10.2 Significance Tests for the Difference of Two Means

Learning Objectives:

1. Describe the shape, center, and spread of the sampling distribution of $\bar{x}_1 - \bar{x}_2$.
2. Determine whether the conditions are met for doing inference about $\mu_1 - \mu_2$
3. Construct and interpret a confidence interval to compare two means.
4. Perform a significance test to compare two means.
5. Determine when it is appropriate to use two-sample *t* procedures versus paired *t* procedures.

Read 634–639

What is meant by "the sampling distribution of the difference between two means"?

What are the shape, center, and spread of the sampling distribution of $\bar{x}_1 - \bar{x}_2$? Are there any conditions that need to be met?

Read 639–640

What is the standard error of $\bar{x}_1 - \bar{x}_2$? Is this on the formula sheet?

What is the formula for the two-sample *t* statistic? Is this on the formula sheet? What does it measure?

What are the conditions for performing inference about $\mu_1 - \mu_2$?

What distribution does the two-sample *t* statistic have? Why do we use a *t* statistic rather than a *z* statistic? How do you calculate the degrees of freedom?

Degrees of Freedom calculation:

Option 1: $$DF = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\left[\frac{1}{n_1 - 1}\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2 - 1}\left(\frac{s_2^2}{n_2}\right)^2\right]}$$

Option 2: Use the smaller of the two df's

Is it ok to use your calculator for the Do step? Are there any drawbacks?

Read 644–649

Alternate Example*: Leaking Helium*

After buying many helium balloons only to see them deflate within a couple of days, Erin and Jenna decided to test if helium-filled balloons deflate faster than air-filled balloons. To find out, they bought 60 balloons of the same type and randomly divided them into two piles of 30, filling the balloons in the first pile with helium and the balloons in the second pile with air. Then, they measured the circumference of each balloon immediately after being filled and again three days later. The average decrease in circumference of the helium-filled balloons was 26.5 cm with a standard deviation of 1.92 cm. The average decrease of the air-filled balloons was 2.1 cm with a standard deviation of 2.79 cm.

(a) Why was it important that they used the same type of balloons? What is this called in experiments?

(b) Do these data provide convincing evidence that helium-filled balloons deflate faster than air-filled balloons?

(c) Interpret the *P*-value you got in part (a) in the context of this study.

HW page 654 (31, 33, 45, 51)

10.2 Confidence Intervals for the Difference of Two Means / Projects

Read 641–643

What is the formula for the two-sample t interval for $\mu_1 - \mu_2$? What are the conditions for this interval to be valid? Is this formula on the formula sheet?

Is it OK to use your calculator for the DO step?

When doing two-sample t procedures, should we pool the data to estimate a common standard deviation? Is there any benefit? Are there any risks?

Alternate Example *Chocolate Chips*

Ashtyn and Olivia wanted to know if generic chocolate chip cookies have as many chocolate chips as name-brand chocolate chip cookies, on average. To investigate, they randomly selected 10 bags of Chips Ahoy cookies and 10 bags of Great Value cookies and randomly selected 1 cookie from each bag. Then, they carefully broke apart each cookie and counted the number of chocolate chips in each. Here are their results:

Chips Ahoy: 17, 19, 21, 16, 17, 18, 20, 21, 17, 18

Great Value: 22, 20, 14, 17, 21, 22, 15, 19, 26, 18

(a) Construct and interpret a 99% confidence interval for the difference in the mean number of chocolate chips in Chips Ahoy and Great Value cookies.

(b) Does your interval provide convincing evidence that there is a difference in the mean number of chocolate chips?

HW page 654 (35, 37, 43, 47, 49) ***Note*****: 35 is about conditions only**

10.2 Using *t* Procedures Wisely

Read 650–651
Should you use two-sample *t* procedures with paired data? Why not? How can you know which procedure to use?

Alternate Example: *Testing with distractions*
Suppose you are designing an experiment to determine if students perform better on tests when there are no distractions, such as a teacher talking on the phone. You have access to two classrooms and 30 volunteers who are willing to participate in your experiment.
(a) Design an experiment so that a two-sample *t* test would be the appropriate inference method.

(b) Design an experiment so that a paired *t* test would be the appropriate inference method.

(c) Which experimental design is better? Explain.

(d) What is the purpose of random assignment in this experiment?

HW page 659 (53–62)