Machine Learning

Steps in Hypothesis Testing - Traditional Method

Steps in Hypothesis Testing

- 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: the **null hypothesis** and the **alternative hypothesis**.

Steps in Hypothesis Testing

- 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.

Steps in Hypothesis Testing

- **Example-1:**
  - 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.

Steps in Hypothesis Testing

- **Example-2:**
  - 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

$$H_0: \mu = \$78 \text{ and } H_1: \mu < \$78$$

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

Steps in Hypothesis Testing

- **Example-3:**
  - Will the pulse rate increase, decrease, or remain unchanged after a patient takes a particular 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

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

  - This test is called a ***two-tailed*** *test*.

Steps in Hypothesis Testing

Here 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
$H_0: \mu = k$ $H_1: \mu \neq k$	$H_0: \mu = k$ $H_1: \mu > k$	$H_0: \mu = k$ $H_1: \mu < k$

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Possible Outcomes of a Hypothesis Test

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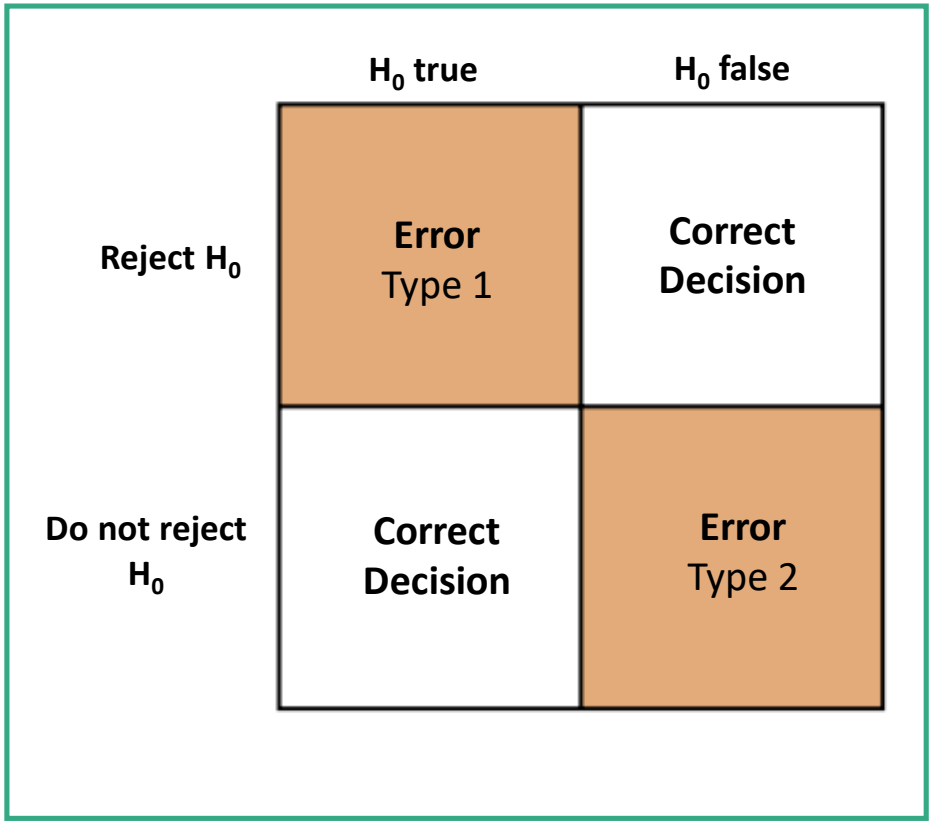
	Actual Condition		
	Total Population	Condition Positive	Condition Negative
Predicted Condition	Predicted Condition Positive	True Positive (TP)	False Positive (FP) α (Type-I Error)
	Predicted Condition Negative	False Negative (FN) β (Type-II Error)	True Negative (TN)



Possible Outcomes of a Hypothesis Test

- A **type I error** occurs if you reject the null hypothesis when it is true.

- A **type II error** occurs if you do not reject the null hypothesis when it is false.

- The hypothesis-testing situation can be likened to a jury trial. In a jury trial, there are four possible outcomes. The defendant is either guilty or innocent, and he or she will be convicted or acquitted.

➢ Now the hypotheses are –
  - H_0**:** The defendant is innocent
  - H_1**:** The defendant is not innocent (i.e., guilty)

Possible Outcomes of a Hypothesis Test

H_0 : The defendant is innocent
H_1 : The defendant is not innocent
The results of a trail can be shown as follows:

	H_0 true (innocent)	**H_0 false (not innocent)**
Reject H_0 (convict)	**Error** Type 1 **1.**	**Correct Decision** **2.**
Do not reject H_0 (acquit)	**Correct Decision** **3.**	**Error** Type 2 **4.**