Statistical Methods

Unit- I : Testing of hypotheses- procedures- types- errors in hypothesis- standard error – estimation – properties of good estimator

Meaning

- **Definition:** The Hypothesis is an assumption which is tested to check whether the inference drawn from the sample of data stand true for the entire population or not.
- Hypothesis is an assumption that is made on the basis of some evidence. This is the initial point of any investigation that translates the research questions into a prediction.
- It includes components like variables, population and the relation between the variables.
- A research hypothesis is a hypothesis that is used to test the relationship between two or more variables.

Meaning

Meaning and Definition

- A hypothesis, generally means a mere assumption or supposition to be proved or disproved.
- Hypothesis provides the basis for investigation and ensures proper direction in which the study should proceed.
- It facilitates the collection of adequate facts and helps one to arrive at appropriate conclusions, suggestions and observations.
- E.g.: "Sales growth is directly correlated to the expenditure on advertisement "

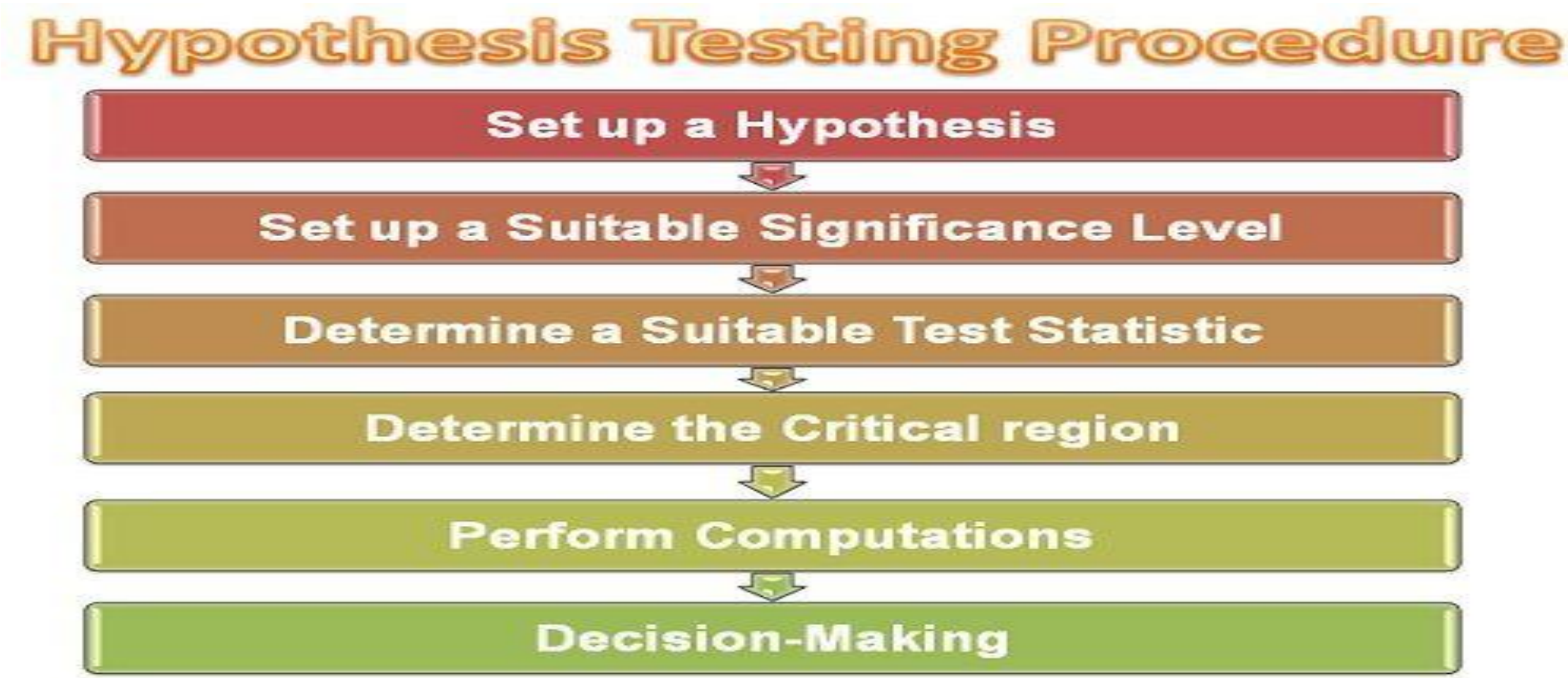
Function of hypothesis

Functions of hypothesis(Uses of hypothesis)

Hypothesis are inevitable in scientific research. They have the following functions to perform.

