

1.3: Two-Sample Practice

10.2 Comparing Two Independent Population Means

Use the following information to answer the next 15 exercises: Indicate if the hypothesis test is for

- a. independent group means, population standard deviations, and/or variances known
- b. independent group means, population standard deviations, and/or variances unknown
- c. matched or paired samples
- d. single mean
- e. two proportions
- f. single proportion

1. It is believed that 70% of males pass their drivers test in the first attempt, while 65% of females pass the test in the first attempt. Of interest is whether the proportions are in fact equal.
2. A new laundry detergent is tested on consumers. Of interest is the proportion of consumers who prefer the new brand over the leading competitor. A study is done to test this.
3. A new windshield treatment claims to repel water more effectively. Ten windshields are tested by simulating rain without the new treatment. The same windshields are then treated, and the experiment is run again. A hypothesis test is conducted.
4. The known standard deviation in salary for all mid-level professionals in the financial industry is \$11,000. Company A and Company B are in the financial industry. Suppose samples are taken of mid-level professionals from Company A and from Company B. The sample mean salary for mid-level professionals in Company A is \$80,000. The sample mean salary for mid-level professionals in Company B is \$96,000. Company A and Company B management want to know if their mid-level professionals are paid differently, on average.
5. The average worker in Germany gets eight weeks of paid vacation.
6. According to a television commercial, 80% of dentists agree that Ultrafresh toothpaste is the best on the market.
7. It is believed that the average grade on an English essay in a particular school system for females is higher than for males. A random sample of 31 females had a mean score of 82 with a standard deviation of three, and a random sample of 25 males had a mean score of 76 with a standard deviation of four.
8. The league mean batting average is 0.280 with a known standard deviation of 0.06. The Rattlers and the Vikings belong to the league. The mean batting average for a sample of eight Rattlers is 0.210, and the mean batting average for a sample of eight Vikings is 0.260. There are 24 players on the Rattlers and 19 players on the Vikings. Are the batting averages of the Rattlers and Vikings statistically different?
9. In a random sample of 100 forests in the United States, 56 were coniferous or contained conifers. In a random sample of 80 forests in Mexico, 40 were coniferous or contained conifers. Is the proportion of conifers in the United States statistically more than the proportion of conifers in Mexico?
10. A new medicine is said to help improve sleep. Eight subjects are picked at random and given the medicine. The means hours slept for each person were recorded before starting the medication and after.
11. It is thought that teenagers sleep more than adults on average. A study is done to verify this. A sample of 16 teenagers has a mean of 8.9 hours slept and a standard deviation of 1.2. A sample of 12 adults has a mean of 6.9 hours slept and a standard deviation of 0.6.
12. Varsity athletes practice five times a week, on average.
13. A sample of 12 in-state graduate school programs at school A has a mean tuition of \$64,000 with a standard deviation of \$8,000. At school B, a sample of 16 in-state graduate programs has a mean of \$80,000 with a standard deviation of \$6,000. On average, are the mean tuitions different?
14. A new WiFi range booster is being offered to consumers. A researcher tests the native range of 12 different routers under the same conditions. The ranges are recorded. Then the researcher uses the new WiFi range booster and records the new ranges. Does the new WiFi range booster do a better job?
15. A high school principal claims that 30% of student athletes drive themselves to school, while 4% of non-athletes drive themselves to school. In a sample of 20 student athletes, 45% drive themselves to school. In a sample of 35 non-athlete students, 6% drive themselves to school. Is the percent of student athletes who drive themselves to school more than the percent of nonathletes?

Use the following information to answer the next three exercises: A study is done to determine which of two soft drinks has more sugar. There are 13 cans of Beverage A in a sample and six cans of Beverage B. The mean amount of sugar in Beverage A is 36 grams with a standard deviation of 0.6 grams. The mean amount of sugar in Beverage B is 38 grams with a standard deviation of 0.8 grams. The researchers believe that Beverage B has more sugar than Beverage A, on average. Both populations have normal distributions.

16. Are standard deviations known or unknown?

17. What is the random variable?
18. Is this a one-tailed or two-tailed test?

Use the following information to answer the next 12 exercises: The U.S. Center for Disease Control reports that the mean life expectancy was 47.6 years for White people born in 1900 and 33.0 years for non-White people. Suppose that you randomly survey death records for people born in 1900 in a certain county. Of the 124 White people, the mean life span was 45.3 years with a standard deviation of 12.7 years. Of the 82 non-White people, the mean life span was 34.1 years with a standard deviation of 15.6 years. Conduct a hypothesis test to see if the mean life spans in the county were the same for White and non-White people.

19. Is this a test of means or proportions?
20. State the null and alternative hypotheses.
- a. H_0 : _____
- b. H_a : _____
21. Is this a right-tailed, left-tailed, or two-tailed test?
22. In symbols, what is the random variable of interest for this test?
23. In words, define the random variable of interest for this test.
24. Which distribution (normal or Student's t) would you use for this hypothesis test?
25. Explain why you chose the distribution you did for [Exercise 10.24](#).
26. Calculate the test statistic.
27. Sketch a graph of the situation. Label the horizontal axis. Mark the hypothesized difference and the sample difference. Shade the area corresponding to the p -value.
28. At a pre-conceived $\alpha = 0.05$, what is your:
- a. Decision:
- b. Reason for the decision:
- c. Conclusion (write out in a complete sentence):
29. Does it appear that the means are the same? Why or why not?

