

Scientific Programming Assignment 2

MPhil in Computational Biology

October 25, 2023

If there are errors found, I will update the assignment on the moodle.

Due date: 2023-11-09 23:45

For this assignment, you should submit two files:

1. Your assignment as either a Rmarkdown (.Rmd) or Knitr (.Rnw) file.
2. A Makefile which will compile your document from point 1.

To compile your document, I will simply type 'make' in a folder containing your two files. Only use R packages that are available on the system for everyone. If I cannot compile the PDF, your mark will be reduced depending on how much editing is required to compile it. (Hint: ask someone else to compile it for you.)

Your report must be a maximum of ten pages, excluding the appendix. This course work will consist of 25% towards your overall mark for this module.

1 Ping pong [25 marks]

Your task is to simulate the game of ping pong according to the following rules:

1. Player 1 serves first. Each player serves for $S = 2$ points before switching to the other player, irrespective of how many points have been scored.
2. The game is won when one player has won P points, where $P \geq T$ (e.g. $T = 11$) points AND the other player has at most $P - 2$ points. So a player can win 11-8, 11-9, 12-10 (but not 11-10 or 12-11).
3. When player i serves the ball, they have a probability A_i of winning the point by serving an Ace. Otherwise, each player has a probability P_i of winning the point when they hit the ball back to the other player. The rally length for a point is the number of times the ball was hit before the point was won.

Your task is to discover if Player 1 has an advantage by serving first under three different scenarios. You should investigate:

1. What fraction of games does player one win?
2. What is the distribution of rally lengths?
3. Keeping all other parameters fixed, how would you adjust A_2 to ensure that the game is as fair as possible?

You will need to investigate three different scenarios playing the game. The six parameters for each scenario are stored in the files pingpong-a.dat, pingpong-b.dat and pingpong-c.dat.

These files are stored on github and can be read into R like this:

```
data1 <- function(file) {  
  scan(quiet=TRUE,  
       paste0("https://raw.githubusercontent.com/sje30/sp2023/",  
              "main/assigns/a2/",file))  
}  
  
data <- data1("pingpong-a.dat")  
a1 <- data[1]; a2 <- data[2];  
p1 <- data[3]; p2 <- data[4];  
s <- data[5]; t <- data[6];  
sprintf("A1 = %0.2f; A2 = %0.2f; P1=%0.2f; P2=%0.2f; S=%d; T=%d\n",  
        a1, a2, p1, p2, s, t)  
  
## [1] "A1 = 0.60; A2 = 0.60; P1=0.50; P2=0.50; S=2; T=11\n"
```

Write up your findings as a short report, including evidence to support your answers. I may choose to change the files after your submission, so do not hardcode the values of these parameters, or your results, in your report.