Hypothesis Testing

Introduction

Researchers are interested in answering many types of questions. For example, a scientist might want to know whether the earth is warming up. A physician might want to know whether a new medication will lower a person's blood pressure.

An educator might wish to see whether a new teaching technique is better than a traditional one. Automobile manufacturers are interested in determining whether seat belts will

reduce the severity of injuries caused by accidents. These types of questions can be addressed through statistical hypothesis testing,

which is a decision-making process for evaluating claims about a population

In hypothesis testing, the researcher must define the population under study, state the particular hypotheses that will be investigated, give the significance level, select a sample from the population, collect the data, perform the calculations required for the statistical test, and reach a conclusion.

Hypotheses concerning parameters such as means and proportions can be investigated.

There are two specific statistical tests used for hypotheses concerning means: the *z test* and the *t test.* This lesson will explain in detail the hypothesis-testing procedure along with the *z* test and the *t* test.

The three methods used to test hypotheses are:

1. The traditional method.

2. The *P*-value method.

3. The confidence interval method.

Steps in Hypothesis Testing—Traditional Method

Every hypothesis-testing situation begins with the statement of a hypothesis.

A statistical hypothesis is a conjecture about a population parameter. This conjecture may or may not be true.

There are two types of statistical hypotheses for each situation:

1/ the null hypothesis

2/ the alternative hypothesis.

The null hypothesis, symbolized by H_0, is a statistical hypothesis that states that there is no difference between a parameter and a specific value, or that there is no difference between two parameters.

The alternative hypothesis, symbolized by H_1, is a statistical hypothesis that states the existence of a difference between a parameter and a specific value, or states that there is a difference between two parameters.

Situation A:

A medical researcher is interested in finding out whether a new medication will have any undesirable side effects. The researcher is particularly concerned with the pulse rate of the patients who take the medication. Will the pulse rate increase,decrease, or remain unchanged after a patient takes the medication?

Since the researcher knows that the mean pulse rate for the population under study is 82 beats per minute, the hypotheses for this situation are

$$H_0: \mu = 82 \text{ and } H_1: \mu \neq 82$$

The null hypothesis specifies that the mean will remain unchanged, and the alternative hypothesis states that it will be different. This test is called a *two-tailed test* , since the possible side effects of the medicine could be to raise or lower the pulse rate.

Situation B

A chemist invents an additive to increase the life of an automobile battery.

If the mean lifetime of the automobile battery without the additive is 36 months, then her hypotheses are

$$H_0: \mu = 36 \text{ and } H_1: \mu > 36$$

In this situation, the chemist is interested only in increasing the lifetime of the batteries, so her alternative hypothesis is that the mean is greater than 36 months.

The null hypothesis is that the mean is equal to 36 months. This test is called *right-tailed,* since the interest is in an increase only.

Situation C

A contractor wishes to lower heating bills by using a special type of insulation in houses. If the average of the monthly heating bills is $78, her hypotheses

about heating costs with the use of insulation are

$$H0: \mu = \$78 \text{ and } H1: \mu < \$78$$

This test is a *left-tailed test*, since the contractor is interested only in lowering heating costs.

The null and alternative hypotheses are stated together, and the null hypothesis contains

the equals sign, as shown (where *k* represents a specified number).

Two-tailed test	Right-tailed test	Left tailed test
$H_0: \mu = k$	$H_0 : \mu = k$	$H_0 : \mu = k$
$H_1: \mu \neq k$	$H_1: : \mu > k$	$H_1: \mu < k$