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INEG 33103 - Probability and Statistics

Week 11 Homework (100 points)

For each problem, you can solve by hand or use Excel to help. You need to show all work in either case. Use alpha = 0.05 for these problems unless otherwise specified.

Think about the following (conceptual) questions are each of the problem below. You do not need to submit the work but reach out to the instructor if you have difficulty answering these questions.

(1) Why do you choose the specific hypothesis test (it is associated with the lecture, so you are likely choosing the method just introduced); what information in the problem statement supports your choice?

(2) How do you decide if this is a one-sided test or two-sided test?

(3) Can you reach the same conclusion with the CI approach compared to the hypothesis testing approach?

Question 1 (adapted from p258, 5-42) Fifteen adult males between the ages of 35 and 50 participated in a study to evaluate the effect of diet and exercise on the blood cholesterol levels. The total cholesterol was measured in each subject initially, and then 3 months after participating in an aerobic exercise program and switching to a low-fat diet, as shown in the following table.

(a) Do the data support the claim that low-fat diet and aerobic exercise are of value in producing a mean reduction in blood cholesterol levels?

a. Null Hypothesis: There is no mean reduction in cholesterol
b. Alternative Hypothesis: There is a mean reduction in cholesterol
c. t = d/s_d/sqrt(n)
d. Using excel paired t-test, the t value is calculated as 5.47 and the p-value is 0.0000.
e. Since the p-value is much less than 0.05, we reject the null hypothesis. This provides strong evidence that the low-fat diet and aerobic exercise reduce blood cholesterol levels.

(b) Find a 95% CI on the mean reduction in blood cholesterol levels.

a. 26.87 +- 2.15 x 19.04/sqrt(15)
b. 16.32,37.41

(c)

Blood Cholesterol Level					
Subject	Before	After	Subject	Before	After
1	265	229	9	260	247
2	240	231	10	279	239
3	258	227	11	283	246
4	295	240	12	240	218
5	251	238	13	238	219
6	245	241	14	225	226
7	287	234	15	247	233
8	314	256			

Question 2 (p264, 5-54) Eleven resilient modulus observations of a ceramic mixture of type A are measured and found to have a sample average of 18.42 psi and sample standard deviation of 2.77 psi. Ten resilient modulus observations of a ceramic mixtures of type B are measured and found to have a sample average of 19.28 psi and sample standard deviation of 2.41 psi. Is there sufficient evidence to support the investigator's claim that type A ceramic has larger variability than type B?

a) Null Hypothesis: The variability of type A ceramic is less than or equal to that of type B.

b) Alternative Hypothesis: The variability of type A ceramic is greater than that of type B.

c) $F = s^2_A / s^2_B$

  - Where s^2_A is the variance of type A ($s_a = 2.77$)
  - Where s^2_B is the variance of type A ($s_B = 2.41$)

b) Degrees of freedom

  - $df_a = 11 - 1 = 10$
  - $df_b = 10 - 1 = 9$

c) Using excel the F-Statistic is 1.32

d) Critical Value is 3.14

e) p-value is 0.343

f) Since the F-statistic (1.32) is less than the critical value (3.14), and the p-value is greater than 0.05, we fail to reject the null hypothesis. Therefore there is not enough evidence to support the investigators claim that type A ceramics larger variability than type B.

Question 3 (p271, 5-66) Two different types of injection-molding machines are used to form plastic parts. A part is considered defective if it has excessive shrinkage or is discolored. Two random samples, each of size 300, are selected, and 15 defective parts are found in the sample from Machine 1 whereas 8 defective parts are found in the sample from Machine 2.

(a) Is it reasonable to conclude that both machines provide the same fraction of defective parts?

(b) Find the *P*-value for this test.

a. Null hypothesis: The proportion of defective parts is the same for both machines

b. Alternative Hypothesis: The proportion of defective parts is different for both machines

c. Z = (p1-p2)/sqrt(p(1-p)(1/n1+1/n2)

  i. P1 = x1/n1

  ii. P2 = x2/n2

  iii. P = (x1+x2)/(n1+n2)

  iv. X1 = 15

  v. X2 = 8

  vi. N1 = 300

  vii. N2 = 300

d. P1 = 0.05 (5%)

e. P2 = 0.0267 (2.67%)

f. Z = 1.49

g. P-Value = 2 * P(Z > |z|)

h. P – Value = 0.137

i. Since P-Value > 0.05 we fail to reject the null hypothesis and conclude that there is insufficient evidence that two machines have different fractions of defective parts. Therefore it is reasonable to conclude that both machines provide the same fraction of defective parts.