number that line. Here are two examples:

\begin{verbatim}
\begin{eqnarray}
x & = & 5y + 6z \\
y & > & a + b + c + d + e + f + g \\
\end{eqnarray}
\end{verbatim}

\begin{verbatim}
\begin{eqnarray*}
10 & = & 5x \\
x & = & 10/5 \\
x & = & 2
\end{eqnarray*}
\end{verbatim}

\[x = 5y + 6z \quad (2)\]
\[y > a + b + c + d + e + f + g \quad (3)\]

\[10 = 2x + 3x\]
\[10 = x(2 + 3)\]
\[x = 2\]
3.4 Stacking

You can overline with the \overline command and underline with the \underline command. For example, $\overline{\overline{y}^3 + 1} = \underline{3x}$ yields $\overline{\overline{y}^3 + 1} = \underline{3x}$.

Overbracing and underbracing works similarly: $\overbrace{w + \underbrace{x + y}_{12}}^{24}$ yields $w + \underbrace{x + y}_{12}^{24}$.

Some common math accents:

\[
\begin{array}{cccc}
\hat{x} & \bar{x} & \vec{x} & \dot{x}
\end{array}
\]

The letters $i$ and $j$ should not have dots when accented, so use \imath and \jmath to produce these: \imath + \jmath.

The \stackrel command allows us to stack arbitrary symbols: $\vec{X}\stackrel{\text{def}}{=} (x_1, \ldots, x_n)$ yields $\vec{X} \stackrel{\text{def}}{=} (x_1, \ldots, x_n)$.

3.5 Theorems and Such

We can define and automatically number theorems as shown in the following examples:

\newtheorem{theorem}{Theorem}
\newtheorem{axiom}{Axiom}

\begin{theorem}
This is a theorem.
\label{TheoremThis}
\end{theorem}

\begin{axiom}
All theorems are dull.
\label{AxiomDullTheorems}
\end{axiom}

Theorem 1 This is a theorem.

Axiom 1 All theorems are dull.

By Axiom 1, we can state that Theorem 1 is dull.