

## 11.1 Exercises

### Basic Concepts

1. What questions are we interested in answering when comparing two population means?
2. What is an independent experimental design?
3. Which sampling distribution do we use in the formulation of the test statistic when comparing two population means with population variances known? What are the properties of this distribution?
4. Does the determination of the critical value(s) for two-sample hypothesis tests differ from one-sample hypothesis tests?
5. What conditions are necessary to perform a test for the difference between two population means?

### Exercises

6. Determine the critical value(s) of the test statistic for each of the following tests for the comparison of two population means where the population standard deviations are known.
  - a. Left-tailed test,  $\alpha = 0.05$
  - b. Right-tailed test,  $\alpha = 0.10$
  - c. Two-tailed test,  $\alpha = 0.01$
7. Determine the critical value(s) of the test statistic for each of the following tests for the comparison of two population means where the population standard deviations are known.
  - a. Left-tailed test,  $\alpha = 0.04$
  - b. Right-tailed test,  $\alpha = 0.08$
  - c. Two-tailed test,  $\alpha = 0.02$
8. A luxury car dealer is considering two possible locations for a new auto mall. The rent on the south side of town is cheaper. However, the dealer believes that the average household income is significantly higher on the north side of town. The dealer has decided that he will locate the new auto mall on the north side of town if the results of a study that he commissioned show that the average household income is significantly higher on the north side of town. The results of the study are as follows.

Income (Thousands of Dollars)			
	$n$	$\bar{x}$	$\sigma$
North Side	35	50	10
South Side	40	43	5

- a. Calculate a 90% confidence interval for the difference in average income between the north and south sides of town. Interpret the interval.
- b. Based on the study, will the auto dealer decide to locate the new auto mall on the north side of town? Use  $\alpha = 0.05$ .

9. An internal auditor for Tiger Enterprises has been asked to determine if there is a difference in the average amount charged for daily expenses by two top salesmen, Mr. Ellis and Mr. Ford. The auditor randomly selects 45 days and determines the daily expenses for each of the salesmen.

Expenses (Dollars)			
	$n$	$\bar{x}$	$\sigma$
Mr. Ellis	45	\$55	\$8
Mr. Ford	45	\$60	\$3

- Calculate a 95% confidence interval for the difference in the average amounts charged for daily expenses between Mr. Ellis and Mr. Ford. Interpret the interval.
  - Based on the survey, can the auditor conclude that there is a difference in the average amounts charged for daily expenses by the two top salesmen? Use  $\alpha = 0.05$ .
  - Explain how the 95% confidence interval in part **a.** would lead you to make the same decision that was made in part **b.**
10. The military has two different programs for training aircraft personnel. A government regulatory agency has been commissioned to evaluate any differences that may exist between the two programs. The agency administers standardized tests to randomly selected groups of students from the two programs. The results of the tests for the students in each of the programs are as follows

Military Training Programs			
	$n$	$\bar{x}$	$\sigma$
Program A	50	85	10
Program B	55	87	9

- Calculate a 99% confidence interval for the difference between the average scores of the two military programs. Interpret the interval.
  - Can the agency conclude that there is a difference in the average test scores of students in the two programs? Use  $\alpha = 0.01$ .
11. Tom Sealack, a supply clerk with the Navy, has been asked to determine if a new battery that has been offered to the Navy (at a reduced price) has a shorter average life than the battery they are currently using. He randomly selects batteries of each type and allows them to run continuously so that he can measure the time until failure for each battery. The results of the test are as follows.

Battery Life (Hours)			
	$n$	$\bar{x}$	$\sigma$
New Battery	35	700	30
Old Battery	35	710	35

- Do the data suggest at  $\alpha = 0.10$  that the time until failure for the new battery is significantly less than the time until failure for the old battery?
- Calculate the  $P$ -value for the test in **a.**
- Based on the  $P$ -value, would the decision change at  $\alpha = 0.05$ ?

12. The City Bank believes that checking account balances are significantly larger for customers who are aged 40 to 49 than those who are aged 30 to 39. To investigate this belief, they randomly select customers from each age group and determine the average daily account balance for each customer for the current month. The results of the study are as follows.

Checking Account Balances			
Age Group	$n$	$\bar{x}$	$\sigma$
30 – 39	200	\$2500	\$550
40 – 49	150	\$3500	\$950

- Do the data suggest at  $\alpha = 0.05$  that the average daily account balances are significantly higher for the 40 to 49 age group than the 30 to 39 age group?
- Calculate the  $P$ -value for the test in a.
- Based on the  $P$ -value, would the decision change at  $\alpha = 0.10$ ?

## 11.2 Comparing Two Population Means, $\sigma_1$ and $\sigma_2$ Unknown

It is still possible to make comparisons between two population means if the population standard deviations are unknown.

There are several assumptions that must be met which are outlined below.

### Assumptions

#### Assumptions for Inferences about $\mu_1 - \mu_2$ when the Population Standard Deviations are Unknown

- An independent experimental design is used.
- Both populations of interest are approximately normal.
- Both of the populations have approximately equal (but unknown) variances,  $\sigma_1^2 = \sigma_2^2 = \sigma^2$ .

In order to determine if both populations of interest are approximately normal, it is helpful to draw histograms of the sample observations from each population. If these histograms appear to be approximately normal, then it is reasonable to infer this assumption is satisfied. With limited data, it is sometimes difficult to determine if the sample data are from a normal population. In these situations, you may have to assume normality and recognize that your inferences are predicated on the validity of the assumption. Figure 11.2.1 shows three histograms of sample data drawn from normal populations.

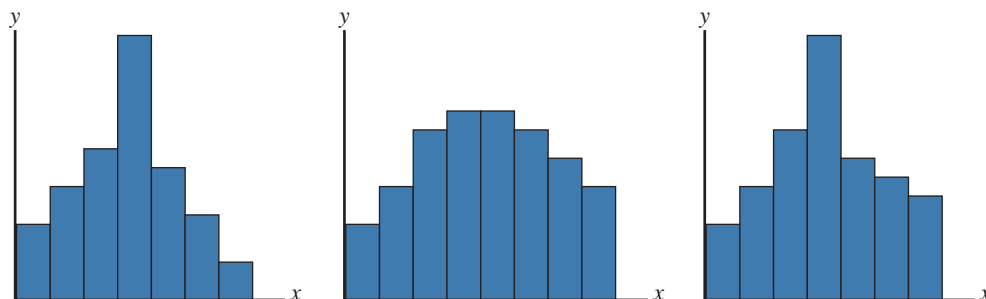


Figure 11.2.1