

Section 11/4

1 Question 9.2

One of Gregor Mendel's models was about a type of pea plant that is either tall or short. His model was that each such plant is short with chance $1/4$, independently of all other plants. In the plants that he bred, he observed 787 tall ones and 277 short ones. Do the data support his model? Or do they indicate that the model is not good? Make a decision in the following steps.

- a) State an appropriate null hypothesis in informal terms and also in terms of random variables.
- b) State an appropriate alternative hypothesis.
- c) What test statistic do you want to use? Justify your choice.
- d) Find the p -value of the test, exactly if possible or approximately if it is not possible to get an exact answer.
- e) At the 5% level, what is the conclusion of the test? Why?

2 Question 9.5

Suppose you toss a coin 400 times to test whether it is fair or unfair. And suppose you decide to use 5% as the level of significance.

Let X be the number of heads in the 400 tosses. For which values of X will your test conclude that the coin is unfair? Why?

3 Question 9.8

A survey organization takes a large simple random sample of people in a country and uses the methods of our class to construct an approximate 95% confidence interval for the percent of senior citizens in the country. The interval goes from 16.8% to 23.2%.

In each part below, find the quantity if possible. If it is not possible, explain why.

a) the percent of senior citizens in the country

b) the percent of senior citizens in the sample

c) the sample size

d) and approximate 90% confidence interval for the percent of senior citizens in the population

4 Question 9.9

A randomized controlled trial was conducted as part of a effort to encourage high school students from under-resourced communities to apply for college. The trial had 200 participants. A simple random sample of 95 participants received special coaching for the ACT. The remaining participants received no intervention.

At the end of the experiment, the participants got to decide whether or not they would take the ACT. Among the 95 students in the treatment group, 75 decided to take the test. Among the 105 students in the control group, 70 decided to take it.

Is the difference statistically significant? Answer this question by performing a test of whether or not the intervention had any effect.

5 Question 9.10

Randomized experiments and tests of hypotheses are part of the standard methodology of science. The origin of the methods centered on an English-woman called Muriel Bristol and the English love of tea taken with milk. There has long been debate about whether the tea should be poured first, or the milk. Muriel Bristol claimed to Sir Ronald Fisher that she could tell which was poured first just by tasting the tea in the cup.

To test her claim, Fisher provided eight cups of tea, four with the tea poured first and four with the milk poured first. Apart from this the cups and contents were identical. Muriel Bristol was asked to taste the tea in each cup and say whether milk or tea had been poured first. This experiment of The Lady Tasting Tea became one of the pillars of modern science.

Fisher's colleagues reported that the lady identified all eight cups correctly.

a) The lady knew that there were four cups of each kind, so if she had just picked four at random for the "milk first" group, how likely was she to pick the right four?

b) Was the result statistically significant? As you know, the definition of statistical significance was also due to Fisher.