Intro to Stats

Significance Testing

Hypothesis Test

- A statistical method that uses sample data to evaluate a hypothesis about a population

- 1. State a hypothesis
- 2. Use the hypothesis to predict the characteristics the sample should have
- 3. Obtain a random sample from the population
- 4. Compare the obtained sample data with the prediction made from the hypothesis

"Significant"

- Suggests that the difference or relationship is systematic and not due to chance
- A significance level gives the risk that the effect is due to chance
- At $p < .05$, there is about a 5% (5/100) chance that an effect just happened in a normal distribution and is not related to any other variable

Qualifying factors

- The size between the sample mean and the original population mean
- The variability of scores
- The number of scores in the sample

Assumptions Made

- We make certain assumptions about the impact of the methods used to obtain the data sample
- Random sampling
  - That the sample represents the population
- Independent observations
  - The first measurement has no relationship to the probability of the second measurement
- The value of variability is unchanged by the treatment
  - In most hypothesis-testing situations, we do not have the "original" population variability
- A normal distribution

Never Sure

- Researchers can never be sure that their hypothesis is "true"
  - Sample may not perfectly reflect the population
  - Other influences (confounds) may cause the results
  - It just might be one of those few chances
- These concerns are lessened every time that a finding is replicated

Can lead to errors

- The null is rejected, but there really is no effect (Type I error)
- Or the null is accepted, but there really is an effect (Type II error)

Never Sure 2

- Never know the truth about the null hypothesis
- The likelihood of a Type I error is defined by the level of significance
  - $p < .05$ means there is a 5% chance of rejecting the null when the null is true (conclude there is a difference when there is none)
- Type II error is related to power and sample size

Effect sizes

- Rather than rely on hypothesis testing, some researchers have suggested using effect sizes
  - Most hypothesis tests simply state that a finding is UNLIKELY (or not)
  - Significance does not mean it's important
  - Effect sizes give a way to capture the SIZE of an effect and make stronger statements about the relationship
  - This also sidesteps issues of power
    - Power is strongly linked to sample size and therefore effects may be underestimated in small samples and overestimated in large samples

Significance vs. Meaning

- Studies may show significant differences but the differences may not be meaningful
  - Small differences in large samples
  - Small differences that come with a large cost
- Studies may not show significance but the differences may be meaningful
  - Small differences in small samples
  - Small differences that come with a big benefit and little cost

Inferential Statistics

- Inferences made about the population based on a sample
- Which test determined by
  - Continuous vs. categorical variables
  - Number of variables
  - Whether variables vary between subjects or within subjects

*Your book has a useful chart

Setting the Stage

- 1. State the null hypothesis
- 2. Set the level of risk (usually .05)
- 3. Select the appropriate test statistic
- 4. Compute the test statistic
- 5. Determine the critical value for rejection of the null
- 6. Determine whether the statistic exceeds the critical value (usually at $p < .05$)
- 7&8. If over the critical value, the null hypothesis is unlikely THEREFORE effect must be due to other variable
- If not over the critical value, the null is accepted
- INTERPRET

One-sample z-tests

- One-sample z-tests are inferential statistics that allow you to compare a mean from a sample to the average of a population.

Calculating

$$Z = \frac{\overline{X} - \mu}{SEM}$$

X = mean of sample
M = population average
SEM = standard error of the mean

SEM = σ/square root of n
σ = standard deviation for the population
n = size of the sample