
Research Design

If given a research question, be able to determine each of the following:

- Population,
- Element,
- Data,
- Population parameter,
- Sample,
- Sample statistic.

What is the difference between a convenience sample and a random sample? Which method yields a better sample?

If given a research scenario, be able to determine:

- whether a particular characteristic is a constant or a variable;
- the independent variable;
- the dependent variable;
- an extraneous variable;
- how mathematicians would classify each of the variables (i.e., qualitative or quantitative);
- how behavioral scientists would classify each of the variables (i.e., nominal, ordinal, interval, ratio);
- the research design (experimental, quasi-experimental, observational);
- how to modify the design to control for an extraneous variable;
- give an example of an operational definition for a particular hypothetical construct.

Graphs

- What is the difference between a histogram and a bar chart?
- How does a Scatterplot differ from a histogram?
- If given a boxplot, interpret the graph.

Central Tendency

Sample Mode

- Calculate and interpret the sample mode.
- Be able to determine and interpret the mode from a graph.

Sample Median

- Calculate and interpret the sample median.
- Interpret the SPSS output associated with the sample median.
- Know the characteristics of the median.

Sample Mean

- Calculate and interpret the sample mean.
- Interpret the SPSS output associated with the sample mean.
- Know the characteristics of the sample mean.

What are the relationships among the mean, median, and mode?

Variability

Range, Sample Interquartile Range and Semi-interquartile Range

- Calculate and interpret the IQR.
- Calculate and interpret the SIQR.
- Calculate and interpret the range.

Note. This guide is not comprehensive.

Sample Variance and Standard Deviation

- ❑ Calculate and interpret the standard deviation and variance.
- ❑ Interpret the SPSS output associated with the sample variance and standard deviation.
- ❑ Know their characteristics.

Skewness, Kurtosis

- ❑ Be able to determine whether a particular graph is symmetric, positively skewed, or negatively skewed.
- ❑ Be able to determine whether a particular graph is leptokurtic, mesokurtic, or platykurtic.

Linear Transformations of Data

- ❑ If a constant is added (or subtracted) from all of the scores, how do the mean, standard deviation, and variance change?
- ❑ If all of the scores are multiplied (or divided) by a constant, how do the mean, standard deviation, and variance change?

Z-scores and Normal Distributions

- ❑ Calculate and interpret Z-scores.
- ❑ Know the characteristics of Z-scores.
- ❑ Find the probability associated with a particular range of scores using a Z-score transformation and the standard normal distribution table.

Distribution of Sample Means

- ❑ Explain the four criteria commonly used to evaluate estimators (bias, consistent, efficient, resistant).
- ❑ Be able to describe how the sample mean relates to the population mean (i.e., bias, consistent, efficient, resistant?).
- ❑ Be able to describe how the sample variance relates to the population variance (i.e., bias, consistent, efficient, resistant?).
- ❑ Be able to determine the expected value of the sample mean when given information about the population.
- ❑ Be able to determine the standard error of the sample mean when given information about the population.
- ❑ Be able to determine the shape of the Distribution of the Sample Means.
- ❑ What is the Central Limit Theorem?
- ❑ Find the probability of obtaining a range of sample means using a Z-score transformation and the standard normal distribution table when given information about the population.

Hypothesis Testing

- ❑ How does a hypothesis differ from a theory?
- ❑ Which hypothesis (null or alternative) is tested?
- ❑ Be able to distinguish between a directional and non-directional hypothesis.
- ❑ Be able to determine the appropriate critical value(s) for non-directional hypotheses based on an alpha of .05.
- ❑ Be able to determine the appropriate critical value(s) for directional hypotheses based on an alpha of .05.
- ❑ Be able to determine the appropriate critical value(s) for non-directional hypotheses based on an alpha of .01.
- ❑ Be able to determine the appropriate critical value(s) for directional hypotheses based on an alpha of .01.
- ❑ What is alpha? What are the common alpha levels?
- ❑ What is a type one error? How likely are we to make a type one error?
- ❑ What is a type two error? How likely are we to make a type two error?
- ❑ What is power? What level of power do we want?
- ❑ What methods can be used to increase power? Which method is the best method for increasing power? Why are the other methods for increasing power not 'ideal'?

Note. This guide is not comprehensive.

One Sample Z test

If given a research scenario, be able to use the One Sample Z test to test the null hypothesis.

- Identify the null and alternative hypotheses.
- Identify the alpha level and determine the critical value(s).
- Calculate the statistical test.
- Determine the significance of the statistical test by comparing it to the critical value(s).
- Write a sentence that explains your results. This will be graded for accuracy as well as format.

