1. (8 points) Statistician A is rejecting a specific null hypothesis against a specific alternative at significance level $\alpha = 0.05$. Statistician B is working with the same data and the same hypotheses, but would like to use significance level $\alpha = 0.01$. Do we know what the result of B’s test will be? If yes, state what the result is. If no, explain why not.

We do not know what the result of B’s test will be. We do know that A’s $p$-value must have been less than 0.05, but we do not know whether the $p$-value was less than 0.01 as well.

2. The US geological service defines an area to be a 100 year flood plane, if the probability that the area will be flooded in any given year is $\frac{1}{100} = 0.01$ (or 1%). Suppose we consider floods in different years to be independent events. Recall from Math 161A that the number of trials until (and including) the next success in a sequence of independent trials has a geometric distribution with probability mass function

$$p(x) = (1 - p)^{x-1}p, \quad \text{and } F(x) = 1 - (1 - p)^x$$

Suppose that Dallston has been flooded in 2013 and then again in 2017.

(a) (6 points) Suppose you want to test the hypothesis that Dallston is in a 100 year flood plane against the alternative that it is flooded more frequently. Define a test statistic you could use for this test in words.

A possible test statistic to use is the number of years between subsequent flood-years. This test statistic has a geometric distribution with parameter $p = 0.01$.

(b) (6 points) Use your test statistic to find the $p$-value for this test using the flooding data for Dallston given above.

For the given city, the test statistic value is $X = 2017 - 2013 = 4$. The $p$-value is the probability to observe more extreme flooding (i.e., floods closer together) if Dallston really is in a 100 year flood plane. That is

$$p = P(X \leq 4) = F(4) = 1 - (1 - 0.01)^4 = 0.0394$$