Philosophy of Statistics: Homework 9

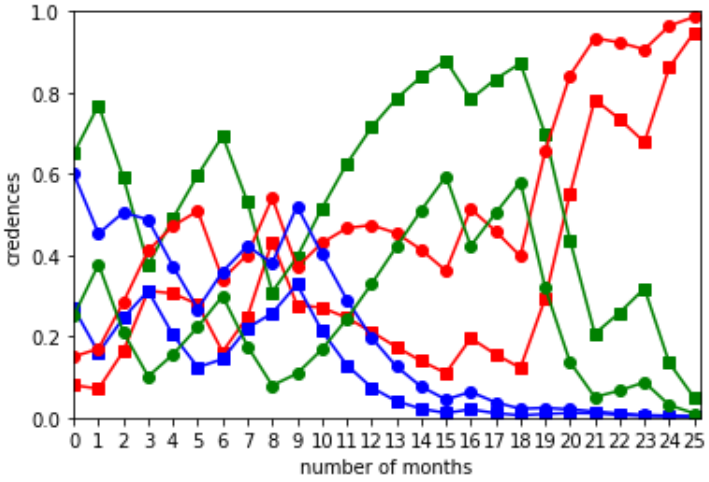
due on Gradescope by 11am on Friday March 12

Guidelines. Some questions ask you to justify your answers. For these questions, credit will be based on how well you justify your answers, not on whether your answers are correct. (There's often no consensus on the correct answers, even among statisticians.) However, that doesn't mean that anything goes: some answers will be hard to justify well. I give suggested word counts but these are just ballpark numbers. Don't sweat them too much. Collaboration is encouraged, but make sure to write up your answers by yourself and list your collaborators.

Problem 1 (20 points). Mount Stromboli is a volcano off the north coast of Sicily. Creed and Angela, who recently left office jobs to become volcanologists, have been studying it. They've come up with three geological models, but they're not sure which model is right and they disagree between themselves about how plausible the models are. They use the models to predict how many times Mount Stromboli will erupt in any given month. The table below shows the likelihoods on each model, as well as Creed and Angela's priors (in that order):

		0	1	2	3	≥ 4
.08 / .15 :	Model 1	.1	.3	.3	.2	.1
.27 / .60 :	Model 2	.2	.2	.2	.2	.2
.65 / .25 :	Model 3	.2	.4	.1	.1	.2

As it happens, Model 1 is correct. Creed and Angela observe the volcano over several years, seeing how many times it erupts each month and updating their credences accordingly. The plot below, similarly to the plots we saw in class, shows how their credences change over time:



Explain in more detail what the plot shows: (a) what do the colors mean? (b) what do the line markers (square or circle) mean? (c) why do the lines fluctuate up and down? (d) what happened by the time two years passed?

Problem 2 (20 points). The typical Bayesian response to the problem of subjectivity is the washing out theorem. But it's easy to misconstrue what exactly the theorem says. Here are two misconstruals:

1. If two Bayesians perform an experiment often enough, their credences in the true hypothesis will get close to each other and to 1.
2. If two Bayesians perform an experiment 100 times, their credences in the true hypothesis will likely get close to each other and to 1.

First, explain why the statements are incorrect. Second, what is the correct statement of the washing out theorem? Third, explain why the washing out theorem doesn't apply to Bayesians who start out with credence 0 in the true hypothesis.

Problem 3 (20 points). According to the Bayesian, our beliefs come in degrees which can be measured numerically. In class we discussed a variety of analogies for degrees of belief and how to measure them: about poetry, about biological clocks, about other attitudes such as hope, regret, and love, about temperature, and so on. Some analogies seemed to tell in favor of the Bayesian's claim; others seemed to tell against. In the reading, Jonathan Weisberg discussed a common proposal for how to measure degrees of belief—by betting rates—and some problems for that proposal.

Do you think the Bayesian's claim is right? If so, how can we measure someone's degrees of belief? If not, can anything be salvaged from Bayesianism? (300 words)

Problem 4 (20 points). Our question in this course has been: how should we evaluate statistical hypotheses? Following Royall, we split that question up into three sub-questions. And we looked at four approaches to answering Royall's questions: significance testing, Neyman-Pearson testing, Bayesianism, the Likelihood Theory. Summarize how these four approaches work. You should discuss: which of Royall's questions they answer; what an experiment looks like from their point of view; how they answer the questions; and any other notable features, such as whether they use an absolute or relative concept of evidence. (300 words)

Problem 5 (20 points). Here, at long last, is your chance to answer the million-dollar question: how should we evaluate statistical hypotheses?

Make sure, no matter which approach you think is correct, that you consider at least one criticism of the approach and why you're unconvinced by that criticism. If you're not sure which approach is correct, that's fine: just explain why not. If you think which approach we should use depends on the context, then what exactly does it depend on, and why? If you think all the approaches are wrong, then what do you think the correct approach might be?

That's it for the homeworks. You made it. Well done!