Homework #5

Chapter 9

**Section 1**

In Exercises 9.5–9.13, hypothesis tests are proposed. For each hypothesis test,

a. determine the null hypothesis.

b. determine the alternative hypothesis.

c. classify the hypothesis test as two tailed, left tailed, or right tailed**.**

**5.** Toxic Mushrooms? Cadmium, a heavy metal, is toxic to animals. Mushrooms, however, are able to absorb and accumulate cadmium at high concentrations. The Czech and Slovak governments have set a safety limit for cadmium in dry vegetables at 0.5 part per million (ppm). M. Melgar et al. measured the cadmium levels in a random sample of the edible mushroom Boletus pinicola and published the results in the paper “Influence of Some Factors in Toxicity and Accumulation of Cd from Edible Wild Macrofungi in NW Spain” (Journal of Environmental Science and Health, Vol. B33(4), pp. 439–455). A hypothesis test is to be performed to decide whether the mean cadmium level in Boletus pinicola mushrooms is greater than the government’s recommended limit.

**a) h0  = 0.5 ppm (safety limit for cadmium level)  
b) ha  > 0.5 ppm (greater than the limit)  
c) right tailed**

6. Agriculture Books. The R. R. Bowker Company collects information on the retail prices of books and publishes the data in The Bowker Annual Library and Book Trade Almanac. In 2005, the mean retail price of agriculture books was $57.61. A hypothesis test is to be performed to decide whether this year’s mean retail price of agriculture books has changed from the 2005 mean.

**a)** **h0 = $ 57.61 (mean retail price of agriculture books)  
b) ha  $ 57.61 (mean retail price has changed from the previous mean)  
c) two tailed**

7. Iron Deficiency? Iron is essential to most life forms and to normal human physiology. It is an integral part of many proteins and enzymes that maintain good health. Recommendations for iron are provided in Dietary Reference Intakes, developed by the Institute of Medicine of the National Academy of Sciences. The recommended dietary allowance (RDA) of iron for adult females under the age of 51 years is 18 milligrams (mg) per day. A hypothesis test is to be performed to decide whether adult females under the age of 51 years are, on average, getting less than the RDA of 18 mg of iron.

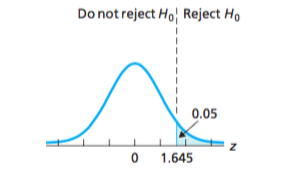
**a)** **h0 = 18 mg (of iron per day)  
b) ha < 18 mg (less than 18 mg or iron per day)  
c) left tailed**

**Section 2**

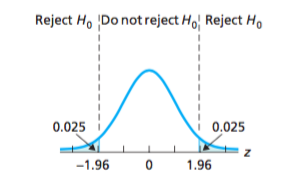
Exercises 9.33–9.38 contain graphs portraying the decision criterion for a one-mean z-test. The curve in each graph is the normal curve for the test statistic under the assumption that the null hypothesis is true. For each exercise, determine the

a. rejection region.  
b. nonrejection region.  
c. critical value(s).  
d. significance level.  
e. Construct a graph similar to that in Fig 9.2 on page 368 that depicts your results from parts (a)–(d).  
f. Identify the hypothesis test as two tailed, left tailed, or right tailed.

33.

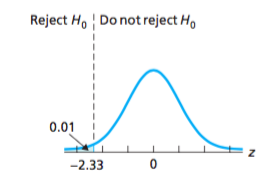
**a) z => 1.645  
b) z < 1.645  
c) z = 1.645  
d)   
e) the graph is same as the graph on left having non-rejection region till the value of 1.645, critical value at 1.645, and rejection region from 1.645, and significance level of 0.05.  
f) right tailed**

34.

 **a) z <= -1.96 or z => 1.96  
 b) -1.96 < z < 1.96  
 c) z = 1.96  
 d)   
 e) the graph is the same as one on the left, having a non-rejection region between -1.96 and 1.96, critical value(s)**

**-+ 1.96, rejection region, less than 1.96 and greater than 1.96 and significanle level of 0.05  
 f) two tailed**

35.

**a) z <= -2.33**

**b) z > -2.33  
c) z = -2.33  
d)   
e) the graph is the same as one on the left with non-rejection region, greater than -2.33, critical value of -2.33, rejection region smaller than -2.33, and significance level of 0.01  
f) left tailed**

**Section 3**

In Exercises 9.55–9.60, we have given the value obtained for the test statistic, z, in a one-mean z-test. We have also specified whether the test is two tailed, left tailed, or right tailed. Determine the P-value in each case and decide whether, at the 5% sig- nificance level, the data provide sufficient evidence to reject the null hypothesis in favor of the alternative hypothesis.