1. A hypothesis adequately explain all the facts connected with the hypothesis.
2. It enables to direct enquiry along right lines.
3. It determines the method of verification as well as the procedure for enquiry.
4. It makes deductions possible.
5. It forms the starting point of investigation.
6. It makes observation and experiment possible.

Hypothesis Testing Procedure



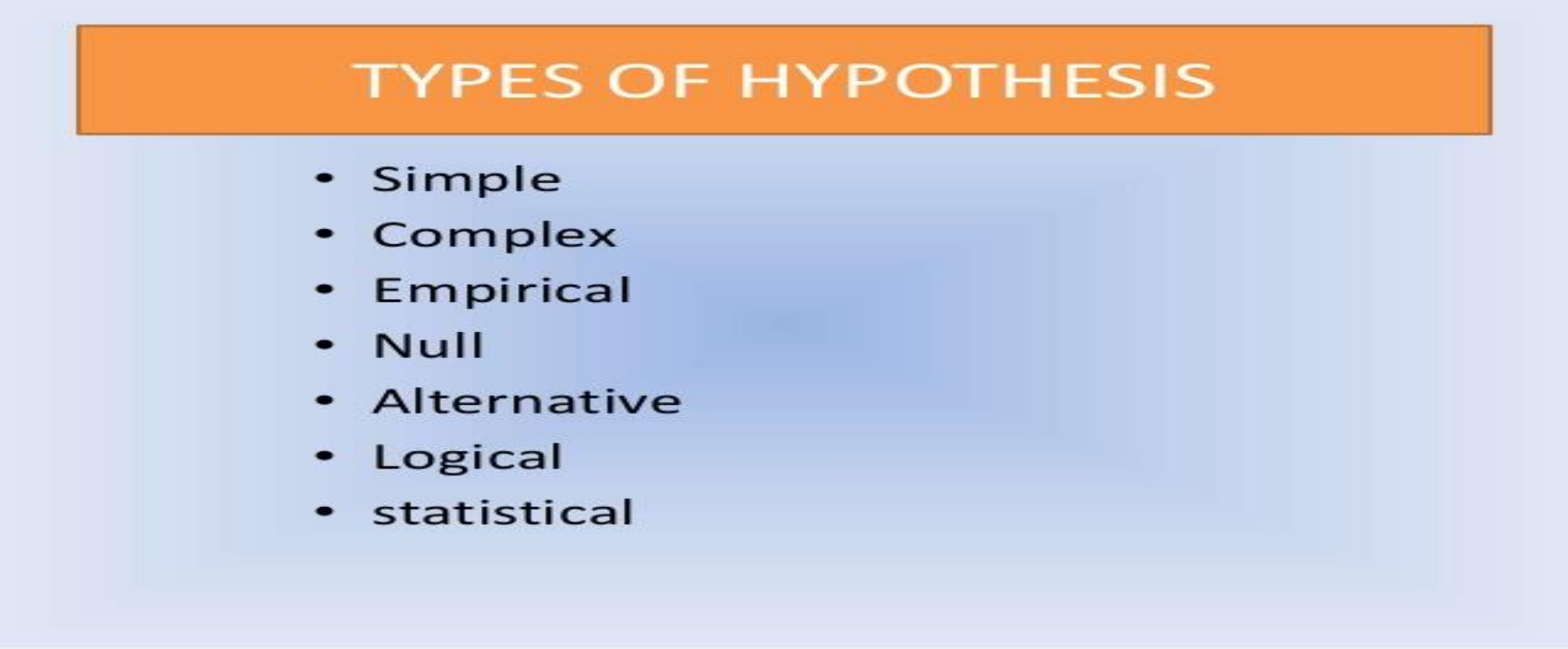
Characteristics

Characteristics of good hypothesis (Condition for a valid hypothesis)

The basic characteristics of a good hypothesis are:

1. Conceptual clarity and definiteness.
2. Verifiable and capable of being tested.
3. Specific in nature.
4. Non contradictoriness.
5. Simplicity.
6. Related to available techniques.
7. Related to body of theory.

