

# Questions for the Course on Bayesian Modeling

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Below are sets of questions that you'll be graded on. In order to answer these questions correctly and pass the course you will find it necessary to work through the chapters that the questions pertain to.

## Exercises Chapter 6, Part 2

Print out your answer to the exercise below and bring it with you next Monday. Before you concentrate on the exercise first work through the remainder of chapter 6.

1. Let's continue our exploration of a hierarchical Bayesian solution to the important problem of determining what ResMas teacher should receive the best teacher award. Suppose that Sanne Bentvelzen has received your letter from last week, and is convinced by your theoretical arguments. However, she writes a letter back, asking for a concrete implementation:

“Dear Bayesian student,

I am convinced by your arguments. However, I would like to see the solution in action. This year I have the following results. Out of a class of  $n[i]$  students, a subset of  $k[i]$  students rate teacher  $i$  as the best. Let's keep this simple and assume that each of my ten ResMas teachers teach only one class, and ignore the fact that students can only vote once. First, here are the number of votes for each teacher:  $k = c(0, 0, 0, 1, 1, 2, 2, 2, 4, 10)$ , and here are the class sizes for each teacher:  $n = c(10, 15, 20, 10, 15, 3, 10, 20, 40, 40)$ .

Please create a hierarchical model for this data set, include WinBUGS or JAGS code, and answer me the following questions: (a) according to your hierarchical Bayesian model, who is the best teacher? Who is second-best? (b) How confident are you that the first teacher is better than the runner-up? (c) does the hierarchical Bayesian model provide shrinkage?

I look forward to your response,  
Sanne”

Please write Sanne another letter and address her questions. As mentioned during the lecture, you might want to use the WinBUGS and JAGS function `rank` (or similar functions). Another hint is to match the domains of the individual level and the group level: for instance, you can have both vary from 0 to 1, or have both vary from  $-\infty$  to  $+\infty$ . Mixing them up may lead to problems. After you've implemented the model,

you might also examine whether you can add some prior knowledge and change the prior distributions – does this affect the results?