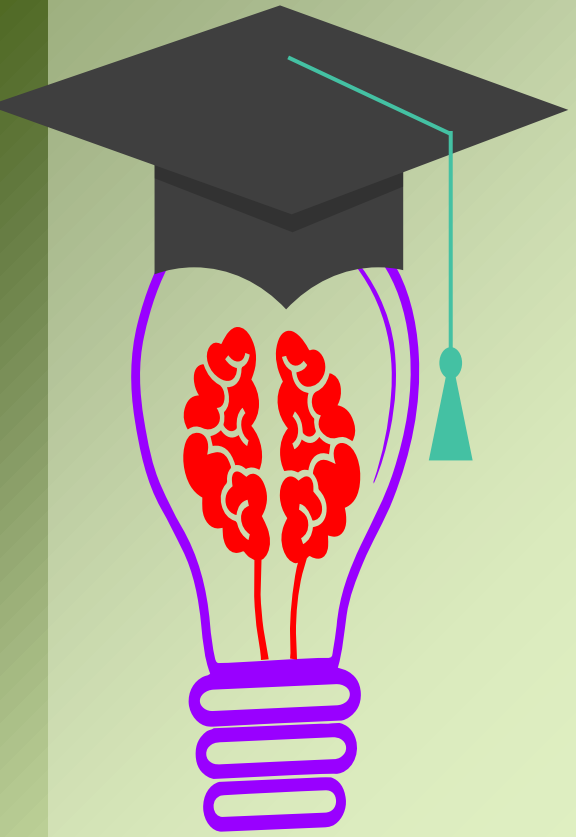

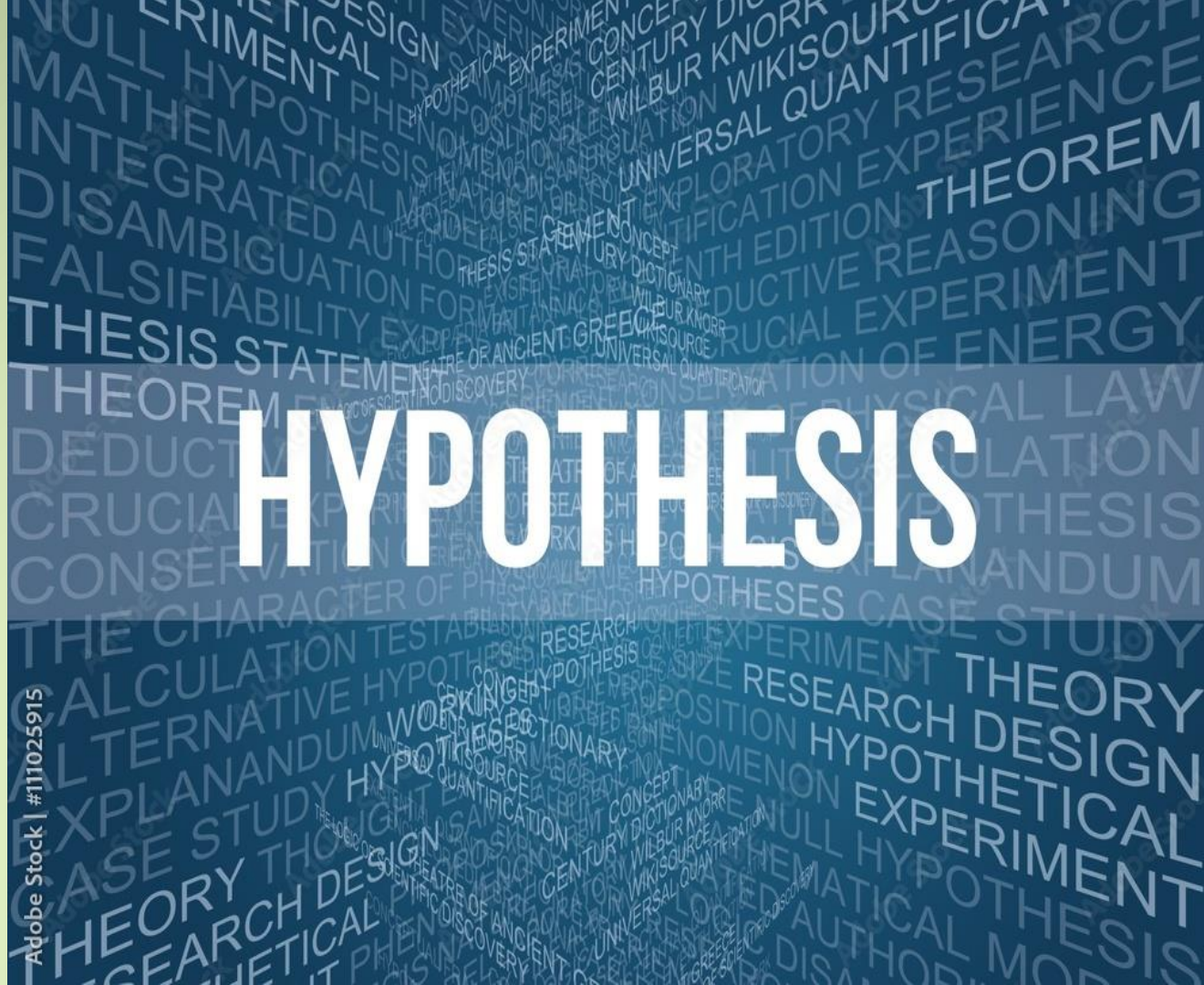
HYPOTHESIS
THESIS STATEMENT
THEOREM
RESEARCH DESIGN
HYPOTHETICAL
EXPERIMENT
THEORY
HYPOTHESES
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What is Hypothesis Testing

