

## Comparing Two Populations, 2

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BUS 301: Int. Bus. Stats  
Lebanese American University

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### Overview

## Today's Lecture

- Quiz 1 graded, average 81, will return it when all students have taken the exam.
- Assignment 4 assigned, Due 13 November
- Overview of Ch. 13
- Examples, Testing Means Unpaired, Two Populations (13.1)
- Experiment v. Observation (13.2)
- Paired Population (13.3)
- Required Conditions

Announcement: We will extend class by 10 minutes each day (6, 8, 11, 13); No class on 15.

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### Assignment 4

## Assignment 4, due at the START of class, 13 November

- 1 13.24 (Show your work)
- 2 13.47
- 3 13.55
- 4 13.59 (You will need to use the data sets from blackboard for this.)
- 5 13.81

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### Exercise 1: Comparing the total exam score between types

After comparing question by question, I also compare across the total exam scores. Here's the data, work with a partner and tell me if the exam was fair across the two different versions.

	Mean	Std. Dev.	n
Exam Type 1	77.97	16.12	19
Exam Type 2	84.14	13.79	19

Note,  $F_{\alpha/2, \nu_1, \nu_2} = F_{.025, 18, 18} = 2.596$  and  $F_{1-\alpha/2, \nu_1, \nu_2} = F_{.975, 18, 18} = .385$   
 HELPFUL EQUATIONS:

**Equal variance:**

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{s_p^2 \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

$$\nu = n_1 + n_2 - 2.$$

**Unequal variance:**

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$\nu = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}.$$

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### Exercise 2: Example 13.4 from book

The book poses an interesting question about the relative value of the marketing versus finance majors within an MBA. Specifically, they exam the highest salary offers given to each type of major at the school and then seek to determine if finance majors get higher offers. The relevant data is as follows:

Major	Mean	Variance	n
Finance	65,438	444,981,810	25
Marketing	60,373	469,441,785	25

Note,  $F_{\alpha/2, \nu_1, \nu_2} = F_{.025, 24, 24} = 2.27$  and  $F_{1-\alpha/2, \nu_1, \nu_2} = F_{.975, 24, 24} = .44$   
 HELPFUL EQUATIONS:

**Equal variance:**

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{s_p^2 \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

$$\nu = n_1 + n_2 - 2.$$

**Unequal variance:**

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$\nu = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}.$$

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### Where does data come from?

- 1 Your instructor
- 2 The website with the book: [cengagebrain.co.uk](http://cengagebrain.co.uk)
- 3 The real world!

How is data collected from the real world? Either by observation or by experiment.

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## Activity

I have noticed that smoking at LAU seems to be a rather social activity. As such, I would like to test the following hypothesis: Smokers have more friends than non-smokers. Before I can test this hypothesis, I will need data.

Please take 5 minutes to collect as much data as possible. Ask your classmates (a) if they smoke and (b) how many friends they have.

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## Activity Follow-up

What kind of data did you collect? Observational data

Now, let's imagine that we design an experiment to collect data. I assign half the class to a smoking group and force them to smoke a certain number of cigarettes per day (yes, this is not ethically appropriate!) and I assign half the class to a no-smoking group and forbid them to smoke anything. After 5 years, I see how many friends each person has.

What are the pros and cons of each method?

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## Exercise 2: Another variable?

What else could contribute to the salary offers of MBA students? Their work ethics and personalities may play a role. ... What metric might capture that? GPA

So, now let's make a paired test: 50 students are selected, 25 finance and 25 marketing majors, but they are selected in pairs such that each pair has the same GPA. Now, let's test the hypotheses. How?

Data in Excel File: Example13-4.xlsx

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## Paired Comparison of Means

When comparing paired samples, we compute a new variable: the difference between each pair's value. This new variable is then tested – what are the hypotheses?

$$H_0 : \mu_D = 0$$

$$H_1 : \mu_D \neq 0$$

Now what test should we use? The  $t$ -test from Chapter 12!

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