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**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE ACTUARIAL**

**4TH YEAR 1ST SEMESTER 2015/2016 ACADEMIC YEAR**

**REGULAR (MAIN)**

**COURSE CODE: SAS 403**

**COURSE TITLE: NON PARAMETRIC METHODS**

**EXAM VENUE: STREAM: (BSc. Actuarial)**

**DATE: EXAM SESSION:**

**TIME: 2.00 HOURS**

**Instructions:**

1. **Answer question 1 (Compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**QUESTION ONE (20 MARKS)**

1. State briefly what these test are applied for:
2. Wald-Wolfowitz run test
3. Wilcoxon signed rank test
4. Wilcoxon rank sum test (6 marks)
5. A random variable Y has the density function $f\left(y\right)=\left\{\begin{array}{c}0.2 , \&-1<x\leq 0\\0.2+1.2y , \&0<x<1\end{array}\right.$

Compute

1. The lower quartile value.
2. The 90th and 10th percentiles (4 marks)

1. Let $Y\_{1}<Y\_{2}<Y\_{3}<…<Y\_{25}$ be the order statistic of a random sample from a distribution of the continuous type. Compute the approximate value of $Pr⁡\left(Y\_{4}<ξ\_{0.2}<Y\_{12}\right)$ hence state the associated confidence interval. (5marks)
2. Perform a Chi- square test to investigate whether the following is drawn from a binomial distribution with parameter $p=0.3$. Use a 5% level of significance.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 | 4 | 5 |
| f(x) | 12 | 39 | 27 | 15 | 4 | 3 |

 (5 marks)

1. Assume you are given two independent populations $X\_{1}$ and $X\_{2}$. Suppose you want to test that samples differ possibly only in their locations, mention the test you would apply and an assumption you would. Also give a brief procedure about how you would apply this test. (5 marks)
2. Ten candidates sat for two aptitude tests A and B, and the results were as follows.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| candidate |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Test A |  | 20 | 15 | 13 | 10 | 14 | 15 | 18 | 19 | 14 | 12 |
| Test B |  | 6 | 8 | 8 | 4 | 5 | 7 | 3 | 6 | 8 | 9 |

By clearly stating the null and alternative hypothesis, test at 5% level of significance whether or not the results correlated. (5 marks)

**QUESTION TWO (20 MARKS)**

1. Test whether or not the following sample values are random. Assume that the sample values were observed in the strict order in which they appear in the rows of the table, the first and last observations being 71 and 66 respectively.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 71 | 67 | 55 | 64 | 82 | 66 | 74 | 58 | 79 | 61 |
| 78 | 48 | 84 | 93 | 72 | 54 | 78 | 86 | 48 | 52 |
| 67 | 95 | 70 | 43 | 70 | 73 | 57 | 64 | 60 | 83 |
| 73 | 40 | 78 | 70 | 64 | 86 | 76 | 63 | 95 | 66 |

1. marks)
2. Consider the 2x2 contingecy table

|  |  |
| --- | --- |
| a | b |
| c | d |

Derive the Chi-square test statistics for the independence of rows and columns of this table (12 marks)

**QUESTION THREE (20 MARKS)**

1. i. Clearly explain how Kendall’s Tau statistic is constructed and when it is applied.

(4marks)

1. The table below shows data collected during an investigation into attempted suicides . It indicates suicidal intent and a depression rating score for some cases in a scale of 19 and above. Use the daa to compute Kendall’s Tau statistic and interpret its meaning.

|  |  |
| --- | --- |
|  | Depression rating |
| **Suicidal intent** | **19** | **21-29** | **30-39** | **More than 39** |  |
| Do not prefer death | 20 | 8 | 5 | 10 |  |
| unsure | 6 | 4 | 13 | 5 |  |
| Prefer death | 10 | 12 | 16 | 20 |  |

1. arks)
2. To join the University for a given course, it was a requirement that an aptitude test be administered out of 200 marks to prospective candidates. Results for some candidates were recorded as follows:

99, 123, 100, 90, 94, 135, 108, 107, 111, 133,156, 106, 127,119, 104, 127, 109, 117, 105, 125,145, 184

It is proposed that the median aptitude score for the sample is different from 127. Test this claim at $α=0.05$ and state the associated P value. (6marks)

**QUESTION FOUR (20 MARKS)**

1. Find the smallest value of n for which $Pr⁡(Y\_{1}<ξ\_{0.5}<Y\_{n})\geq 0.9$ , where

 $Y\_{1},<Y\_{2}<,…,<Y\_{n}$ are the order statistic of a random sample of size n from a distribution of the continuous type. (10 marks)

1. Analysis of the rate of turnover of employees by a personnel manager produced the following table showing the length of stay of 200 people before they left the company for other employment.

|  |  |
| --- | --- |
|  | Length of stay at the company (years) |
| 0-2  | 2-5 | Over 5 |
| Grade | managers | 4 | 11 | 6 |
| Skilled worker | 32 | 28 | 21 |
| Unskilled worker | 25 | 23 | 50 |

1. State a hypothesis for this problem.
2. Test this hypothesis at 1% level of significance. ( 10 marks)

**QUESTION FIVE (20 MARKS)**

1. Perform a Chi- square test to investigate whether the following is drawn from a binomial $(n,p)$ distribution with parameter $p$ unknown. Use a 5% level of significance.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 | 4 | 5 |
| f(x) | 12 | 39 | 27 | 15 | 4 | 3 |

 (10 marks)

1. By first stating clearly the null and alternative hypothesis, apply the Wilcoxon rank- sum test at 1% level of significance to the following pair of samples.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | 88 | 75 | 92 | 71 | 63 | 84 | 55 | 64 | 82 | 96 |  |  |  |  |
| B | 72 | 65 | 84 | 53 | 76 | 80 | 51 | 60 | 57 | 85 | 94 | 87 | 73 | 61 |

 (10 marks)