Lab 1 – MATH 240 – Computational Statistics

Jake Schneider
Computational Statistics
Mathematics
jdschneider@colgate.edu

Abstract

This document provides a basic template for the 2-page labs we will complete each week. Here, you should provide a succinct summary about what you did and why it might be helpful.

Keywords: What topics does the lab cover with respect to class?

1 Instructions

For this lab, you will

1. Install R and RStudio
2. Install tinytex (if necessary):

   `install.packages("tinytex")`
3. Create a Github account here, and email me your username.
4. Install GitHub Desktop.
5. Accept the LAB 1 assignment here
6. Recreate this document (except put your name/info at the top) to get used to writing in LaTeX and to see the types of things we can do when creating a document to convey statistical information. Make sure to commit and push your work using GitHub desktop as you finish each section.

Remark: You will find the class Sweave cheatsheet to be *incredibly* (`\emph{incredibly}`) helpful.

2 Word Processing Tasks

2.1 Centering Text

We can center text in Sweave.

2.2 Bold, Italics, and Underlining

We can **bold**, *italicize*, underline, and *emphasize* text in Sweave.

Note, I did a column break here so that the list wasn't broken across columns.

2.3 List, and Numbered Lists

We can write an unordered list in Sweave.

- first item
- second item
- third item

We can write a numbered list in Sweave.

1. first item
2. second item
3. third item

We can write a lettered list in Sweave.

a. first item
b. second item
c. third item

2.4 Submissions

This part of the midterm is due Sunday November 14 by 5p. I will not accept late submissions. Note that you may use this template to help build your introduction and methods sections, and you can use the work you did as a group during the datathon. Still, I expect this submission to be your own summary and extension of that work without collaboration.

2.5 Typing Mathematical Equations

We can write a one line equation that is centered like this

$$\widehat{y_i} = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{1i} x_{2i} + \epsilon_i.$$

This can be written in the test, as $\widehat{y_i} = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{1i} x_{2i} + \epsilon_i$ using as well.

When we need to show mulitple steps, we can create a multi-line equation that is centered like this

$$\begin{aligned}
8(x-5)+x &= 9(x-5)+5 \\
8x-40+x &= 9x-45+5 && \text{(Distribution))} \\
9x-40 &= 9x-40 && \text{(Combining like terms)} \\
9x &= 9x && \text{(adding 40 to both sides)} \\
x &= x && \text{(Dividing bohth sides by 9)}
\end{aligned}$$

The equality holds for any x.

Note, I did a page break here so that the next section started on a clean page.

2.6 Running R Code

Code chunks can be entered into Sweave; e.g., here are some comments

```
# R code goes here
# Output is automatically printed in the pdf
```

Below, you can see that we can do algebra with R.

```
8*(9-5) + 9 # 8(x-5) + x for x=9

## [1] 41
```

Below, we show we can produce the code without evaluating it.

```
8*(9-5) + 9 # 8(x-5) + x for x=9
```

Alternatively, we can proudce the output without the code.

```
## [1] 41
```

We can also call object values from R directly.

```
result<- 8*(9-5)+9 # 8(x-5)+x for x=9
result.with.error<- result + rnorm(1, mean=0, sd=0.1)
result.with.error

## [1] 40.98377
```

The result is 40.9837732. Note that I did not type the result, but I used the `\Sexpr{}` command.

2.7 Plotting

We can also plot with R.

```
#Plot a histogram of random exponential data
hist(rexp(100))
```

Figure 1: A histogram of random exponetially distributed data, $n = 100$.

2.8 tables

Below, we load and take a peek at some data about the death rates per 1000 in Virginia in 1940 (Molyneaux et al., 1947).

```
data(VADeaths)
head(VADeaths) # Take a peek of the data

##       Rural Male Rural Female Urban Male Urban Female
## 50-54       11.7          8.7       15.4          8.4
## 55-59       18.1         11.7       24.3         13.6
## 60-64       26.9         20.3       37.0         19.3
## 65-69       41.0         30.9       54.6         35.1
## 70-74       66.0         54.3       71.1         50.0
```

If we want to print this nicely, we can do so using the xtable package (Dahl et al., 2019), which we can reference using the label (Table 1).

```
library(xtable)
sleep.table<-xtable(VADeaths ,
                    label = "VADeaths.tab",
                    caption = "Death Rates per 1000 in Virginia (1940)")
```

Rural Male	Rural Female	Urban Male	Urban Female
11.70	8.70	15.40	8.40
18.10	11.70	24.30	13.60
26.90	20.30	37.00	19.30
41.00	30.90	54.60	35.10
66.00	54.30	71.10	50.00

Table 1: Death Rates per 1000 in Virginia (1940)

References

Dahl, D. B., Scott, D., Roosen, C., Magnusson, A., and Swinton, J. (2019). *xtable: Export Tables to LaTeX or HTML*. R package version 1.8-4.