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A Hypothesis is an assumption about the population parameter.
A rule or procedure to check whether to accept or reject the claim

- ➔ The Parameter must be identified before analysis
- ➔ A Parameter is a Population Mean or Proportion.
- ➔ Cases where we have small samples or large samples
- ➔ Based on parameter and sample methods changed slightly
- ➔ Collect or get the sample data to study the population

I assume the mean GPA of this class is 4.5.

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Types of Hypothesis

Null Hypothesis

Hypothesis of no difference is called as Null hypothesis OR
The assumption we wish to test.
Null hypothesis is denoted by Ho

E.g.The mean of systolic blood pressure of the population is 120 mmHg”

i.e (Ho: SBP=120 mmHg)

Alternative Hypothesis

Alternative Hypothesis of null hypothesis.
Alternative Hypothesis is denoted by Ha OR H1
Alternative hypothesis may be two tailed (i.e not equal to) OR One tailed (Greater than or Less than)

H1:- The mean of systolic blood pressure of the population is not equal to / Less than / Greater than 120 mmHg”

I.e H1: SBP != 120 mmHg
Means H1: SBP > OR < OR =120mm Hg

The null hypothesis Ho represents a theory that has been put forward either because it is believed to be true or because it is used as a basis for an argument and has not been proven.

E.g.In a clinical trial of a new drug, the null hypothesis might be that new is no better, on average than the current drug.
i.e Ho: there is no difference between the two drugs on an average.

Alternative hypothesis,
Alternative hypothesis is also called as a research hypothesis, this hypothesis is what you're trying to test.
Eg. In a trial of a new drug, alternative hypothesis might be that new drug has a different effect on average, compared to the current durg.
H1: New drug is better than the current drug, on average.

Outcome of the test:

- Reject null hypothesis
- Fail to reject null hypothesis

Types of Error

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Type I Error:- Rejecting Ho when it's true. (H0 is wrongly rejected)

Type II Error:- Accepting Ho when it's false.

E.g.
If the pregnancy test gives a positive result when you are not pregnant then this is a false positive, a Type I error.
If the pregnancy test gives a negative result when you are pregnant then this is a *false negative*, a Type II error

Types of Error

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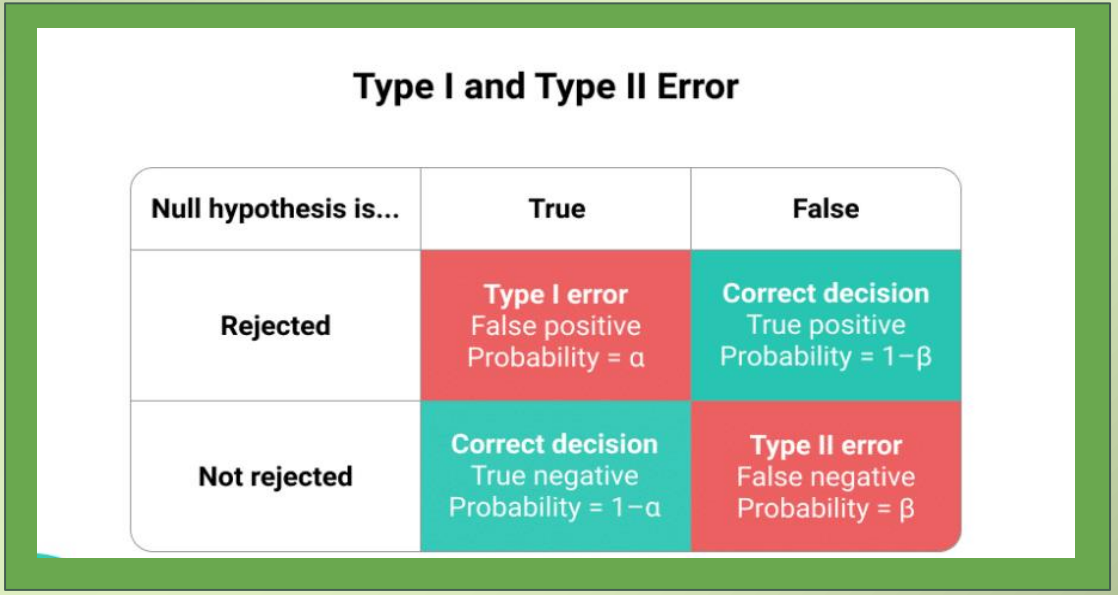
E.g. 1
H0: Person is innocent.
H1: Person is guilty.
Person is not found innocent and is sent to jail, despite actually being innocent is a Type I error.



