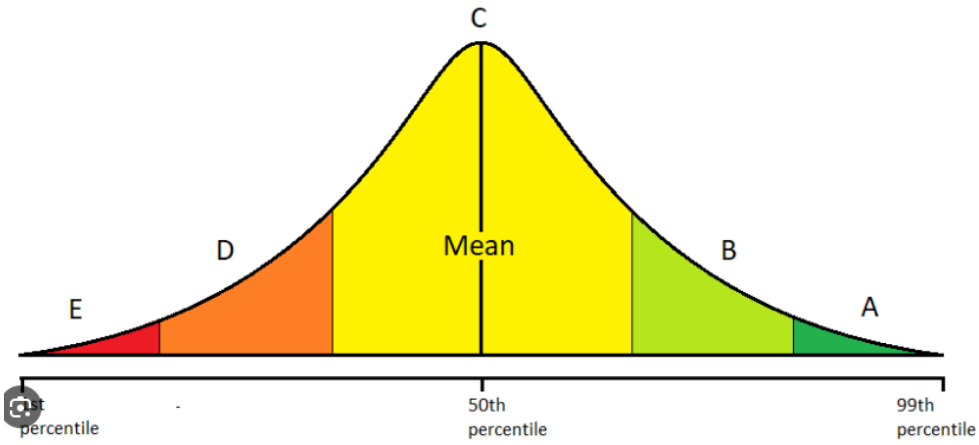
**Unit 6, Statistical Inference, Confidence Intervals, and Hypothesis Testing→**

Hypothesis testing, distributions, and significance levels enable researchers and analysts to make inferences about populations based on sample data, assess the probability of observed outcomes under a given assumption, and determine the strength of evidence against a null hypothesis.

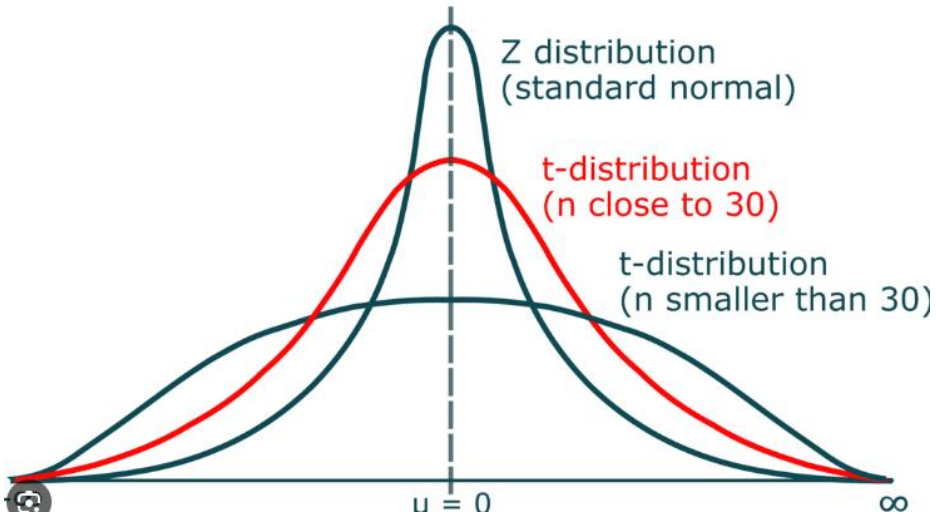
Hypothesis testing allows us to test evaluate two propositions:

- Null Hypothesis (H0): This is a statement of no effect or no difference, asserting that any observed difference in the sample is due to chance. It's what the test aims to challenge.
- Alternative Hypothesis (H1 or Ha): Contrasts the null hypothesis, suggesting that observed effects are real and not due to random variation.

Normal Distribution: A symmetric, bell-shaped distribution where most observations cluster around the central peak and probabilities for values further from the mean taper off equally in both directions. Many statistical tests assume a normal distribution because of the Central Limit Theorem, which states that the means of samples from a population will tend to follow a normal distribution, regardless of the shape of the population distribution, provided the sample size is sufficiently large.




t-Distribution: Similar to the normal distribution but with fatter tails, allowing for the increased variability in sample estimates. It's particularly useful when dealing with small sample sizes or when the population standard deviation is unknown.



The significance level (denoted as α) is a threshold used to determine the strength of the evidence against the null hypothesis. It's the probability of rejecting the null hypothesis when it is actually true (Type I error). Common significance levels are 0.05, 0.01, and 0.10, which correspond to 5%, 1%, and 10% risks of making a Type I error, respectively.

**Hypothesis Testing Process**

1. Formulate Hypotheses: Define the null and alternative hypotheses based on the research question.
2. Choose the Significance Level (α): Decide on the probability of committing a Type I error you are willing to accept.
3. Select the Appropriate Test: Based on the data type, distribution, and study design, choose a statistical test.
4. Calculate the Test Statistic: Using sample data, compute the value that will be compared against a critical value or used to compute a p-value.
5. Make a Decision: Compare the p-value to the significance level. If the p-value ≤ α, reject the null hypothesis. Otherwise, fail to reject it.

By understanding and applying these principles, researchers can objectively evaluate evidence, control for random chance, and make informed conclusions about population parameters based on sample data.