1. In a previous problem, we considered the following situation (the "Base Rate Fallacy"): Suppose a disease occurs in the population at a rate of 1%, and a test for the disease has the following properties:
   -If a person has the disease, they will certainly test positive.
   -If a person does not have the disease, they will test negative 95% of the time and will test positive 5% of the time.
   We showed that even if someone tests positive for the disease, they would only have about a 16.8% chance of actually having it.
   Thinking of the disease test result as a "test statistic" with a "rejection region" being a positive test, describe this as a statistical hypothesis test in the orthodox sense.
   Let H_0 be the hypothesis, "The person does not have the disease." Would the orthodox procedure reject H_0?

2. Consider the "optional stopping" problem with this setup: Adam performs a series of independent experiments each with a Good (G) or Bad (B) outcome and obtains the data,
   $D = GGGBGGBGGGGB$.
   Assume the **only** possible hypotheses are $H_0 =$ "The success rate of obtaining good results is 50%." and $H_1 =$"The success rate of obtaining good results is 75%."
   Assume a prior probability assignment for H_0 of 10%.
   1. First, assume the background assumptions X specify that the **number of trials** was fixed at 12 (Adam was going to do 12 trials no matter what). Compute the posterior probability $P[H_0|DX]$.
   2. Now, assume instead that the background assumptions X' specify that the **number of bad results** was fixed at 3 (Adam was going to keep going until he obtained 3 bad results). Compute the posterior probability $P[H_0|DX']$.
   3. Does the result surprise you?

3. ("Prosecutor's Fallacy") A well-known misuse of statistics in criminal law occurs when a prosecutor argues that if the defendant is innocent then some of the observed evidence would be extremely unlikely, and therefore the defendant is unlikely to be innocent. (For a famous example, see the case of Sally Clark, convicted in 1999 for the murder of her two infant children due to the testimony of pediatrician Roy Meadow, who argued that the chance of two children from a given family suffering from sudden infant death syndrome was 1 in 73 million, and therefore this was very unlikely to be the cause of death.) What is the logical problem with that argument in general? Do you see any similarities with the orthodox methods of testing hypotheses?