One Sample t test

- How does the formula for the one sample t test differ from the formula for the one sample Z test?
- What impact does using the sample variance instead of the population variance have on the statistical test?
- How do the standard normal distribution and the t distributions compare?
- What are the assumptions of the one sample t test? If a particular assumption is not true, what effect does this have on the use of the one sample t test?

If given a research scenario, be able to use the One Sample t test to test the null hypothesis by hand.

- Identify the null and alternative hypotheses.
- Identify the alpha level and determine the critical value(s).
- Calculate the statistical test.
- Determine the significance of the statistical test by comparing it to the critical value(s).
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.
- Calculate and interpret the 95% confidence interval associated with the sample mean.

The sentence will be graded for accuracy as well as format.

If given a research scenario, be able to use the One Sample t test to test the null hypothesis based on the SPSS output.

- Identify the null and alternative hypotheses.
- Identify the alpha level.
- Determine the significance of the statistical test by comparing the significance level to the alpha level.
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.

T test for Two Independent Samples—Assuming Equal Population Variances

- When should this test be used?
- What are the assumptions of the test?
- Can the results of the test be trusted if a particular assumption is not true?

If given a research scenario, be able to use the *t* test for two independent samples to test the null hypothesis by hand.

- Identify the null and alternative hypotheses.
- Identify the alpha level, calculate degrees of freedom, and determine the critical value(s).
- Calculate the statistical test.
- Determine the significance of the statistical test by comparing it to the critical value(s).
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.
- Calculate and interpret the 95% confidence interval associated with the sample mean. The sentence will be graded for accuracy as well as format.

If given a research scenario, be able to use the *t* test for two independent samples to test the null hypothesis based on the SPSS output.

- Identify the null and alternative hypotheses.
- Identify the alpha level.

Note. This guide is not comprehensive.

- Determine the significance of the statistical test by comparing the significance level to the alpha level.
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.

Welch T test for Two Independent Samples—Not Assuming Equal Population Variances

- The *Welch t test* is a modification of the *t test* for two independent samples. What modifications are made? Why are the modifications made?
- The *Welch df* cannot be larger than _____.
- The *Welch df* cannot be smaller than _____.
- When should this test be used?
- What are the assumptions of the test?
- Can the results of the test be trusted if a particular assumption is not true?

If given a research scenario, be able to use the *Welch t for two independent samples* to test the null hypothesis by hand.

- Identify the null and alternative hypotheses.
- Identify the alpha level, calculate degrees of freedom, and determine the critical value(s).
- Calculate the statistical test.
- Determine the significance of the statistical test by comparing it to the critical value(s).
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.
- Calculate and interpret the 95% confidence interval associated with the sample mean. The sentence will be graded for accuracy as well as format.

If given a research scenario, be able to use the *Welch t test for two independent samples* to test the null hypothesis based on the SPSS output.

- Identify the null and alternative hypotheses.
- Identify the alpha level.
- Determine the significance of the statistical test by comparing the significance level to the alpha level.
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.

T Test for Two Dependent Samples

- What are the three research designs that would lead to dependence between the two samples?
- Be able to read a scenario and determine whether the research design used would lead to independent data or data that are dependent. If dependent, determine why the data are dependent (i.e., two scores for each person, naturally occurring pairs, or matched on an extraneous variable).
- How do we statistically control for the dependence in the data?
- When should this test be used?
- What are the assumptions of the test?
- Can the results of the test be trusted if a particular assumption is not true?

If given a research scenario, be able to use the *t test* for two dependent samples to test the null hypothesis by hand.

- Identify the null and alternative hypotheses.
- Identify the alpha level, calculate the degrees of freedom, and determine the critical value(s).
- Calculate the statistical test.
- Determine the significance of the statistical test by comparing it to the critical value(s).
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.
- Calculate and interpret the 95% confidence interval associated with the sample mean. The sentence will be graded for accuracy as well as format.

If given a research scenario, be able to use the *t test* for two dependent samples to test the null hypothesis based on the SPSS output.

Note. This guide is not comprehensive.

- Identify the null and alternative hypotheses.
- Identify the alpha level.
- Determine the significance of the statistical test by comparing the significance level to the alpha level.
- Write a sentence that explains your results. The sentence will be graded for accuracy as well as format.

One-way Anova and Pairwise Comparisons

- What are the assumptions of the one-way anova?
- Can the one-way anova results be trusted if a particular assumption is not valid?
- What influences the numerator of the one-way anova F test?
- What influences the denominator of the one-way anova F test?
- What is the expected value of the one-way anova F if the null hypothesis is true?
- What is the expected value of the one-way anova F if the null hypothesis is false?
- When is it appropriate to use a one-way anova?
- Calculate omega-squared.
- What are the three issues associated with conducting pairwise comparisons?
- What are the assumptions of the Tukey HSD procedure?

