Ve401 Probabilistic Methods in Engineering

Spring 2020 — Assigment 6

Date Due: 11:00 PM, Friday, the 17$^{\text{th}}$ of April 2020

This assignment has a total of (**18 Marks**).

Exercise 6.1   Wilcoxon Signed Rank Test

The diameter of a ball bearing was measured by an inspector using a new type of caliper. The results were as follows (in mm):

0.265, 0.263, 0.266, 0.267, 0.267, 0.265, 0.267, 0.267, 0.265, 0.268, 0.268, 0.263.

i) Use the sign test to evaluate the claim that the median ball diameter is equal to 0.265 mm.
(**2 Marks**)

ii) Use the Wilcoxon signed-rank test to evaluate the claim that the median ball diameter is equal to 0.265 mm.
(**3 Marks**)

iii) Comment on and interpret the results of your tests.
(**2 Marks**)

Exercise 6.2   Inferences on Proportions

An article in *Knee Surgery, Sports Traumatology, Arthroscopy* (2005, Vol. 13, pp. 273279), considered arthroscopic meniscal repair with an absorbable screw. Results showed that for tears greater than 25 millimeters, 14 of 18 (78%) repairs were successful while for shorter tears, 22 of 30 (73%) repairs were successful.

i) Is there evidence that the success rate is greater for longer tears? What type of hypothesis test are you using?
(**2 Marks**)

ii) Calculate a one-sided 95% confidence bound on the difference in proportions that can be used to answer the question in part i).
(**2 Marks**)

Exercise 6.3   Comparing Variances – Neyman-Pearson Test

Two chemical companies can supply a raw material. The concentration of a particular element in this material is important. The mean concentration for both suppliers is the same, but we suspect that the variability in concentration may differ between the two companies. The standard deviation of concentration in a random sample of $n_1 = 10$ batches produced by company 1 is $s_1 = 4.7$ grams per liter, while for company 2, a random sample of $n_2 = 16$ batches yields $s_2 = 5.8$ grams per liter.

Is there sufficient evidence to conclude that the two population standard deviations differ by at least 10%? Use $\alpha = 5\%$. What is the power of the test?
(**3 Marks**)

Exercise 6.4   Comparing Variances – Fischer Test

Prices for regular unleaded gasoline can vary widely from day to day and location to location. These data were obtained on June 1, 2001, from a sample of stations across the respective states (price is in dollars per gallon):

South Carolina					Michigan					
1.46	1.47	1.42	1.51	1.55	1.69	1.79	1.72	1.76	1.80	1.91
1.52	1.48	1.47	1.53	1.50	1.59	1.89	1.72	1.63	1.55	1.71

Use these data to test for equality of variances. What is the P-value of your test, and what conclusions do you draw?
(**4 Marks**)