Statistical Inference Theory – 18MAT289

Hypothesis Testing – Solved Problems

Roll No: ____________________

Name: ____________________________________

In the past the average length of an outgoing telephone call from a business office has been 143 seconds. A manager wishes to check whether that average has decreased after the introduction of policy changes. A sample of 100 telephone calls produced a mean of 133 seconds, with a standard deviation of 35 seconds. Perform the relevant test at the 1% level of significance.

A soft drink maker claims that a majority of adults prefer its leading beverage over that of its main competitor's. To test this claim 500 randomly selected people were given the two beverages in random order to taste. Among them, 270 preferred the soft drink maker's brand, 211 preferred the competitor's brand, and 19 could not make up their minds. Determine whether there is sufficient evidence, at the 5% level of significance, to support the soft drink maker's claim against the default that the population is evenly split in its preference.

Suppose the Acme Drug Company develops a new drug, designed to prevent colds. The company states that the drug is equally effective for men and women. To test this claim, they choose a simple random sample of 100 women and 200 men from a population of 100,000 volunteers. At the end of the study, 38% of the women caught a cold; and 51% of the men caught a cold. Based on these findings, can we reject the company's claim that the drug is equally effective for men and women? Use a 0.05 level of significance.

Past sales data indicate that the average sale was $100 per transaction. After training your sales force, recent sales data (taken from a sample of 25 salesmen) indicates an average sale of $130, with a standard deviation of $15. Did the training work? Test your hypothesis at a 5% alpha level.

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 with 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.

The sodium content of twenty 300-gram boxes of organic cornflakes was determined. The data (in milligrams) are as follows: 131.15, 130.69, 130.91, 129.54, 129.64, 128.77, 130.72, 128.33, 128.24, 129.65, 130.14, 129.29, 128.71, 129.00, 129.39, 130.42, 129.53, 130.12, 129.78, 130.92. Can you support a claim that mean sodium content of this brand of cornflakes differs from 130 milligrams? Use alpha = 0.05. Find the P-value.

The mean water temperature downstream from a power plant cooling tower discharge pipe should be no more than 100°F. Past experience has indicated that the standard deviation of temperature is 2°F. The water temperature is measured on nine randomly chosen days, and the average temperature is found to be 98°F. Is there evidence that the water temperature is acceptable at alpha = 0.05? What is the P-value for this test?

The number of calls arriving at a switchboard from noon to 1:00 P.M. during the business days Monday through Friday is monitored for six weeks (i.e., 30 days). Let X be defined as the number of calls during that one-hour period. The relative frequency of calls was recorded and reported as

Value 5 6 8 9 10
Relative Frequency 0.067 0.067 0.100 0.133 0.200

Value 11 12 13 14 15
Relative Frequency 0.133 0.133 0.067 0.033 0.067

Does the assumption of a Poisson distribution seem appropriate as a probability model for this data? Use alpha = 0.05. Calculate the P-value for this test.

A melting point test of n = 10 samples of a binder used in manufacturing a rocket propellant resulted in Assume that the melting point is normally distributed with sigma = 1.5. Test H0: mu = 155 versus H1: mu != 155 using alpha = 0.01. (b) What is the P-value for this test?

Oxide layers on semiconductor wafers are etched in a mixture of gases to achieve the proper thickness. The variability in the thickness of these oxide layers is a critical characteristic of the wafer, and low variability is desirable for subsequent processing steps. Two different mixtures of gases are being studied to determine whether one is superior in reducing the variability of the oxide thickness. Sixteen wafers are etched in each gas. The sample standard deviations of oxide thickness are $s1 = 1.96$ angstroms and $s2 = 2.13$ angstroms, respectively. Is there any evidence to indicate that either gas is preferable? Use a fixed-level test with $alpha = 0.05$.

An article in the Journal of Aircraft (Vol. 23, 1986, pp. 859–864) described a new equivalent plate analysis method formulation that is capable of modeling aircraft structures such as cranked wing boxes, and that produces results similar to the more computationally intensive finite element analysis method. Natural vibration frequencies for the cranked wing box structure are calculated using both methods, and results for the first seven natural frequencies follow:

Freq.	Finite Element Cycle/s	Equivalent Plate, Cycle/s
1	14.58	14.76
2	48.52	49.10
3	97.22	99.99
4	113.99	117.53
5	174.73	181.22
6	212.72	220.14
7	277.38	294.80

Do the data suggest that the two methods provide the same mean value for natural vibration frequency? Use alpha = 0.05. Find the P-value.

Cloud seeding has been studied for many decades as a weather modification procedure (for an interesting study of this subject, see the article in Technometrics, “A Bayesian Analysis of a Multiplicative Treatment Effect in Weather Modification,” Vol. 17, pp. 161–166). The rainfall in acre-feet from 20 clouds that were selected at random and seeded with silver nitrate follows: 18.0, 30.7, 19.8, 27.1, 22.3, 18.8, 31.8, 23.4, 21.2, 27.9, 31.9, 27.1, 25.0, 24.7, 26.9, 21.8, 29.2, 34.8, 26.7, and 31.6. (a) Can you support a claim that mean rainfall from seeded clouds exceeds 25 acre-feet? Use alpha = 0.01. Find the P-value.