



Testing of Hypothesis

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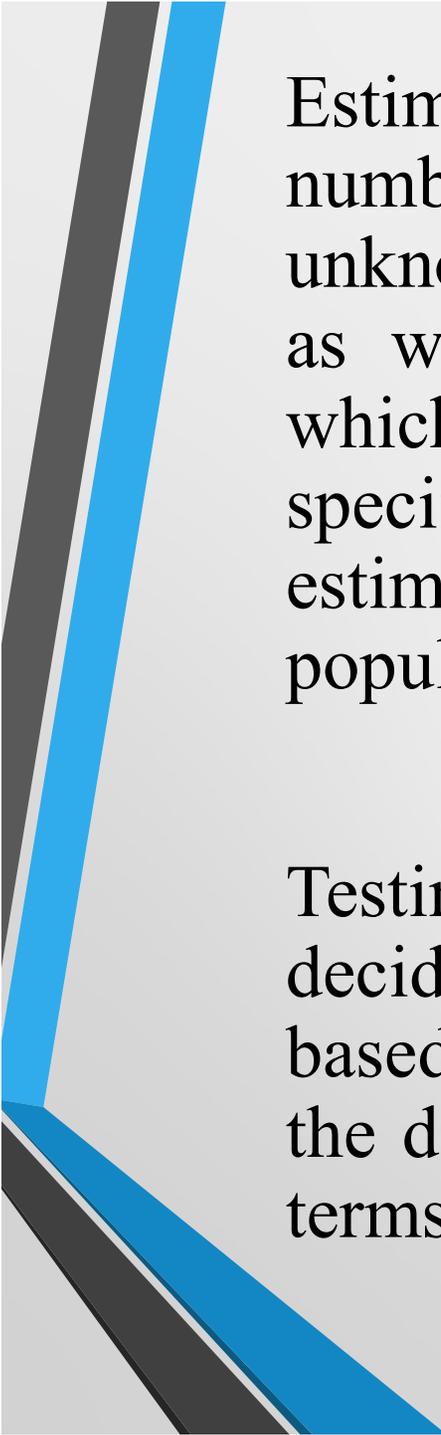
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Statistical Inference

Statistical inference is mainly concerned with making inferences regarding the unknown aspects of the distribution of the population based on samples taken from it. The unknown aspect may be the form of the distribution or values of the parameters involved or both. Statistical inference is broadly classified into two

- Estimation of parameters
- Testing of hypotheses



Estimation deals with methods of determining numbers which may be taken as the values of the unknown parameters (called the point Estimation) as well as with the determination of intervals which will contain the unknown parameters with a specified probability (known as interval estimation), based on samples taken from the population.

Testing of hypotheses deals with the methods for deciding either to accept or reject the hypotheses based on samples taken from the population, with the degree of validity of the decision indicated in terms of probability.

Hypothesis

Definition

A hypothesis is an assertion about the form of the distribution or the value of the parameters of statistical populations.

Example

- The weight of the students follows the normal distribution
- Height of the college students follows the normal distribution with mean 5 feet
- The given data follows normal distribution with mean 10 and standard deviation 4.

Simple and Composite Hypothesis

Definition

If the hypothesis specifies the population completely then the hypothesis is called a simple hypothesis and otherwise it is called composite hypothesis.