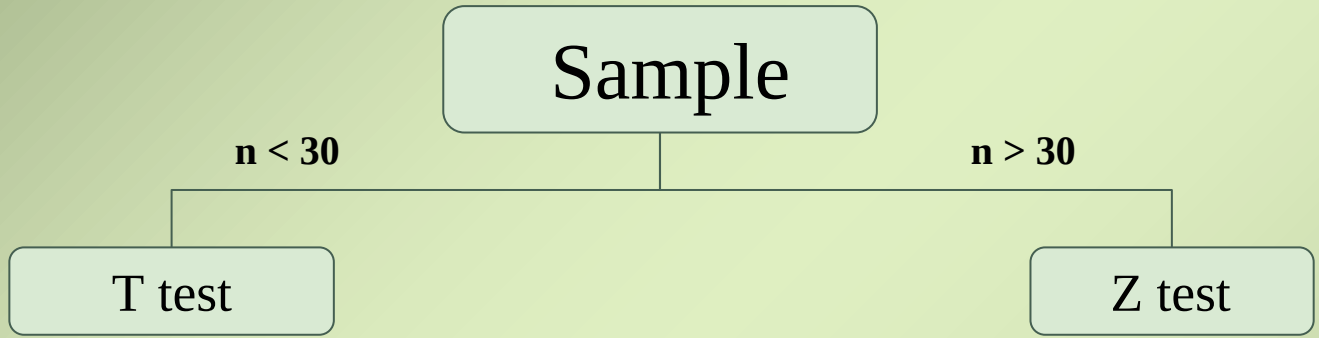
P Value:

In simpler terms, p-values tell you how strongly your sample data contradict the null.
P value is the smallest value of alpha for which we can reject the null hypothesis Ho.

Smaller p-values are taken as stronger evidence against the null hypothesis.

