

## **Quatro for amsmath LaTeX users**

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# Preface

*tldr; For LaTeX users wanting complex math in both html and PDF: 1) Don't mix Quarto equation and amsmath syntax. Stick with amsmath. 2) Add a mathjax.html file and add to your top yaml to turn-on equation numbering and only use LaTeX equation environments (not \$). 2) For referencing, only use \label{} and \eqref{} or \ref{}. Do not use (#eq-) and @eq- for cross-refs. Pandoc (and MathJax) knows LaTeX so all your fancy equations should work if you do 1 and 2.*

These are notes for those creating a Quarto book that they want to display and html and PDF formats. Those only needing Word format, sorry not sure that works as of July 2023; I have not tested since then.

## To do

- Adding equations that look like 3.1 so with the chapter numbering. We need this in Quarto books. MathJax [tagformat](#) looks like the way to go.
- Going forward, I think we might need a lua filter for LaTeX docs. Perhaps this already exists? Like, we should have to re-write a basic LaTeX doc that has \section{abs}. We should be able to include our LaTeX chapters (chap1.tex) directly in the Quarto books and have standard LaTeX code with R or Python code mixed in.

## Contributing!

Please put in a pull request and add more examples. Also Quarto keeps updating so these notes will get out of date. I used Quarto 1.5.55 and output from `pandoc --version` is

pandoc 2.19

Compiled with pandoc-types 1.22.2, texmath 0.12.5.2, skylighting 0.13,  
citeproc 0.8.0.1, ipynb 0.2, hslua 2.2.1

Scripting engine: Lua 5.4

# 1 Background

The default way to number and cross-ref equation numbers in Quarto is a `$$` fence with `{#eq-}`:

```
$$  
S_n = \frac{X_1 + X_2 + \cdots + X_n}{n}  
      = \frac{1}{n} \sum_{i=1}^n X_i  
$$ {#eq-eq1}
```

$$S_n = \frac{X_1 + X_2 + \cdots + X_n}{n} = \frac{1}{n} \sum_{i=1}^n X_i \quad (1.1)$$

Then you cross-ref with `@eq-eq1` which gives you this: Equation 1.1. It works great with single equation in display math...and it causes all sorts of problems for LaTeX users.

The problem with this for LaTeX users is that if you are a LaTeX user then you are using (almost certainly) `amsmath` and the more complex equation environments and equation numbers. That Quarto syntax above is not LaTeX and going to break things for you on many levels (Pandoc, mathjax) for things that expect proper `amsmath` syntax. Also you do not want to be re-writting your LaTeX equation code for 100s of equations from your LaTeX docs!!

Rather than try to get Quarto syntax to work with your AMS equation environments, I suggest never mixing Quarto syntax and `amsmath` syntax. **Only** use proper `amsmath` syntax. So no `$$` fencing around your `\begin{<environment>}` stuff. That `$$` fencing is improper syntax and using it, while seemingly a shortcut to get what you need, is going to make you suffer later.

## 2 yaml for your Quarto book

MathJax is handling the display of your equations in html and you need to set the configuration to show numbers. Oddly, that is not the default. So you need `include-in-header: mathjax.html` in your Quarto book yaml. See the mathjax tab for your `mathjax.html` code.

This is what a minimal `_quarto.yaml` for numbered equations looks like

```
project:
  type: book

book:
  title: "Quatro for amsmath LaTeX users"
  chapters:
    - index.qmd
    - yaml.qmd
    - numbered_equations.qmd

format:
  html:
    include-in-header: mathjax.html
  pdf:
    include-in-header:
      - text: |
          \usepackage{mathtools}
# Don't use this. Breaks numbering (Aug 2024)
#   html-math-method:
#     method: mathjax
#     url: "https://mathjax.rstudio.com/latest/MathJax.js?config=TeX-AMS-MML_HTMLorMML"
```

August 2024: I don't know why that url is not working. It was in Jan 2024. It is just setting the MathJax version. Probably the url is out of date somehow.

## 3 Basic numbered equations

*Reminder: Do not use [Quarto equation numbering syntax](#). Stay with proper *amsmath* *LaTeX*. Quarto syntax is fine if you only have single equations in display math, but you are on this page because that is not what you need. You need the full *amsmath* capabilities.*

**Yes**, the equations don't have 3.1, 3.2 like they should in html output even though they are fine in PDF. Still trying to figure out how to get the Quarto chapter variable over to MathJax tagformat extension which can add the chapter labels.

