

STAT 500

Summary of Methods for Two Samples

Two-sample inference procedures

- Randomization (permutation) test
- t-test
- Welch test
- Data transformations to promote normality and homogeneous variances
- Wilcoxon rank sum test
- Confidence intervals

Choosing Statistical Procedures

- Search for a reasonable analysis: “Correct” analysis unknown
 - depends on unknown characteristics of the population
- Learn about the science and method of data collection to identify test assumptions that are reasonable
- Carefully consider all analyses: graphical, numerical, etc. in determining whether or not assumptions are reasonably met.

Choosing Statistical Procedures

- Some analyses are wrong.
 - Assume independence when observations are not independent
 - Answer the wrong question (e.g. compare means when you should have compared variances)
 - Select a test because it has the smallest p-value (Tests of hypotheses should be specified before the data is collected)
- Small sample sizes provide little information about characteristics of the populations (little information for assessing model assumptions)

Choosing Statistical Procedures

- Use the most simple and familiar procedures that are suitable. Only use more complex procedures if the improvement in accuracy of estimation or power of a test is substantial
- Maintain consistency if possible: Within a manuscript try to handle all analyses in the same way.
- Different types of analyses may reveal different features of the data (and populations)

Choosing Statistical Procedures

- Sometimes several model assumptions are simultaneously violated, and they can be improved with the same data transformation.
- For example, treatment effects on a biological process may be multiplicative and the response populations are skewed and have unequal variances. Both violations may be addressed with a log-transformation.
- The log transformation is not the only possibility, but it frequently works for biological data.

Choosing Statistical Procedures

- Use a t-test (confidence interval) with a pooled estimate of a common variance to compare two means, unless there are reasons to do something else.
- Often best to design the study with equal sample sizes
- Use t-test with pooled variance after data transformation if
 - Data indicate skewness and unequal variances
 - Want to make an inference about a multiplicative effect (transform to a log scale)
 - An appropriate transformation can be found
- Use a t-test (CI) with unequal variances if a good variance stabilizing transformation cannot be found

Choosing Statistical Procedures

- Use a nonparametric test or randomization test if
 - No obvious transformation
 - Comparing means is not meaningful because of potential outliers, or other issues
- Construct confidence intervals using permutation or re-sampling methods
- Use the method that gives the clearest inference for the scientific question and is not misleading. Often several methods yield the same inference.