CHAPTER 4

HYPOTHESIS TESTING

Definitoion

In the previous chapter illustrated how to construct a confidence interval estimate of a parameter from sample data. For example, from taking a sample of n, a researcher estimates that the mean of employee's age is between 24 and 25 years. This illustration is called a **hypothesis** and the decision-making procedure is called **hypothesis testing**. This is one of the most useful aspects of statistical inference, because many types of decision-making problems, tests, or experiments can be formulated as hypothesis-testing problems. Furthermore, a very close connection exists between hypothesis testing and confidence intervals.

From the description above, it can be concluded that the **hypothesis** is a temporary assumption or estimation of a problem and a **statistical hypothesis** is a temporary assumption or estimation of the parameters of one or more populations. Because it use probability distributions to represent populations, a statistical hypothesis may also be thought of as a statement about the probability distribution of a random variable. The hypothesis will usually involve one or more parameters of this distribution. For example, consider the air crew escape system described in the introduction. Suppose that we are interested in the burning rate of the solid propellant. Burning rate is a random variable that can be described by a probability distribution. Suppose that our interest focuses on the mean burning rate (a parameter of this distribution). **Specifically, we are interested in deciding whether or not the mean burning rate is 50 centimeters per second**. We may express this formally as

$H_0: \mu = 50$ centimeters per second

$H_1: \mu \neq 50$ centimeters per second

The statement H_0 is called the **null hypothesis.** This is a claim that is initially assumed to be true. The statement H_1 is called the **alternative hypothesis** and it is a statement that contradicts the null hypothesis. Because the alternative hypothesis specifies values of μ that could be either greater or less than (≠) 50 centimeters per second, it is called **a two-**

sided alternative hypothesis. In some situations, we may wish to formulate a **one-sided alternative hypothesis**, as in

H_0: $\mu = 50$ centimeters per second

H_1: $\mu > 50$ centimeters per second

or

H_0: $\mu = 50$ centimeters per second

H_1: $\mu < 50$ centimeters per second

The second example is a researcher who wants to suspect that ulcer sufferers will relapse if they drink coffee. The hypothesis is

H_0: $drinking\ coffee\ will\ not\ cause\ an\ ulcer\ relapse$

H_1: $drinking\ coffee\ will\ lead\ to\ an\ ulcer\ relapse$

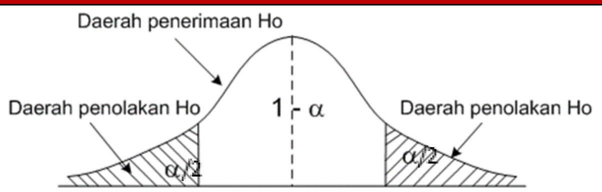
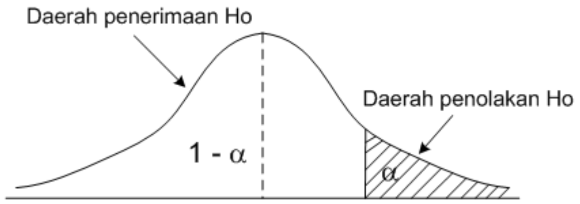
The third example is a researcher who thinks that **fertilizer A is better than fertilizer B**. The hypothesis is:

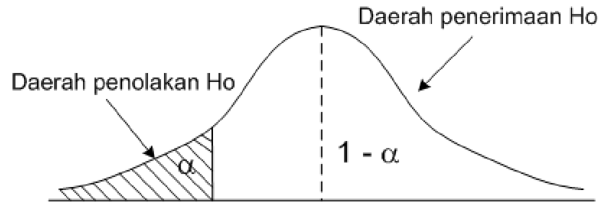
H_0: fertilizer A $=$ fertilizer B

H_1: fertilizer A $>$ fertilizer A

From the First to third examples, **The null hypothesis will always state as an equality claim**. However, when the alternative hypothesis is stated with the < sign, the implicit claim in the null hypothesis can be taken as ≥ and when the alternative hypothesis is stated with the > sign, the implicit claim in the null hypothesis can be taken as ≤.

Hypothesis Formulation

<table>
<tr><th>No.</th><th>Formulation</th><th>Critical Region and Critical Point</th><th>Hypothesis Type</th></tr>
<tr><td>1</td><td>$H_0 : \theta = \theta_0$
$H_1 : \theta \neq \theta_0$</td><td>
</td><td>Two-sided test</td></tr>
<tr><td>2</td><td>$H_0 : \theta = \theta_0$
$H_1 : \theta > \theta_0$</td><td>
</td><td>Right-sided test</td></tr>
</table>

3	$H_0 : \theta = \theta_0$ $H_1 : \theta < \theta_0$		Left-sided test

Type of Error

There are two types of errors, namely, type I error and type II error. Rejecting the null hypothesis H0 when it is true is defined as a type I error and Failing to reject (accepting) the null hypothesis when it is false is defined as a type II error.

Decision	Statement	
	H_0 is true	H_0 is false
Rejecting H_0	Type I error (α)	$(1-\beta)$
Failing H_0	$(1-\alpha)$	Type II error (β)

From the table above, it can be formulated:

$\alpha = P(\text{Rejecting } H_0 | H_0 \text{ is true})$

$1-\alpha = P(\text{Failing } H_0 | H_0 \text{ is true})$

$\beta = P(\text{Failing } H_0 | H_0 \text{ is false})$

$1-\beta = P(\text{Rejecting } H_0 | H_0 \text{ is false})$

The principle of good hypothesis testing is to minimize type I error and type II error. In statistics, the α value is called the significance level. The significance level is used to determine critical regions and critical points of the hypothesis testing

Hypothesis Testing Procedure

1. Formulating the null and alternative hypothesis
2. Selecting the significance level
3. Selecting the test statistic and calculate its value.
4. Conclusion.