## Hypothesis Test Statistics and Confidence Intervals

### 1 - \( \alpha \) Confidence Interval

#### Point Estimate \( \pm \) Maximum Error \( E \)

### Hypothesis Test Value (Statistic)

**NULL Hypothesis**: Use the statement containing the condition of equality either directly or implied, as the null hypothesis \( H_0 \).

### Single Population

#### (TI-84)

**One Sample for mean \( \mu \) (\( \sigma \) is known)**

\[
\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}
\]

Use the Normal \( Z \)-Table for the critical value \( Z \)

\[
z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}
\]

**One Sample for mean \( \mu \) (\( \sigma \) is unknown)**

\[
\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}
\]

Use the \( t \)-distribution Table for the critical value \( t \)

\[
t = \frac{\bar{x} - \mu}{s/\sqrt{n}}
\]

#### (ZInterval)

**One Sample for Proportion \( p \)**

\[
\hat{p} \pm z_{\alpha/2} \sqrt{\frac{pq}{n}}
\]

Use the Normal \( Z \)-Table for the critical value \( Z \)

\[
z = \frac{\hat{p} - p}{\sqrt{pq/n}}
\]

#### (TI-84)

**Dual Population**

#### (TI-84)

**Dependent Paired for \( \mu_d \)**

\[
d \pm t_{\alpha/2} \frac{s_d}{\sqrt{n}}
\]

Use the \( t \)-distribution Table for the critical value \( t \)

\[
t = \frac{\bar{d} - \mu_d}{s_d/\sqrt{n}}
\]

**Use \( H_0 : \mu_d = 0 \)**

#### (2-SampZTest)

**Two Independent Samples for \( \mu_1 - \mu_2 \) (\( \sigma_1, \sigma_2 \) are known)**

\[
(x_1 - x_2) \pm z_{\alpha/2} \frac{\sigma_1^2 + \sigma_2^2}{n_1/n_2}
\]

Use the Normal \( Z \)-Table for the critical value \( Z \)

\[
z = \frac{(x_1 - x_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}
\]

**Use \( H_0 : \mu_1 - \mu_2 = 0 \)**

#### (2-SampTTest)

**Two Independent Samples for \( \mu_1 - \mu_2 \) (\( \sigma_1, \sigma_2 \) are unknown)**

\[
(x_1 - x_2) \pm t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}
\]

\[
df = \text{smaller of } n_1 - 1 \text{ or } n_2 - 1\]

Use the \( t \)-distribution Table for the critical value \( t \)

**Use \( H_0 : \mu_1 - \mu_2 = 0 \)**

#### (2-SampTTest)

**Two Independent Samples for Proportions \( p_1 - p_2 \)**

\[
(p_1 - p_2) \pm \frac{z_{\alpha/2} \sqrt{pq}}{\sqrt{n_1} + \sqrt{n_2}}
\]

Use the Normal \( Z \)-Table for the critical value \( Z \)

\[
z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{pq}{n_1} + \frac{pq}{n_2}}}
\]

**Use \( H_0 : p_1 - p_2 = 0 \)**

#### (2-PropZTest)

**Sample Size Determination**

For Mean \( \mu \)

\[
n = \frac{z_{\alpha/2}^2 \sigma^2}{E^2} = \left( \frac{z_{\alpha/2} \sigma}{E} \right)^2
\]

(round up)

For Proportion \( p \)

\[
n = \frac{z_{\alpha/2}^2 pq}{E^2} \quad \text{or use} \quad n = \frac{z_{\alpha/2}^2(.25)}{E^2}
\]

(if \( p, q \) unknown)

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Handout created by Professor Jahn on 3/01/00 and updated by Ms. Neginsky on 1/26/18
Hypothesis Testing Steps

1) Set up H₀ and H₁.
H₀: Use the "≤" or "≠" or "≥" indicate inequality, etc.
H₁: Use the "<", "≠", ">", or "<" indicate equality, dependence, etc. (Label the Claim)

2) Determine the critical number(s)
When α is known, refer to the Z-table. Also, use the Z-table for proportions. When n is NOT known (and α is given), use the Table. For others (Chi-square, regression, F-dist, ANOVA, etc.) refer to the proper table or method.

3) Draw a curve and plot the critical number(s).
Label the "Fail to Reject H₀ Zone" and, label and shade the "Reject H₀ Zone"

4) Determine the test statistic - see the applicable formula sheet, and plot it.

5) Reject H₀ or Fail to Reject H₀
1) Reject if the test statistic is in the Critical Zone or
2) Using p-values, Reject if α ≥ p-value or Fail to reject if p-value ≤ α

6) Write the final conclusion (see the flowchart below)

Confidence Interval Steps:

1) Find the critical Z, or t
When α is known, refer to the Z-table. Also, use the Z-table for proportions.
When α is NOT known (and S is given), use the Student's-t table. For others, refer to the proper table or method.

2) Calculate the Maximum Error (see formulas – reverse page)

3) The Interval is:
Point Est. ± Max. Error

Hypothesis Testing using p-Values:

Left tail: Area to the left of the test statistic
Right tail: Area to the right of the test statistic
Two tail: If Test Stat to left of center:
Twice the area to the left of the test statistic
If Test Stat to right of center:
Twice the area to the right of the test statistic
(To find the areas, use the "Strategies to Find Areas")
Reject H₀ if, p ≤ α
Fail to Reject H₀ if, p > α