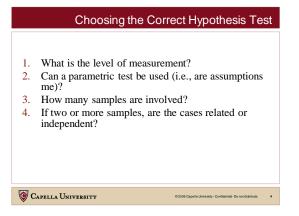


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	Levels of Measurement
Nominal	
Categorical data	
No order or magnitude	
Examples	
Gender	
 Numbers on football jerseys 	
Colors	
 Ordinal Categorical data 	
Order but no magnitude	
Examples	
Highest degree completed	
Letter grade in course	
Likert scale data	
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Parametric vs. NonParametric

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- Parametric tests:
 - · involve parameters (i.e., means, proportions, variances,...)
 - · have assumptions that must be met (e.g., normality, equal
 - variances, ...)
 - · are powerful but sensitive to outliers
 - · use if there is a scale variable
 - ** this should be your first choice if the assumptions can be met **

· Nonparametric tests:

- · assess the population distributions instead of parameters
- · have minimal assumptions
- · are not sensitive to outliers
- · use if data is only nominal and/or ordinal
- · ** there is a nonparametric equivalent for every parametric test **

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One-Sample

· Evaluate a variable for a single group within a population e.g., Test Scores for all students

How Many Samples?

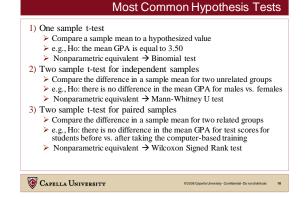
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- Two-Samples
 - · Evaluate a variable for two unrelated groups from a population
 - > e.g., Test Scores for Males vs. Females
- k-Samples
 - · Evaluate a variable for three or more groups from a population

> e.g., Test Scores for Bus. vs. Educ. vs. Psych. students

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Relationship of Groups Independent Membership in one group is not dependent upon membership in another group e.g., attendance for MBA vs. PhD students Related · Membership in one group is linked to membership in another group · pre-test/post-test data (same person under two circumstances) · Same circumstance with two different people (e.g., have two different people appraise same homes) · paired observations (two different people in two different circumstances whose results are paired because they are expected to have similar results if they switched places) CAPELLA UNIVERSITY ©2008 Capella University - Confidential - Do not distribute



Most Common Hypothesis Tests

4) One-Way Analysis of Variance (ANOVA)

- > Compare the difference in a sample mean for 3+ unrelated groups
- e.g., Ho: there is no difference in the mean GPA for Business vs. Education vs. Psychology students
- ➢ Nonparametric equivalent → Kruskal-Wallis H test
- 5) Correlation
 - > Assess the correlation (relationship) between two scale variables
 - > e.g., Ho: there is no relationship between a student's test score vs. the
 - number of hours he/she spent studying for the test.
 - ➢ Nonparametric equivalent → Spearman Rank test
- 6) Chi Square Test of Independence
 - > Test whether two nominal / ordinal variables are independent / unrelated
 - > e.g., Ho: a student's choice of major is independent of his/her gender

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DEMO of the Most Common Hypothesis Tests

- o Let's use a data file reflecting student GPA and comprehensive test scores.
- o The variables included are:
 - > Gender (0 = male, 1 = female)
 - School (1 = business, 2 = education, 3 = psychology, 4 = human svcs)
 Employment status (0 = unemployed, 1 = part-time, 2 = full-time)
 - Age (age in years as of last birthday)

 - > GPA (overall GPA as of the completion of the comps exam) Recommend (1 = would recommend PhD program, 0 = would not)
 - Comps (actual score on the comps exam, on a scale from 10 to 50)
 - P/F score (0 = fail if score is less than 30, 1 = pass if score is 30+)
 - MS-GPA (student's GPA from the Masters level)
- The PhDlearners.sav file consists of 200 fictional student records and can be 0 found on http://www.DrJimMirabella.com/SPS

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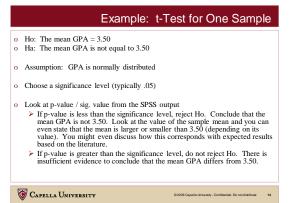
DEMO of the Most Common Hypothesis Tests

Now let's conduct the common hypothesis tests from the prior 0 slides. Here are the steps involved:

- 1. State the hypotheses
- 2. State the assumptions
- 3. Evaluate the assumptions where necessary
- 4. Use SPSS to generate statistical output
- 5. Interpreting all parts of the output
- 6. Reject or Do not reject the null hypothesis
- 7. State your conclusion IN ENGLISH