If given a research scenario, be able to use the one-way anova and Tukey's HSD to test the null hypothesis by hand.

- Identify the null and alternative hypotheses of the one-way anova.
- Identify the alpha level, calculate the degrees of freedom, and determine the critical value(s) for the one-way anova.
- Calculate the one-way anova.
- Determine the significance of the statistical test by comparing it to the critical value(s).
- Calculate and interpret the omega-squared value.
- Calculate Tukey's HSD value.
- Compare the Tukey's HSD value to the differences between each pair of means.
- Write a few sentences that explain your results. The sentences will be graded for accuracy as well as format.

If given a research scenario, be able to use the one-way anova and Tukey's HSD to test the null hypothesis based on the SPSS output.

- Identify the null and alternative hypotheses of the one-way anova.
- Identify the alpha level.
- Determine the significance of the anova by comparing the significance level to the alpha level.
- Calculate and interpret the omega-squared value.
- Determine the significance of the pairwise comparisons.
- Write a few sentences that explain your results. The sentences will be graded for accuracy as well as format.

Correlation/Regression

- What are the null and alternative hypotheses of the correlation coefficient test?
 - What are the possible values of a correlation coefficient?
 - What does the sign of the correlation coefficient tell us?
 - What does the value of the correlation tell use?
 - When is it impossible to calculate the sample correlation?
 - Is the relationship between X and Y influenced by the scales of X and Y?
 - Know each of the factors to consider when using the sample correlation.
 - Know how to interpret the squared correlation.
-
- If a regression analysis is to be performed, know which variable should be X and which should be Y.
 - If given a linear regression equation, be able to predict scores for people.

Note. This guide is not comprehensive.

If given a research scenario with SPSS output, be able to write a few sentences interpreting the output.

- Determine which variable is the dependent variable and which variable is the predictor.
- Identify the descriptive statistics for each variable.
- Identify the correlation and determine whether it is significantly different from 0.
- Identify the linear regression equation.
- Interpret the regression coefficient.
- Identify and interpret the r^2
- Identify and interpret the standard error of the estimate.
- Be able to predict a person's score using the linear regression equation.

If given a research scenario with the following table filled in (i.e., already calculated for you),

| Score | Score minus the Mean | | Score | Score minus the Mean | | X and Y variables |
|----------|-------------------------------------|-------------------------------|----------|-------------------------------------|-------------------------------|--|
| X | $(X - \bar{X})$ | $(X - \bar{X})^2$ | Y | $(Y - \bar{Y})$ | $(Y - \bar{Y})^2$ | $(X - \bar{X})(Y - \bar{Y})$ |
| $\sum X$ | $\sum (X - \bar{X}) = 0$ Always! | $SS_x = \sum (X - \bar{X})^2$ | $\sum Y$ | $\sum (Y - \bar{Y}) = 0$ Always! | $SS_y = \sum (Y - \bar{Y})^2$ | $SP = \sum (X - \bar{X})(Y - \bar{Y})$ |

- Calculate the mean, variance, standard deviation for each variable.
- Calculate the correlation value.
- Determine whether the correlation is significantly different from zero. Write a sentence interpreting the results.
- Calculate and interpret the regression coefficient (slope) of the regression equation.
- Calculate the intercept of the regression equation.
- Write the regression equation.
- Calculate and interpret r^2
- Calculate and interpret the standard error of the estimate (a.k.a., 'average' prediction error).
- Be able to predict a person's score using the linear regression equation.

Chi-square Goodness of Fit

- Know the assumptions of the test.
- Know the null and alternative hypotheses.
- Calculate the expected frequencies for each of the categories.
- Calculate the chi-square test, comparing the observed frequencies to the expected frequencies across all the categories.
- Determine the degrees of freedom and find the critical value.
- Determine the significance of the statistical test.
- Write a sentence or two that interprets the results of the test.
- Be able to write an APA interpretation from SPSS output.

Chi-square Test of Independence

- Know the assumptions of the test.
- Know the null and alternative hypotheses.
- Calculate the expected frequencies for each of the categories.
- Calculate the chi-square test, comparing the observed frequencies to the expected frequencies across all the categories.

Note. This guide is not comprehensive.

- ❑ Determine the degrees of freedom and find the critical value.
- ❑ Determine the significance of the statistical test.
- ❑ Write a sentence or two that interprets the results of the test.
- ❑ Be able to write an APA interpretation from the SPSS output.

Note. This guide is not comprehensive.