

Grandma's Glop Recipe

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Setup

```
library(tidyverse)
library(knitr)
```



Figure 1: Eric Anderson

Prelude

Many thanks to my r-mentor [Eric Anderson](#) for sharing this lesson.

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, MS Word documents and even slideshows. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Render** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document.

We are going to go through using many of the features of R Markdown whilst writing up a recipe that can calculate appropriate quantities if you want to increase the recipe by any factor.

First, we are going to make a subsection dedicated to grandma from whom this recipe came.

Dedication to grandma

This recipe came from my grandmother whom I always remember used to say:

```
You only get to be young once,  
But you can stay immature forever  
-grandma
```

Notice in the above that we used `>` to make a block quote and we *also* used two spaces (which, of course, you cannot see!) at the end of each line to force a line break.

I leave this dedication with a picture of grandma:

Holy Oversized Image Batman! You have got to be kidding me! There must be some way to make that image smaller.



Figure 2: A pic of grandma

With Quarto, there is a way

```
! [A pic of grandma] (figures/Warthog4.jpg){width=50%}  
! [A pic of grandma] (figures/Warthog4.jpg){width=2in}
```



Figure 3: A pic of grandma

We might come back to this [Dedication](#) at some point, so we have linked it to a tag. Note that it does not seem you can link to arbitrary text, but you can to section headers.

The Ingredients (Static Version)

Let's list those ingredients for a single recipe's worth of Grandma's Glop. We call it "static" because it applies to just a single recipe. We will look at "automagically" doubling, or tripling, or "pi"-ing the recipe in a [later section](#).

Static List version

Let's see, we have already seen how to make text *italic* and **bold**. Did you notice how Rstudio highlights those bits in the text editor window? That is called "Syntax Highlighting" and it is super helpful.

Let's write our recipe in a list. Be wary! There has to be an empty line above the list *and* the space after the asterisk or number is important (i.e. mandatory)!

- 2 cups flour
- 4 eggs
- 1 Pound of Grandma Gorp:
 - 0.5 pounds raisins
 - 0.5 pounds cashews

Notice, the indent level is 4 spaces. You can use a `-` or a `*` or a `+` to start those list items. In fact, you can mix and match them too, as I did, but it is probably better to be consistent. (Use the same symbol within a nested level and different ones between).

Hey! did you notice the backticks (upper left of your keyboard— same key as the tilde) around things. Those include inline code-fragments—basically they get printed out in monospaced type (any maybe in a different color). Super useful for variable names or functions like `x_data` or `y_data`.

While we are at it, let's look at what I have done with the text in the `.Rmd` file (the text file). Note that I have put plenty of line endings in so that there are not big long lines. This is a good habit to get into because git likes to look at differences between files on a line by line basis. If the lines are long, then it is harder for git to reasonably merge changes. Rstudio's editor will soft-wrap the lines so that it looks like there are line breaks but there really aren't. Like this ridiculously long line.

And do keep in mind that a blank line equates to a paragraph break.

Static table version

We could also have written that stuff out in a table. There are actually lots of ways to write tables. See [this link](#).

Table 1: *Whoa! that is neat, but kind of a lot of work to input. I sure wouldn't want to do that for a big table! We will investigate ways to automate that. Note that the colons dictate the alignment.*

What	How Much	Units
Flour	2	cups
Eggs	4	eggs!
Raisins	1/2	lbs
Cashews	1/2	lbs

How to make it

Once you have the ingredients, you have to prepare the meal. This is a great task for an ordered list:

1. Break the eggs and scramble them
2. Grind the cashews in a food mill

3. Eat the raisins to keep your energy up because you are going to have a lot of stirring to do. Notice that you can break lines in the text within an item, so long as you don't leave a blank line. The indenting makes the text source more readable but is not necessary.
4. Add cashews to eggs, stir in flour
5. Mix for 30 minutes.

Note that you can put whatever number you want in the front and the markdown interpreter will figure out which numbers they should be. The numbers must be followed by a period!

Cooking time: It's complicated

Now, the big trick to getting grandma's glop just right is cooking it for the proper length of time. Describing this is going to require that we cite some literature and also that we write down some equations...What fun! Let's see how we do that with R Markdown. Cooking time M (for minutes) decreases as the square root of the cooking temperature T , but increases as the $\frac{3}{2}$ -power of the elevation a (for altitude), in feet. For $300^\circ \leq T \leq 500^\circ$ and $0 \leq a \leq 5000$, cooking time is

$$M = (20 - \sqrt{T/4}) \times \left(\frac{a + 5000}{2500} \right)^{\frac{3}{2}}$$

Anyone that is really interested in writing technical mathematical documents should learn to use LaTeX directly. Thankfully, you can imbed R code within LaTeX much as can be done with R Markdown.

