STT 380

In-Class Activity 18

1. Suppose in the ping pong example you have prior probabilities of 0.1, 0.3, and 0.6 for winning 20%, 40%, or 60% of the games.
   a. After playing 4 games, you win 2 and lose 2. What are your posterior probabilities after these 4 games?
      i. theta <- c(0.2,0.4,0.6)
      ii. prior <- c(0.1,0.3,0.6)
      iii. n <- 4
      iv. win <- 2
      v. posterior <- prior*dbinom(win,n,theta)/sum(prior*dbinom(win,n,theta))
      vi. posterior = 0.04705882 0.31764706 0.63529412
   b. (Use the original prior probabilities and disregard the results of (a)) Next, simulate wins and losses from a distribution with a 40% chance of winning (you can use runif(0,1) and if it is less than 0.4, it counts as a win; otherwise, a loss).
      i. Run an iteration and compute the posterior probabilities each time.
      ii. About how many times do you play before the posterior odds for winning 40% reach 0.9?
         1. theta <- c(0.2,0.4,0.6)
         2. prior <- c(0.1,0.3,0.6)
         3. games <-0
         4. while (prior[2] < 0.9){
         5. n <- 1
         6. win <- rbinom(1,1,0.4)
         7. prior <- prior*dbinom(win,n,theta)/sum(prior*dbinom(win,n,theta))
         8. games = games+1
         9. }
         10. prior = 0.078388276 0.917421569 0.004190155
         11. Games = 32

2. Suppose the prior weights for the probability of winning a game is proportional to sin(πx). Suppose after 30 games you win 10.

   a. Use a grid discretization (100 cells) to find the posterior probabilities.

      i. x <- seq(0,1, by = 0.01)

      ii. prior <- sin(pi*x)/sum(sin(pi*x))

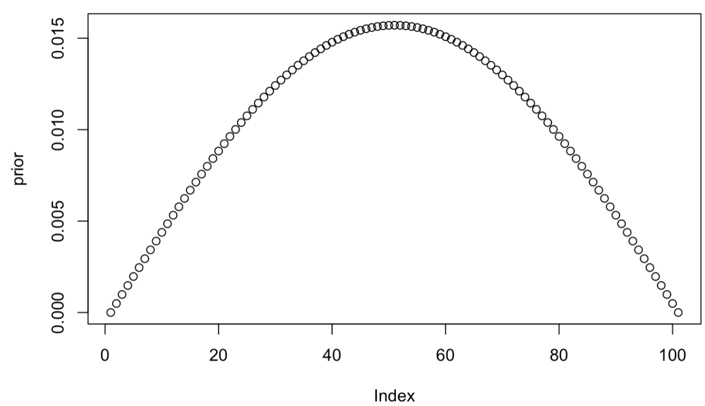
      iii. plot(prior)

      iv. # play 12, win 4

      v. n <- 30

      vi. wins <- 10

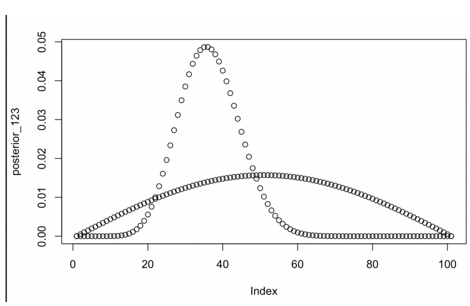
      vii. posterior_123 <- prior*dbinom(wins,n,theta)/sum(prior*dbinom(wins,n,theta))



   b. Graph the prior and posterior together.

      i. plot(posterior_123)

      ii. points(prior)



c. Is the mean value of the posterior closer to 0.5 (the mean value of the prior) and 1/3 (the proportion of games won)?

    i. mean(posterior_123*x*100) = 0.3511255

    ii. So it is closer to 0.3 (1/3) which is the proportion of games won.