Example

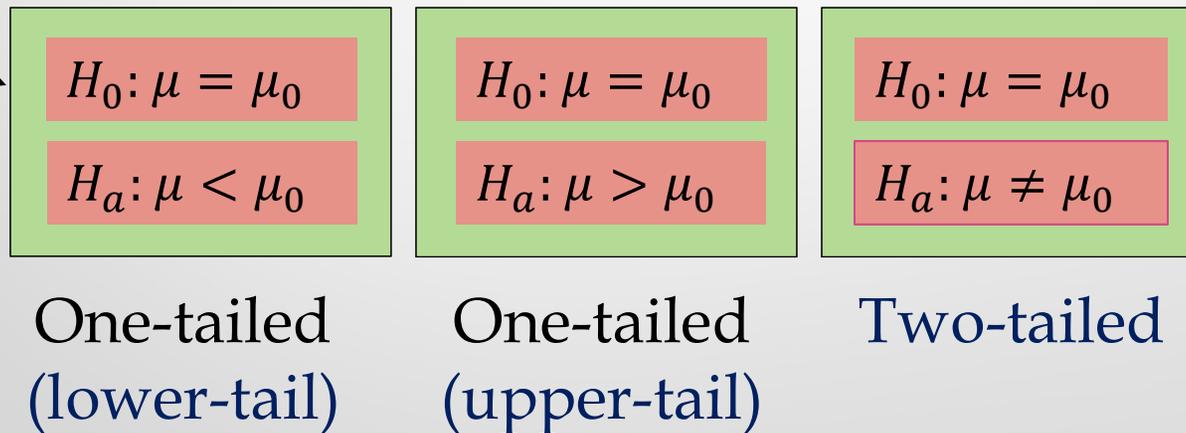
- The given data follows normal distribution with mean 10 and standard deviation 4.
- The weight of the students follows the normal distribution
- Height of the college students follows the normal distribution with mean 5 feet

Null hypothesis and Alternative hypothesis

- The hypothesis that is tested is called the '*null hypothesis*' and is usually denoted by H_0 .
- The hypothesis which we will accept or reject according as we reject or accept H_0 . This hypothesis is called the '*alternative hypothesis*' and is usually denoted by H_1 .

Summary of Forms for Null and Alternative Hypotheses about a Population Mean

- ▶ The equality part of the hypotheses always appears in the null hypothesis.
- ▶ In general, a hypothesis test about the value of a population mean μ must take one of the following three forms (where μ_0 is the hypothesized value of the population mean).



Two Types of Errors

It is impossible to assert whether a hypothesis is correct or wrong by a statistical test, as the decision is based on a sample only. A true hypothesis may be rejected and a false hypothesis accepted in a test. In short we admit that our procedure may result in committing one or the other of the following two types of errors

- **Rejecting H_0 when it is true**
- **Accepting H_0 when it is false**

Type I and Type II Errors

		Population Condition	
Conclusion		H_0 True ($\mu \leq \mu_0$)	H_0 False ($\mu > \mu_0$)
Accept H_0 (Conclude $\mu \leq \mu_0$)		Correct Decision	Type II Error
Reject H_0 (Conclude $\mu > \mu_0$)		Type I Error	Correct Decision

Significance level

The probability of the test statistics falling in the critical region when the hypothesis is true is called the significance level or size of the test. That is the significance level is the probability of the first type of error and is denoted by α . (Also called P value in Social Science)

$$\text{significance level} = \alpha = \text{Prob.}\{\text{Rejecting } H_0 \mid H_0\}$$

Power of the test

Probability of correct decision is called the power of the test. That is power of the test is the probability of rejecting the null hypothesis when the alternative hypothesis is true and is denoted by β .

$$\begin{aligned}\text{Power} &= \beta = \text{Prob.}\{\text{Rejecting } H_0 \mid H_1\} \\ &= 1 - \text{Prob.}\{\text{Accepting } H_0 \mid H_1\} \\ &= 1 - \text{Prob.}\{\text{second type of error}\}.\end{aligned}$$

Statistics

Any function of the sample values is known as a statistics.

Test Statistics

The function of the sample observations (statistics) chosen to take the decision either to accept or reject the hypothesis is called the test statistics.