P-value calculator: https://www.socscistatistics.com/pvalues/tdistribution.aspx

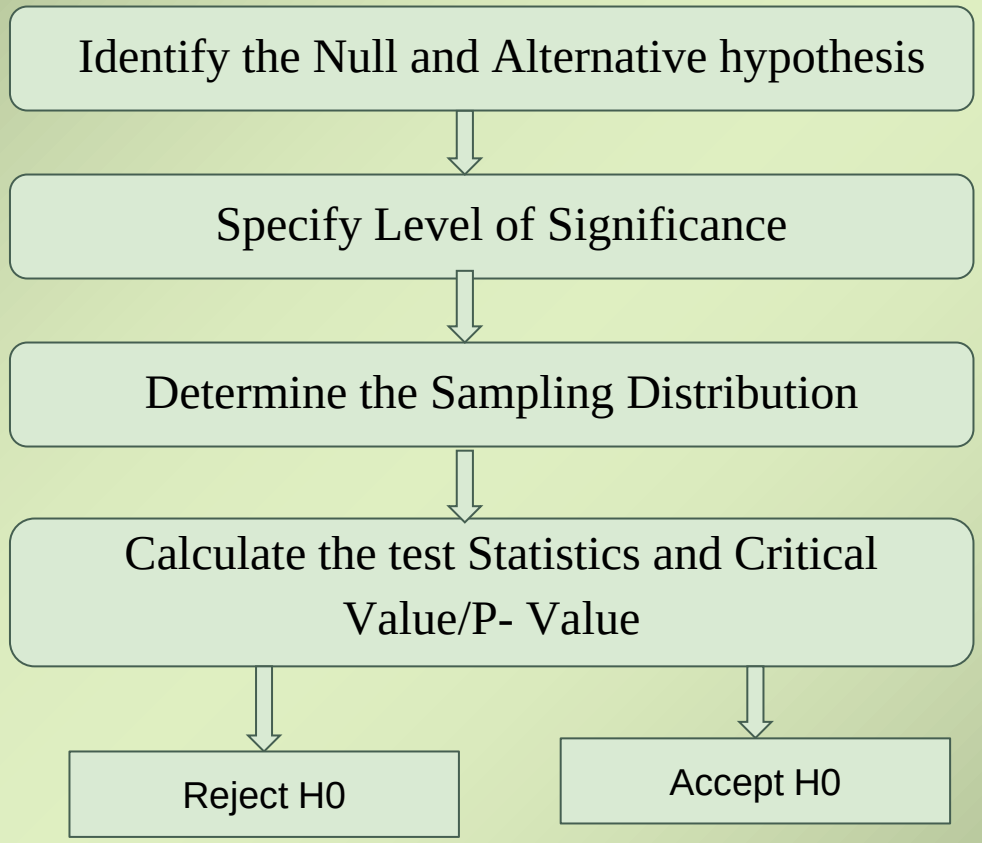
Types of Test

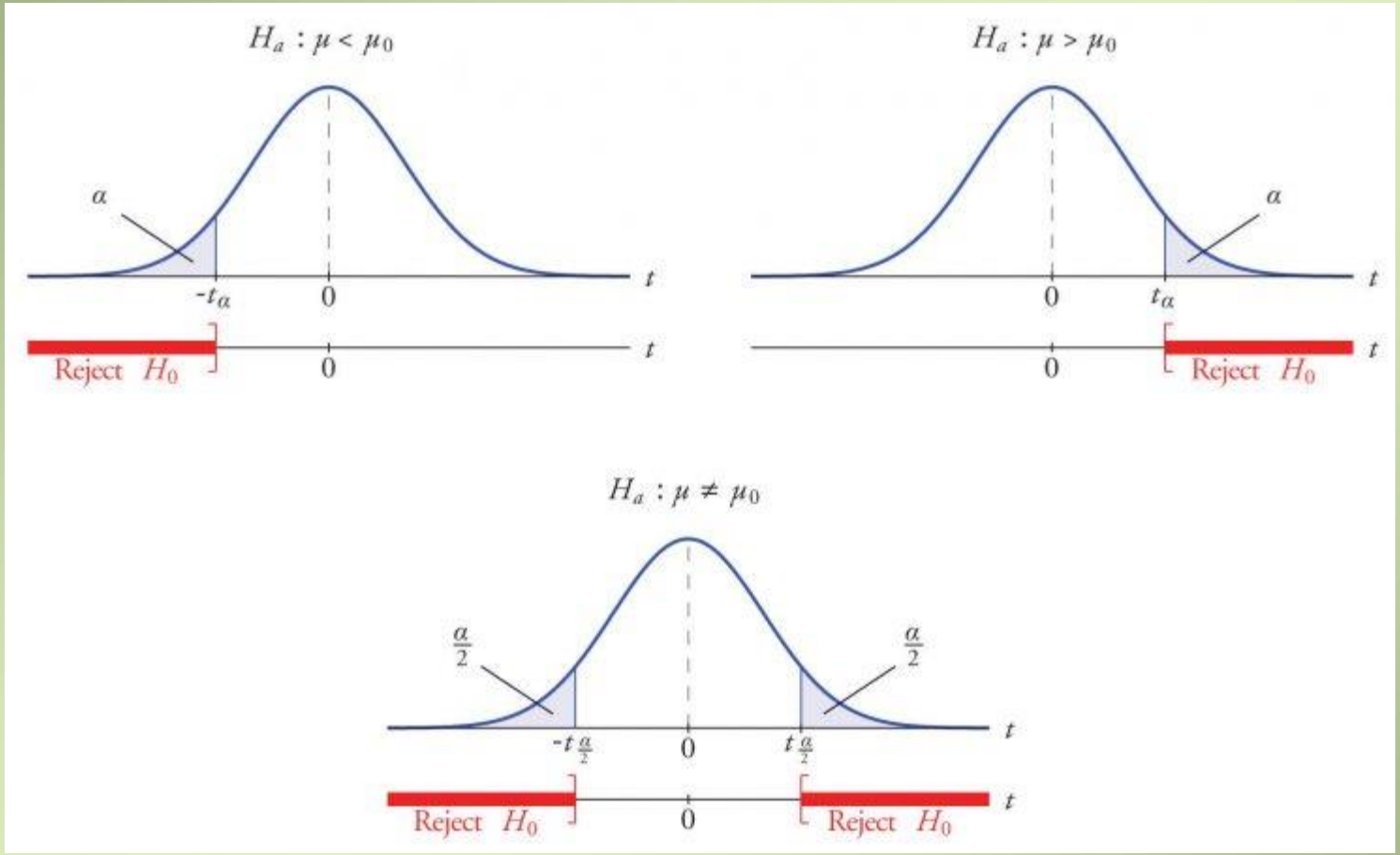


- One Sample t test
- Two Sample t test
- Paired Sample t test

- One Sample Z Test
- Two Sample Z Test

Steps in Hypothesis Testing




$H_a : \mu < \mu_0$
α
$-t_\alpha$
0
t
Reject H_0
$H_a : \mu > \mu_0$
α
0
t_α
t
Reject H_0
$H_a : \mu \neq \mu_0$
$\frac{\alpha}{2}$
$\frac{\alpha}{2}$
$-t_{\frac{\alpha}{2}}$
$t_{\frac{\alpha}{2}}$
Reject H_0
Reject H_0

Assumptions of Z- test:-

- ★ The random variable x is normally distributed.
- ★ The sample size is greater than 30.
- ★ All observations in the sample are independent of each other.
- ★ The population variance σ is known.

One Sample Z-test

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One Sample Z-test

This test is used when we want to check whether the mean of the single population is equal to the targeted value or not.

The test statistic is,

$$z = \frac{(xbar - \mu)}{\frac{6}{\sqrt{n}}}$$

E.g. We want to test whether the mean level of Sugar in the body is equal to 120 mg or not.

Two Sample Z test

This test is used when we want to check whether the mean of two populations is equal to the target population value or not.

$$z = \frac{x1bar - x2bar}{\sqrt{\frac{\sigma 1^2}{n1} + \frac{\sigma 2^2}{n2}}}$$

E.g. To test whether the average level of BP in a Diabetes patient is the same as the average level of BP of a no Diabetes patients.

Assumptions of t - test :-

- ★ The random variable x is normally distributed.
- ★ The sample size is less than 30.
- ★ All observations in the sample are independent of each other.
- ★ The population variance σ is unknown.

One Sample t-test

This test is used when we want to check whether the mean of the single population is equal to the targeted value or not.

$$t = \frac{(xbar - \mu)}{\frac{s}{\sqrt{n}}}$$

$$\text{where } s^2 = \frac{1}{(n-1)} * \sum(xi - xbar)^2$$

E.g.

2.A doctor may want to know if some new drug leads to a significant reduction in Sugar Level compared to the current standard drug used.

Two Sample t-test

This test is used when we want to check whether the mean of two populations is equal to the target population value or not

$$t = \frac{x1bar - x2bar}{s * \sqrt{\frac{1}{n1} + \frac{1}{n2}}}$$

