

Course EPIB-675 - Bayesian Analysis in Medicine

Assignment 6

1. Suppose there is a standard treatment A and a newly developed treatment B for a certain condition. The success rate of A is known to be 70%, and treatment B, which is more expensive than A, will be considered as clinically superior to A if its success rate is 80% or greater.

(a) Construct an “enthusiastic” prior distribution for the success rate of Drug B, which is centered at the clinical superiority value (80%), and such that approximately 5% of the prior probability falls below the success rate of A (70%).

(b) Similarly, construct a skeptical prior distribution for the success rate of Drug B, centered on the success rate of Drug A, and with only 5% of the prior probability falling above the clinical superiority limit of B (80%).

Suppose that a small trial of B is carried out, with 18 successes in 20 trials.

(c) What is the posterior distribution of the success rate for B using a uniform (reference) prior?

(d) What is the posterior distribution of the success rate for B using the enthusiastic prior?

(e) What is the posterior distribution of the success rate for B using a skeptical prior?

(f) What is your overall conclusion regarding the choice of Drug A or Drug B, given the posterior distributions calculated in (c), (d), and (e)?

2. Repeat parts (c) through (f) of Question 1, but now suppose that a larger data set is available, with 180 successes in 200 trials of Drug B.

3. (a) Again considering the scenario described in Question 1, would you recommend stopping the accumulating of evidence after the 20 observations

of Drug B?

(b) Would you recommend stopping the accumulating of evidence after the 200 observations of Drug B?

4. The scenario discussed above is somewhat unrealistic, since the rate of Drug A is assumed exactly known, and all inferences were for the success rate of drug B alone. We will now consider a more realistic clinical trial directly comparing Drug A with Drug B.

(a) Create a beta prior distribution for Drug A with mean of 70% and standard deviation of 2.5% (so the 95% range is approximately 65% to 75%).

(b) Using each of the three prior distributions you used for Drug B and the (unique) prior for A, calculate the three prior probabilities that Drug B is clinically superior (i.e., 10% better) than Drug A. [Hint: We have already seen WinBUGS programs for the difference of two binomial parameters. Using this as a base (and noting that there are no data to input, just priors), you need to add a line that calculates the probability that B is better than A by 0.1 or greater. Look in the WinBUGS manual and consider using the step command).

(c) Repeat the three calculations from (b) above, but now use posterior rather than prior distributions (so now add data to your WinBUGS program). For Drug B, use the 180 successes in 200 trials, and for Drug A, assume 155 successes were observed in 200 trials.

5. Consider the table at the bottom of page 1425 of the article by Fayers, Ashby and Parmar. It might seem that the column headings “Uninformative” and “Enthusiastic” have been mislabelled. Do you think that is the case? Why or why not?