**55**. Right-tailed test:  
**a. *z*=2.03 🡪 P = 0.0212; sufficient to reject h0  
b. z=−0.31 🡪 P = 0.6217; do not reject h0**

**56**. Left-tailed test:   
**a. *z*=−1.84 🡪 P = 0.0329; sufficient to reject h0  
b. *z*=1.25 🡪 P = 0.8944; do not reject h0**

**58.** Two-tailed test:   
**a. *z*=3.08 🡪 P = 0.002; sufficient to reject h0  
b. z=−2.42 🡪 P = 0.0156; sufficient to reject h0**

**Section 4**

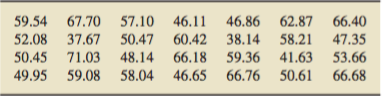
**73.** Toxic Mushrooms? Cadmium, a heavy metal, is toxic to animals. Mushrooms, however, are able to absorb and accumulate cadmium at high concentrations. The Czech and Slovak governments have set a safety limit for cadmium in dry vegetables at 0.5 part per million (ppm). M. Melgar et al. measured the cadmium levels in a random sample of the edible mushroom Boletus pinicola and published the results in the paper “Influence of Some Factors in Toxicity and Accumulation of Cd from Edible Wild Macrofungi in NW Spain” (Journal of Environmental Science and Health, Vol. B33(4), pp. 439–455). Here are the data.



At the 5% significance level, do the data provide sufficient evidence to conclude that the mean cadmium level in Boletus pinicola mushrooms is greater than the government’s recommended limit of 0.5 ppm? Assume that the population standard deviation of cadmium levels in Boletus pinicola mushrooms is 0.37 ppm. (Note: The sum of the data is 6.31 ppm.)

**h0  = 0.5 ppm  
h0  > 0.5 ppm  
α=0.05   
x = 6.31/ 12 = 0.526  
P = 0.405 ; do not reject h0At the 5% significance level, the data do not provide sufficient evidence to conclude that the mean cadmium level is greater than the government’s recommended limit of 0.5 ppm.**

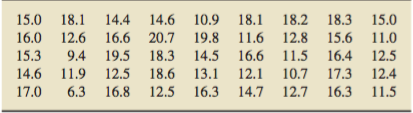
**74.** Agriculture Books. The R. R. Bowker Company collects information on the retail prices of books and publishes the data in The Bowker Annual Library and Book Trade Almanac. In 2005, the mean retail price of agriculture books was $57.61. This year’s retail prices for 28 randomly selected agriculture books are shown in the following table.



At the 10% significance level, do the data provide sufficient evidence to conclude that this year’s mean retail price of agriculture books has changed from the 2005 mean? Assume that the population standard deviation of prices for this year’s agriculture books is $8.45. (Note: The sum of the data is $1539.14.)

**h0  = 57.61  
h0  57.61  
α=0.1   
x = 1539.14/ 28 55  
   
P = 0.1032; reject h0At the 10% significance level, the data provides enough evidence to conclude that this year’s mean retail price of agriculture books has changed from the 2005 mean of $57.61.**

**75.** Iron Deficiency? Iron is essential to most life forms and to normal human physiology. It is an integral part of many proteins and enzymes that maintain good health. Recommendations for iron are provided in Dietary Reference Intakes, developed by the Institute of Medicine of the National Academy of Sciences. The recommended dietary allowance (RDA) of iron for adult females under the age of 51 is 18 milligrams (mg) per day. The following iron intakes, in milligrams, were obtained during a 24-hour period for 45 randomly selected adult females under the age of 51.



At the 1% significance level, do the data suggest that adult females under the age of 51 are, on average, getting less than the RDA of 18 mg of iron? Assume that the population standard deviation is 4.2 mg. (Note: x ̄ = 14.68 mg.)

**h0  =18 mg  
h0  < 18 mg  
α=0.01   
x = 14.68  
   
P = 0.000; reject h0At the 1% significance level, the data do provide enough evidence that adult females under the age of 51, on average get less than the RDA of 18 mg of iron.**

**Section 5**

**102.** Golf Robots. Serious golfers and golf equipment companies sometimes use golf equipment testing labs to obtain precise information about particular club heads, club shafts, and golf balls. One golfer requested information about the Jazz Fat Cat 5-iron from Golf Laboratories, Inc. The company tested the club by using a robot to hit a Titleist NXT Tour ball six times with a head velocity of 85 miles per hour. The golfer wanted a club that, on average, would hit the ball more than 180 yards at that club speed. The total yards each ball traveled was as follows.



a. At the 5% significance level, do the data provide sufficient evidence to conclude that the club does what the golfer wants? (Note: The sample mean and sample standard deviation of the data is 182.7 yards and 2.7 yards, respectively.)

