1-Way ANOVA- Model Representations, Power, and Sample Size Tutorial

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Contents

Chapter 1

Introduction

ANOVA is short for analysis of variance. It is a widely used statistical method used with designed experiments. Given its frequency of use, it is my opinion that anyone interested in academic research understand the basics. . . even if you never use it in your own research, I guarantee you will encounter it somewhere in the literature! Briefly, ANOVA is an "accounting" procedure that keeps track of all the variation in a response variable. ANOVA partitions this variation into pieces and uses these pieces to assess the likelihood that differences found between means in sample data could be the result of random chance.

This tutorial focuses on 1-way ANOVA, specifically ways to model our data in the context of this statistical method. We introduce the means and effects models and their assumptions and implement these approaches manually in R. We also discuss power and sample size and provide an interactive visualization to see what influences power in an ANOVA. Discussion of power and sample size helps answer the question: "How might we increase the chances of getting a statistically significant result from our ANOVA?" Thinking about power and sample size not only will bolster your statistical chops, it might also come in handy in practice when planning research design or writing research grant proposals.

The tutorial assumes you have used R before. Many of the examples and demos utilize functions from the Tidyverse. This tutorial was written using the **bookdown** package (Xie, 2020), which was built on top of R Markdown and **knitr** (Xie, 2015).

You can label chapter and section titles using `{#label}` after them, e.g., we can reference Chapter 1. If you do not manually label them, there will be automatic labels anyway, e.g., Chapter **??**.

Figures and tables with captions will be placed in `figure` and `table` environments, respectively.

```r
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```
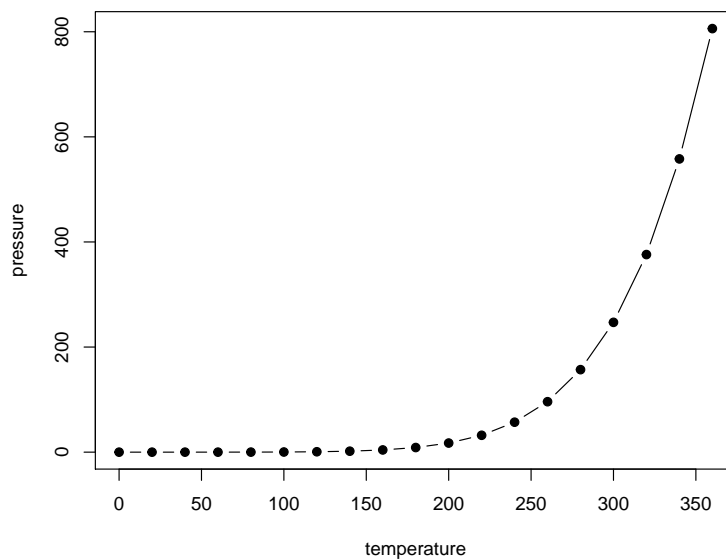

Figure 1.1: Here is a nice figure!

Reference a figure by its code chunk label with the `fig:` prefix, e.g., see Figure 1.1. Similarly, you can reference tables generated from `knitr::kable()`, e.g., see Table 1.1.

```r
knitr::kable(
  head(iris, 20), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

You can write citations, too. For example, we are using the **bookdown** package (Xie, 2020) in this sample book, which was built on top of R Markdown and **knitr** (Xie, 2015).

Remember each Rmd file contains one and only one chapter, and a chapter is defined by the first-level heading `#`.

To compile this example to PDF, you need XeLaTeX. You are recommended to install TinyTeX (which includes XeLaTeX): https://yihui.name/tinytex/.

Table 1.1: Here is a nice table!

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3.0	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa
4.6	3.1	1.5	0.2	setosa
5.0	3.6	1.4	0.2	setosa
5.4	3.9	1.7	0.4	setosa
4.6	3.4	1.4	0.3	setosa
5.0	3.4	1.5	0.2	setosa
4.4	2.9	1.4	0.2	setosa
4.9	3.1	1.5	0.1	setosa
5.4	3.7	1.5	0.2	setosa
4.8	3.4	1.6	0.2	setosa
4.8	3.0	1.4	0.1	setosa
4.3	3.0	1.1	0.1	setosa
5.8	4.0	1.2	0.2	setosa
5.7	4.4	1.5	0.4	setosa
5.4	3.9	1.3	0.4	setosa
5.1	3.5	1.4	0.3	setosa
5.7	3.8	1.7	0.3	setosa
5.1	3.8	1.5	0.3	setosa

Chapter 2

ANOVA Basics

Chapter 3

The Means and Effects Models

Chapter 4

Power and Sample Size

Bibliography

Xie, Y. (2015). *Dynamic Documents with R and knitr*. Chapman and Hall/CRC, Boca Raton, Florida, 2nd edition. ISBN 978-1498716963.

Xie, Y. (2020). *bookdown: Authoring Books and Technical Documents with R Markdown*. R package version 0.19.