STAT 305 D Homework 9

Due Apr 11, 2013 at 12:40 PM in class

Show all 6 steps in your hypothesis tests.

1. Let the test statistic Z have a standard normal distribution when H_0 is true. Give the significance level for each of the following situations:

   a. H_a: $\mu > \mu_0$, rejection region $z \geq 1.88$

   b. H_a: $\mu < \mu_0$, rejection region $z \leq -2.75$

   c. H_a: $\mu \neq \mu_0$, rejection region $z \geq 2.88$ *or* $z \leq -2.88$

2. Use the method of critical values (not p-values) in the following problem. You may assume the test statistic has a N(0,1) distribution.

   The melting point of each of 16 samples of a certain brand of hydrogenated vegetable oil was determined, resulting in

   $\bar{x} = 94.32$. Assume that the distribution of melting point is normal with $\sigma = 1.20$.

   Do a hypothesis test at significance level $\alpha = 0.01$ to test the hypothesis that the true mean melting point is different from 95.

3. Use the method of critical values (not p-values) in the following problem.

Lightbulbs of a certain type are advertised as having an average lifetime of 750 hours. The price of these bulbs is very favorable, so a potential customer has decided to go ahead with a purchase arrangement unless it can be conclusively demonstrated that the true average lifetime is smaller than what is advertised. A random sample of 50 bulbs was selected, the lifetime of each bulb determined, and the appropriate hypotheses were tested using MINITAB, resulting in the accompanying output.

Variable	N	Mean	StDev	SEMean	Z	P-Value
lifetime	50	738.44	38.20	5.40	-2.14	0.016

What conclusion would be appropriate for a significance level of .05? A significance level of .01? What significance level and conclusion would you recommend?

4. Use the method of p-values in the following problem.

A random sample of soil specimens was obtained, and the amount of organic matter (%) in the soil was determined for each specimen, resulting in the accompanying data (from "Engineering Properties of Soil," *Soil Science,* 1998: 93–102).

1.10	5.09	0.97	1.59	4.60	0.32	0.55	1.45
0.14	4.47	1.20	3.50	5.02	4.67	5.22	2.69
3.98	3.17	3.03	2.21	0.69	4.47	3.31	1.17
0.76	1.17	1.57	2.62	1.66	2.05		

The values of the sample mean, sample standard deviation, and (estimated) standard error of the mean are 2.481, 1.616, and .295, respectively. Does this data suggest that the true average percentage of organic matter in such soil is something other than 3%? Carry out a test of the appropriate hypotheses at significance level .10 by first determining the *P*-value. Would your conclusion be different if $\alpha = .05$ had been used? [*Note:* A normal probability plot of the data shows an acceptable pattern in light of the reasonably large sample size.]

5. Vardeman and Jobe chapter 6 section 3 problem 3 (page 385). Solve using the method of p-values at significance level $\alpha = 0.05$.

The machine screw measurement study of DuToit, Hansen, and Osborne referred to in Exercise 4 of Section 6.1 involved measurement of diameters of each of 50 screws with both digital and vernier-scale calipers. For the student referred to in that exercise, the differences in measured diameters (digital minus vernier, with units of mm) had the following frequency distribution:

Difference	−.03	−.02	−.01	.00	.01	.02
Frequency	1	3	11	19	10	6

(a) Make a 90% two-sided confidence interval for the mean difference in digital and vernier readings for this student.
(b) Assess the strength of the evidence provided by these differences to the effect that there is a systematic difference in the readings produced by the two calipers (at least when employed by this student).
(c) Briefly discuss why your answers to parts (a) and (b) of this exercise are compatible. (Discuss how the outcome of part (b) could easily have been anticipated from the outcome of part (a).)

6. Musculoskeletal neck-and-shoulder disorders are all too common among office staff who perform repetitive tasks using visual display units. The article Upper-Arm Elevation During Office Work (Ergonomics, 1996: 1221-1230) reported on a study to determine whether more varied work conditions would have any impact on arm movement. The accompanying data

was obtained from a sample of n = 16 subjects. Each observation is the amount of time, expressed as a proportion of total time observed, during which arm elevation was below 30°. The two measurements from each subject were obtained 18 months apart. During this period, work conditions were changed, and subjects were allowed to engage in a wider variety of work tasks. Does the data suggest that true average time during which elevation is below 30 differs after the change from what it was before the change? Do a hypothesis test at $\alpha = 0.1$ to answer this question.

Subject	1	2	3	4	5	6	7	8
Before	81	87	86	82	90	86	96	73
After	78	91	78	78	84	67	92	70
Subject	9	10	11	12	13	14	15	16
Before	74	75	72	80	66	72	56	82
After	58	62	70	58	66	60	65	73

7. Weekly feedback. You get full credit as long as you write something.

   a. Is there any aspect of the subject matter that you currently struggle with? If so, what specifically do you find difficult or confusing? The more detailed you are, the better I can help you.

   b. Do you have any questions or concerns about the material, class logistics, or anything else? If so, fire away.