Key Statistical Concepts in Hypothesis Testing

1. Confidence Level

The probability that a confidence interval contains the true population parameter.
Typical values: 90%, 95%, or 99%.
Example: A 95% confidence level means that if we took 100 different samples and built confidence intervals, about 95 of them would contain the true population parameter.

2. Level of Significance (α)

The probability of making a Type I error (rejecting a true null hypothesis).
Typical values: 0.01, 0.05, or 0.10.
Example: At $\alpha = 0.05$, there is a 5% risk of wrongly rejecting the null hypothesis.

3. Confidence Coefficient

The complement of the level of significance, i.e., $(1 - \alpha)$.
Example: If $\alpha = 0.05$, then the confidence coefficient = 0.95 (95%).

4. Critical Region (Rejection Region)

The set of values of the test statistic for which the null hypothesis is rejected.
Example: In a two-tailed Z-test at $\alpha = 0.05$, the critical region is $Z < -1.96$ or $Z > 1.96$.

5. Decision Making in Hypothesis Testing

1. State null (H■) and alternative hypothesis (H■).
2. Select significance level (α).
3. Compute test statistic (e.g., Z, t, F, χ^2).
4. Define critical region.
5. Compare test statistic with critical region.
6. Decision: If statistic $\in$ critical region $\rightarrow$ Reject H■. If statistic $\notin$ critical region $\rightarrow$ Fail to reject H■.

6. Critical Value/Deviation

The boundary point(s) that separate the acceptance region from the rejection region.
Example: For a Z-test at $\alpha = 0.05$ (two-tailed), the critical deviations are ± 1.96.

7. B Risk (Type II Error Probability, β)

The probability of failing to reject the null hypothesis when it is false.
Example: If a new drug truly works, but we fail to detect it in the test, we commit a Type II error.

8. Power of the Test

The probability of correctly rejecting a false null hypothesis.
Formula: Power = $1 - \beta$
Interpretation: Higher power means a better chance of detecting true effects. Researchers aim for a power of at least 0.80 (80%).

9. Factors Affecting Power of a Test

- Sample Size (n): Larger samples increase power.
- Significance Level (α): Higher α increases power (but also increases risk of Type I error).
- Effect Size: Larger true differences between population parameters make it easier to detect effects.
- Variability in Data: Lower variance increases power.
- Choice of Test: More appropriate tests give higher power.