HSCC 470
Research Methods and Data Analysis in Health Sciences

Hypothesis Testing II:
Inferential Statistics continued

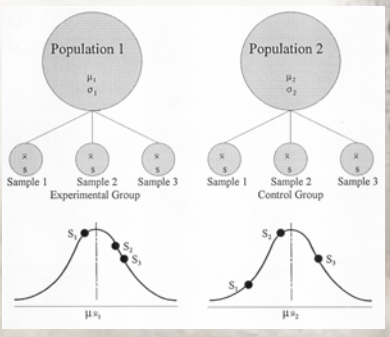
Unit Objectives

- **Upon completion of this unit, the student will be able to:**
  - Describe in general terms the process of hypothesis testing
  - Distinguish between the null and alternative hypothesis
  - Discuss the meaning of "alpha" and "beta"
  - Compare and Contrast Type I and Type II errors
  - Discuss the significance of the "p value"
  - Compare and contrast statistical significance and clinical significance

Null and Alternative Hypotheses

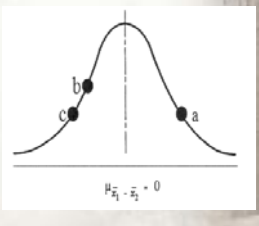
- **Null (H_0) – the hypothesis that there is no difference between the groups being compared, with respect to the measured variable**
- **Alternative (H_a) – the hypothesis that a difference does exist between the groups being compared**
- **Example**
  - H_0 There is no difference in the CPR survival rate between patients receiving amiodorone and those receiving lidocaine.
  - H_a There is a difference in the CPR survival rate between patients receiving amiodorone and those receiving lidocaine.

Sampling Distribution of the Mean



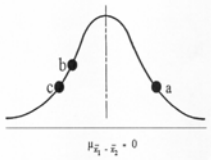
Standard Error of the Mean

- **SEM is the measure of dispersion for a sampling distribution.**
- **"standard deviation of the mean of sample means"**



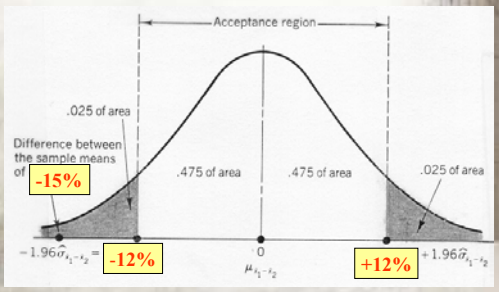
Sampling Distribution of the Difference Between 2 Sample Means

Samples from Population 1		Samples from Population 2		difference
$\bar{x}_1$	-	$\bar{x}_2$	=	a
$\bar{x}_1$	-	$\bar{x}_2$	=	b
$\bar{x}_1$	-	$\bar{x}_2$	=	c
$\bar{x}_1$	-	$\bar{x}_2$	=	*n*



The sampling distribution of the difference between sample means.

Determine Acceptance Region



P value

- **The probability of obtaining a test statistic as large or larger than the one computed fro the data when in reality there is no difference between the different treatments.**
- **The P value is the probability of being wrong when asserting that a true difference exists.**

Standard Alpha Levels

- **Typical alpha levels in medical research are 0.01, 0.05, 0.1.**
- **When we compute a p value for the observed difference between our experimental and control sample data less than or equal to the alpha level, we reject the null hypothesis and conclude there is a true difference.**

Type I and Type II Errors

Conclude from Observations	Actual Situation: Treatment has an Effect	Actual Situation: Treatment has No Effect
Treatment has an Effect	True Positive, correct conclusion	False Positive, Type I Error
Treatment has no Effect	False Negative, Type II error	True Negative, correct conclusion

- **Type I Error**
  - Alpha (α)
  - Risk of rejecting the null hypothesis when it is actually true.
  - We conclude there is a treatment effect when none exists.
- **Type II Error**
  - Beta (β)
  - Risk of accepting the null hypothesis when it is actually false.
  - We conclude there is not a treatment effect when there actually is.

Example

- **Hypotheses**
  - H_0 - Pediatric patients receiving prehospital ETI and BVT ventilations are ***no more likely*** to survive cardiac arrest than those receiving BVM ventilations alone.
  - H_a - Pediatric patients receiving prehospital ETI and BVT ventilations are ***more likely*** to survive cardiac arrest than those receiving BVM ventilations alone.

Example continued

- **Collect data on survivors for both experimental (ETI and BVM) group and control (BVM only) group.**
- **Establish alpha level ($\alpha = 0.05$)**
- **Measure differences in survivors between experimental and control group.**
- **Calculate P value for observed difference between experimental and control group.**
- **If P value less than alpha, reject the null hypothesis: conclude that there is a difference in survivability.**
- **If P value is greater than alpha, accept the null hypothesis: conclude that there is no difference in survivability.**

Statistical vs. Clinical Significance

- **Very small P values ≠ "highly significant findings"**
- **Statistically significant findings may be clinically unimportant**
  - Small treatment effect
  - Few patients will benefit
  - Treatment is more problematic than the disease
- **Differences that are not statistically significant are not necessarily unimportant**
  - May be due to small sample size