Understand that valid statistical conclusions are based on randomly selected, representative samples of the population. That is to say, if the sample is not representative of the population, then all bets are off.

Understand the caveats that statistical conclusions are based on the sample data and the level of significance. That is to say, if we were to use a different sample and/or a different level of significance, then we might arrive at a different conclusion regarding the hypotheses.

Be able to apply hypothesis testing for ***Two Sample*** Testing both ***Dependent* and *Independent* Samples**.

Two Sample Dependent

Paired *t*-test (same subjects measured twice {Example: *Pre & Post Testing* and *Different Instruments*}).

Two Sample Independent (H_0: $\mu_1 = \mu_2$) for both cases where population variances are known and unknown.

Test for Equal Variances

Test for Unequal Variances

State the Claim
State the Null & Alternate Hypotheses
Type of Test, Number of Tails, Degrees of Freedom
Determine Critical Value
Calculate Test Value
Conclusion Regarding the Null Hypothesis
Conclusion Regarding the Alternate Hypothesis
Conclusion Regarding the Claim

For any problems dealing with hypothesis testing: you must be able to correctly
- state both the null hypothesis and the alternate hypothesis;
- determine the appropriate critical value(s);
- calculate the pertinent test statistic;
- decide whether to "Reject the Null" or to "Fail to Reject the Null";
- draw a proper conclusion about the problem specifics based on your decision regarding the null hypothesis.

Remember "Reject the Null" is a strong conclusion.
In general, "Fail to Reject the Null" is at its best, a suggestion that there is *insufficient evidence to warrant rejecting H_0*, or equivalently, *insufficient evidence to warrant accepting H_1*.

Two-Sample Hypothesis Testing examples of conclusions in cases where we failed to reject the null hypothesis:

if H_1: $\mu_1 \neq \mu_2$, then an appropriate statement would be "insufficient evidence to say $\mu_1 \neq \mu_2$".
if H_1: $\mu_1 < \mu_2$, then an appropriate statement would be "insufficient evidence to say $\mu_1 < \mu_2$".
if H_1: $\mu_1 > \mu_2$, then an appropriate statement would be "insufficient evidence to say $\mu_1 > \mu_2$".

Be mindful that hypotheses are assumptions about population parameters and that conclusions are not facts but only suppositions with some associated degree of confidence. We can never know whether the null hypothesis is true or false and therefore we risk encountering either a Type I or a Type II Error regardless of how carefully we conducted the experiment and how diligently we collected the data

Define *Type I Error, Type II Error, Power of the Test.*
Describe the effect of changing the *Level of Significance* has on both the *Probability of Type I & Type II Errors*.
Know the definition and application of *p-value s* (it will not be necessary to calculate p-values).

For the test, you will be given the sample size, mean, and standard deviation as needed;
you will not be required to calculate these sample statistics.
You may use one page of your own generated notes and appropriate tables from the textbook as needed.
You must have your own calculators, notes, and tables, no sharing!
Cell phones use is NOT permitted during the test and must be out of sight.

Practice Review Problems: (Use α = 5% for all problems. It is not necessary to calculate any p-values.)

Homework #7 Two Sample Hypothesis Testing

Example Problems and Questions from Previous Exams (see page 2).

Questions *(Check out the correct answers at Recitations)*

1. Define
   Type I Error
   Type II Error

2. Type I and Type II Errors:
   T / F Increasing the Level of Significance increases the probability of a Type I Error.
   T / F Decreasing the Level of Significance increases the probability of a Type II Error.
   T / F *Rejecting the Null Hypothesis* is logically equivalent to *Accepting the Alternate Hypothesis*.
   T / F *Failing to Reject the Null Hypothesis* may lead to Type Two Errors.
   T / F Figures never lie, but liars sometimes figure.

Two Sample Hypothesis Testing

1. **Dependent (Paired-t Test)**
Two different analytical procedures were used to determine the impurity levels in well water.
Fifteen specimens were tested using each procedure. The data is shown in the table below.
The average difference between the two procedures is 26.87, with a standard deviation of the differences of 19.04.
Based on the sample data, is there sufficient evidence to conclude that the procedures produced significantly different results? Note: Use a two-tailed test, $\alpha = 5\%$.

Specimen	Procedure 1	Procedure 2	Difference
1	265	229	36
2	240	231	9
3	258	227	31
4	295	240	55
5	251	238	13
6	245	241	4
7	287	234	53
8	314	256	58
9	260	247	13
10	279	239	40
11	283	246	37
12	240	218	22
13	238	219	19
14	225	226	-1
15	247	233	14

2. **Independent**
Test the data from two independent samples to determine whether or not their means are significantly different.
Assume equal variances; use Level of Significance $\alpha = 0.05$

$X_1 = 91.0$ $X_2 = 92.2$ $Sp = 3.42$
$s_1 = 8.74$ $s_2 = 12.2$
$n_1 = 10$ $n_2 = 10$