Types


TYPES OF HYPOTHESIS
• Simple
• Complex
• Empirical
• Null
• Alternative
• Logical
• statistical

Potential Outcomes in Hypothesis Testing

- Hypothesis testing is a procedure in inferential statistics that assesses two mutually exclusive theories about the properties of a population. For a generic hypothesis test, the two hypotheses are as follows:
- **Null hypothesis**: There is no effect
- **Alternative hypothesis**: There is an effect.
- The sample data must provide sufficient evidence to reject the null hypothesis and conclude that the effect exists in the population. Ideally, a hypothesis test fails to reject the null hypothesis when the effect is not present in the population, and it rejects the null hypothesis when the effect exists.
- Statisticians define two types of errors in hypothesis testing. Creatively, they call these errors Type I and Type II errors. Both types of error relate to incorrect conclusions about the null hypothesis.

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- **Type I error**
- When the null hypothesis is true and you reject it, you make a type I error. The probability of making a type I error is α, which is the level of significance you set for your hypothesis test.
- An α of 0.05 indicates that you are willing to accept a 5% chance that you are wrong when you reject the null hypothesis. To lower this risk, you must use a lower value for α. However, using a lower value for alpha means that you will be less likely to detect a true difference if one really exists.

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- **Type II error**
- When the null hypothesis is false and you fail to reject it, you make a type II error. The probability of making a type II error is β, which depends on the power of the test. You can decrease your risk of committing a type II error by ensuring your test has enough power. You can do this by ensuring your sample size is large enough to detect a practical difference when one truly exists.
- The probability of rejecting the null hypothesis when it is false is equal to 1–β. This value is the power of the test.

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	Truth about the population	
Decision based on sample	H_0 is true	H_0 is false
Fail to reject H_0	Correct Decision (probability = 1 - α)	Type II Error - fail to reject H_0 when it is false (probability = β)
Reject H_0	Type I Error - rejecting H_0 when it is true (probability = α)	Correct Decision (probability = 1 - β)

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	Accept	**Reject**
Ho is true	Correct decision	Type – I error
Ho is false	Type-II error	Correct decision

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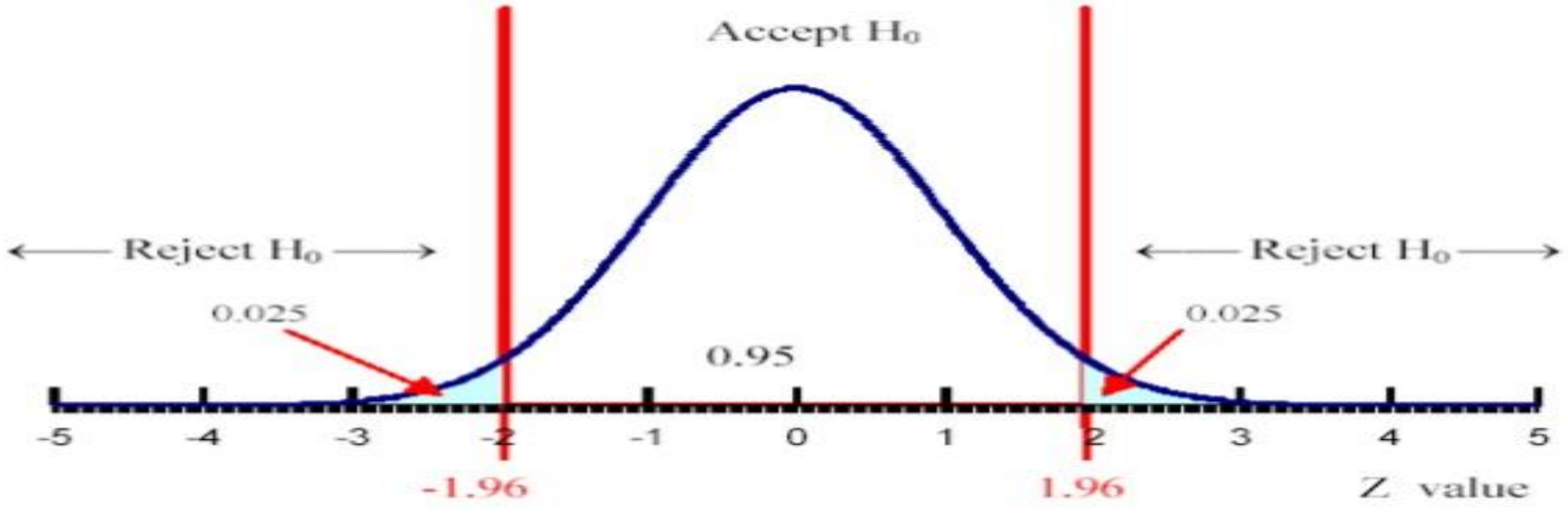

