Null and alternative hypotheses for commonly used statistical tests are as follows:

1. Z-Test:

- Null Hypothesis (H0): The population mean is equal to a specified value.

- Alternative Hypothesis (HA): The population mean is not equal to the specified value.

2. T-Test:

- One-Sample T-Test:

- Null Hypothesis (H0): The population mean is equal to a specified value.

- Alternative Hypothesis (HA): The population mean is not equal to the specified value.

- Independent Samples T-Test:

- Null Hypothesis (H0): The means of two independent populations are equal.

- Alternative Hypothesis (HA): The means of two independent populations are not equal.

- Paired Samples T-Test:

- Null Hypothesis (H0): The means of two related samples are equal.

- Alternative Hypothesis (HA): The means of two related samples are not equal.

3. F-Test (ANOVA):

- Null Hypothesis (H0): The means of all groups are equal.

- Alternative Hypothesis (HA): At least one mean is different from the others.

4. Chi-Square Test:

- Chi-Square Goodness-of-Fit Test:

- Null Hypothesis (H0): The observed frequencies follow the expected frequencies.

- Alternative Hypothesis (HA): The observed frequencies do not follow the expected frequencies.

- Chi-Square Test of Independence:

- Null Hypothesis (H0): There is no association between two categorical variables.

- Alternative Hypothesis (HA): There is an association between two categorical variables.

- Chi-Square Test of Homogeneity:

- Null Hypothesis (H0): The distributions of two or more groups are the same.

- Alternative Hypothesis (HA): The distributions of two or more groups are not the same.

In terms of coefficient

In terms of coefficients, the null and alternative hypotheses for various statistical tests can be stated as follows:

1. Z-Test:

- Null Hypothesis (H0): The coefficient (slope) of the predictor variable is equal to zero.

- Alternative Hypothesis (HA): The coefficient (slope) of the predictor variable is not equal to zero.

2. T-Test:

- One-Sample T-Test:

- Null Hypothesis (H0): The population coefficient (slope) of the predictor variable is equal to a specified value.

- Alternative Hypothesis (HA): The population coefficient (slope) of the predictor variable is not equal to the specified value.

- Independent Samples T-Test:

- Null Hypothesis (H0): The difference in coefficients (slopes) of the predictor variable between two independent populations is equal to zero.

- Alternative Hypothesis (HA): The difference in coefficients (slopes) of the predictor variable between two independent populations is not equal to zero.

- Paired Samples T-Test:

- Null Hypothesis (H0): The difference in coefficients (slopes) of the predictor variable between two related samples is equal to zero.

- Alternative Hypothesis (HA): The difference in coefficients (slopes) of the predictor variable between two related samples is not equal to zero.

3. F-Test (ANOVA):

- Null Hypothesis (H0): The coefficients (slopes) of the predictor variable are equal across all groups or categories.

- Alternative Hypothesis (HA): At least one coefficient (slope) of the predictor variable is different from the others.

4. Chi-Square Test:

- Chi-Square Goodness-of-Fit Test:

- Null Hypothesis (H0): The coefficients (expected frequencies) for each category follow a specified distribution.

- Alternative Hypothesis (HA): The coefficients (expected frequencies) for each category do not follow the specified distribution.

- Chi-Square Test of Independence:

- Null Hypothesis (H0): The coefficients (association measures) for two categorical variables are equal to zero, indicating no association.

- Alternative Hypothesis (HA): The coefficients (association measures) for two categorical variables are not equal to zero, indicating an association.

- Chi-Square Test of Homogeneity:

- Null Hypothesis (H0): The coefficients (distributions) of the categorical variable are the same across different groups.

- Alternative Hypothesis (HA): The coefficients (distributions) of the categorical variable are not the same across different groups.

Assumptions of hypothesis test

1. Independence: The observations or data points used in the hypothesis test are assumed to be independent of each other. This assumption ensures that the observations are not influenced by each other and that each observation provides unique information.

2. Random Sampling: The data used in the hypothesis test are assumed to be randomly sampled from the population of interest. This assumption helps ensure that the sample is representative of the population, allowing for generalizations to be made.

3. Normality: Many hypothesis tests assume that the underlying population or sample follows a normal distribution. This assumption is particularly important when dealing with tests involving means, such as the t-test or ANOVA. Violations of this assumption may affect the accuracy and reliability of the test results.

4. Homogeneity of Variance: Some tests, such as the t-test or ANOVA, assume that the variance of the dependent variable is equal across different groups or conditions. This assumption is known as homogeneity of variance or homoscedasticity. Violations of this assumption may impact the validity of the test results.

5. Linearity: Linear regression models and related tests assume a linear relationship between the independent and dependent variables. Violations of linearity assumptions may lead to biased estimates and incorrect inferences.

6. Equal Covariance: In multivariate hypothesis tests, such as the Hotelling's T-square test or MANOVA, it is assumed that the covariance matrix is the same across groups or conditions. This assumption is known as equal covariance or homogeneity of covariance.

when to use which hypothesis test

1. t-test:
   * Use when comparing means of two groups (independent samples) or before-after measurements (paired samples).
   * Assumes continuous or numerical data, approximately normally distributed, and homogeneity of variances (unless using Welch's t-test).
2. Analysis of Variance (ANOVA):
   * Use when comparing means of three or more groups.
   * Assumes continuous or numerical data, approximately normally distributed, and homogeneity of variances.
3. Chi-square test:
   * Use when assessing the association between categorical variables.
   * Assumes categorical or ordinal data and independence of observations.
4. Fisher's exact test:
   * Use when assessing the association between categorical variables with small expected cell frequencies.
   * Similar to the chi-square test but applicable when the expected cell frequencies are low.

how to interpret these test

1. Test statistic:
   * The test statistic quantifies the difference or relationship being tested. Its interpretation depends on the specific test being conducted.
   * For example, in a t-test or ANOVA, a positive test statistic indicates that the sample mean(s) is larger than the hypothesized mean(s), while a negative test statistic suggests the opposite.
2. P-value:
   * The p-value represents the probability of observing a test statistic as extreme as or more extreme than the observed test statistic, assuming the null hypothesis is true.
   * A small p-value (typically below the chosen significance level, α) suggests strong evidence against the null hypothesis and supports the alternative hypothesis.
   * A large p-value suggests weak evidence against the null hypothesis and fails to reject it. However, it does not necessarily provide evidence in favor of the null hypothesis.
3. Significance level (α):
   * The significance level is the threshold set to determine the level of evidence required to reject the null hypothesis.
   * Commonly used significance levels are 0.05 (5%) or 0.01 (1%). If the p-value is smaller than α, the result is considered statistically significant.
   * The choice of the significance level depends on the desired level of confidence and the consequences of making Type I and Type II errors.
4. Decision:
   * If the p-value is smaller than α (p < α), the result is statistically significant. We reject the null hypothesis in favor of the alternative hypothesis.
   * If the p-value is larger than α (p > α), the result is not statistically significant. We fail to reject the null hypothesis.
   * It is important to note that "failing to reject" the null hypothesis does not imply that the null hypothesis is proven true. It simply means that there is not enough evidence to support the alternative hypothesis.
5. Conclusion:
   * Based on the decision made, interpret the results in the context of the research question and draw appropriate conclusions.
   * If the null hypothesis is rejected, it suggests that there is evidence to support the alternative hypothesis.
   * If the null hypothesis is not rejected, it indicates that there is not enough evidence to support the alternative hypothesis.