**h0  =180 yards  
h0  >180 yards  
α=0.05  
x = 182.7  
   
t0.05  with df = n-1 = 5 🡪 2.015 (critical value); do not reject h0At the 5% significance level, the data does not provides enough evidence to conclude that the club on average would hit ball more than the 180 yards at that club speed.**

b. Repeat part (a) for a test at the 1% significance level.

**h0  =180 yards  
h0  >180 yards  
α=0.01  
x = 182.7  
   
t0.01  with df = n-1 = 5 🡪 3.365 (critical value); reject h0At the 1% significance level, the data provides enough evidence to conclude that the club on average would hit ball more than the 180 yards at that club speed.**

**103**. Brewery Effluent and Crops. Because many industrial wastes contain nutrients that enhance crop growth, efforts are being made for environmental purposes to use such wastes on agricultural soils. Two researchers, M. Ajmal and A. Khan, re- ported their findings on experiments with brewery wastes used for agricultural purposes in the article “Effects of Brewery Effluent on Agricultural Soil and Crop Plants” (Environmental Pollution (Series A), 33, pp. 341–351). The researchers studied the physico-chemical properties of effluent from Mohan Meakin Breweries Ltd. (MMBL), Ghazibad, UP, India, and “. . . its effects on the physico-chemical characteristics of agricultural soil, seed germination pattern, and the growth of two common crop plants.” They assessed the impact of using different concentrations of the effluent: 25%, 50%, 75%, and 100%. The following data, based on the results of the study, provide the percentages of limestone in the soil obtained by using 100% effluent.



Do the data provide sufficient evidence to conclude, at the 1% level of significance, that the mean available limestone in soil treated with 100% MMBL effluent exceeds 2.30%, the percentage ordinarily found? (Note: x ̄ = 2.5 and s = 0.149.)

**h0  = 2.30%  
h0  > 2.30%  
α=0.01  
x = 2.5  
t0.01  with df = n-1 =9 🡪 2.821(critical value); P < 0.005; reject h0At the 1% level of significance, the data provide enough evidence to conclude that the mean available limestone in soil treated with 100% MMBL effluent exceeds 2.30% the percentage ordinarily found.**

**105.** Ankle Brachial Index.The ankle brachial index (ABI) compares the blood pressure of a patient’s arm to the blood pressure of the patient’s leg. The ABI can be an indicator of different diseases, including arterial diseases. A healthy (or normal) ABI is 0.9 or greater. In a study by M. McDermott et al. titled “Sex Differences in Peripheral Arterial Disease: Leg Symptoms and Physical Functioning” (Journal of the American Geriatrics Society, Vol. 51, No. 2, pp. 222–228), the researchers obtained the ABI of 187 women with peripheral arterial disease. The results were a mean ABI of 0.64 with a standard deviation of 0.15. At the 5% significance level, do the data provide sufficient evidence to conclude that, on average, women with peripheral arterial disease have an unhealthy ABI?

**h0  => 0.9  
h0  < 0.9  
α=0.05  
x = 0.64  
   
t0.05  with df = n-1 = 186 🡪 -1.653 (critical value); P < 0.005; reject h0At the 5% significance level, the data provide enough evidence to conclude that on average, women with peripheral arterial disease have an unhealthy ABI (<0.9).**

Chapter 10

**Section 1**

In Exercises 10.9–10.14, hypothesis tests are proposed. For each hypothesis test,

a. identify the variable.  
b. identify the two populations.  
c. determine the null and alternative hypotheses.  
d. classify the hypothesis test as two tailed, left tailed, or right tailed.

**11.** Driving Distances. Data on household vehicle miles of travel (VMT) are compiled annually by the Federal Highway Administration and are published in National Household Travel Survey, Summary of Travel Trends. A hypothesis test is to be per- formed to decide whether a difference exists in last year’s mean VMT for households in the Midwest and South.

**a) Variable: Last year VMT  
b) Two populations: Households in the Midwest and households in the South  
c) h0 : mean(MW) = mean(S) -- ha : mean(MW) mean(S)  
d) two tailed**

**12**. Age of Car Buyers. In the introduction to this chapter, we mentioned comparing the mean age of buyers of new domestic cars to the mean age of buyers of new imported cars. Suppose that we want to perform a hypothesis test to decide whether the mean age of buyers of new domestic cars is greater than the mean age of buyers of new imported cars.

**a) Variable: Age of buyers  
b) Two populations: Buyers of new domestic cars and buyers of new imported cars  
c**) **h0 : mean(D) = mean(I) -- ha : mean(D) > mean(I)  
d) right tailed**

In each of Exercises 10.15–10.20, we have presented a confidence interval (CI) for the difference, μ1 − μ2, between two population means. Interpret each confidence interval.

