1. Position paper (can be shorter than the usual position paper, since there’s a problem here too): In the Hebets and Papaj review on multimodal signal evolution, they argue for a framework of hypotheses to explain the evolution and persistence of multimodal signals. In the Rendall, et al. (2009) paper, the authors argue that the concept of information does more harm than good in the study of animal communication. Which of the hypotheses in the Hebets and Papaj framework are incompatible with the premise of the Rendall paper? Discuss why you think these are incompatible. Which hypotheses you put on your list may depend on whether you use the concept of information described by Rendall or the definition we talked about in class. Discuss why this distinction might matter. So what do you think? Would the Hebets and Papaj paper be better off without these hypotheses?

2. Problem: A female chicken hears a rooster giving a food call, and she needs to decide whether the male actually has some food, or whether he’s just trying to get her close so that he can court her. She begins with the prior estimate that males in this population have a 31% chance of actually having food and the rest of the time they have no food and just want to court. Male produce one of two signals, a “food call” or a “courtship call”. The female knows that when males have food, they give food calls 77% of the time and when they don’t have food, they give food calls 21% of the time; the rest of the time they give courtship calls.

Assuming that the female is a Bayesian updater, how does her estimate of the probability that the male has food change after she receives a sequence of 6 food calls? How would the probability have changed if she had instead received 6 courtship signals? The next day, a second male is signaling; how does the female’s estimate of the probability that the second male has food change after she receives the following sequence of 6 signals: 1 courtship call, followed by 1 food, 1 courtship, 1 food, 1 courtship and 1 food? Alternatively, how would the female’s estimate have changed if she had instead received 1 food, 3 courtship and 2 food calls?

(a) Create a coding matrix for this signal.

(b) How much information in bits is transmitted by each signal in the four sequences? On one plot, graph the female’s estimate of the probability that the male has food for each signal during the four encounters; on a second plot, graph the information exchanged for each signal.

(c) How much information would have been required to eliminate all uncertainty about the first male’s having food before he called?

(c) Briefly (1-2 sentences for each) discuss the patterns you see; does the order of presentation of the signals affect the final probability estimates and information? Does the same signal always have the same value in terms of information to the receiver? With the method we’re using, is the female’s estimate of the second male’s probability of having food affected by her interaction with the first male? What do negative values for $H_T$ mean?

Show your work either by writing it by hand the old-school way, or do this in Excel and send me the data sheet and plots. (Note: it’s much easier if you use Excel rather than a calculator. Once you enter the equations in once, you can just cut and paste for the different parts of the problem).