Homework # 4, Hierarchical models

Due, in two parts:

Thursday, Nov 30, end of class: Choice of problem and description of your model(s)
Monday, Dec 11, 2:15 (the scheduled final time for a Tu 3:40 class): Presentations

Hierarchical modeling is best learned by doing. You will work in a small group to determine an appropriate model, or small number of models, for a problem. You will fit that model, use the results to answer a biological question, critique your analysis, and present the model and your results to the class.

Groups: There are three statisticians (Ben, Ben, and Chance) and five biologists (Bridie, Huong, Rachel, Robbie, and Dan) taking the class. Anna is contributing a problem. I recommend one statistician and one or two biologists each group. Other configurations are possible. If you want to propose something other the recommended, please get my approval.

Model description: Turn in a short summary of your problem and proposed model by end of class on Thursday, Nov 30. One page or less should be adequate. The purpose is so that I can provide feedback on your model. I will get that to you by 5pm Friday, Dec 1. If you submit your summary sooner, I will get you feedback sooner.

Presentations: during the scheduled final time for this class, Monday, Dec 11 from 2:15 - 4:15. Prepare and give a 15 minute presentation describing the problem, your model, and your results. Include why you believe your model is appropriate for the problem. Each member of the group should give part of the presentation.

Then answer questions for up to 10 minutes. I expect everyone in the audience to ask questions.

HW 4 grading: 75 points total

Presentation:
  good description of the problem: 10 pts
  good description of your model and its components: 15 pts
  model is appropriate (at least in concept) for the problem: 5 pts
  clear presentation of the results: 10 pts
  connect the results to the context of the problem: 10 pts
  describe any concerns with your analysis: 5 pts

Question/Answer:
  good, i.e., careful but comprehensible, answers about your presentation: 10 pts
  number and quality of questions you ask about other presentations: 10 pts
Problems: I give very short summaries of five different projects. I indicate my thoughts about potential questions you could ask. Where I indicate more than one question, your project only needs to focus on one of them (your choice).

1. Something that interests you (and even better if you have data). Send me your topics. If there isn’t any data, it is possible that I can simulate something quasi-realistic.

2. Huong is interested in population dynamics of a weed, *Amaranthus tuberculatus*. She wants to look at individual variation. I can probably simulate some realistic data. More details will be coming.

3. I have data on waterfowl (duck and geese) population counts from the mid 1950’s. The sorts of questions you could ask include the relationship between population growth rate and habitat quality (number of ponds), or evidence for density dependence.

4. I have data on the numbers of nesting Kemp’s ridley sea turtle from 1991. The data are the number of nests found on 7 beaches from northern Mexico to Texas although there is no data for 2 beaches prior to 1995 and 2 beaches prior to 1996. The sorts of questions you could ask include whether these counts represent seven separate populations, each with its own fluctuations, or whether they are 7 observations from a single population and reconstructing how much nesting might have happened prior to 1995/6 on those beaches without data.

5. Anna is interested in Bayesian Networks, which is a form of hierarchical modeling. She works with chickens and has data on multiple egg characteristics (e.g. egg weight, shell color, albumen and yolk) and the layer (e.g., egg production rates, body weight). She is interested in causal modeling; we would have to work out a question.