Calculus Made EasieR

William Murrah

2021-08-08

Contents

Preface

This is a collection of notes I generated while using R to learn calculus for statistics in general and nonlinear modeling specifically. The notes are based multiple sources including a classic book by Thompson and Gardner (1998), and a great textbook focusing on calculus and probability in the life sciences(Adler, 2012).

Chapter 1

Introduction

1.1 Algebra and Calculus Basics

1.1.1 Exponentials and Logarithms

An exponential is represented as e^x or $\exp(x)$, with e being the constant 2.718…. Some things to know about exponentials, and how to generate them in are include (Bolker, 2008):

$\exp(1) = e = 2.718282$,

```
exp(1)
```

```
## [1] 2.718282
```

$\exp(0) = 1$,

```
exp(0)
```

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

$\exp(-\infty) = 0$,

```
exp(-Inf)
```

```
## [1] 0
```

and $\exp(\infty) = \infty$,

```
exp(Inf)
```

```
## [1] Inf
```

Logarithms can have

Chapter 2

Functions

Two functions, $f(x)$ and $g(x)$ are below:

$$f(x) = 4 + x - x^2$$

$$g(x) = 2x$$

```
f <- function(x) 4 + x - x^2
g <- function(x) 2*x
```

2.0.1 Composition of Functions

$$(f \circ g)(x) = f(g(x))$$

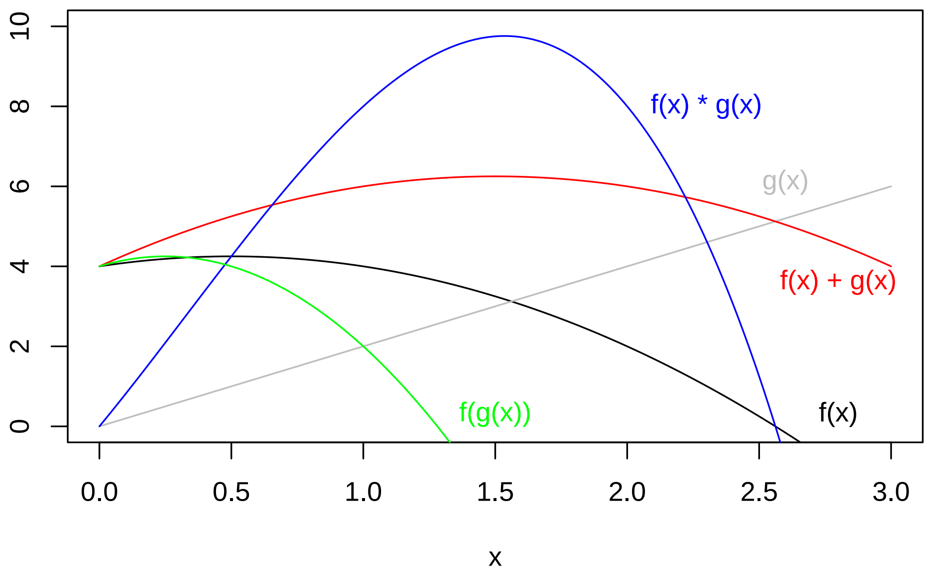
```
x <- seq(0, 3, .5)
fx <- f(x)
gx <- g(x)
f_gx <- f(x) + g(x)   # (f + g)(x) adding functions
f.gx <- f(x) * g(x)   # (f * g)(x) multiplying functions
fgx <- f(g(x))        # (f o g)(x) composition of functions

modelsummary::datasummary_df(data.frame(x, fx, gx, f_gx, f.gx, fgx), title = "Combining Functions
```

```
x <- seq(0, 3, .001)
plot(f(x) ~ x, type = "l", ylim = c(0, 10), ylab = "")
text(2.8, .3, labels = "f(x)")
lines(g(x) ~ x, col = "grey")
text(2.6, 6.1, "g(x)", col = "grey")
lines(f(x) + g(x) ~ x, col = "red")
```

Table 2.1: Combining Functions

x	fx	gx	f_gx	f.gx	fgx
0.00	4.00	0.00	4.00	0.00	4.00
0.50	4.25	1.00	5.25	4.25	4.00
1.00	4.00	2.00	6.00	8.00	2.00
1.50	3.25	3.00	6.25	9.75	-2.00
2.00	2.00	4.00	6.00	8.00	-8.00
2.50	0.25	5.00	5.25	1.25	-16.00
3.00	-2.00	6.00	4.00	-12.00	-26.00

```
text(2.8, 3.6, "f(x) + g(x)", col = "red")
lines(f(x) * g(x) ~ x, col = "blue")
text(2.3, 8, "f(x) * g(x)", col = "blue")
lines(f(g(x)) ~ x, col = "green")
text(1.5, .3, "f(g(x))", col = "green")
```



Note that when x is zero, $f(x)$ is 4, and $g(x)$ is zero. So it makes sense that $g(x)$ starts at 0 on the y-axis. It also make sense that $(f * g)$ starts at zero on the y-axis, because any value of $f(x)$ will be multiplied by zero, which will result in zero. It is also intuitive that both $f(x)$ and $f(x) + g(x)$ start at 4 on the y axis, because $f(x)$ is 4 when x is zero ($f(x) = 0$), and adding zero to this does not change this value ($f(x) + g(x) = (4 + 0) = 4$, when $x = 0$).

2.0.2 1.2.4 Finding Inverse Functions

Chapter 3

Methods

We describe our methods in this chapter.

Chapter 4

Applications

Some *significant* applications are demonstrated in this chapter.

4.1 Example one

4.2 Example two

Chapter 5

Final Words

We have finished a nice book.

Bibliography

Adler, F. R. (2012). *Modeling the dynamics of life: calculus and probability for life scientists*. Cengage Learning.

Bolker, B. M. (2008). *Ecological models and data in R*. Princeton University Press.

Thompson, S. P. and Gardner, M. (1998). *Calculus made easy*. Macmillan.