[10.4 Comparing Two Independent Population Proportions](#)

Use the following information for the next five exercises. Two types of phone operating system are being tested to determine if there is a difference in the proportions of system failures (crashes). Fifteen out of a random sample of 150 phones with OS₁ had system failures within the first eight hours of operation. Nine out of another random sample of 150 phones with OS₂ had system failures within the first eight hours of operation. OS₂ is believed to be more stable (have fewer crashes) than OS₁.

30. Is this a test of means or proportions?
31. What is the random variable?
32. State the null and alternative hypotheses.
33. What can you conclude about the two operating systems?

Use the following information to answer the next twelve exercises. In the recent Census, three percent of the U.S. population reported being of two or more races. However, the percent varies tremendously from state to state. Suppose that two random surveys are conducted. In the first random survey, out of 1,000 North Dakotans, only nine people reported being of two or more races. In the second random survey, out of 500 Nevadans, 17 people reported being of two or more races. Conduct a hypothesis test to determine if the population percents are the same for the two states or if the percent for Nevada is statistically higher than for North Dakota.

34. Is this a test of means or proportions?
35. State the null and alternative hypotheses.
- a. H_0 : _____
- b. H_a : _____
36. Is this a right-tailed, left-tailed, or two-tailed test? How do you know?
37. What is the random variable of interest for this test?
38. In words, define the random variable for this test.
39. Which distribution (normal or Student's t) would you use for this hypothesis test?
40. Explain why you chose the distribution you did for the [Exercise 10.56](#).
41. Calculate the test statistic.

42. At a pre-conceived $\alpha = 0.05$, what is your:

- Decision:
- Reason for the decision:
- Conclusion (write out in a complete sentence):

43. Does it appear that the proportion of Nevadans who are two or more races is higher than the proportion of North Dakotans? Why or why not?

10.6 Two Population Means with Known Standard Deviations

Use the following information to answer the next five exercises. The mean speeds of fastball pitches from two different baseball pitchers are to be compared. A sample of 14 fastball pitches is measured from each pitcher. The populations have normal distributions. the table below shows the result. Scouts believe that Rodriguez pitches a speedier fastball.

Pitcher	Sample mean speed of pitches (mph)	Population standard deviation
Wesley	86	3
Rodriguez	91	7

44. What is the random variable?

45. State the null and alternative hypotheses.

46. What is the test statistic?

47. At the 1% significance level, what is your conclusion?

Plant group	Sample mean height of plants (inches)	Population standard deviation
Food	16	2.5
No food	14	1.5

48. Is the population standard deviation known or unknown?

49. State the null and alternative hypotheses.

50. At the 1% significance level, what is your conclusion?

Use the following information to answer the next five exercises. Two metal alloys are being considered as material for ball bearings. The mean melting point of the two alloys is to be compared. 15 pieces of each metal are being tested. Both populations have normal distributions. The following table is the result. It is believed that Alloy Zeta has a different melting point.

	Sample mean melting temperatures ($^{\circ}\text{F}$)	Population standard deviation
Alloy Gamma	800	95
Alloy Zeta	900	105

51. State the null and alternative hypotheses.

52. Is this a right-, left-, or two-tailed test?

53. At the 1% significance level, what is your conclusion?

10.7 Matched or Paired Samples

Use the following information to answer the next five exercises. A study was conducted to test the effectiveness of a software patch in reducing system failures over a six-month period. Results for randomly selected installations are shown in Table 1.3.11. The “before” value is matched to an “after” value, and the differences are calculated. The differences have a normal distribution. Test at the 1% significance level.

Installation	A	B	C	D	E	F	G	H
Before	3	6	4	2	5	8	2	6
After	1	5	2	0	1	0	2	2

54. What is the random variable?

55. State the null and alternative hypotheses.

56. What conclusion can you draw about the software patch?

Use the following information to answer next five exercises. A study was conducted to test the effectiveness of a juggling class. Before the class started, six subjects juggled as many balls as they could at once. After the class, the same six subjects juggled as many balls as they could. The differences in the number of balls are calculated. The differences have a normal distribution. Test at the 1% significance level.

Subject	A	B	C	D	E	F
Before	3	4	3	2	4	5
After	4	5	6	4	5	7

57. State the null and alternative hypotheses.

58. What is the sample mean difference?

59. What conclusion can you draw about the juggling class?

Use the following information to answer the next five exercises. A doctor wants to know if a blood pressure medication is effective. Six subjects have their blood pressures recorded. After twelve weeks on the medication, the same six subjects have their blood pressure recorded again. For this test, only systolic pressure is of concern. Test at the 1% significance level.

Patient	A	B	C	D	E	F
Before	161	162	165	162	166	171
After	158	159	166	160	167	169

60. State the null and alternative hypotheses.

61. What is the test statistic?

62. What is the sample mean difference?

63. What is the conclusion?

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