Acceptance Region and Critical Region

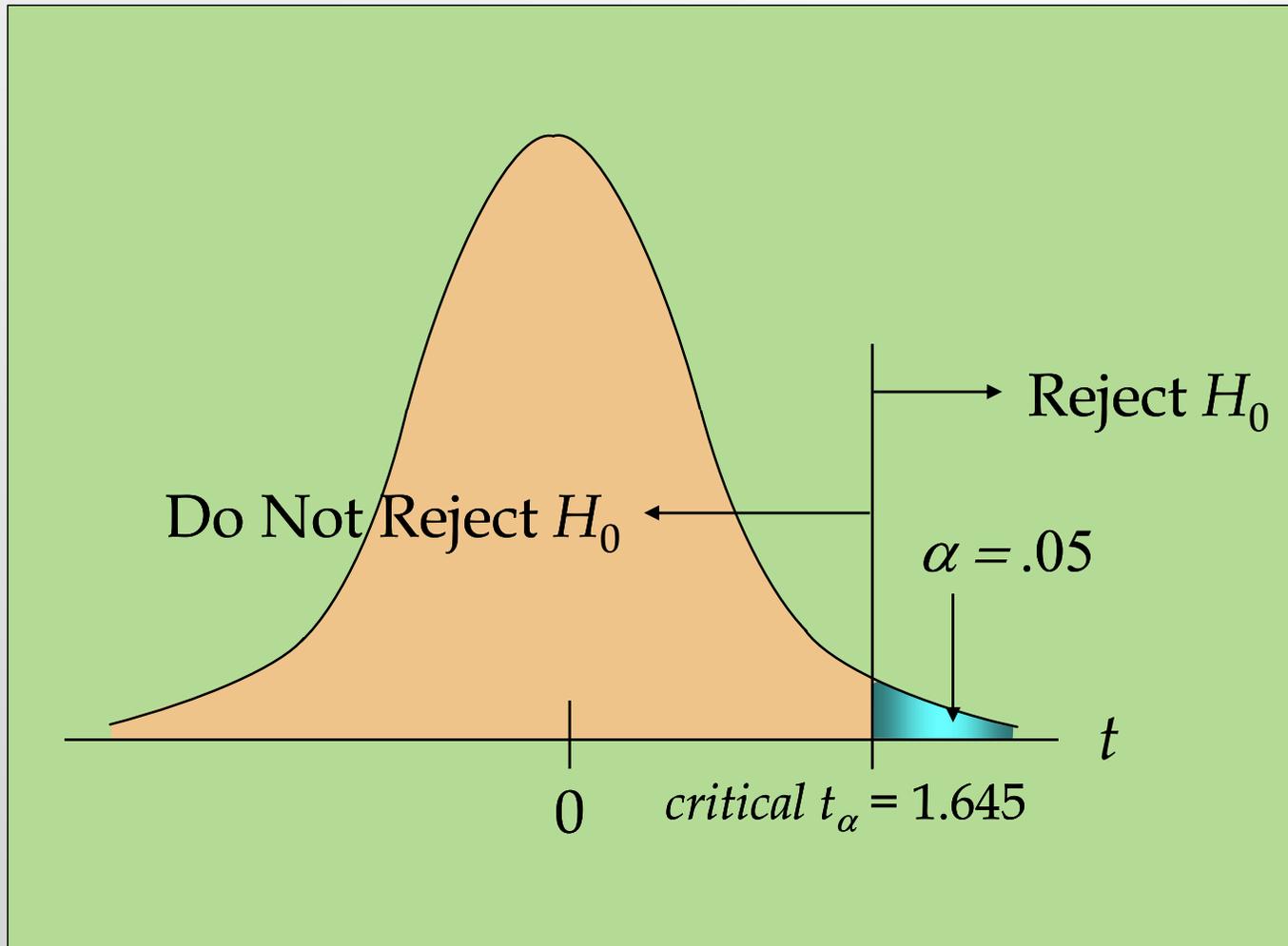
We divide the range of variation of the test statistics into two regions :

