Department of Computer Science, University of Karachi

BSCS: 306: Probability and Statistical Methods

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Assignment: 09: Hypothesis Testing – II

Q.1. A large automobile manufacturing company is trying to decide whether to purchase brand A or brand B tires for its new models. To help arrive at a decision, an experiment is conducted using 12 of each brand. The tires are run until they wear out. The results (in kilometers) are: $\bar{x}_1 = 37900, s_1 = 5100;\ \bar{x}_2 = 39800, s_2 = 4900$. Test the hypothesis that there is no difference in the average wear of 2 brands of tires. Assume the populations to be approximately normally distributed with equal variances. Use a P-value.

Q.2. An experiment was performed to compare the abrasive wear of two different laminated materials. Twelve pieces of material 1 were tested by exposing each piece to a machine measuring wear. Ten pieces of material 2 were similarly tested. In each case, the depth of wear was observed. The samples of material 1 gave an average (coded) wear of 85 units with a sample standard deviation of 4, while the samples of material 2 gave an average of 81 and a sample standard deviation of 5. Can we conclude at the 0.05 level of significance that the abrasive wear of material 1 exceeds that of material 2 by more than 2 units? Assume the populations to be approximately normal with equal variances.

Q.3. In a study conducted in the forestry and wildlife department at Virginia Polytechnic Institute and State University, J. A. Wesson examined the influence of the drug succinylcholine on the circulation levels of androgens in the blood. Blood samples from wild, free-ranging deer were obtained via the jugular vein immediately after an intramuscular injection of succinylcholine using darts and a capture gun. Deer were bled again approximately 30 minutes after the injection and then released. The levels of androgens at time of capture and 30 minutes later, measured in nanograms per milliliter (ng/ml), for 15 deer are given in Table.

	Absolute Time Differences	
Subject	Prefatigue	Postfatigue
1	158	91
2	92	59
3	05	215
4	98	226
5	33	223
6	89	91
7	148	92
8	58	177
9	142	134
10	117	116
11	74	153
12	66	219
13	109	143
14	57	164
15	85	100

Do you think there is significant difference between n pre-fatigue and post-fatigue results? Use α = 5%. Also report the corresponding P-value.

Q.4. According to the published reports, practice under fatigued conditions distorts mechanisms which govern performance. An experiment was conducted using 15 college males who were trained to make a continuous horizontal right-to-left arm movement from a microswitch to a barrier, knocking over the barrier coincident with the arrival of a clock sweep hand to the 6 o'clock position. The absolute value of the difference between the time, in milliseconds, that it took to knock over the barrier and the time for the sweep hand to reach the 6 o'clock position (500 msec) was recorded. Each participant performed the task five times under prefatigued and post fatigue conditions, and the sums of the absolute differences for the five performances were recorded as follows:

Deer	Androgen (ng/ml)		d_i
	Time of Injection	30 Minutes after Injection	
1	2.76	7.02	4.26
2	5.18	3.10	2.08
3	2.68	5.44	2.76
4	3.05	3.99	0.94
5	4.10	5.21	1.11
6	7.05	10.26	3.21
7	6.60	13.91	7.31
8	4,79	18.53	13.74
9	7,39	7.91	0.52
10	7.30	4.85	-2.45
11	11.78	11.10	-0.68
12	3.90	3.74	-0.16
13	26.00	94.03	68.03
14	67.48	94.03	26.55
15	17.04	41.70	24.66

Q.5. The following data represent the running times of films produced by 2 motion-picture companies:

Company	Time (minutes)						
1	102	86	98	109	92		
2	81	165	97	134	92	87	114

Test the hypothesis that the average running time of films produced by company 2 exceeds the average running time of films produced by company 1 by 10 minutes, against the one-sided alternative that the difference is less than 10 minutes. Use a 0.1 level of significance and assume the distributions of times to be approximately normal with unequal variances. Assuming that the populations of androgen at time of injection and 30 minutes later are normally distributed, test at the 0.05 level of significance whether the androgen concentrations are altered after 30 minutes of restraint.

Q.6. The volume of containers of a particular lubricant is known to be normally distributed with a variance of 0.03 liter, Test the hypothesis that $\sigma^2 = 0.03$ against the alternative that $\sigma^2 \neq 0.03$ for the random sample of 10 containers 10.2, 9.7, 10.1, 10.3, 10.1, 9.8, 9.9, 10.4, 10.3, and 9.8 liters. Use 5% level of significance.

Q.7. Past data indicate that, the amount of money contributed by the working residents of a large city to a volunteer rescue squad is a normal random variable with a standard deviation of St.40. It has been suggested that the contributions to the rescue squad from just the employees of the sanitation department are much more variable. If the contributions of a random sample of 12 employees from the sanitation department had a standard deviation of $1.75, can we conclude at the 0.01 level of significance that the standard deviation of the contributions of all sanitation workers is greater than that of all workers living in this city?

Q.8. The hydrocarbon emissions are known to have decreased dramatically during the 1980s. A study was conducted to compare the hydrocarbon emissions at idling speed, in parts per million (ppm), for automobiles of 1980 and 1990. Twenty cars of each year model were randomly selected and their hydrocarbon emission levels were recorded. The data are as follows:

1980 models: 141, 359, 247, 940, 882, 494, 306, 210, 105, 880, 200, 223, 188, 940, 241, 190, 300, 435, 241. 380
1990 models: 140, 160, 20, 20, 223, 60, 20, 95, 360, 70, 220, 400, 217, 58, 235, 380, 200, 175, 85, 65.

Test the hypothesis that $\sigma_1=\sigma_2$ against the alternative that $\sigma_1 \neq \sigma_2$. Assume both populations are normal. Use 2% level of significance.