ENV 316: R Markdown Tutorial

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Howdy!

We understand that virtual classes may not have been what you had in mind when you signed up for a course titled *Laboratory and Field Methods in Environmental Science*, but it does provide us with a great oppertunity to really dive into what seperates science from a walk in the woods: writting stuff down! As you've probably already heard, the ENV 316 course will make prodigious use of R and RStudio as we explore concepts of environmental chemistry and ecology. Since you're already using R and RStudio for your data analysis and manipulations, we're encouraging you to submit your work using R Markdown.

The aim of this document is to briefly explain what R Markdown is, why you should use it (hint: it'll make everyone's lives easier), and how to create simple documents for this course.

First off, what is R Markdown?

In a nutshell, R Markdown allows you to analyse your data with R and write your report in the same place (this document is written with R Markdown). This has loads of benefits including increased reproducibility, and streamlined thinking. No more flipping back and forth between code and writing to figure out what's going on. Let's some some simple code as an example:

```r
# Look at me go mom
x <- 2+2
x
```

```
## [1] 4
```

What we've done here is write a snippet of R code, ran it, and printed the results (as they would appear in the console). While the above code isn't anything special, we can extend this concept so that our R markdown document contains any data, figures or plots we generate thoughout our analysis in R. For example:

```r
library(tidyverse)
library(knitr)
airPol <- read_csv("./data/Toronto_60433_2018_Jan2to8.csv",
                   na = "-999")
kable(airPol[1:5, ],
      caption = "Example table of airborn pullutant levels used for Figure 1.")
```

Table 1: Example table of airborn pullutant levels used for Figure 1.

temperature	pollutant	concentration	date
-11.7	NO2	41	2018-01-01 19:00:00
-11.7	O3	2	2018-01-01 19:00:00

temperature	pollutant	concentration	date
-11.3	NO2	28	2018-01-01 20:00:00
-11.3	O3	14	2018-01-01 20:00:00
-11.6	NO2	20	2018-01-01 20:59:59

```
ggplot(airPol, aes(date, concentration, colour = pollutant)) +
  geom_line() +
  theme_classic()
```
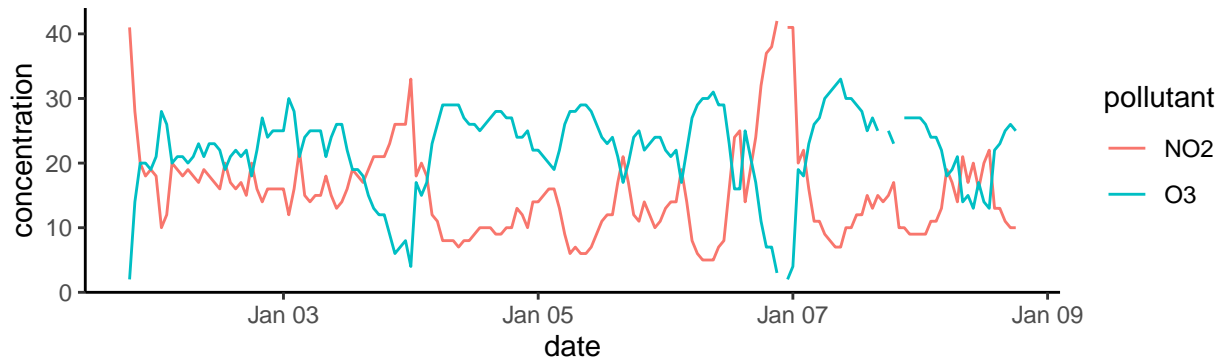

Figure 1: Time series of 2018 ambient atmospheric O_3 and NO_2 concentrations (ppb) in downtown Toronto

Pretty neat, eh? You might not think so, but let's imagine a common scenario you'll encounter soon enough. You're about to submit your assignement, you've spent hours analyzing your data and beautifying your plots. Everything is good to go until you notice at the last minute you were supposed to *substract* value `x` and not value `y` in your analysis. If you did all your work in *Excel* (tsk tsk), you'll need to find the correct worksheet, apply the changes, reformat your plots, and import them into word (assuming everything is going well, which is never does when deadlines loom). Now if you did all your work in R markdown, you go to your one `.rmd` document, briefly apply the changes and compile your document.

How do I get started with R markdown?

As you've already guessed, R markdown documents use R and are most easily written and assembled in the RStudio IDE. If you have not done so, download R from the comprehensive R archive network (CRAN), link here: `http://cran.utstat.utoronto.ca/`, and RStudio, link here: `https://rstudio.com/products/rstudio/download/`). Follow the listed instructions and you should be well on your way.

Once setup with R and RStudio, we'll need to install the **rmarkdown** and **tinytex** packages. In the console, simply run the following code:

```
install.packages("rmarkdown") # downloaded from CRAN

install.packages("tinytex")
tinytex::install_tinytex()  # install TinyTeX
```

The **rmarkdown** package is what we'll use to generate our documents, and the **tinytex** package enables compiling documents as PDFs. There's a lot more going on behind the scenes, but you shouldn't need to worry about it.

Now that everything is setup, you can create your first RMarkdown document by opening up RStudio, selecting FILE -> NEW FILE -> Rmarkdown. A dialog box will appear asking for some basic input paramets for your Rmarkdown document. Add your title and select PDF as your default output format (you can always change these later if you want). A new file should apear that's alraedy populated with some basic script illustrating the key components of an R markdown document.