Hypothesis Testing Roadmap *(Minitab 17)*

LEAN METHODS GROUP

Tips to Remember

1. Proper sample size selection is required for tests to be effective.
2. H_1 can be <, >, or ≠ depending on whether a 1- or 2-sided test is being performed.
3. If $p > \alpha$, then do not reject H_0.
4. If $p \leq \alpha$, then reject H_0.
5. An α-risk of 0.05 is used typically, based on a 0.95 confidence level.

Start → What type of analysis? → (Model Building / Hypothesis Test)

Building Models

Tests for Significance (All types of models)
For each model as a whole:
H_0: Model is not Significant.
H_1: Model is Significant.
For each factor in a model:
H_0: Factor is not Significant.
H_1: Factor is Significant.

Multiple Binary Logistic Regression
Stat > Regression > Binary Logistic Regression > Fit Binary Logistic Model

Multiple Ordinal Logistic Regression
Stat > Regression > Ordinal Logistic Regression

Multiple Nominal Logistic Regression
Stat > Regression > Nominal Logistic Regression

Binary Logistic Regression
Stat > Regression > Binary Logistic Regression > Fit Binary Logistic Model
OR
Analysis of Means
Stat > ANOVA > Analysis of Means

Ordinal Logistic Regression
Stat > Regression > Ordinal Logistic Regression
OR
Analysis of Means
Stat > ANOVA > Analysis of Means

Nominal Logistic Regression
Stat > Regression > Nominal Logistic Regression

Multiple Regression
Stat > Regression > Regression > Fit Regression Model
OR
General Linear Model
Stat > ANOVA > General Linear Model > Fit General Linear Model
OR
D. O. E.
Multiple Continuous or Discrete Xs
(Choice of procedure will depend on the structure of the experimental data.)

Fitted Line Plot
Stat > Regression > Fitted Line Plot
or
Regression
Stat > Regression > Regression > Fit Regression Model

Decision nodes (Model Building branch): What type of Y data? (Discrete / Continuous); What type of discrete Y data? (Binary / Ordinal / Nominal); What number of Xs? (1 / >1)

Discrete Data (Hypothesis Test → Discrete Y)

What type of analysis?

- Test Two Discrete Variables for Dependency → **Chi-Square Test for Association**
  Stat > Tables > Chi-Square Test for Association
  H_0: No association exists.
  H_1: An association exists.
  (Known as contingency tables.)

- Compare Groups of Binomial Data → How many levels of X?
  - One (Group) → **1 Proportion Test**
    Stat > Basic Statistics > 1 Proportion
    H_0: $p = p_0$
    H_1: $p \neq p_0$
  - Two (Groups) → **2 Proportions Test**
    Stat > Basic Statistics > 2 Proportions
    H_0: $p_1 - p_2 = p_0$
    H_1: $p_1 - p_2 \neq p_0$
  - > Two (Groups) → **Analysis of Means**
    Stat > ANOVA > Analysis of Means
    H_0: $p_1 = p_2 = \ldots p_k$
    H_1: At least one of the population proportions is different from the other proportions.

- Test a Multinomial Distribution Fit to an Assumed Distribution → **Chi-Square Goodness-of-Fit Test (One Variable)**
  Stat > Tables > Chi-Square Goodness-of-Fit Test (One Variable)
  H_0: Data follow a multinomial distribution with certain proportions.
  H_1: Data do not follow a multinomial distribution with certain proportions.

Normality Test (Hypothesis Test → Continuous Y)

Is each group of data normal?

Normality Test
Stat > Basic Statistics > Graphical Summary
or
Stat > Basic Statistics > Normality Test
or
Graph > Probability Plot > Multiple
H_0: Data follow a normal distribution
H_1: Data do not follow a normal distribution

Continuous Data – Non-Normal (a.k.a. Nonparametric Methods) [No branch]

How many levels of X?

