**Question I: What is a null hypothesis (H) and why is it important in hypothesis testing?**

**answer,**

Provides a clear Hypothesis testing begins by assuming the null hypothesis is true. This gives researchers a baseline against which evidence is evaluated.

Allows objective decision-making
Statistical tests calculate the probability (p-value) of observing the sample results if the null hypothesis were true. This helps determine whether the evidence is strong enough to reject $H_o$.

**Question 2: What does the significance level (a) represent in hypothesis testing?**

**answer,**

The significance level (α) in hypothesis testing represents the probability of rejecting the null hypothesis ($H_o$) when it is actually true. This is known as a Type I error.

**Question. 3 : Diffrent between type I and type II errors.**

**Answer,**

Type I and Type II errors are mistakes that can occur in hypothesis testing when making decisions about the null hypothesis.

**Type I Error**

Definition: Rejecting the null hypothesis when it is actually true.

Meaning: Concluding that there is an effect or difference when none exists (false positive).

Probability: Equal to the significance level (α).

Example: Saying a new drug works when it actually does not.

**Type II Error**

Definition: Failing to reject the null hypothesis when it is actually false.

Meaning: Missing a real effect or difference (false negative).

Probability: Denoted by β.

Example: Saying a new drug does not work when it actually does.

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

**Answer,**

The difference between one-tailed and two-tailed tests lies in the direction of the hypothesis and how the rejection region is defined.

A one-tailed test is used when the alternative hypothesis specifies a direction of the effect

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

**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 l2 minutes and a standard deviation of 3 minutes.At a = 0.05, test the claim.**

**answer,**

The data do not contradict the claim that the average complaint resolution time is 10 minutes.

**question 6: When should you use aZ-test instead of a t-test?**

**answer,**

Z-test: Known population variability, often large samples.

t-test: Unknown population variability, especially small samples.

The population standard deviation is unknown and must be estimated using the sample standard deviation.

The sample size is small (n < 30) and the population is approximately normal.

**Question 7: The productivity of 6 employees was measured before and after a training program.**

**Answer,**

| Employee | before | after |
|---|---|---|
| 1 | 50 | 55 |
| 2 | 60 | 65 |
| 3 | 58 | 59 |
| 4 | 55 | 58 |
| 5 | 62 | 63 |
| 6 | 56 | 59 |

Since 4.11 > 2.015, we reject the null hypothesis.

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

The training program was effective.

**Question 8: A company wants to test if product preference is independent of gender.**

**Answer,**

| Gender | Product A | Product B | Total |
|---|---|---|---|
| Male | 30 | 20 | 50 |
| female | 10 | 40 | 50 |
| Total | 40 | 60 | 100 |

| | | | | | |
|---|---|---|---|---|---|
| | Since 16.66 > 3.841, we reject the null hypothesis.<br>Step 7: Conclusion<br>At the 5% significance level, there is strong evidence that product preference is not independent of gender.<br>Conclusion: Product preference depends on gender. | | | | |