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, even if the equations are really long, or if you have to include several equations in the same line.

Contents

Introduction

The standard LaTeX tools for equations may lack some flexibility, causing overlapping or even trimming part of the equation when it's too long. We can surpass this difficulties with *amsmath*. Let's check an example:

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

$$A = \frac{\pi r^2}{2} = \frac{1}{2}\pi r^2 \tag{1}$$

You have to wrap you equation in the *equation* environment if you want it to be numbered, use *equation** (with an asterisk) otherwise. Inside the *equation* environment use the *split* environment to split the equations into smaller pieces, these smaller pieces will be aligned accordingly. The double backslash works as a newline character. Use the ampersand character *&*, to set the points where the equations are vertically aligned.

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Including the amsmath package

This is a simple step, if you use LaTeX frequently sure you already know this. In the preamble of the document include the code:

```
\usepackage{amsmath}
```

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Writing a single equation

To display a single equation, as mentioned in the introduction, 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 a 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
```

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

The beautiful equation 1 is known as the Euler equation

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Displaying long equations

For equations longer than a line use the *multline* 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 to the right.

Again, the use of an asterisk * in the environment name determines whether the equation is numbered or not.

```
\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*}
```

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

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Splitting and aligning an equation

Split is very similar to *multline*. Use the *split* environment to break an equation and to align it in columns, just as if the parts of the equation were in a table. This environment must be used inside an *equation* environment. For an example check the introduction of this document.

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*}
```

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

Usually the binary operators (>, < and =) are the ones aligned for a nice-looking document.

As mentioned before, the ampersand character *&* determines where the equations align. Let's check a more complex example:

```
\begin{align*}
x&=y          &  w &=z              &  a&=b+c\\
2x&=-y        &  3w&=\frac{1}{2}z    &  a&=b\\
-4 + 5x&=2+y  &  w+2&=-1+w          &  ab&=cb
\end{align*}
```

$$x = y \qquad w = z \qquad a = b + c$$
$$2x = -y \qquad 3w = \frac{1}{2}z \qquad a = b$$
$$-4 + 5x = 2 + y \qquad w + 2 = -1 + w \qquad ab = cb$$

Here we arrange the equations in three columns. LaTeX assumes that each equation consists of two parts separated by a *&*; also that each equation is separated from the one before by an *&*.

Again, use * to toggle the equation numbering. When numbering is allowed, you can label each row individually.

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Grouping and centering equations

If you just need to display a set of consecutive equations, centered and with no alignment whatsoever, use the *gather* environment. The asterisk trick to set/unset the numbering of equations also works here.

```
\begin{gather*}
2x - 5y =  8 \\
3x^2 + 9y =  3a + c
\end{gather*}
```

$$2x - 5y = 8$$
$$3x^2 + 9y = 3a + c$$

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Further reading

For more information see

- Mathematical expressions
- Brackets and Parentheses
- Subscripts and superscripts
- Spacing in math mode
- Display style in math mode
- Mathematical fonts
- List of Greek letters and math symbols
- Operators
- Fractions and Binomials
- amsmath package documentation