Acceptance region, and

Rejection region or Critical region

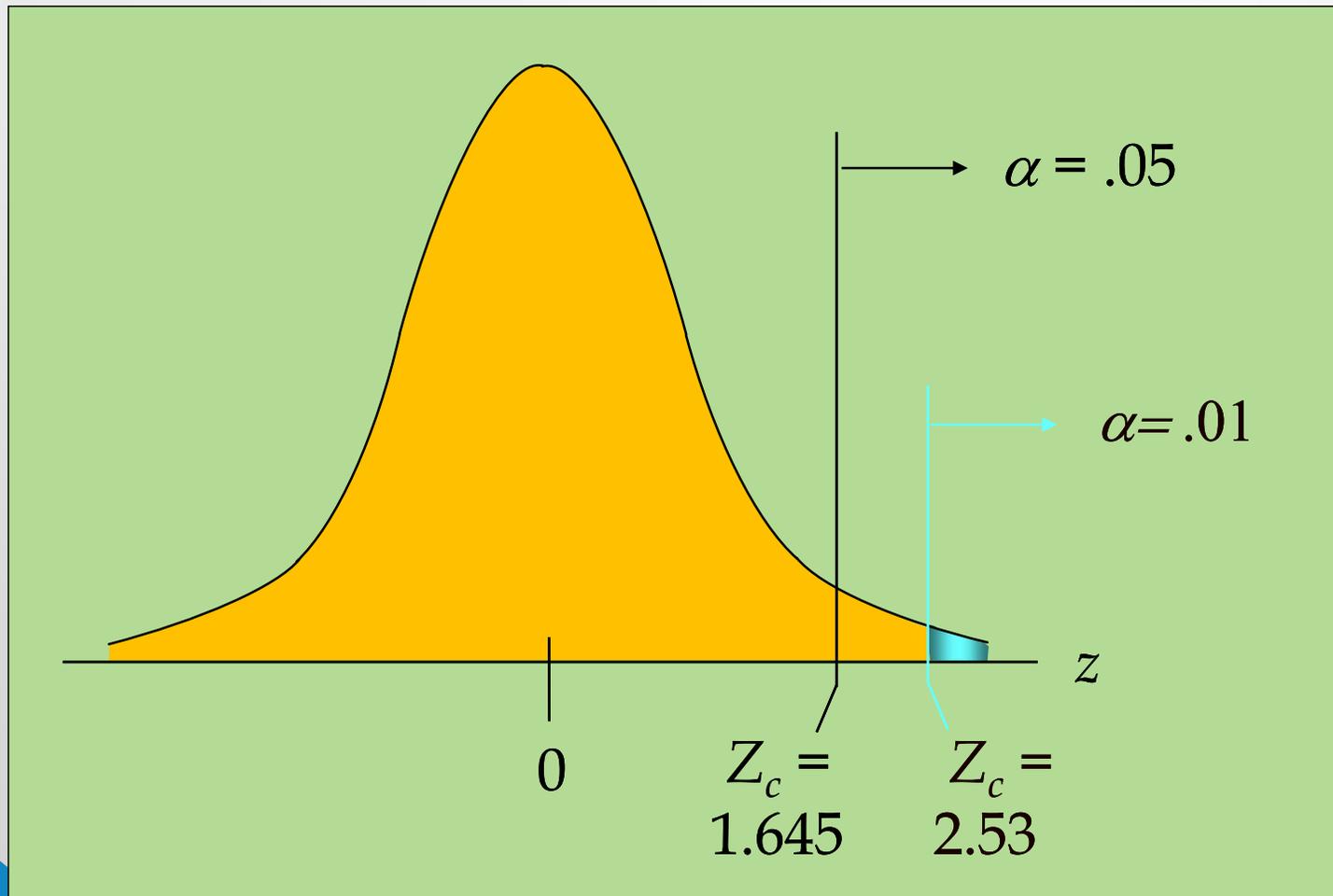
This done in such a way that the probabilities of the two types of errors are not very large

