# Understanding Statistical Inferences

Chapter 10, pt 1



# Discussion Topics

- Inferential statistics
  - Purpose
  - Error
  - Terminology
  - Hypothesis testing
- Inferential tests
- Effect size



# Purpose of Inferential Statistics

- The purpose of inferential statistics is to draw inferences about a population on the basis of an estimate from a sample
- Inferential statistics - specific statistical procedures that accomplish this purpose
- The ultimate goal is to draw accurate conclusions about the population



# Estimating Error

- Two types of errors
  - Sampling error
    - Without measuring the entire population, the results can be inaccurate due to sampling error
      - The larger the proportion of the population that is sampled, the lower the sampling error; the smaller the proportion of the population that is sampled, the higher the sampling error
      - A sample of 99% of a population is likely to show results that are very, very similar to those that would have been found if everyone in the population was measured
      - A sample of 1% is likely to show results that are different from those in the population - the question is how different are the sample results
    - Need to estimate the level of sampling error relative to the inferences being drawn



# Estimating Error

- Measurement Error
- Regardless of the sample size, the results can be inaccurate due to measurement error
  - Lack of validity
  - Lack of reliability
- Need to estimate the level of measurement error relative to the inferences being drawn



# Terminology

- Null hypothesis
  - No differences between groups
  - No relationships between variables
- Level of significance
  - Probability of being wrong in rejecting the null hypothesis
  - Known as *alpha,* symbolized by p
- Types of errors
  - Type I - reject the null hypothesis when it is true
    - My study shows a difference or a relationship when this is not true in the population
  - Type II - do not reject the null hypothesis when it is not true
    - My study shows no difference or no relationship when there really is one in the population



# Type I and Type II Error

| | | TRUTH | |
|---|---|---|---|
| | | Do Not Reject | Reject |
| Current Study | Reject | Type I error | No error |
| | Do Not Reject | No error | Type II error |



# 5 Steps of Hypothesis Testing

- An experimental control group comparison
  - State the null hypothesis - no difference between the mean scores for the experimental and control groups
  - Assume the null hypothesis is true
  - Calculate the observed difference between the mean scores for the two groups
  - Determine if this difference is statistically significant
  - Reject  or do not reject the null hypothesis
    - If the observed difference is not statistically significant, the null hypothesis is likely true and it is not rejected
    - If the observed difference is statistically significant, the null hypothesis is likely untrue and it is rejected.



# Statistical Significance

- Statistical significance
  - The comparison of the observed difference between the groups can be estimated using statistical theory
    - The estimate is the probability of being wrong in rejecting the null hypothesis
    - It is stated as $p = x$ where $x$ is the specific probability of the comparison (e.g., $p = .001$, $p = .042$, $p = .56$)
    - p = .001 means in rejecting the null hypothesis I will be wrong 1 time out of 1000 times
    - p = .05 means in rejecting the null hypothesis I will be wrong 5 time out of 100 times



# Statistical Significance

- Whenever we obtain a p value of .05 or LESS (i.e., .04, .01, .001) we reject the null hypothesis, it is statistically significant
- Whenever we obtain a p value greater than .05 (i.e. .06, .10) we do not reject the null hypothesis, it is not statistically significant
- This is the arbitrary threshold we have set. We are not willing to be wrong more than 5 times out of 100 when saying that we have found something effective.



# Factors Affecting the Level of Significance

- The actual differences between the groups
  - Very small differences are hard to find, thus we may not reject when we should
  - Larger differences are easier to find, accuracy in rejecting the null is greater
- Sampling and measurement errors
  - Larger the error more likely to over- or underestimate level of significance
- The size of the sample
  - Larger the sample the smaller the difference needed to be significant, smaller the sample the larger the difference needed to be significant