Q1: What is the difference between a t-test and a z-test? Provide an example scenario where you would use each type of test.

: The main difference between a t-test and a z-test is the type of data they are used for. A z-test is used when you have a large sample size (typically n > 30) and you know the population standard deviation. In contrast, a t-test is used when you have a smaller sample size (typically n < 30) or when you don't know the population standard deviation.

Example scenario for each:

Use a z-test when you want to test if the mean height of a population of adult males is different from 175 cm (if you have a large sample and know the population's standard deviation). Use a t-test when you want to test if a new drug has a significant effect on blood pressure (if you have a small sample or don't know the population's standard deviation).

Q2: Differentiate between one-tailed and two-tailed tests.

One-tailed tests and two-tailed tests differ in the direction of the hypothesis being tested.

One-tailed test: It tests for a relationship in one specific direction. For example, you might test if a new drug increases blood pressure (specifically, you expect it to increase, not decrease). Two-tailed test: It tests for a relationship in either direction. For example, you might test if a new drug has any effect on blood pressure without specifying if it should increase or decrease.

Q3: Explain the concept of Type 1 and Type 2 errors in hypothesis testing. Provide an example scenario for each type of error.

Type 1 Error (False Positive): This occurs when you reject a true null hypothesis. For example, you conclude that a new drug is effective when it actually has no effect.

Type 2 Error (False Negative): This occurs when you fail to reject a false null hypothesis. For example, you conclude that a new drug has no effect when it actually is effective.

Q4: Explain Bayes's theorem with an example.

Bayes's theorem is a way to update the probability for a hypothesis as more evidence or information becomes available. It is used in Bayesian statistics.

Example: Suppose you want to find the probability of a person having a certain disease, given their test result. You start with the prior probability of having the disease, and then you use Bayes's theorem to update that probability based on the test's sensitivity and specificity.

Q5: What is a confidence interval? How to calculate the confidence interval, explain with an example.

A confidence interval is a range of values that likely contains the true population parameter (e.g., population mean) with a specified level of confidence. To calculate it, you need the sample mean, sample standard deviation, sample size, and a chosen level of confidence.

Example: To calculate a 95% confidence interval for the average height of a population, you would use the sample mean and sample standard deviation of a height sample along with the z or t critical value for a 95% confidence level based on the sample size.

Q6. Use Bayes' Theorem to calculate the probability of an event occurring given prior knowledge of the event's probability and new evidence. Provide a sample problem and solution.

Please provide a specific sample problem, and I'll help you calculate the probability using Bayes's theorem.

Q7. Calculate the 95% confidence interval for a sample of data with a mean of 50 and a standard deviation of 5. Interpret the results.

To calculate a 95% confidence interval for a sample with a mean of 50 and a standard deviation of 5, you'd use the z-score formula for a 95% confidence interval:

Margin of Error = Z * (Standard Deviation / √n)

Where Z is the critical value for a 95% confidence level, and n is the sample size. For a 95% confidence interval, Z is approximately 1.96.

Margin of Error = 1.96 * (5 / √n)

You would plug in the sample size to calculate the margin of error and then use it to construct the interval around the sample mean (50).

Interpretation: With 95% confidence, the true population mean falls within the calculated interval.

Q8. What is the margin of error in a confidence interval? How does sample size affect the margin of error? Provide an example of a scenario where a larger sample size would result in a smaller margin of error.

The margin of error in a confidence interval quantifies the range within which you expect the population parameter to lie with a certain level of confidence. The margin of error decreases with a larger sample size. For example, if you increase the sample size in a survey, the margin of error for estimating the proportion of people with a particular opinion decreases.

Q9. Calculate the z-score for a data point with a value of 75, a population mean of 70, and a population standard deviation of 5. Interpret the results.

To calculate the z-score for a data point with a value of 75, a population mean of 70, and a population standard deviation of 5, you'd use the formula:

$Z = (X - \mu) / \sigma$

Where:

X is the data point (75) μ is the population mean (70) σ is the population standard deviation (5) $Z = (75 - 70) / 5 = 1$

Interpretation: The data point is 1 standard deviation above the mean.

Q10. In a study of the effectiveness of a new weight loss drug, a sample of 50 participants lost an average of 6 pounds with a standard deviation of 2.5 pounds. Conduct a hypothesis test to determine if the drug is significantly effective at a 95% confidence level using a t-test.

To conduct a t-test for the effectiveness of a weight loss drug with a sample of 50 participants, you would perform a one-sample t-test using the sample mean, sample standard deviation, and the null hypothesis (e.g., drug has no effect). You would then calculate the t-statistic and compare it to the critical t-value at a 95% confidence level with 49 degrees of freedom. If the calculated t-statistic is beyond the critical t-value, you can reject the null hypothesis.

Q11. In a survey of 500 people, 65% reported being satisfied with their current job. Calculate the 95% confidence interval for the true proportion of people who are satisfied with their job.

: To calculate the 95% confidence interval for the proportion of people satisfied with their job, you'd use the formula:

Confidence Interval = $p \pm Z * \sqrt{(p(1-p) / n)}$

Where:

p is the sample proportion (0.65 in this case) Z is the critical value for a 95% confidence interval n is the sample size (500) Calculate the margin of error using Z, then construct the interval around the sample proportion (0.65).

Interpretation: With 95% confidence, the true proportion of people satisfied with their job lies within the calculated interval.

Q12. A researcher is testing the effectiveness of two different teaching methods on student performance. Sample A has a mean score of 85 with a standard deviation of 6, while sample B has a mean score of 82 with a standard deviation of 5. Conduct a hypothesis test to determine if the two teaching methods have a significant difference in student performance using a t-test with a significance level of 0.01.

To compare two teaching methods, conduct a two-sample t-test. Calculate the t-statistic using the sample means, sample standard deviations, and sample sizes of both groups.

Then, compare the t-statistic to the critical t-value at the 0.01 significance level with the appropriate degrees of freedom.

Q13. A population has a mean of 60 and a standard deviation of 8. A sample of 50 observations has a mean of 65. Calculate the 90% confidence interval for the true population mean.

To calculate the 90% confidence interval for the true population mean, use the formula:

Confidence Interval = $\bar{X} \pm Z * (\sigma / \sqrt{n})$

Where:

$\bar{X}$ is the sample mean (65) Z is the critical value for a 90% confidence interval σ is the population standard deviation (8) n is the sample size (50) Calculate the margin of error using Z and construct the interval around the sample mean (65).

Interpretation: With 90% confidence, the true population mean falls within the calculated interval.

Q14. In a study of the effects of caffeine on reaction time, a sample of 30 participants had an average reaction time of 0.25 seconds with a standard deviation of 0.05 seconds. Conduct a hypothesis test to determine if the caffeine has a significant effect on reaction time at a 90% confidence level using a t-test.

To conduct a hypothesis test for the effects of caffeine on reaction time, perform a one-sample t-test using the sample mean, sample standard deviation, and the null hypothesis (e.g., caffeine has no effect). Calculate the t-statistic and compare it to the critical t-value at a 90% confidence level with 29 degrees of freedom. If the calculated t-statistic is beyond the critical t-value, you can reject the null hypothesis.