

# Annotating Equations in Quarto

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## Annotating Equations

Using the LaTeX [annotate-equations](#) package in Quarto allows you to easily annotate equations within your quarto reports, documents or manuscripts.

### Step-by-step example

Here's a straightforward step-by-step guide to annotating equations using the `annotate-equations` package. We'll use the genomic selection GEBV equation as the example.

### Quarto Setup

Quarto itself will attempt to automatically download and install the `annotate-equations` package into its LaTeX engine, all you need to do is tell Quarto that you need it by adding the following to your yaml at the top of your .qmd file

```
```{yaml}
header-includes:
  - \usepackage{annotate-equations}
```
```

### Begin with Your LaTeX Equation

Start by writing the equation you want to annotate in LaTeX format:

```
```{latex}
\begin{equation*}
  \text{GEBV} = \sum_{i=1}^n X_i b_i
\end{equation*}
```

...

$$GEBV = \sum_i^n X_i b_i$$

## Split the Equation into Nodes

Break down the equation into individual nodes. To highlight a node, enclose it in `\eqnmarkbox[color]{node name}{equation term(s)}`. If you only want to color the node's text, use `\eqnmark[color]{node name}{equation term(s)}`.

*For example:*

```

```{latex}
\begin{equation*}
  \eqnmark[purple]{node1}{GEBV}
  \tikzmarknode{node2}{=}
  \eqnmark[black]{node3}{\sum_{i}^n}
  \eqnmarkbox[blue]{node4}{X_{i}}
  \eqnmarkbox[red]{node5}{b_{i}}
\end{equation*}
```
```

$$GEBV = \sum_i^n X_i b_i$$

## Add Annotations

Now, introduce annotations to each node using the `\annotate[tikzoptions]{annotate keys}{node name[,...]}{annotation text}` command:

- For `{annotate keys}`, choose whether the annotation appears above or below, to the right or left of the node.

- For `[tikzoptions]`, include a `yshift` value to adjust the annotation's position above or below (use negative values for below). You may need to fine-tune these values, especially in complex equations. `xshift` can be defined if necessary.

For example:

```

```\latex
\begin{equation*}
\eqnmark[purple]{node1}{GEBV}
\tikzmarknode{node2}{=}
\eqnmark[black]{node3}{\sum_{i}^n}
\eqnmarkbox[blue]{node4}{X_{i}}
\eqnmarkbox[red]{node5}{b_{i}}
\end{equation*}
\annotate[yshift=1em]{left}{node3}{sum across n loci}
\annotate[yshift=-1em]{below,left}{node1}{Genomic Estimated Breeding Value}
\annotate[yshift=-1em]{below,right}{node5}{effect at locus i}
\annotate[yshift=-2.5em]{below,right}{node4}{genotype at locus i}
```\code
```

The diagram shows the equation  $GEBV = \sum_i^n X_i b_i$ . The term  $GEBV$  is in purple. The summation symbol  $\sum$  has a superscript  $n$  and a subscript  $i$ . The term  $X_i$  is in a blue box, and  $b_i$  is in a red box. Annotations with arrows point to these elements:
 

- A purple arrow points from the text "Genomic Estimated Breeding Value" to  $GEBV$ .
- A black arrow points from the text "sum across n loci" to the summation symbol  $\sum$ .
- A blue arrow points from the text "genotype at locus i" to the blue box  $X_i$ .
- A red arrow points from the text "effect at locus i" to the red box  $b_i$ .

## Other example

### Annotate to multiple nodes

For some equations a variable will appear multiple times. In these scenarios you may want your annotation to link both occurrences. To archive this you just use the `\annotatetwo` definition and add both node names.

An example using the Hardy-Weinberg equation:

```


\begin{equation*}
  \eqnmarkbox[green]{node1}{p}
  \tikzmarknode{node2}{^{\{2\}}
  \tikzmarknode{node3}{+}
  \tikzmarknode{node4}{2}
  \eqnmarkbox[green]{node5}{p}
  \eqnmarkbox[blue]{node6}{q}
  \tikzmarknode{node7}{+}
  \eqnmarkbox[blue]{node8}{q}
  \tikzmarknode{node9}{^{\{2\}}
  \tikzmarknode{node10}{=}
  \tikzmarknode{node11}{1}
\end{equation*}
\annotatetwo[yshift=1.5em]{above, label above}{node1}{node5}{frequency of allele A}
\annotatetwo[yshift=-1.5em]{below, label below}{node6}{node8}{frequency of allele B}


```

The diagram shows the Hardy-Weinberg equation  $p^2 + 2pq + q^2 = 1$ . The terms  $p^2$ ,  $2pq$ , and  $q^2$  are highlighted with colored boxes:  $p^2$  is green,  $2pq$  is light green, and  $q^2$  is light blue. A green arrow points from the text "frequency of allele A" to the  $p$  in  $p^2$ . A blue arrow points from the text "frequency of allele B" to the  $q$  in  $q^2$ .

### Additional Information

For more in-depth instructions and possibilities with `annotate-equations` in LaTeX, refer to the documentation at <https://github.com/st-/annotate-equations/blob/main/annotate-equations.pdf>