

22S:138, Bayesian Statistics
Fall 2003, Homework 2

Due: Mon. 9/15

Suppose you are the coach of a college baseball team. A new player is joining your team. As a high school player, he had 40 hits in 120 at-bats. You wish to estimate θ , his underlying true probability of getting a hit in any at-bat as a college-level player.

1. Specify a Beta prior that seems appropriate to capture your knowledge or uncertainty about θ before he plays in any college-level games. Use any information you have that seems important – his high-school record, what you know about college-level ball players, etc. You may use R/Splus functions if you wish. Explain in a few sentences how you chose the values of α and β . There is no one right answer here – I want to see how you think about this and what procedure you use.
2. Specify a Beta prior that you think might reflect the player's father's beliefs about θ .
3. Suppose the player now plays eight college-level games, has thirty at-bats, and gets 5 hits. Thus the data are:

$$y = 5, \quad n = 30$$

We will use a binomial likelihood for these data. This requires the assumption that, conditional on θ , each at-bat is an independent Bernoulli trial with success probability θ . There are several reasons why independence might actually *not* be a reasonable assumption in this problem. Give one.

Note: For our present purposes, we'll use a binomial likelihood anyway. We'll come up with a better model when we talk about hierarchical models later in the semester.

4. Obtain the following characteristics of the posterior distribution $p(\theta|y)$
 - (a) name of posterior distribution and its parameter values
 - (b) posterior density plot
 - (c) posterior mean and mode
 - (d) 95% posterior interval for θ
 - (e) posterior probability that $\theta > .25$

based on the data from the college-level games under each of three priors:

- (a) your prior from part 1.
 - (b) the father's prior
 - (c) a uniform prior
5. Comment on whether or not the conclusions in part 4 are robust to different prior specifications.