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Probabilistic Modeling - HW4

A.1
A.1.1) $P(D|H_0) = (\tfrac{1}{6})^5(\tfrac{5}{6})^5 = .0000517$

A.1.2) $P(D|H_1) = (1/2)^5(1/2)^5 = .000977$. This "psychic" hypothesis does not explain our data very well, as the likelihood of our data set occurring when the person is psychic enough to predict the correct value half the time is still incredibly small. The fact that the supposed "psychic" thinks that this explanation would justify them guessing half of the throws demonstrates that they do not understand how probabilities work.

A.1.3) Likelihood of H_1/H_0 = 18.896

A.1.4) H_1 is not a good description of having psychic powers, because s/he claims that with this particular partial psychic ability they will be able to correctly guess half of all throws they see, when the reality is that they will only correctly guess each independent throw correctly half the time. They would be well advised to reformulate their hypothesis to say that their overall prediction accuracy is .5 when only looking at individual tosses, not a sequence of correct and incorrect guesses.

A.1.5) I tested two cases, when the prior probabilities of H_1/H_0 were .01 and .99 and .5 and .5, respectively. When H_1 was relatively improbable (.01), this hypothesis was not much more likely than the null (odds = .191). When H_1 and H_0 were equally probable (.5), the odds returned to the original likelihood value (18.896), indicating that psychic ability was a more likely hypothesis than the random chance hypothesis.

A.1.6) I would define this space by a measure of each psychics' actual ability, that is, a self report of the probability that they would correctly predict a single event. Then, it would be possible to measure their guessing performance given their reported probability, and to see how likely it is that their performance matched their hypothesis.

A.2
A.2.1-3) See code output.

A.1.4) After calculating the AIC values for each model, it appears as if the cumulative gaussian model better accounts for the data, as it has a lower AIC (140) relative to the step-wise linear model (146) -- see code output.