**15.** 95% CI is from 15 to 20.

**We are 95% confident that the μ1 − μ2, lies in between 15 and 20, which means that the μ1 is greater than μ2, for something that lies within 15 and 20.**

**21**. A variable of two populations has a mean of 40 and a standard deviation of 12 for one of the populations and a mean of 40 and a standard deviation of 6 for the other population.

a. For independent samples of sizes 9 and 4, respectively, find the mean and standard deviation of x ̄1 − x ̄2.

**x1 – x2 = μ1 – μ2 = 40 – 40 = 0  
 x1 – x2 = =**

b. Must the variable under consideration be normally distributed on each of the two populations for you to answer part (a)? Explain your answer.

**No, it does not have to normally distributed. It is necessary just when we want to conclude that the x1-x2 is normally distributed.**

c. Can you conclude that the variable x ̄1 − x ̄2 is normally distributed? Explain your answer.

**No, we can’t conclude it, because we don’t know if the variable on the two populations is normally distributed or not.**

**23.** A variable of two populations has a mean of 40 and a standard deviation of 12 for one of the populations and a mean of 40 and a standard deviation of 6 for the other population. Moreover, the variable is normally distributed on each of the two populations.

a. For independent samples of sizes 9 and 4, respectively, determine the mean and standard deviation of x ̄1 − x ̄2.

**x1 – x2 = μ1 – μ2 = 40 – 40 = 0  
 x1 – x2 = =**

b. Can you conclude that the variable x ̄1 − x ̄2 is normally distributed? Explain your answer.

**Yes, we can conclude that the x1-x2 is normally distributed, because it is said that the variable on each of the two populations is normally distributed as well.**

c. Determine the percentage of all pairs of independent samples of sizes 9 and 4, respectively, from the two populations with the property that the difference x ̄1 − x ̄2 between the sample means is between −10 and 10.

**Section 2**

In each of Exercises 10.33–10.38, we have provided summary statistics for independent simple random samples from two populations. In each case, use the pooled t-test and the pooled t- interval procedure to conduct the required hypothesis test and obtain the specified confidence interval.

**33**. *x* ̄1 =10, *s*1 =2.1, *n*1 =15, *x* ̄2 =12, *s*2 =2.3, *n*2 =15   
**a.** Two-tailed test, α = 0.05

**sp 2 = = 4.85 🡪 sp = 2.2  
t =**   
**α = 0.05 (two side 🡪 0.025)  & df = n1+n2 -2= 28** 🡪 **critical value = -+ 2.048;   
0.01< P < 0.025; reject** **h0**

**b.** 95% confidence interval   
(x1-x2) t α/2 \* sp  🡪 **-3.645 to -0.355**

(x1-x2) - t α/2 \* sp = -2 – (-2.048) \* 2.2 = - 0.355

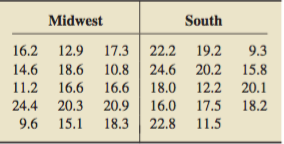
(x1-x2) - t α/2 \* sp = -2 + (-2.048) \* 2.2 = -3.645

**35**.x ̄1 =20,*s*1 =4,*n*1 =10,*x* ̄2 =18,*s*2 =5,*n*2 =15   
**a.** Right-tailed test, α = 0.05  
**sp 2 = 🡪 sp = 4.28  
t = 1.06  
α = 0.05 (right side)  & df = n1+n2 -2= 23** 🡪 **critical value = 1.714;   
P > 0.10; do not reject h0**

 **b.** 90% confidence interval   
(x1-x2) t α/2 \* sp  🡪 **0.995 to 4.995**(x1-x2) - t α/2 \* sp  = 2 – 1.714\* 4.28( = 0.995

(x1-x2) - t α/2 \* sp  = 2 + 1.714\* 4.28( = 4.995

**42.** Driving Distances. Data on household vehicle miles of travel (VMT) are compiled annually by the Federal Highway Ad- ministration and are published in National Household Travel Survey, Summary of Travel Trends. Independent random samples of 15 midwestern households and 14 southern households provided the following data on last year’s VMT, in thousands of miles.



At the 5% significance level, does there appear to be a difference in last year’s mean VMT for midwestern and southern households? (Note: x ̄1 = 16.23, s1 = 4.06, x ̄2 = 17.69, and s2 = 4.42.)

**sp 2 = 🡪 sp = 4.24  
t =   
α = 0.05 (two tailed 🡪 0.025)  & df = n1+n2 -2=27 🡪 critical value -+ 2.052   
0.1 < P < 0.05; don’t reject h0**

**At the 5% significance level, the data don’t provide enough evidence to show that there was a difference in last year’s mean for Midwestern and southern households.**