Assingment 04 (Hypothesis testi

Questuion 1		What is a null hypothesis (H_0) and why is it important in hypothesis testing?
Answer		The null hypothesis, denoted by H_0, is a statement in statistics that assumes no effect, no difference, or no relationship between variables in a population.
		it represents the default or starting assumption that any observed result is due to random chance, not because of a real effect.

example	H_0: There is no difference between the mean heights of boys and girls.

Important

Foundation of Hypothesis Testing

All statistical tests are designed to test the validity of H_0. Decisions are made based on whether the data provides enough evidence to reject it.

Provides Objectivity

Starting with H_0 avoids bias. We only reject it when strong statistical evidence exists.

Basis for Decision Making

Reject H_0 → strong evidence against it

Fail to reject H_0 → insufficient evidence against it

Helps Control Errors

Type I error (rejecting a true H_0)

Type II error (failing to reject a false H_0)

The null hypothesis (H_0) is a crucial part of hypothesis testing because it provides a clear, testable statement that allows researchers to use data objectively and make statistically sound conclusions

QUESTION 2	What does the significance level (α) represent in hypothesis testing?
ANSWER	The significance level, denoted by α (alpha), is the maximum probability of making a Type I error in hypothesis testing
	A Type I error occurs when we reject a true null hypothesis (H_0)
	α is the risk we are willing to take of concluding that an effect exists when it actually does not.
	Common Values of α
	α = 0.05 (5%) → Most common in research
	α = 0.01 (1%) → Stricter evidence required
	α = 0.10 (10%) → Used in exploratory studies
	The significance level (α) represents the tolerance for error in hypothesis testing. It controls how much risk we accept when making decisions based on sample data.

QUESTION 3	Differentiate between Type I and Type II errors.
ANSWER	**Type I Error**
	Rejecting the null hypothesis (H_0) when it is actually true
	Symbol: α (alpha)
	A false positive — concluding there is an effect when there is none.
	Occurs due to random sampling variation or choosing a high significance level.
	Concluding that a new medicine works when, in reality, it does not.
	Type II Error
	Failing to reject the null hypothesis (H_0) when it is actually false.
	Symbol: β (beta)
	A false negative — missing a real effect.
	Small sample size, high variability, or very strict α.
	Concluding that a new medicine does not work when it actually does.
	Type I error: Finding a result that does not exist
	Type II error: Missing a result that does exist

QUESTION 4 Explain the difference between a one-tailed and two-tailed test. Give an example of each.

ANSWER

One Tailed Test

A one-tailed test is used when the alternative hypothesis specifies a direction of the effect (either greater than or less than).

H_0 (Null hypothesis): Parameter is equal to a specific value

H_1 (Alternative hypothesis): Parameter is greater than or less than that value

Right-tailed test: Tests if the value is greater than

Left-tailed test: Tests if the value is less than

Two-Tailed Test

A two-tailed test is used when the alternative hypothesis looks for any difference, without specifying a direction.

H_0: Parameter equals a specific value

H_1: Parameter is not equal to that value

Use a one-tailed test only when a direction is clearly justified before collecting data.

Use a two-tailed test when any difference is important.

QUESTION 5		A company claims that the average time to resolve a customer complaint is 10 minutes.				
		A random sample of 9 complaints gives an average time of 12 minutes and a standard deviation of 3 minutes. At α = 0.05, test the claim.				
ANSWER		**mean = 10 minitue**		**sample size (n)= 9**	**standard deviation = 3**	**α = 0.05**
		H0:μ=10		H1:μ- =10		
		This is a two-tailed test.				
		Sample size is small (n<30)				
		t=	**x̄−μ /s/√n**			
			12-10/3/√9			
			2/1			
			2			

QUESTION 6		When should you use a Z-test instead of a t-test?
ANSWER		**When we use z -test**
		Population Standard Deviation (σ) is Known
		The most important condition.
		If the population standard deviation σ is known, a Z-test is appropriate
		If σ is unknown, you generally use a t-test (using sample standard deviation).
		If the sample size is small (n < 30) and the population is normally distributed, a Z-test can be used only if σ is known
		Otherwise, use a t-test.
	Example	Use a Z-test when the population standard deviation is known and/or the sample size is large.
		Use a t-test when the population standard deviation is unknown, especially with small samples.

QUESTION 7

The productivity of 6 employees was measured before and after a training program.

EMPLOYEE	BEFORE	AFTER
1	50	55
2	60	65
3	58	59
4	55	58
5	62	63
6	56	59

At α = 0.05, test if the training improved productivity.

Null hypothesis (H_0): Training has no effect

ANSWER

H0:μd=0

Alternative hypothesis (H_1): Training improves productivity

H1:μd>0

compute the difference

EMPLOYEE	BEFORE	AFTER	Difference
1	50	55	5
2	60	65	5
3	58	59	1
4	55	58	3
5	62	63	1
6	56	59	3

n=6

d=5+5+1+3=1+3/6= 18/6= 3

std= 1.79

df=n−1=5

tcritical=2.015

At the 5% significance level, there is strong statistical evidence that the training program improved employee productivity

4.11>2.015

QUESTION 8

A company wants to test if product preference is independent of gender.

GENDER	PRODUCT A	PRODUCT B	TOTAL
MALE	30	20	50
FEMALE	10	40	50
TOTAL	40	60	100

At α = 0.05, test independence

ANSWER

This is a Chi-square test of independence, used to check whether product preference is independent of gender

E = (Row Total)(Column Total)/grand total

expected value

male product (a)= 50*40/100= 20

female product (a)=50*40/100 = 20

male product (b) = 50860/100= 30

female product (b)=50*60/100= 30

χ2=∑E(O−E)2

male a	30	20	**5**
male b	20	30	**3.33**
female a	10	20	**5**
female b	40	30	**3.33**

χ2=5+3.33+5+3.33=16.66

		At the 5% significance level, there is strong statistical evidence that product preference is not independent of gender					
		Gender significantly influences product preference					