1. Can dogs smell cancer? To answer this question, an experiment was conducted in which 80 dogs were each presented with seven urine samples. The dogs were taught to indicate a cancer sample by lying besides it. Six of the seven samples used in the experiment were from healthy (non-cancer) patients and one sample came from a patient with bladder cancer.

19 of the dogs in the experiment correctly identified the cancer sample. The other dogs picked a sample that came from a healthy patient.

(a) Identify (in words) the population parameter of interest in this problem (i.e., is this a problem about a mean $\mu$ or a proportion $p$)? What does the parameter stand for, (e.g., mean of what, proportion of what?).

(b) Formulate the null hypothesis and alternative hypothesis for this example. Write both twice - once using complete English sentences (about dogs and cancer) and once in form of an equation involving the symbol you defined in (a).

(c) Define an appropriate test statistic for this problem and state the value of the test statistic for this experiment. State the exact distribution of this test statistic if the null hypothesis is true. Do not use large sample approximations to approximate the distribution of the test statistic.

(d) Compute the $p$-value for this test (you may use your calculator, a table from a book, R, or Excel).

(e) Interpret your $p$-value (at a significance level of your choice) and formulate a conclusion sentence.

2. Recall, that the significance level of a test is the probability that the null hypothesis is rejected if it is, in fact, true. The power of a hypothesis test is defined as the probability that the null hypothesis will be rejected if it is, in fact, false. Suppose an exact Binomial test is to be conducted to test

$$H_0 : p = \frac{1}{2} \quad \text{vs.} \quad H_a : p < \frac{1}{2}$$

Twenty trials are conducted and the null hypothesis is rejected in favor of the alternative if six or fewer successes are observed. Here $p$ denotes the probability of a success in each trial.

(a) Find the significance level of this testing procedure.

(b) Suppose that in fact $p = \frac{1}{3}$. In this case what is the power of the test?