INFERENCE GUIDE

CONFIDENCE INTERVALS

Use **confidence intervals** to **estimate** a parameter with a particular **confidence level, C**.

IDENTIFY: Identify the parameter and the confidence level.

CHOOSE: Choose and name the appropriate interval.

CHECK: Check that conditions for the procedure are met.

CALCULATE:
CI: $\textbf{point estimate} \pm \textbf{critical value} \times \textbf{\textit{SE}}\textbf{ of estimate}$

df = (if applicable)
(_____ , _____)

CONCLUDE:
We are C% confident that the true [parameter] is between _____ and _____ . (Put the parameter in *context.*)

We have evidence that […], because […]. OR
We do not have evidence that […], because […].

HYPOTHESIS TESTS

Use **hypothesis tests** to **test** H_0 versus H_A at a particular **significance level, α**.

IDENTIFY: Identify the hypotheses and the significance level.

CHOOSE: Choose and name the appropriate test.

CHECK: Check that conditions for the procedure are met.

CALCULATE:

$$\textbf{standardized test statistic} = \frac{\textbf{point estimate} - \textbf{null value}}{\textbf{\textit{SE}}\textbf{ of estimate}}$$

df = (if applicable)
p-value =

CONCLUDE:
p-value < α, so we reject H_0.
We have evidence that [H_A]. (Put H_A in *context.*)
OR
p-value > α, so we do NOT reject H_0.
We do NOT have evidence that [H_A]. (Put H_A in *context.*)

When the parameter is: **a single proportion *p***

CHOOSE: **1-Proportion Z-Interval** to estimate p, or
1-Proportion Z-Test to test $H_0: p = p_0$.

CHECK:
- Data come from a random sample or process.
- for CI: $n\hat{p} \geq 10$ and $n(1-\hat{p}) \geq 10$.
  for Test: $np_0 \geq 10$ and $n(1-p_0) \geq 10$.

CALCULATE: (`1-PropZInt` or `1-PropZTest`)
point estimate: sample proportion $\hat{p}$
***SE* of estimate:** for CI, use $\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$; for Test, use $\sqrt{\frac{p_0(1-p_0)}{n}}$

When the parameter is: **a single mean μ**

CHOOSE: **1-Sample T-Interval** to estimate μ, or
1-Sample T-Test to test $H_0: \mu = \mu_0$.

CHECK:
- Data come from a random sample or process.
- $n \geq 30$, OR population known to be nearly normal, OR population could to be nearly normal because data has no excessive skew or outliers (draw graph).

CALCULATE: (`TInterval` or `T-Test`)
point estimate: sample mean $\bar{x}$
***SE* of estimate**: $\frac{s}{\sqrt{n}}$
$df = n - 1$

When the parameter is: **a difference of proportions p_1-p_2**

CHOOSE: **2-Proportion Z-Interval** to estimate $p_1 - p_2$, or
2-Proportion Z-Test to test $H_0: p_1 = p_2$.

CHECK:
- Data come from 2 independent random samples or 2 randomly assigned treatments.
- $n_1\hat{p}_1 \geq 10,\ n_1(1-\hat{p}_1) \geq 10,$
  $n_2\hat{p}_2 \geq 10,\ n_2(1-\hat{p}_2) \geq 10.$
  Note: use $\hat{p}_c$, the pooled proportion, in place of $\hat{p}_1$ and $\hat{p}_2$ when checking condition for the 2-Proportion Z-Test

CALCULATE: (`2-PropZInt` or `2-PropZTest`)
point estimate: difference of sample proportions $\hat{p}_1 - \hat{p}_2$
***SE* of estimate:**
CI, use $\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$; Test, use $\sqrt{\hat{p}_c(1-\hat{p}_c)}\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$

When the parameter is: **a difference of means μ_1-μ_2**

CHOOSE: **2-Sample T-Interval** to estimate $\mu_1 - \mu_2$, or
2-Sample T-Test to test $H_0: \mu_1 = \mu_2$.

CHECK:
- Data come from 2 independent random samples or 2 randomly assigned treatments.
- $n_1 \geq 30$ and $n_2 \geq 30$, OR *both* populations known to be nearly normal, OR *both* populations could be nearly normal because both data sets have no excessive skew or outliers (draw 2 graphs).

CALCULATE: (`2-SampTInt` or `2-SampTTest`)
point estimate: difference of sample means $\bar{x}_1 - \bar{x}_2$
***SE* of estimate**: $\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$
df: use technology

When the parameter is: **a mean of differences μ_{diff}**

CHOOSE: **1-Sample T-Interval** to estimate μ_{diff}, or
1-Sample T-Test to test H_0: $\mu_{diff} = 0$.

CHECK:

- There is paired data from a random sample or matched pairs experiment.
- $n_{diff} \geq 30$, OR population of differences known to be nearly normal, OR population of differences could be nearly normal because observed differences have no excessive skew or outliers (draw graph of *differences*).

CALCULATE: (`TInterval` or `T-Test`)

point estimate: mean of sample difference $\bar{x}_{diff}$

***SE* of estimate**: $\frac{s_{diff}}{\sqrt{n_{diff}}}$

$df = n_{diff} - 1$

When the parameter is: **the slope β of a regression line**

CHOOSE: **T-Interval for the slope** to estimate β, or
T-Test for the slope to test H_0: $\beta = 0$.

CHECK:

- There is (*x*, *y*) data from a random sample or experiment.
- The residual plot shows no pattern making a linear model reasonable. (More specifically, the residuals should be independent, nearly normal, and have constant standard deviation.)

CALCULATE: (`LinRegTInt` or `LinRegTTest`)

point estimate: sample slope b

***SE* of estimate**: SE of slope (from computer output)

$df = n - 2$

The χ2 tests for categorical variables: **chi-square statistic** $= \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$

When comparing the distribution of **one categorical variable to a fixed/specified population distribution**

CHOOSE: **χ2 Goodness of Fit Test**

CHECK:

- Data come from a random sample or process.
- All expected counts ≥ 5. (To calculate expected counts for each category, multiply the sample size by the expected proportion under H_0.)

CALCULATE: (`χ2GOF-Test`)

$\chi^2 =$

df = # of categories – 1

When comparing the distribution of **a categorical variable across 2 or more populations/treatments**

CHOOSE: **χ2 Test for Homogeneity**

CHECK:

- Data come from 2 or more independent random samples or 2 or more randomly assigned treatments.
- All expected counts ≥ 5. (Calculate expected counts and verify this to be true.)

CALCULATE: (`χ2-Test`, then `2ND MATRIX, EDIT, 2: [B]` to find expected counts)

$\chi^2 =$

df = (# of rows – 1)(# of cols – 1)

When looking for **association or dependence between two categorical variables**

CHOOSE: **χ2 Test for Independence**

CHECK:

- Data come from a random sample or process.
- All expected counts ≥ 5. (Calculate expected counts and verify this to be true.)

CALCULATE: (`χ2-Test`, then `2ND MATRIX, EDIT, 2: [B]` to find expected counts)

$\chi^2 =$

df = (# of rows – 1)(# of cols – 1)