



# Hypothesis Testing I

Spring 2013

# Hypothesis Testing

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- 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

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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

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- Examples of hypothesis tests include t-test, Chi-Square, and correlation analysis to name a few
- To use this tool properly, you must have a statistics background
- Applying an incorrect test to a given set of data will give incorrect results

# Hypothesis Testing

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- 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**.”

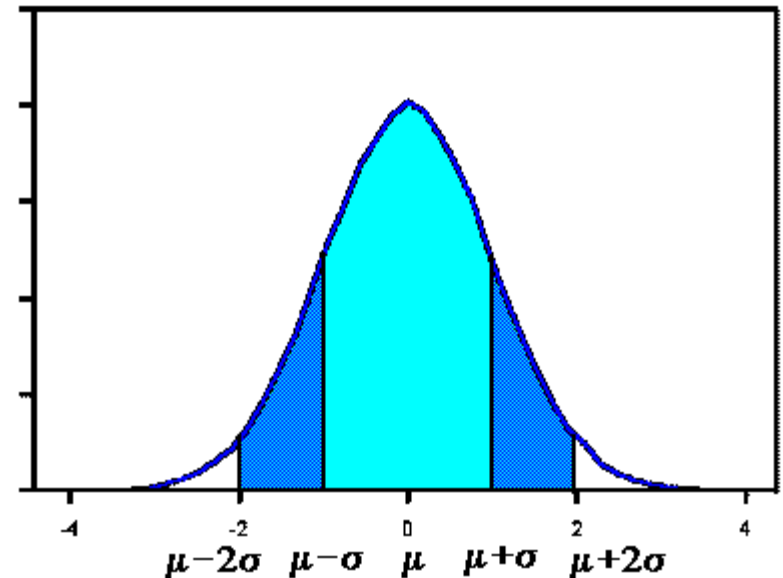
[http://en.wikipedia.org/wiki/Statistical\\_hypothesis\\_testing](http://en.wikipedia.org/wiki/Statistical_hypothesis_testing)

# NULL Hypothesis

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# 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  $\sigma$  of the mean  $\mu$  which in this case is  $(-1,1)$



<http://www.stat.yale.edu/Courses/1997-98/101/normal.htm>

# The Normal Distribution Continued

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- 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?

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Median</b>	<b>StDev</b>	<b>Min</b>	<b>Max</b>
<b>BODY TEMP</b>	<b>130</b>	<b>98.249</b>	<b>98.300</b>	<b>0.733</b>	<b>96.300</b>	<b>100.800</b>



# One-Sample T-Test

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- This is the easiest of the statistical tests to understand
- Compare **observed** vs **hypothesized** mean
  - Observed: measured
  - Hypothesized: we choose this value to be meaningful
- T Test determines the likelihood that the difference between the means occurs by chance
- The chance is reported as the p-value

# p-value

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- p-value: the probability that the difference 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

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- The lower the p-value, the more certain that we can be that there is a **statistically significant** difference
- Most disciplines look for a p-value of 0.05 or less
  - if  $p < 0.05$ , reject the null hypothesis
  - if  $p \geq 0.05$ , accept the null hypothesis

# Problem 11.1

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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

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- 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

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1. Open Lipid Data.
2. From the Analyse 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

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- 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

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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 greater than 190



# Paired T-Test

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- 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 **same** 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

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- 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

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- 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