**Important** All the *LaTeX* is included plain in the qmd so none of this type of fencing:

Wiki showing examples [advanced math](#)

If you want one equation number, then use `\begin{equation}\end{equation}` fence. You can use `\begin{gathered}\end{gathered}` or `\begin{aligned}\end{aligned}` **inside** that fence to affect alignment of your equations. If you want each equation to be numbered, then use `\begin{gather}\end{gather}` or `\begin{align}\end{align}` fence alone without `\begin{equation}\end{equation}`.

If you want no numbering, use `*` after the outer environment name, so like `\begin{equation*}\end{equation*}` and `\begin{align*}\end{align*}`. If you want to drop one equation number in the align or gather environments, use `\nonumber`. See examples.

**cross-refs** If you need to cross-reference the equation number in the text, you use `\label{equation-name}` to give the equation a name. Then cross-reference in text with `\eqref{equation-name}`. It is good practice with *amsmath* to use `\eqref{}` instead of `\ref{}`. If you don't need to cross-reference the equation in the text, then you don't need `\label{}`. It is only giving the equation a name; it is not saying "number this equation". The numbering or not comes from having `*` or not in the outer `\begin{...}\end{...}` or having `\nonumber` on an equation.

### 3.1 Basic split

This is similar behavior to aligned.

```

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

```

$$\begin{aligned}
 A &= \frac{\pi r^2}{2} \\
 &= \frac{1}{2} \pi r^2
 \end{aligned}
 \tag{3.1}$$

The cross-ref with `\eqref{eq1}` to get (3.1).

## 3.2 Basic gathered

Gathered gets you one number for all equations with centered equations.

```

\begin{equation}
\begin{gathered}
3(a-x) = 3.5x + a - 1 \\
3a - 3x = 3.5x + a - 1 \\
a = \frac{13}{4}x - \frac{1}{2}
\end{gathered} \label{eq4}
\end{equation}

```

$$\begin{aligned}
 3(a-x) &= 3.5x + a - 1 \\
 3a - 3x &= 3.5x + a - 1 \\
 a &= \frac{13}{4}x - \frac{1}{2}
 \end{aligned}
 \tag{3.2}$$

The cross-ref with `\eqref{eq4}` to get (3.2).

### 3.3 Basic aligned

Same idea as gathered but we want to spec the equation alignment with `&`. `##` Basic gathered

Gathered gets you one number for all equations with centered equations.

```
\begin{equation}
\begin{aligned}
3(a-x) &= 3.5x + a - 1 \\
3a - 3x + 3a - 3x &= 3.5x + a - 1
\end{aligned} \label{eq5}
\end{equation}
```

$$\begin{aligned} 3(a-x) &= 3.5x + a - 1 \\ 3a - 3x + 3a - 3x &= 3.5x + a - 1 \end{aligned} \tag{3.3}$$

The cross-ref with `\eqref{eq5}` to get (3.3).

### 3.4 Basic align

Align (not aligned) gets you each equation numbered with aligning at the `&`.

```
\begin{align}
3(a-x) &= 3.5x + a - 1 \label{eq4a} \\
3a - 3x &= 3.5x + a - 1 \label{eq4b} \\
a &= \frac{13}{4}x - \frac{1}{2} \label{eq4c}
\end{align}
```

$$3(a-x) = 3.5x + a - 1 \tag{3.4}$$

$$3a - 3x = 3.5x + a - 1 \tag{3.5}$$

$$a = \frac{13}{4}x - \frac{1}{2} \tag{3.6}$$

The cross-ref with `\eqref{eq4a}` to get (3.4).



You can put aligned environment within align to get fancier (look at the raw qmd file for code).

$$\begin{aligned} 1 + 1 &= 2 \\ 1 * 2 * 3 * 4 * 5 * 6 * 7 &= 7! \end{aligned} \tag{3.7}$$

$$\begin{aligned} 7 + 5 &= 12 + 1 - 1 + 1 - 1 + 1 - 1 + 1 - 1 \\ 12 &= 11 + 1 \end{aligned} \tag{3.8}$$

Equations (3.7), (3.8).