Acceptance and Critical region



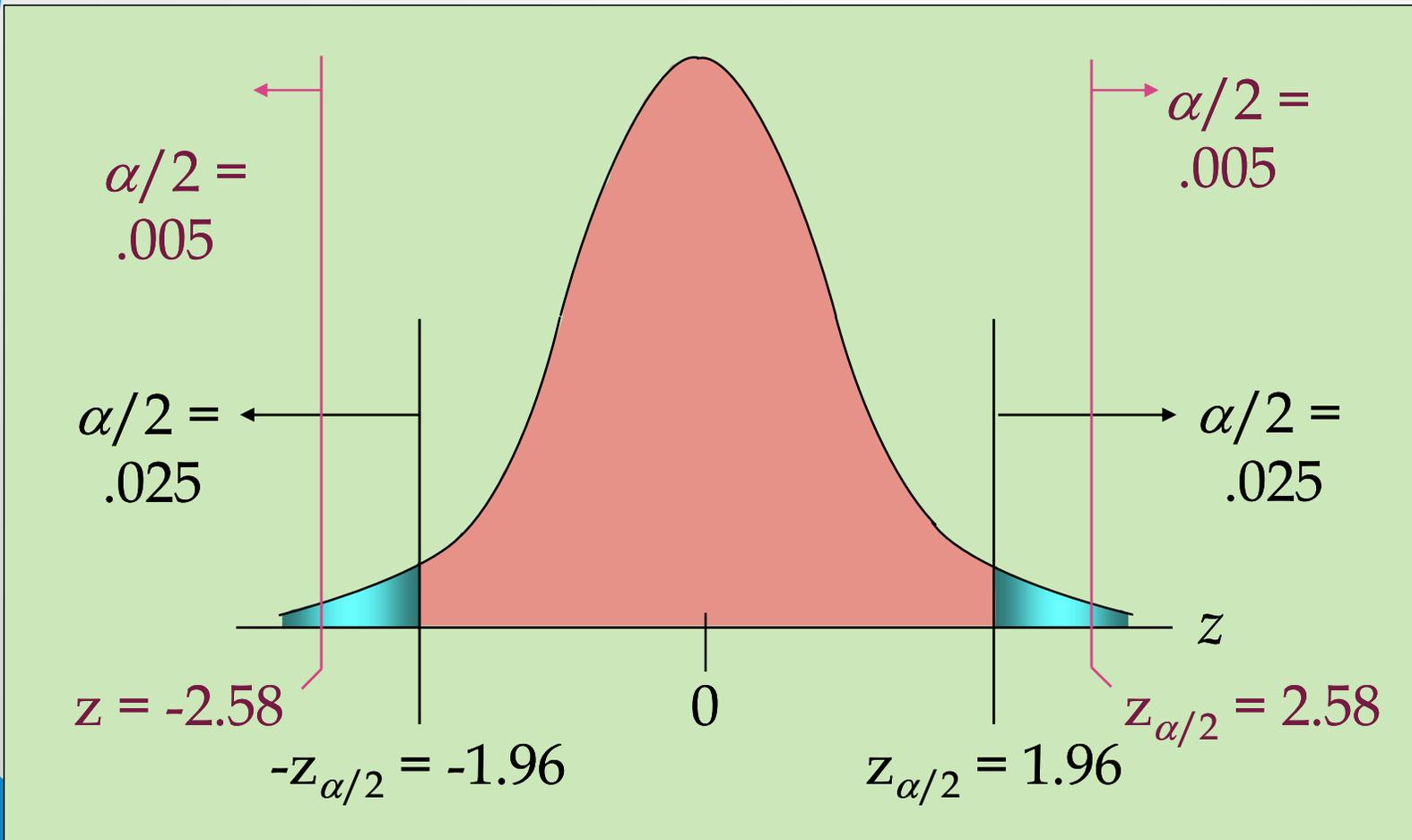
One tail Critical region

$\alpha = .01$ and $\alpha = .05$



Two tailed Critical region

$$\alpha = .01 \text{ and } \alpha = .05$$



Size of the critical Region

Probability for a selected sample belong to the critical region is called the size of the critical region.

Size of the critical region is also known as significance level

Best Critical Region

While fixing the size of the critical region we general considered significance level and try to minimize it or type I error. This result in increase in the other type of error. This is undesirable. So we have to keep the critical region such that it has least type II error. Such a region is called best critical region.

Rejection Criteria

In testing hypothesis we accept or reject the null hypothesis based on the following procedure

1. Chose the test statistics t
2. Take a random sample from the given population
3. Calculate the value of t (actual t)
4. Divide the range of variation of the t into two region called the critical region and acceptance

If the **actual t** (value of test statistics) is in the rejection region, then reject the null hypothesis.

Steps in a Statistical Test Procedure

The different steps in testing of hypothesis is as follows

- Define the population and formulate the hypothesis
- Choose an appropriate test statistics
- Divide the range of variation of the test statistics into two regions, acceptance region (A) and rejection or critical region (C) so that probability of type I error significance level has a pre-assigned value
- Take a sample, calculate the test statistics and decide whether to accept or reject the hypothesis.

The End

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