- > Two (Groups) → **Test for Equal Variances**
  Stat > ANOVA > Test for Equal Variances
  H_0: $\sigma_1 = \sigma_2 = \sigma_3 = \ldots = \sigma_k$
  H_1: At least one σ is different from another.
  → Are σ^2 values equal?
    - Yes → **Kruskal-Wallis**
      Stat > Nonparametrics > Kruskal-Wallis
      OR
      Mood's Median Test
      Stat > Nonparametrics > Mood's Median Test
      H_0: The population medians are all equal.
      H_1: The population medians are not all equal.
      (Consult Minitab Help to select the procedure.)
    - No → **Proceed with caution** ⚠

- One (Group) → Working with η or σ?
  - η → **1-Sample Sign Test**
    Stat > Nonparametrics > 1-Sample Sign
    OR
    1-Sample Wilcoxon
    Stat > Nonparametrics > 1-Sample Wilcoxon
    H_0: Median = Hypothesized Median
    H_1: Median ≠ Hypothesized Median
    (Consult Minitab Help to select the procedure.)
  - σ → **1 Variance Test**
    Stat > Basic Statistics > 1 Variance
    H_0: $\sigma^2 = \sigma_0^2$
    H_1: $\sigma^2 \neq \sigma_0^2$

- Two (Groups) → **Test for Equal Variances**
  Stat > ANOVA > Test for Equal Variances
  H_0: $\sigma_1 = \sigma_2 = \sigma_3 = \ldots = \sigma_k$
  H_1: At least one σ is different from another.
  → Are σ^2 values equal?
    - Yes → **Mann-Whitney Test**
      Stat > Nonparametrics > Mann-Whitney
      H_0: $\eta_1 = \eta_2$
      H_1: $\eta_1 \neq \eta_2$
    - No → **Proceed with caution** ⚠

Continuous Data – Normal (Yes branch)

How many levels of X?

- One (Group) → Working with μ or σ?
  - μ → **1-Sample t Test**
    Stat > Basic Statistics > 1-Sample t
    H_0: $\mu = \mu_0$
    H_1: $\mu \neq \mu_0$
  - σ → **1 Variance Test**
    Stat > Basic Statistics > 1 Variance
    H_0: $\sigma^2 = \sigma_0^2$
    H_1: $\sigma^2 \neq \sigma_0^2$

- > Two (Groups) → **Test for Equal Variances**
  Stat > ANOVA > Test for Equal Variances
  H_0: $\sigma_1 = \sigma_2 = \sigma_3 = \ldots = \sigma_k$
  H_1: At least one σ is different from another.
  → Are σ^2 values equal?
    - Yes → **One-Way**
      Stat > ANOVA > One-Way
      H_0: $\mu_1 = \mu_2 = \mu_3 = \ldots = \mu_k$
      H_1: At least one μ is different from another.
      (Check the "Assume Equal Variances" box under "Options".)
    - No → **One-Way**
      Stat > ANOVA > One-Way
      H_0: $\mu_1 = \mu_2 = \mu_3 = \ldots = \mu_k$
      H_1: At least one μ is different from another.
      (Do not check the "Assume Equal Variances" box under "Options".)

- Two (Groups) → Is data paired?
  - Yes → **Paired t Test**
    Stat > Basic Statistics > Paired t
    H_0: $\mu_d = \mu_0$
    H_1: $\mu_d \neq \mu_0$
  - No → **2 Variances Test**
    Stat > Basic Statistics > 2 Variances
    H_0: $\sigma_1^2 / \sigma_2^2 = 1$
    H_1: $\sigma_1^2 / \sigma_2^2 \neq 1$
    (This is called the F test traditionally.)
    → Are σ^2 values equal?
      - Yes → **2-Sample t Test**
        Stat > Basic Statistics > 2-Sample t
        H_0: $\mu_1 - \mu_2 = \delta_0$
        H_1: $\mu_1 - \mu_2 \neq \delta_0$
        (Check the "Assume Equal Variances" box under "Options".)
      - No → **2-Sample t Test**
        Stat > Basic Statistics > 2-Sample t
        H_0: $\mu_1 - \mu_2 = \delta_0$
        H_1: $\mu_1 - \mu_2 \neq \delta_0$
        (Do not check the "Assume Equal Variances" box under "Options".)