Announcements

- One Handout Today
- HOMEWORK 4 IS DUE TODAY
- HOMEWORK 5 IS UP FRONT, PLEASE PICK ONE UP
- Unclaimed exams & homeworks (1 & 2) are up front
- Did you accidently pick up an exam that wasn't yours? Please return it to the front table, no questions asked.
- No Lecture Friday 11/12/04

Chapter 20: Recall Hypothesis Testing

- State a Null Hypothesis it suggests that any deviations from the parameter are just due to chance
- State an Alternative this is usually what a researcher is setting out to prove. It suggests that deviations from the parameter are not due to chance but that the value give to the parameter is incorrect.
- Perform a Test this is a "Z" test and it is interpreted as the number of standard deviations (of the sampling distribution) the particular sample outcome is from the parameter.
- Find the p-value (probability value) using the Z score that resulted from the test, look up the "tail" area of the normal distribution.

4. The ultimate result of the Z-test is called a P-VALUE (probability value). This is the chance (probability, area under the curve) of getting results (our Z score) as or more extreme than what we got, IF the null hypothesis were true. So a .57 is +2.00 Z scores away from a .47. So how far is that? One checks the area under the curve that is as extreme or more extreme than the result of the Z-test, so the P-VALUE (area) at +2.00 and beyond is .0228 (or 2.28%)

Last Step: Interpretation

- P-VALUE can be interpreted as an "observed significance level" and it is simply the "tail" area associated with the Z score calculated using the sample information and parameter information.
- P-VALUES can be interpreted as "if-then" statements:
 - "If the null hypothesis were true, then there would be a "p value" chance of getting these kind of results from a single sample."
 - The less probable (low probability) an outcome is, the stronger the evidence that we would reject the null in favor of the alternative.
- So we might conclude that "a p-value of .0228 suggests that MS patients who used marijuana experience more pain relief than those who do not (.57 vs. .47)"

Hypothesis Testing Summarized

- · Clearly identify the parameter and the statistic
- State the null hypothesis. This is what is being tested. A test of significance assesses the strength of evidence (outcomes) against the null hypothesis. Usually the null hypothesis is a statement of "noeffect" or "no difference" and it is ALWAYS a statement about the parameter.
- The alternative hypothesis is a restatement of the parameter in the direction of your evidence (sample). Note this is a ONE-SIDED alternative because you are only interested in deviations in one direction.
- Choose an appropriate test. In the above example, the parameter is the
 population proportion and the outcome is the sample proportion and
 the appropriate test-statistic is Z.
- The probability that results from the test is called a P-VALUE and that is the tail area associated with the resulting Z score. The smaller the pvalue the stronger is the evidence against the null hypothesis.

Concepts from Chapter 21

- The p-value is NOT the probability that the null is false, it is not the probability that it is true either.
- When a p-value is small, this suggests that our sample statistic was rare GIVEN the null hypothesis.
- We arbitrarily determine what is rare. If a sample statistic has a pvalue below some threshold called an ALPHA LEVEL, we consider it "rare" and rare results are called "STATISTICALLY SIGNIFICANT"
 - Alpha levels are typically .01, .05 and .10 and it's symbol is α.
 - An alpha level of .05 is usually the most commonly used.
- In our example in the last lecture, the p-value was less than .05
 and if our alpha level was .05 we would conclude that that the
 marijuana treatment of persons with MS was statistically
 significant. This means that you have sufficient evidence to
 REJECT THE NULL (we don't say accept) in favor of the
 ALTERNATIVE HYPOTHESIS and this suggests that the patients
 using marijuana are experience more pain relief that patients on
 more traditional treatments.

Interpretation, One More Time

- Given a p-value of .0228 and a standard alpha of .05 we would conclude that the difference between .57 and .47 is "statistically significant" meaning that MS patients who use marijuana experience less pain.
- Statistical Significance
 - All it means is that the p-value which results from the test is smaller than some arbitrary alpha (e.g. .0228 < .05)
 - Significance does not mean "important". Just means different.
 - Significance does not mean that the null is wrong, it just means that the evidence is in favor of the alternative. (We call rejecting a correct null a "Type I Error")
 - A large sample size can make the tiniest difference statistically significant.