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Example: t-Test for Independent Samples	
 Ho: The mean GPA for males = mean GPA for females Ha: The mean GPA is different for males vs. females Assumptions: 	o Ho: The me o Ha: The me
 GPAs are independent GPAs are normally distributed Males vs. females are independent of each other GPAs for males vs. GPAs for females have equal variances 	 o Assumption o Look at p-ve ➢ If p-value is differ two san
 Look at p-value / sig. value from the SPSS output If p-value is less than the significance level, reject Ho. Conclude that the mean GPA is different for males vs. females. Look at the value of the two sample means and you can even state which mean GPA is larger. You might even discuss how this corresponds with expected results based on the literature. If p-value is greater than the significance level, do not reject Ho. There is insufficient evidence to conclude that the mean GPA differs by gender. 	decreas with exy ≻ If p-val evidenc the PhD
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Example: t-Test for Paired Samples

- ean PhD GPA = the mean Masters GPA for PhD learners.
- nean PhD GPA does not equal the mean Masters GPA for PhD learners.
- n: GPA is normally distributed
- alue / sig. value from the SPSS output
- lue is less than the significance level, reject Ho. Conclude that the mean GPA rent at the Masters and PhD level for PhD learners. Look at the value of the mple means and you can even state whether a learner's GPA increases or ses from the Masters to the PhD. You might even discuss how this corresponds spected results based on the literature.
- lue is greater than the significance level, do not reject Ho. There is insufficient ce to conclude that the mean GPA changes from a learner's Masters program to) program.

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Example: Correlation

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Example: One-Way Analysis of Variance

- Ho: The mean GPA is the same for learners who are unemployed vs. part-time employees vs. full-time employees.
- Ha: There is a difference in the mean GPA for learners who are unemployed vs. part-time employees vs. full-time employees.
- o Assumptions:
 - > The samples from each employment group are independent
 - > The population of GPAs by employment group are normally distributed
 - > The population variances are equal across the employment groups
- o Look at p-value / sig. value from the SPSS output
 - If p-value is less than the significance level, reject Ho. Conclude that the mean GPA is not equal across the employment groups. Then conduct a Post Hoc test to determine where the specific differences lie.
 - If p-value is greater than the significance level, do not reject Ho. There is insufficient evidence to conclude a difference in the mean GPA across the employment groups. No need to conduct a Post Hoc test.

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Ha: The correlation between a learner's GPA and Comps Score is not equal to 0 GPA and Comps Score are normally distributed

The variance of the GPAs is the same across all Comps Score values
 There is a linear relationship between GPA and Comps Score

Ho: The correlation between a learner's GPA and Comps Score = 0

All observations are independent of each other

Look at p-value / sig. value from the SPSS output

- b) If p-value is less than the significance level, reject Ho. Conclude that there is a correlation between OPA and Comps Score, and so you can predictore's Comps Score from one's GPA. A positive correlation coefficient means that the better the learner's GPA, the lower the Comps Score. You might even discuss how this corresponds with expected results based on the statistic statistics. literature.
- If Ip-value is greater than the significance level, do not reject Ho. There is insufficient evidence to conclude a correlation exists between GPA and Comps Score. If the correlationce/ficient is large, it is likely that your sample is just too small to justify concluding significance exists.

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Example: Chi Square Test of Independence

- o Ho: A student's choice of major is independent of his/her gender.
- o Ha: A student's choice of major is dependent on his/her gender.
- o Assumption: All observations are independent of each other
- o Look at p-value / sig. value from the SPSS output
 - If p-value is less than the significance level, reject Ho. Conclude that one's choice of major depends on one's gender, so a male is likely to make a different choice than a female. Look at the crosstabulation to see the patterns and discuss more specifically. You might even discuss how this corresponds with expected results based on the literature.
 - If p-value is greater than the significance level, do not reject Ho. There is insufficient evidence to conclude that one's choice of major depends on one's gender (i.e., that males and females choose their majors differently).

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Parting Tips
If you cannot meet the assumptions for a test, do not hesitate to use a nonparametric equivalent.
In the nonparametric test, do not use "means" in your hypothesis as you are no longer testing a population parameter. Just hypothesize about differences in the populations.
If you fail to reject the null, NEVER accept the null → you can never prove the null is true.
If you fail to reject the null by a small margin, it is not "almost significant". Likewise, if you reject the null with a very small p-value, it is not highly

- significant. Findings are either significant or not significant.
 Do not make excuses for failing to reject the null. It is okay to suggest further research with a larger sample, but you have proven nothing, so don't make positive statements about results that aren't there.
- Don't overstate your results. You can only draw inferences to the population being tested and only in regards to the variables tested.

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Session Objectives

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Recap: After attending this session you are able to:

- \checkmark Learn how to recognize the appropriate hypothesis test to run.
- ✓ Explore the many graphical and statistical options in the SPSS menu that you can use to conduct the appropriate hypothesis test correctly
- ✓ Learn how to interpret the SPSS output and make decisions in regards to the hypothesis test.
- ✓ Understand ways to draw conclusions in layman's terms at the conclusion of a hypothesis test

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