Horst, A. M., Hill, A. P., and Gorman, K. B. (2020). *palmerpenguins: Palmer Archipelago (Antarctica) penguindata*. R package version 0.1.0.

Molyneaux, L., Gilliam, S. K., and Florant, L. C. (1947). Differences in virginia death rates by color, sex, age and rural or urban residence. *American Sociological Review*, 12(5):525–535.

3 Appendix

Below is a table from a paper I'm currently working on. Without the analysis object in R, I have to create table myself.

Term	SS(Type III)	df	F	p-value	ϵ_p^2
(Intercept)	4.95	1.00	5.37	0.0209	
White-Poor (Z)	3.17	1.00	3.44	0.0642	0.02
Zero-Sum (Z)	17.96	1.00	19.48	<0.0001	0.03
Education (Z)	0.39	1.00	0.42	0.5161	0.00
Income (Z)	0.16	1.00	0.17	0.6817	0.00
Democrat	9.60	1.00	10.42	0.0013	0.02
Black-Poor (Z)	1.92	1.00	2.08	0.1496	0.00
White-Poor (Z)xZero-Sum (Z)	7.96	1.00	8.63	0.0034	0.01
Residuals	506.92	550.00			

Table 2: ANOVA table for Case Study I.

The palmerpenguins package for R (Horst et al., 2020) provides data on adult foraging penguins near Palmer Station, Antartica. Figure 2 is too big to fit nicely in our column-based-template above, so I've placed it here in the abstractby saving it and presenting it scaled to 0.75.

```
library(palmerpenguins)
pdf("figure/pengiuins.pdf", width = 8, height =5)
plot(penguins)
dev.off()
```

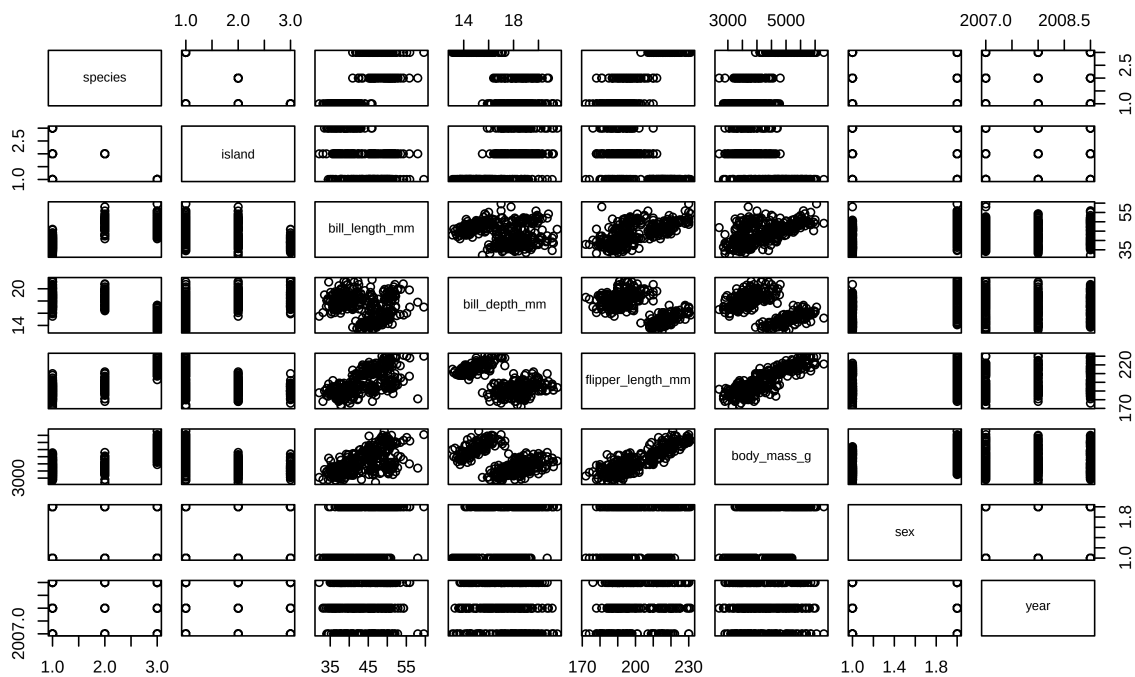

Figure 2: Data on adult foraging penguins near Palmer Station, Antartica.