Including Mathematics Symbols in Reports

Embedding math symbols right in the midst of text is done by placing the symbols between *single* dollar signs. Isaac Newton's famous 2nd law is $F = ma$ (coded in RMarkdown as $F = ma$), but perhaps Einstein's $E = mc^2$ (coded as $E = mc^2$) is even more well-known. It is generally preferred to enclose even simple variables in dollar signs, as the italics make them *look* math-y. So, x is considered better than just plain x.

Note that certain mathematical constructions follow the same sort of conventions that R functions follow: there is a name, often one that begins with a backslash character, indicating *what* sort of construct you want, and then there can be information that follows that name, often enclosed in curly braces { } (though these usually aren't needed if there is just one character), indicating what sorts of symbols are part of the construct.

- **Subscripts**. One uses the underscore _ character, with *no* backslash. x_1, x_2, ..., x_{n-1}, x_n are produced by the inclusion, in the RMarkdown source file, of commands such as x_{n-1} and x_n. We get ${}_nC_r$ from the command $_nC_r$.
- **Exponents/superscripts**. One uses the caret ^ character, with *no* backslash. t^* and e^{2x-1} are the result of t^* and e^{2x-1}.
- **Roots**. The keyword is \sqrt. $\sqrt{x^2+1}$ and $\sqrt[3]{35}$ come from the commands $\sqrt{x^2+1}$ and $\sqrt[3] {35}$.
- **Lines over the top of characters**. The keyword is \overline. $\overline{x}$ and $\overline{x+y}$ result from the commands $\overline x$ and $\overline{x+y}$.
- **Fractions**. The keyword is \frac, which is followed by *two* sets of curly braces, the first indicating the numerator's symbols, and the second the denominator's. $\frac{X+Y}{2}$ is obtained from $\frac{X+Y}{2}$. (Note: because the denominator has just one symbol, $\frac{X+Y} 2$ would achieve the same thing.)
- **Summations**. The keyword is \sum. $\sum x_i$ produces $\sum x_i$, $\sum_{i=1}^n x_i$ produces $\sum_{i=1}^{n} x_i$.
- **Hat-notation**. The keyword is \hat (or sometimes \widehat). $\hat p$ produces $\hat{p}$. But we probably prefer $\widehat{Price}$ (from $\widehat{Price}$) over $\hat{Price}$.
- **Binary operators**. These are produced by keywords alone. The symbols $+$, $-$, $\times$, $\cdot$, $\div$ are produced by $+$, $-$, $\times$, $\cdot$, $\div$.
- **Greek letters**. Use backslash and the letter's name spelled out in English. α produces α, β_0 produces β_0, ρ produces ρ, μ produces μ, σ produces σ, ϵ produces ϵ, χ^2 produces χ^2.
- **Special symbols**. Like some of the binary operators mentioned above, there are a host of special symbols in mathematics, like $\pm$ (generated by $\pm$), $\sim$ (generated by $\sim$), $\leq$ (generated by $\le$), $\geq$ (generated by $\ge$), and $\circ$. The last of these may be of most use as a superscript, when describing angles, or temperatures as in 42° F.

When you want an equation to have its own line, set apart from other text, place your mathematical symbols between *double* dollar signs, not single ones. You may remember the **quadratic formula** $\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ from a mathematics class you once took. To put it in the previous sentence, I placed the command $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ in the RMarkdown file. If, instead of surrounding the command with just one dollar sign on each end, I place two (with no space in between them) on each end, then the same formula is set apart, as in

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

See if you can typeset the formula for the sample standard deviation (see below) using only the constructs we have described here.

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

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