We should perhaps qualify this model with a few statements. This model was not empirically derived by rigorous tests, rather we guessed at it given similar work done on cooking times of *Cassiopea* jellies at altitude (Sharp *et al.* 2022) and for *Orbicella* with different microbiomes (Boville *et al.* 2023). But please bear in mind that we did not account for the issues noted by Gonzalez-Pech *et al.* (2021) which arise while using next generation oven technology. You can easily add citations by clicking "Addins" and "Insert Citations"

Clearly, it would be nice to have a table of cooking times, M , for a few values of T and a . Let's take $T \in \{300, 350, 400, 450, 500\}$ and $a \in \{0, 1250, 2500, 3750, 5000\}$. Holy smokes! There will be 25 rows in that table! I don't want to write that by hand!

Thankfully, we can use R to do it for us. We make a a data frame of values, then use a nifty function `kable` from the `knitr` package to make the table. Get ready, we are going to use some R:

```
# first make the data frame
temps <- rep(seq(300,500,50), 5)
alts <- rep(seq(0, 5000, 1250), each=5)
tab <- tibble(T = temps, a = alts, M = (20-sqrt(temps/4)) * ((alts+5000)/2500) ^ (3/2))
```

And then we print it and it looks like this. (Check out how I hid that code block)

T	a	M
300	0	32.07365
350	0	30.11103
400	0	28.28427
450	0	26.56854
500	0	24.94577
300	1250	44.82428
350	1250	42.08144
400	1250	39.52847
450	1250	37.13067
500	1250	34.86277
300	2500	58.92305
350	2500	55.31749
400	2500	51.96152
450	2500	48.80953
500	2500	45.82830
300	3750	74.25153
350	3750	69.70801
400	3750	65.47900
450	3750	61.50704
500	3750	57.75026
300	5000	90.71797
350	5000	85.16685
400	5000	80.00000
450	5000	75.14719
500	5000	70.55728

Cooking times, M , at various temperatures, T , and elevations, a .

Calculating Recipe Quantities

This could be done several ways, but let us simply look at how we would list the ingredients.

First, make an R code block where we declare the quantities:

```
amts <- c(Flour = 2, Eggs = 4, Raisins = 0.5, Cashews = 0.5)
mult <- 40 # make a mult-fold version of the recipe
aa <- amts * mult
```


Then access those variables inline in the list. For example: In order to make 40 times the standard recipe, you will need

- 80 cups flour
- 160 eggs
- 40 lbs of Grandma Gorp:
 - 20 lbs raisins
 - 20 lbs cashews

And, if you want to make π times the standard recipe you need:

- 6.2831853 cups flour
- 12.5663706 eggs
- 3.1415927 lbs of Grandma Gorp:
 - 1.5707963 lbs raisins
 - 1.5707963 lbs cashews

A note about citations and references

You can define different styles in a “CSL” file which you can put where Rstudio can find it (in your project) and then call it out in the YAML header. You apparently can store your citation database in many different ways. I chose BibTeX because that is what I am used to. The citation data base for this document is `blp.bib`

Note that by default only the citations in your data base that actually got cited will be included in the References.

It should be pointed out that you can easily grab BibTeX-formatted citations from [Google Scholar](#).

If you want to use a different bibliography style, browse the styles available at [Zotero Style Repository](#). You can just download them and put them in your project. If we have time, we can try using the *Science* citation style.

If you use [Zotero](#) as your citation manager, you can set it up to maintain a bibliography in your repository based on a collection (folder) in Zotero. Every time you add a citation to the collection, Zotero will automagically write it to the `.bib` file!!

Much more about citations with R markdown can be found [here](#) and you can find plenty of other good links at the bottom of this [page](#).

Making PDF and Word documents

By including `docx:` and `pdf:` in the YAML header, a little arrow appears next to the *Render* button.

To make a PDF document you need the TeX typesetting engine. It is free, but many of you probably don't have it yet.

To make a Word doc, click the down triangle to the right of *Render* and choose “Render Word”. Can you figure out what changes in the document? (Again, it is textual and transparent!) Contrast that to the Word document itself—do this at your Unix command prompt (in the right directory of course):

```
cat grandma-recipe.docx
```

Publishing on the web

Quarto also makes it easy to publish your work on [Github Pages](#)!

Following along with [these instructions](#) (using the **Render to Docs** option)

1. To get started, change your project configuration to use docs as the output-dir. For example:

```
project:
  type: website
  output-dir: docs
```

```
touch .nojekyll
```

2. Render and push to Github.
3. Finally, configure your GitHub repository to publish from the docs directory of your main branch. Not quite working though...

References

- Boville E, Chao J, Tilstra A *et al.* (2023) Microbiome analysis reveals reproductive patterns and variation in cooking times for star coral (*Orbicella faveolata*). *Molecular Ecology*, **22**, 4733–4746.
- Gonzalez-Pech R, Howe C, Garcia V, Crandall ED (2021) Next-generation oven technology and its impact on cooking times for symbiodinium spp. *Molecular Ecology*, **23**, 502–512.
- Sharp V, Li Y, Kitch KM and, Mammone M (2022) A comparison of cooking times for cassiopea xamachana and sea level and at higher elevations. *Transactions of the Superfast Jellyfish Society*, **143**.