# Course EPIB-669 - Intermediate Bayesian Analysis for the Health Sciences

## Assignment 3

1. Drug A is thought to be more effective than Drug B, but at the cost of more complications. Before any data are collected, here is what is known about Drug A and Drug B:

$$\begin{aligned} P(cured|A) &\sim beta(80, 20) \\ P(cured|B) &\sim beta(70, 30) \\ P(complication|A) &\sim beta(10, 20) \\ P(complication|B) &\sim beta(5, 25) \end{aligned}$$

(a) Assuming independence between effectiveness and complications within each patient, what is the probability that a subject with Drug A will be cured and without complications?

(b) Assuming independence between effectiveness and complications within each patient, what is the probability that a subject with Drug B will be cured and without complications?

(c) What is the probability difference, with 95% credible interval for the difference, that a subject with A is both cured and complication free compared to the same probability under Drug B? Provide a clinically relevant conclusion.

Note: You might want to use WinBUGS to solve this question, although it can also be done in R.

2. Continuing the situation of Question 1, some data are now collected on 300 subjects for each of Drug A and Drug B. For A, 250 of the 300 subjects are cured, while 60 suffer complications. For B, 220 of the 300 subjects are cured, while 40 suffer complications. Again assuming independence between cures and complications, redo parts (a), (b) and (c) of Question 1, now combining

the data with the previously available (prior) distributions.

3. The next question consider data from the paper "Brophy J, Joseph L. Medical decision making with incomplete evidence - choosing a platelet glycoprotein IIbIIIa receptor inhibitor for percutaneous coronary interventions, *Medical Decision Making*, 2005;25:222-228," which was discussed in class.

In the only direct comparison between tirofiban and abciximab, the paper states that 7.2% of 2398 patients in the tirofiban group suffered death or nonfatal MI at 30 days, compared to than among the 5.7% of the 2411 patients in the abciximab group. Convert these data to (perhaps approximate) numbers of patients with events in each group, and using WinBUGS, estimate the posterior density of the difference between two beta posterior densities, starting from uniform priors. Calculate the posterior probabilities of being in the interval (-1, -.01), (-0.01, +0.01), and (+0.01, 1). The middle interval might represent the probability of equivalence in rates (within 1% of each other), while the other two represent superiority of one drug or the other.

4. The above paper continues by discussing the probability of clinical equivalence, now adding in data from placebo controlled trials, in other words, adding in information from indirect data. State one advantage and one disadvantage of considering such data along with the data from the main trial.

5. The paper "Harrell F, Shih Y. Using full probability models to compute probabilities of actual interest to decision makers. *International Journal of Technology Assessment in Health Care*, 2001;17:1726" discusses a variety of advantages of the Bayesian approach to decision making. Select any two of the advantages discussed in the paper, and explain why it improves over frequentist approaches (or, if you disagree, or believe that the paper is sometimes too enthusiastic, present the other side).