E.g.

1. The Doctor assigns 25 subjects to use diet A for one month and 25 subjects to use diet B for one month. Then he measures the total weight loss of each subject at the end of the month. So he can use an independent two sample t-test to determine if the mean weight loss is different between the two groups.

Paired t-test

A paired sample t-test is used when we have two dependent sample data of the same subject i.e. to measure the effect on a particular group before and after the treatment . This test is used when we have data like pre-post, before –After.

The test statistic is,

$$t = \frac{d\ bar}{\frac{Sd}{\sqrt{n}}}$$

E.g.

1.During a Clinical Trial, we choose 25 patients and measure their weight before the drug treatment. And again, after the two months, we again measure their weight. By doing so, we can check whether the drug is effective or not. .

F-Test

The F- test is applicable when we want to check whether the variance of two populations is equal or not.

The test statistics is

$$F = \frac{S1^2}{S2^2} \qquad With\ (n1 - 1) * (n2 - 1) df$$

The F-test is also used in Regression analysis to check if the Model fits better to the given data or not

Why ANOVA

- To the point we were comparing only two groups
- what if we want to compare more groups??
- For multiple t-tests error is compound to larger error

Analysis of Variance(ANOVA)

ANOVA is used when we want to compare the means of two or more groups that are significantly different or not. This test is applicable when there are more than two independent groups present.

OR

Statistical significance between mean of the two or more groups

Examples:

1. If there is a statistical significant difference in means of average marks among the three different teaching methods.

Types of ANOVA

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One Way ANOVA

We use one-way ANOVA when you have data like one categorical independent variable and one quantitative dependent variable. The independent variable should have at least three levels (i.e. at least three different groups or categories)

Two Way ANOVA

A two-way ANOVA is an extension of the one-way ANOVA that reveals the results of two independent variables on a dependent variable. A two-way ANOVA tests the effect of two independent variables on a dependent variable.