



MACHAKOS UNIVERSITY

UNIVERSITY EXAMINATIONS 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (STATISTICS AND PROGRAMMING)

STA 402: NON- PARAMETRIC ESTIMATES

DATE: 6/5/2019

TIME: 11.00-1.00 PM

INSTRUCTIONS TO CANDIDATES

Answer Questions ONE and any other TWO questions

QUESTION ONE

- a) Differentiate between parametric statistics and non-parametric statistics (2 marks)
- b) In the Wilcoxon signed rank test, the “zero differences” are discarded when performing the hypothesis test. Explain why it is better to include the zero differences when finding confidence interval for the mean difference (4 marks)
- c) Find the smallest value of n for which $P(y_1 < \varepsilon_{0.5} < y_n) \geq 0.99$ where $y_1 < y_2 < \dots < y_n$ are the order statistics of a random sample of size n from a distribution of the continuous type. (7 marks)
- d) A silver-plating process is being used to coat a certain type of serving tray. When the process is in control the thickness of the silver on the trays will vary randomly following a normal distribution with a mean of 0.002 millimeter and a standard deviation of 0.005 millimeter. Suppose that the next 12 trays examined show the following thickness of silver: 0.019, 0.021, 0.019, 0.020, 0.018, 0.023, 0.021, 0.024, 0.022, 0.023, 0.022 use the runs test to determine if the fluctuations in thickness from one tray to another are random let $\alpha=5\%$ (5 marks)

- e) A sample of 36 individuals were interviewed in a market research survey, with 22 women (W) and 14 men (M) included in the sample. The sampled individuals were obtained in the following order: M, W, W, W, W, M, M, M, W, M, W, W, W, M, M, W, W, W, W, M, W, W, W, M, M, W, W, W, M, W, M, M, W, W, W, M. Use the runs test to test the randomness of this set of observations, using 5 percent level of significance (6 marks)
- f) The following are the number of minutes it took a random sample of 15 men and 12 women to complete a written test for the renewal of their driving license.

Men: 9.9 7.4 8.9 9.1 7.7 9.7 11.8 9.2 10.0 10.2 9.5 10.8 8.0 11.0

Women: 8.6 10.9 9.8 10.7 9.4 10.3 7.3 11.5 7.6 9.3 8.8 9.6

Use the U-test based on the normal approximation to test $H_0: u_1 = u_2$ vs $H_1: u_1 \neq u_2$ (6 marks)

QUESTION TWO (20 MARKS)

- a) The spearman's rank correlation is given by:

$$r_s = \frac{\sum_{i=1}^n (R_i - \bar{R})(S_i - \bar{S})}{\sqrt{[\sum_{i=1}^n (R_i - \bar{R})^2 \sum_{i=1}^n (S_i - \bar{S})^2]}}$$

Where R_i and S_i are the i^{th} rank of x_i and y_i respectively for the bivariate data (x_i, y_i) , $i = 1, \dots, n$ and $\bar{R}$ and $\bar{S}$ are respectively sample means. Show that this reduces to;

$$r_s = 1 - \frac{6 \sum_{i=1}^n D_i^2}{n^3 - n}$$

Where $D_i = R_i - S_i$ (10 marks)

- b) Test the hypothesis by the Kolmogorov-smirnov test that the following sample value:

0.36 0.92 -0.56 1.86 174 0.56 -0.95 0.24

-0.15 -0.74 0.32 0.82 0.70 -0.10 -1.26 -1.06

0.15 0.55 -0.48 -0.49

Came from a normal distribution with mean 07 and variance 1. Take $\alpha=5\%$

NOTE: $P[D_{20} \leq 0.29] = 0.95$ (10 marks)

QUESTION THREE (20 MARKS)

- a) Derive the test statistics for H-test (Kruskal- Wallis test) (10 marks)
- b) In an experiment to determine which of three different missile systems is preferable, the \ propellant burning rate is measured. The data, after coding are given in the table below

Missile system 1	20	31	24	33	23	24	28	16	19	26
Missile system 2	29	18	29	19	20	21	34	33	30	23
Missile system 3	19	31	16	26	31	33	28	28	25	30

Test the hypothesis that the propellant burning rates are the same for the three missile systems at the 0.05 level of significance. (10 marks)

QUESTION FOUR (20 MARKS)

- a) The mean axial stress in tensile members used in an aircraft structure is being studied. Two alloys are being investigated. Alloy 1 is a traditional material, and alloy 2 is a new aluminum-lithium alloy that is much lighter than the standard material. Ten specimens of each alloy type are tested, and the axial stress is measured. The sample data are assembled in the Table below at $\alpha=5\%$ level of significance test the hypothesis that the means of the two stress distributions are identical (10 marks)

Alloy 1	238	3195	3246	3190	3204	3254	3229	3225	3217	3241
Alloy 2	3261	3187	3209	3212	3258	3248	3215	3226	3240	3234

- b) The following are the speeds (in miles per hour) at which every fifth passenger car was timed at a certain check point; 46, 58, 60, 56, 70, 66, 48, 54, 62, 41, 39, 52, 45, 62, 53, 69, 65, 65, 67, 76, 52, 59, 67, 51, 46, 61, 40, 43, 42, 77, 67, 63, 63, 72, 57, 59, 42, 56, 47, 62, 67, 70, 63, 66, 69, 77 Test the hypothesis of randomness at the 0.05 level of significance. (10 marks)