University of Nevada, Reno

A Tale of Two Cities: Reno and Las Vegas

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in
Statistics and Data Science

by

Karen T. Barensby

Dr. Glen J. Smith/Thesis Advisor

May/August/December, 20XX

THE GRADUATE SCHOOL

We recommend that the thesis
prepared under our supervision by

YOUR NAME

entitled

THESIS TITLE

be accepted in partial fullfilment of the
requirements for the degree of

DEGREE

ADVISOR
Advisor

COMMITTEE MEMBER
Committee Member

GRADUATE SCHOOL REPRESENTATIVE
Graduate School Representative

David W. Zeh, Ph.D., Dean
Graduate School

May/August/December, 20XX

Abstract

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Dedication (optional)

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Acknowledgments (optional)

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Contents

List of Tables

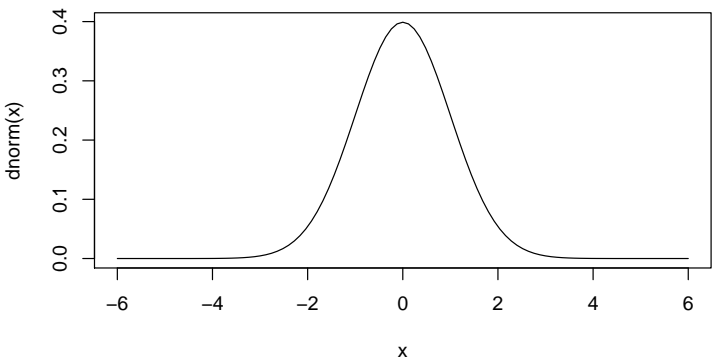# List of Figures

1. Introduction

example of r plot
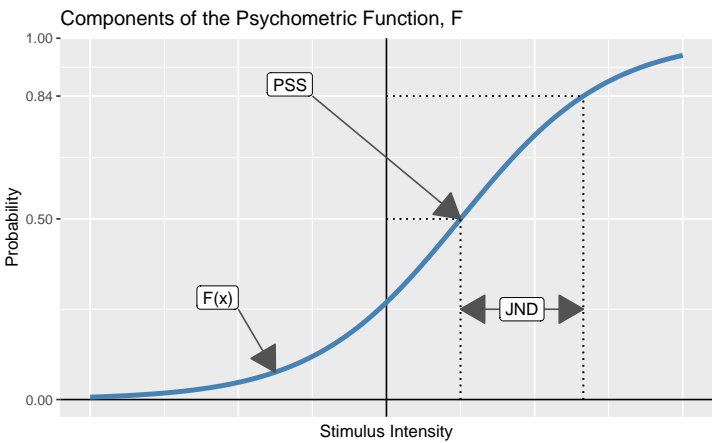

Figure 1.1.: My first figure

example of ggplot

Figure 1.2.: My second figure

example of included graphics

Figure 1.3.: My third figure

2. Using Tables

example of a reference (Britannica, 2014).

example of display math

$$\frac{\Delta I}{I} = k$$

Example of inline math $\Delta I = 0.2$

2.1. Level 2 Heading

example of a table and reference (table 2.1)

Table 2.1.: THIS IS MY TABLE!

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.5	2.5	4.0	1.3	versicolor
5.7	2.6	3.5	1.0	versicolor
5.5	2.6	4.4	1.2	versicolor
6.2	2.2	4.5	1.5	versicolor
5.5	4.2	1.4	0.2	setosa
7.7	3.0	6.1	2.3	virginica
6.5	3.0	5.2	2.0	virginica
5.5	2.4	3.7	1.0	versicolor
6.7	3.3	5.7	2.1	virginica
6.9	3.2	5.7	2.3	virginica

3. Using Equations

Example of equations

$$Y \sim \text{Bernoulli}(\pi) \tag{3.1}$$

$$\pi = P(Y = 1|x;\theta) = F(x;\theta) \tag{3.2}$$

$$P(Y = y|x;\theta) = F(x;\theta)^y (1 - F(x;\theta))^{1-y} \tag{3.3}$$

The likelihood function $\mathcal{L}$ can be determined using equation (3.3)

$$\begin{aligned}
\mathcal{L}(\theta|y,x) &= \prod_i^N P(y_i|x_i;\theta) \\
&= \prod_i^N F(x_i;\theta)^{y_i} (1 - F(x_i;\theta))^{1-y_i}
\end{aligned} \tag{3.4}$$

Equation (3.4) is commonly expressed in terms of its logarithm.

$$\ln \mathcal{L}(\theta|y,x) = \sum_{i}^{N} y_i \ln \left(F(x_i;\theta) \right) + (1 - y_i) \ln \left(F(x_i;\theta) \right)) \tag{3.5}$$

A. Supplementary Code

One model, Three Implementations. There are a few ways to specify a hierarchical model in R. Below I describe three common frameworks that require varying levels of mathematical and programmatic competence. Frameworks with lower barriers for entry are great for researchers in many fields, but they lack fine control over the parameters in a model. As the framework complexity increases, so too does the ability to generate complex models that are typically not possible.

Novice

```r
library(rstanarm)
stan_glmer(cbind(k, n-k) ~ 1 + x + (1 + x | G1) + (1 + x | G2),
           family = binomial(link = "logit"),
           data = dat)
```

Intermediate

```r
library(rethinking)
ulam(alist(
  k ~ binomial(n, pi)
  logit(pi) <- (a + aG1[G1] + aG2[G2]) + (b + bG1[G1] + bG2[G2]) * x,

  a ~ normal(0, 10),
  aG1[G1] ~ normal(0, sd_aG1),
  aG2[G2] ~ normal(0, sd_aG2),
  c(sd_aG1, sd_aG2) ~ half_cauchy(0, 10),

  b ~ normal(0, 10),
  bG1[G1] ~ normal(0, sd_bG1),
  bG2[G2] ~ normal(0, sd_bG2),
```

```
  c(sd_bG1, sd_bG2) ~ half_cauchy(0, 10)
), data = dat, log_lik = TRUE)
```

Bibliography

Britannica, E. (2014). The editors of encyclopaedia britannica.