Hypothesis Testing I

Spring 2011

Hypothesis Testing: Can we show a difference?

- 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

Hypothesis Tests

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

- CS130: give you enough information to use PASW to perform some different hypothesis tests
- You must have a statistics background
- Possible to apply wrong test to data
  - Invalid results

Hypothesis Testing

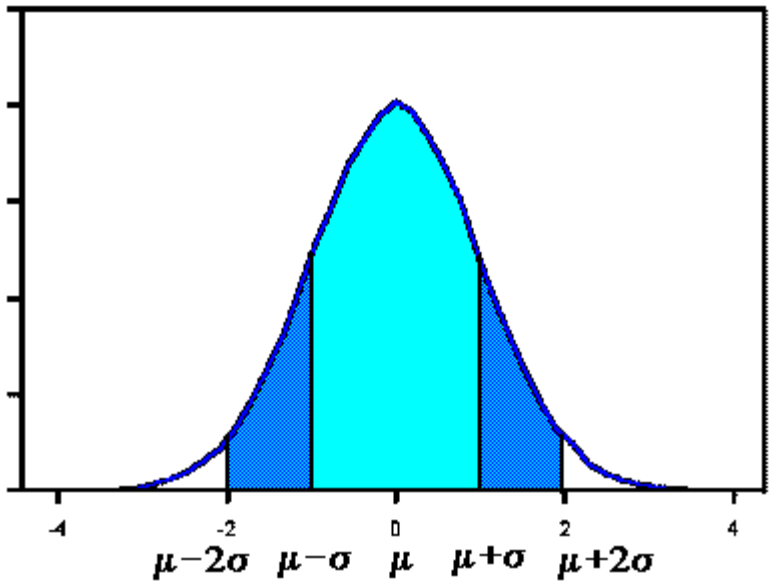
- Hypothesis testing is the formal statistical technique of analysing data to answer questions through the use of a statistical model.

- "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.
- 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 less than 0.05
- If the p-value < 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 PASW and save the file as lipiddata.sav.
2. What is the mean Cholesterol value?
3. Is the cholesterol level significantly different than 190? Can you tell by looking at the data? What do you think?

Problem 11.1 Continued

- One-sample t-test
- Test whether the mean cholesterol level is different than 190 in a *statistically significant* way
  - 190 is 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					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the 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

1. Thus the cholesterol level is not significantly different than 190

Paired T-Test

- Comparison of two measurements
  - From the same individual
  - Before and after a treatment (experiment)
- 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