Example Rmarkdown Notebook

Adam Lauretig

January 5, 2018

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see http://rmarkdown.rstudio.com. To produce the output, click "Knit", next to the magnifying glass.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

When you examine the chunk, you see that the first line has several things going on. You can generate a new chunk with It begins with "'", which marks the beginning of a code chunk. You can create your own new code chunk by clicking "insert," and then selecting R. The chunk first tells you that it is r code, then has a name, "cars." I would recommend giving your code chunks informative names, and making sure these names are unique. `cache = TRUE` tells R to save the results, so that once we run the code once, we won't have to re-run it every time (as long as we don't change anything).

If we don't want our code chunk to be visible (we only want to see the results), we can include another flag in the header, `echo = FALSE`, which tells R to run the code, but to only display the results.

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

If we want to display code which we won't run (such as homework code that you can't get to work, but include for partial credit), you can add an `eval = FALSE` flag to your code chunk.

```
This code will not run.
```

Generally, for homework assignments, you will use the `echo = FALSE` flag, and just display your output. You should also use the `cache = TRUE` flag, so that you won't have to re-run all of your code every time.

Including Plots

You can also embed plots, for example:
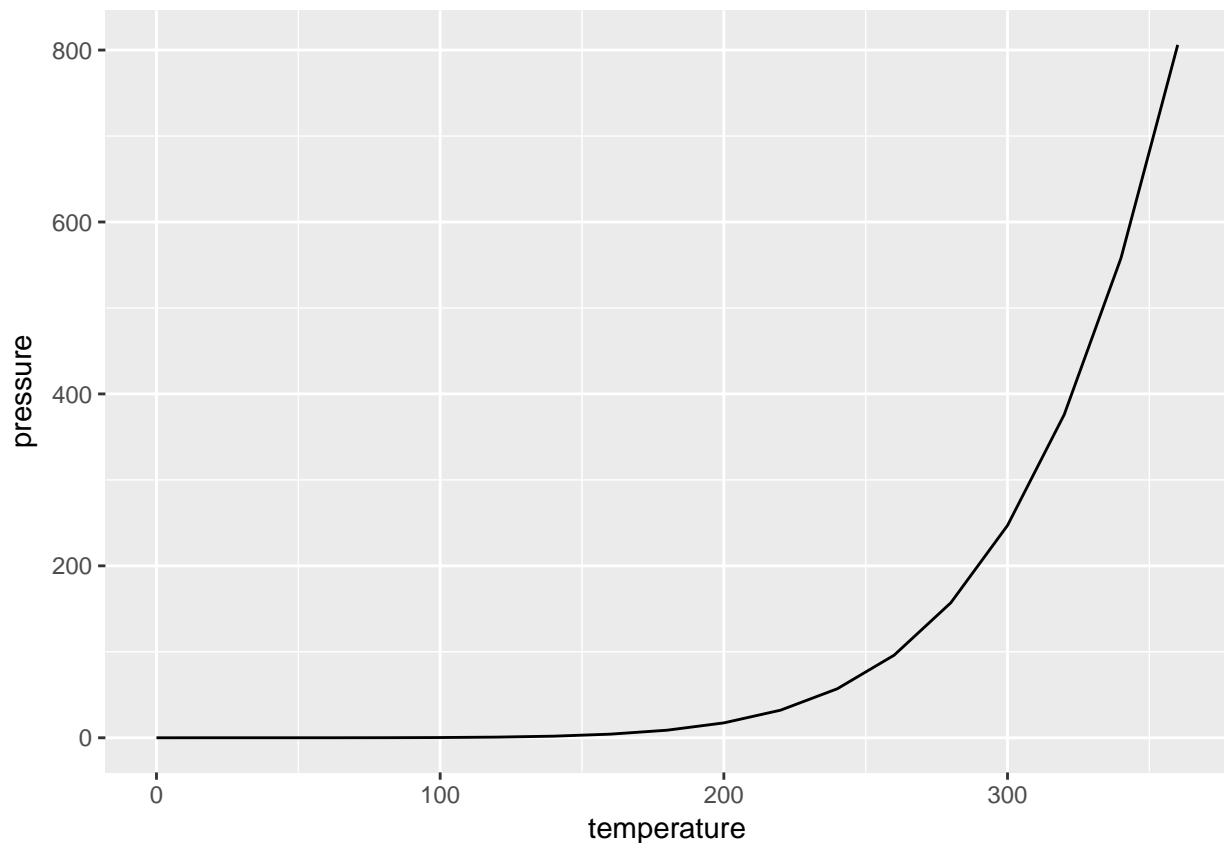
We'll use `echo = FALSE`, so that we only see the plot. However, we may want to add a caption to the image, so that we can describe what we'll see. We can put this in the header:

But this figure is pretty big. We can adjust the size with a few more flags in the header. Using `fig.width = 3, fig.height= 2`, we'll tell R we want a 4×3 inch figure for our plot.

