Q1: Difference between t-test and z-test:

- **T-test:** It's used when you're dealing with small sample sizes (typically less than 30) or when the population standard deviation is unknown. For example, if you want to test whether the mean weight of a sample of 20 individuals is significantly different from the population mean weight.
- **Z-test:** It's used when you have a large sample size (typically greater than 30) and the population standard deviation is known. For instance, if you want to test whether the mean height of a sample of 1000 individuals is significantly different from the population mean height.

Q2: One-tailed vs. two-tailed tests:

- **One-tailed test:** It's used when the direction of the difference or effect is specified. For example, testing whether a new drug increases blood pressure.
- **Two-tailed test:** It's used when you're interested in any difference or effect, regardless of direction. For instance, testing whether a new teaching method affects test scores.

Q3: Type 1 and Type 2 errors:

- **Type 1 error:** It occurs when you reject the null hypothesis when it is actually true. For example, convicting an innocent person in a court trial.
- **Type 2 error:** It happens when you fail to reject the null hypothesis when it is actually false. For instance, failing to diagnose a disease when it is present.

Q4: Bayes's theorem: Bayes's theorem describes the probability of an event, based on prior knowledge of conditions that might be related to the event. It's expressed as P(A|B) = [P(B|A) * P(A)] / P(B), where A and B are events, and P(A|B) is the probability of A given B.

Q5: Confidence interval: A confidence interval is a range of values that likely contains the true value of a population parameter. It's calculated using the sample data and accounts for sampling variability. For example, a 95% confidence interval for the mean weight of a population might be [65, 75], meaning we are 95% confident that the true mean weight falls within this range.

Q6: Bayes's Theorem application:

- **Problem:** Suppose a test for a rare disease is 99% accurate. If 1 out of 1000 people have the disease, what's the probability that a person who tests positive actually has the disease?
- **Solution:** Using Bayes's theorem, P(Disease|Positive) = [P(Positive|Disease) * P(Disease)] / P(Positive).

Q7: Calculate 95% confidence interval: Using the formula: Confidence Interval = Mean ± (Z * Standard Error), where Z is the Z-score corresponding to the desired confidence level. For the given data: Mean = 50, Standard Deviation = 5, and for a 95% confidence level, Z ≈ 1.96. So, the confidence interval is 50 ± (1.96 * (5 / √n)), where n is the sample size.

Q8: Margin of error: The margin of error is the amount added to and subtracted from the sample estimate to create the confidence interval. It decreases as the sample size increases because larger samples provide more precise estimates of the population parameter. For example, increasing a political survey sample from 1000 to 5000 would reduce the margin of error.

Q9: Calculate z-score: Z = (X - μ) / σ, where X is the data point, μ is the population mean, and σ is the population standard deviation. So, Z = (75 - 70) / 5 = 1, meaning the data point is 1 standard deviation above the mean.

Q10: Hypothesis test for the effectiveness of a weight loss drug:
Given:

- Sample size (n) = 50
- Sample mean (x̄) = 6 pounds
- Sample standard deviation (σ) = 2.5 pounds
- Confidence level = 95%
- Null hypothesis (H0): The drug is not significantly effective (μ = 0)
- Alternative hypothesis (H1): The drug is significantly effective (μ ≠ 0)

Since the sample size is small (<30) and the population standard deviation is unknown, we'll use a t-test.
First, we calculate the t-score: �=�¯−���*t*=*nσx*¯−*μ*
�=6−02.550*t*=502.56−0
�≈60.3536*t*≈0.35366

�≈16.97$t \approx 16.97$
Degrees of freedom (df) = n - 1 = 50 - 1 = 49
Next, we find the critical t-value from the t-distribution table or use statistical software. For a two-tailed test at a 95% confidence level with df = 49, the critical t-value is approximately ±2.01.
Since the calculated t-score (|16.97|) is greater than the critical t-value (2.01), we reject the null hypothesis.
Therefore, we conclude that the weight loss drug is significantly effective at a 95% confidence level.

Q12: Hypothesis test for the effectiveness of two teaching methods:

Given:
- Sample A:
  - Mean score ($\bar{x}A$) = 85
  - Standard deviation (σA) = 6
- Sample B:
  - Mean score ($\bar{x}B$) = 82
  - Standard deviation (σB) = 5
- Sample sizes are not provided, assuming they are equal for simplicity.
- Significance level (α) = 0.01

Null hypothesis (H0): There is no significant difference in student performance between the two teaching methods ($\mu A - \mu B = 0$)
Alternative hypothesis (H1): There is a significant difference in student performance between the two teaching methods ($\mu A - \mu B \neq 0$)

Since we are comparing the means of two independent samples and the sample sizes are relatively small (not provided but assumed equal), we'll use a two-sample t-test for independent samples.

First, let's calculate the pooled standard deviation (sp) for the two samples:
$$ sp = \sqrt{\frac{{(n_A - 1) \times \sigma_A^2 + (n_B - 1) \times \sigma_B^2}}{{n_A + n_B - 2}}} $$

Next, we calculate the t-score using the formula:

$$ t = \frac{{\bar{x}_A - \bar{x}_B}}{{sp \times \sqrt{\frac{1}{n_A} + \frac{1}{n_B}}}} $$

We then find the degrees of freedom (df) using:

$$ df = n_A + n_B - 2 $$

Lastly, we compare the calculated t-score to the critical t-value from the t-distribution table or using statistical software at the specified significance level (α).

If the calculated t-score falls within the critical region, we reject the null hypothesis and conclude that there is a significant difference in student performance between the two teaching methods.

Let's calculate the results using the provided data and the specified significance level.