Use `\nonumber` to drop the number from one line. Add `\label{}` if you need to cross-ref the equations numbers.

```
\begin{align}
3(a-x) &= 3.5x + a - 1 \nonumber \\
3a - 3x &= 3.5x + a - 1 \nonumber \\
a &= \frac{13}{4}x - \frac{1}{2} \\
\end{align}
```

$$3(a - x) = 3.5x + a - 1 \tag{3.9}$$

$$\begin{aligned} 3a - 3x &= 3.5x + a - 1 \\ a &= \frac{13}{4}x - \frac{1}{2} \end{aligned} \tag{3.10}$$

## 3.5 Basic gather

gather (not gathered) gets you each equation numbered like align but equations are all centered.

```
\begin{gather}
3(a-x) = 3.5x + a - 1 \label{eq6a} \\
3a - 3x = 3.5x + a - 1 \label{eq46b} \\
a = \frac{13}{4}x - \frac{1}{2} \label{eq6c} \\
\end{gather}
```

$$3(a - x) = 3.5x + a - 1 \tag{3.11}$$

$$3a - 3x = 3.5x + a - 1 \tag{3.12}$$

$$a = \frac{13}{4}x - \frac{1}{2} \tag{3.13}$$

The cross-ref with `\eqref{eq6a}` to get (3.11).

You can put gathered environment within gather to get fancier.

$$\begin{aligned} 1 + 1 &= 2 \\ 1 * 2 * 3 * 4 * 5 * 6 * 7 &= 7! \\ 7 + 5 &= 12 + 1 - 1 + 1 - 1 + 1 - 1 + 1 - 1 \\ 12 &= 11 + 1 \end{aligned} \tag{3.14}$$

Equations (3.14), (3.15).

## 4 Fancier equations

MathJax knows most of [the fancy amsmath stuff](#).

### 4.1 left and right brackets

```
\begin{equation}
\left.\begin{aligned}
B' &= -\partial \times E, \\
E' &= \partial \times B - 4\pi j,
\end{aligned}
\right\}
\quad \text{Maxwell's equations}
\end{equation}
```

$$\left. \begin{aligned} B' &= -\partial \times E, \\ E' &= \partial \times B - 4\pi j, \end{aligned} \right\} \quad \text{Maxwell's equations} \quad (4.1)$$

### 4.2 alignat

```
\begin{alignat}{2}
\sigma_1 &= x + y & \quad \sigma_2 &= \frac{x}{y} \\
\sigma_1' &= \frac{\partial x + y}{\partial x} & \quad \sigma_2' &= \frac{\partial \frac{x}{y}}{\partial x}
\end{alignat}
```

$$\sigma_1 = x + y \quad \sigma_2 = \frac{x}{y} \quad (4.2)$$

$$\sigma_1' = \frac{\partial x + y}{\partial x} \quad \sigma_2' = \frac{\partial \frac{x}{y}}{\partial x} \quad (4.3)$$

### 4.3 split within gather

```
\begin{gather*}
a_0=\frac{1}{\pi}\int\limits_{-\pi}^{\pi}f(x)\,,\mathrm{d}x\\[6pt]
\begin{split}
a_n=\frac{1}{\pi}\int\limits_{-\pi}^{\pi}f(x)\cos nx\,,\mathrm{d}x\\
=\frac{1}{\pi}\int\limits_{-\pi}^{\pi}x^2\cos nx\,,\mathrm{d}x
\end{split}\\[6pt]
\begin{split}
b_n=\frac{1}{\pi}\int\limits_{-\pi}^{\pi}f(x)\sin nx\,,\mathrm{d}x\\
=\frac{1}{\pi}\int\limits_{-\pi}^{\pi}x^2\sin nx\,,\mathrm{d}x
\end{split}\\[6pt]
\end{gather*}
```

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \, dx$$

$$\begin{aligned} a_n &= \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos nx \, dx = \\ &= \frac{1}{\pi} \int_{-\pi}^{\pi} x^2 \cos nx \, dx \end{aligned}$$

$$\begin{aligned} b_n &= \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \sin nx \, dx = \\ &= \frac{1}{\pi} \int_{-\pi}^{\pi} x^2 \sin nx \, dx \end{aligned}$$

### 4.4 Boxes around equations

$$\boxed{f(x) = \int h(x) \, dx} \tag{4.4}$$

$$= g(x) \tag{4.5}$$