We can include links to figures in the text of the document, which is helpful when writing analysis, we'll add text to the caption, so that we can reference figure 3 . I also included `fig.align='center', fig.show='hold'` in the header, so that the figure would stay centered (which is not necessary, but aesthetically, I like it.)
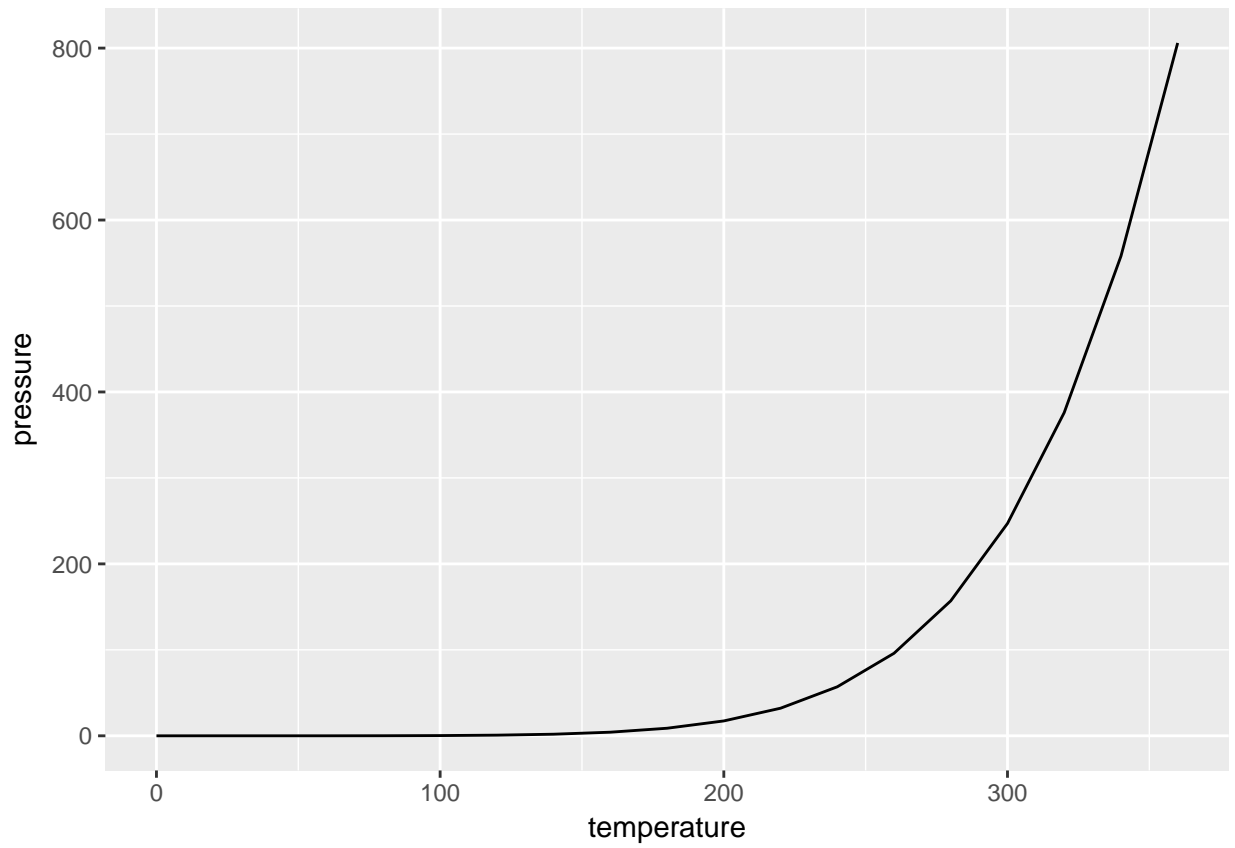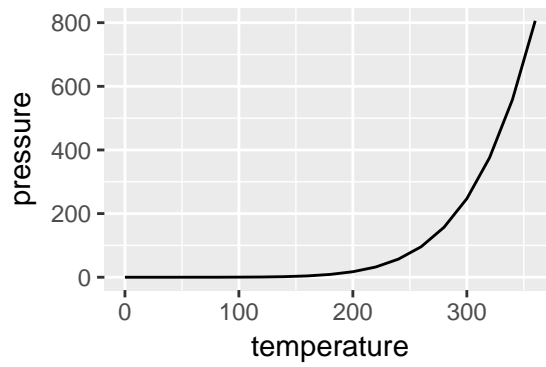
Figure 1: Plotting Temperature vs. Pressure

