Hypothesis Testing I

Fall 2012

Hypothesis Testing

- Hypothesis testing is a decision making process for evaluating claims about a population.

- The researcher must:
  - Define the population under study
  - State the hypothesis that is under investigation
  - Give the significance level
  - Select a sample from the population
  - Collect the data
  - Perform the statistical test
  - Reach a conclusion

Population and Samples

Give at least three examples of a population
1.
2.
3.

For the population listed in 1., give an example of a sample from the population

Can you make up some hypothesis about the population in 1.

Hypothesis Tests

- Examples of hypothesis tests include t-test, Chi-Square, and correlation analysis to name a few

- My goal is to give you enough information to use SPSS to perform some different hypothesis tests without getting into the nitty-gritty detail. To use this tool properly, you must have a statistics background; otherwise, chances are very good that an incorrect test can be applied to a given set of data.

Hypothesis Testing

- Hypothesis testing is the formal statistical technique of collecting data to answer questions through the use of a statistical model.

- "In statistics, a result is called **statistically significant** if it is unlikely to have occurred by chance alone, according to a pre-determined threshold probability, the **significance level**."

    http://en.wikipedia.org/wiki/Statistical_hypothesis_testing

The Normal Distribution

- The following Hypothesis Tests assume that the data is normally distributed. Arrrgh. What does this mean?

- The standard normal curve in the picture has a mean of 0 and standard deviation of 1. A dataset with a normal distribution has about 68% of the observations within σ of the mean μ which in this case is (-1,1)

http://www.stat.yale.edu/Courses/1997-98/101/normal.htm
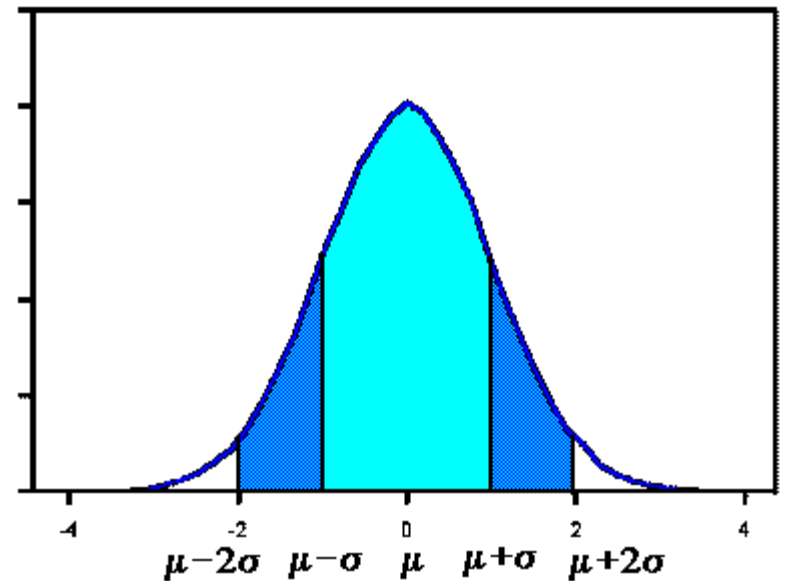
The Normal Distribution Continued

- About 95% of the observations will fall within 2 standard deviations of the mean (-2,2)

- About 99.7% of the observations will fall within 3 standard deviations of the mean

- Example: Consider 130 observations of body temperature with the results below. If the data is normal, what must be the case?

```
Variable       N     Mean    Median   StDev   Min      Max
BODY TEMP     130   98.249   98.300   0.733   96.300  100.800
```

One-Sample T-Test

- This is the easiest of the statistical tests to understand

- Specifically, this test compares an *observed mean* (computed from a set of observed values) to a *hypothesized mean* and determines the likelihood that the difference between the means occurs by chance

- The chance is reported as the p-value

p-value

- The p-value measures the probability that the difference we see between the hypothesized mean and sample mean occurs due to chance
  - A small p-value means that the difference is unlikely to be the result of chance
  - A large p-value means the difference is likely to be the result of chance
- What do we mean by random chance? Keep this question in mind and we will come back and give an answer.

Statistically Significant Difference

- The lower the p-value, the more certain that we can be that there is a **statistically significant** difference between the observed and hypothesized mean

- Most disciplines look for a p-value of 0.05 or less; that is, if the p-value is less than 0.05 then the difference is regarded as statistically significant.
  - if $p < 0.05$, reject the null hypothesis
  - if $p >= 0.05$, accept the null hypothesis

Problem 11.1

The file LipidData in the CS130 Public directory represents a blood lipid screening of medical students.

1. Grab this Excel file, open it up in SPSS and save the file as lipiddata.sav.
2. What is the mean Cholesterol value?
3. Is the cholesterol level significantly greater than 190? Can you tell by looking at the data? What do you think?

Problem 11.1 Continued

- Our first objective is to perform a one-sample t-test on data from blood lipid screening of medical students. Specifically, we will test whether the mean cholesterol level is greater than 190 in a *statistically significant* way, the point at which cholesterol levels may be unhealthy.

What is the NULL Hypothesis?

Problem 11.1 Continued

1. Open Lipid Data.
2. From the Analyze menu, select Compare Means and then One Sample t-test .
3. Select your Test Variable which is Cholesterol .
4. Enter the Test Value which is 190.
5. In the variable browser, select Cholesterol and click ADD

Problem 11.1 Results

- The p-value is given in the box labeled Sig. (2-tailed) which stands for significance level

One-Sample Test

	Test Value = 190				95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Cholesterol	.336	94	.737	1.23158	-6.0356	8.4988

Problem 11.1 Results

1. The mean is slightly higher than 190; however, this difference is well within the range of sampling variance.

2. A significance level of .737 indicates you would see a difference of this magnitude by chance more than 73% of the time

3. Thus the cholesterol level is not significantly greater than 190

Paired T-Test

- The most common use of the paired t-test is the comparison of two measurements (typically one measurement occurs "before" a treatment and the other "after" a treatment from the **<u>same</u>** individual or group.

- This test can determine if the treatment had a statistically significant effect.

- The p-value is the primary statistic of concern and the interpretation of the p-value is the same as for the one-sample t-test

Problem 11.2

- Using the LipidData

  1. What is the mean for Triglycerides?

  2. What is the mean for Trig-3yrs?

  3. Does it look like there is a statistically significant difference between Triglycerides and Trig-3yrs?

Problem 11.2 Continued

- Perform the paired t-test using the LipidData file

- State the Null Hypothesis

- From Analyze menu, select Compare Means and then Paired Samples t-test

- Should we accept the Null Hypothesis? Why?

- State your conclusion