Normal Distribution

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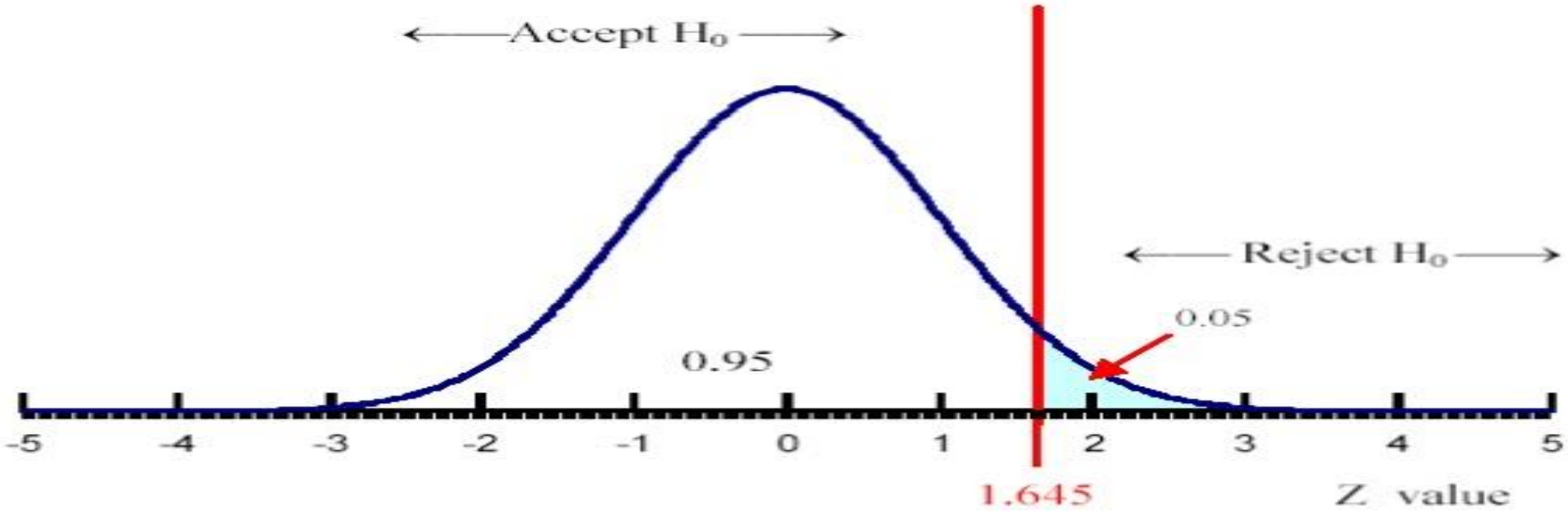

Normal Distribution

Standard Error

- The standard error (SE) of a statistic is the approximate standard deviation of a statistical sample population.
- The standard error is a statistical term that measures the accuracy with which a sample distribution represents a population by using standard deviation.
- In statistics, a sample mean deviates from the actual mean of a population; this deviation is the standard error of the mean.

Estimation in Statistics

- In statistics, **estimation** refers to the process by which one makes inferences about a population, based on information obtained from a sample.
- Point Estimate vs. Interval Estimate
- Statisticians use sample statistics to estimate population parameters.
- For example, sample means are used to estimate population means; sample proportions, to estimate population proportions.

Contn…

- An estimate of a population parameter may be expressed in two ways:
- **Point estimate**. A point estimate of a population parameter is a single value of a statistic. For example, the sample mean x is a point estimate of the population mean μ. Similarly, the sample proportion *p* is a point estimate of the population proportion *P*.
- **Interval estimate**. An interval estimate is defined by two numbers, between which a population parameter is said to lie. For example, $a < x < b$ is an interval estimate of the population mean μ. It indicates that the population mean is greater than *a* but less than *b*.

Properties of Good Estimator

- A distinction is made between an estimate and an estimator.
- The numerical value of the sample mean is said to be an estimate of the population mean figure.
- On the other hand, the statistical measure used, that is, the method of estimation is referred to as an estimator.
- A good estimator, as common sense dictates, is close to the parameter being estimated. Its quality is to be evaluated in terms of the following properties:

Properties of Good Estimator

- 1. **Unbiasedness**
- **2. Consistency**
- **3. Efficiency**
- **4. Sufficiency**

References

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