

## Section 10/26

### 1 Question 9.1

All the patients at a doctor's office come in annually for a check-up when they are not ill. The temperatures of the patients at these check-ups are independent and identically distributed with unknown mean  $\mu$ .

The temperatures recorded in 100 check-ups have an average of 98.2 degrees and an SD of 1.5 degrees. Do these data support the hypothesis that the unknown mean  $\mu$  is 98.6 degrees, commonly known as "normal" body temperature? Or do they indicate that  $\mu$  is less than 98.6 degrees?

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. Be sure to state your assumptions, if you make any.

e) At the 5% level, what is the conclusion of the test? Why?

## 2 Question 10.4

The p -value of a test of hypotheses is 0.001.

Say whether each of the following statements is true or false, and explain.

- a) There is only about a 0.001 chance that the null hypothesis is true.
- b) There is about a 0.999 chance that the alternative hypothesis is true.

### 3 Question 10.11

A company that makes robots has 12 new robots all designed for the same task.

The company times all the robots as they complete their tasks. Then it modifies each robot's mechanism. After the modification, it times the robots again as they complete their tasks.

Assume that the first and second times for Robot  $i$  are  $(X_i, Y_i)$  and that the pairs  $(X_1, Y_1), (X_2, Y_2), \dots, (X_{12}, Y_{12})$  are i.i.d.

You can also assume that time is measured with enough precision that no two times come out exactly equal.

Nine out of the 12 robots performed faster after modification. Come with hypotheses that you can test to see whether the modifications did nothing or whether they made the robots faster. Perform the test at the 5% level and provide your conclusion. The test is called the sign test because it is based on the signs of the differences  $D_i = Y_i - X_i$ .