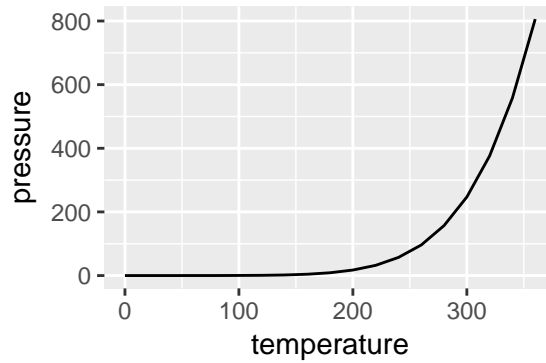Figure 2: Plotting Temperature vs. Pressure

Figure 3: Plotting Temperature vs. Pressure with a label

Writing out Math

One additional reason to use `Rmarkdown` is that we can use the Latex engine underneath it to write out nice looking math, which saves the trouble of having to figure out handwritten notes in a presentation. For example, we can write out a regression equation as $y = \alpha + X\beta + \varepsilon$, without having to copy and past anything in. To write out anything math related, we enclose it in dollar signs `$math$`. The regression example above, for example, is `$ y = \alpha + X\beta + \varepsilon $`. If we want to index something x_1, x_2 etc, the code is `$x_{1}, x_{2}$`. Fractions are written $\frac{1}{2}$, `$\frac{1}{2}$`, and exponents (2^2) are written `$2^{2}$`.

You'll notice the greek letters have a slash before them, but the letters don't. This slash tells Latex to print that as a greek letter. Similarly 2×2 is written `$ 2 \times 2 $`. A useful guide to special characters and formatting in Latex is here https://users.dickinson.edu/~richesod/latex/latexcheatsheet.pdf. I reference it fairly regularly.

Matrices

To implement a matrix:

$$\left[\begin{array}{ccc} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{array} \right]$$

you'll need to write:

```
$$ % start Latex mode
\left[ %creates the left bracket, the "\left" command scales the bracket "["
\begin{array}{ccc} % Creates the "array" (matrix), {ccc} defines the number of columns
1 & 2 & 3 \\ % "&" divides the columns, "\\" creates a new line
4 & 5 & 6\\
7 & 8 & 0
\end{array} % ends the matrix
\right] %creates the left bracket, the "\right" command scales the bracket "]"
$$ % ends Latex mode
```

without comments:

```
$$
\left[
\begin{array}{ccc}
1 & 2 & 3 \\
```

```
4 & 5 & 6\\
7 & 8 & 0
\end{array}
\right]
$$
```

Extra Credit (5 pts)

Due January 12

Reproduce the following examples in `Rmarkdown`, and submit the resulting pdf & `.Rmd` file.

1

Linear regression with fixed effects:
$$y_i = \alpha_0 + \alpha_j + x_i\beta + \varepsilon$$

2

OLS estimation

Data:
$$X = \begin{bmatrix} x_{1,1} & x_{1,2} \\ x_{2,1} & x_{2,2} \end{bmatrix}, y = \begin{bmatrix} y_1 \\ y_2 \end{bmatrix}$$

OLS equation
$$\hat{\beta} = (X'X)^{-1}(X'y)$$

3

Logistic link function:
$$Pr(y_i = 1) = \frac{1}{1 + e^{-x_i\beta}}$$

4

Poisson PMF:
$$\frac{\lambda^k}{k!}e^{-\lambda}$$

5

Gaussian (normal) PDF:
$$\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$