THE OPEN UNIVERSITY OF SRI LANKA

B.Sc. /B.Ed. Degree Programme, Continuing Education Programme

APPLIED MATHEMATICS-LEVEL 03

ADU3201/ADU3218/ADE3201 - Basic Statistics

FINAL EXAMINATION 2024/2025

Duration: Two Hours.

Date: 23.11.2024	**Time: 9.30 a.m. – 11.30 a.m.**

Instructions

- This question paper consists of two parts: Part *A* and Part *B*. Part *A* is **compulsory.** Part *B* consists of five (05) essay type questions of which **three (03) are to be answered.**

PART *A* *(Question 1 is compulsory)*

(1) The school administration conducted a study to analyze factors affecting student performance in a high school. They collected data on the following variables for each student:

W_1: Study time per day coded as

a: Less than 1 hour b:1-3 hours c: More than 3 hours

W_2: Mode of transportation to school coded as

a: Walking b: Public transport c: School bus d: Personal vehicle

W_3: Number of absent days term

W_4: Final exam score (out of per 100)

W_5: Participation in extracurricular activities coded as

a: Active participation b: Occasional participation c: No participation

W_6: Temperature of the classroom during final exams (in Celsius)

(i) Classify the variables as qualitative or quantitative.

(ii) Classify the above variables quantitative variables as discrete or continuous.

(iii) Classify the scale of measurements as nominal, ordinal, interval or ratio.

(iv) State whether each of the following statements is true or false. In each case, give reasons for your answer.

a) A bar chart is appropriate to compare the average final exam scores (W_4) across different hours of study per day (W_1).

b) A stacked bar chart is suitable for visualizing the distribution of final exam scores (W_4) based on the number of absent days (W_3).

c) A histogram is suitable to display the frequency distribution of students' final exam scores (W_4).

d) A pie chart is appropriate to illustrate the proportion of students using each type of transportation (W_2).

e) A line graph is suitable for comparing the final exam scores (W_4) of students in different transportation categories (W_2).

PART B ***(Answer 3 questions only)***

(2) A hotel management is concerned about the reliability of its lift. They keep a weekly record of the number of times it breaks down over 20 weeks. The collected data is summarized in the following table.

Number of breakdowns	Frequency of breakdowns (f):
0-1	3
2-3	6
4-5	4
6-7	2
8-9	5

(i) Estimate the mean number of breakdowns and interpret it in relation to this study.

(ii) Estimate the median number of breakdowns.

(iii)Calculate the Inter Quartile Range (IQR) and Inter Quartile Deviation (IQD) of breakdowns.

(iv) Construct a suitable graph that can be used to find the distribution of frequency of breakdowns.

(v) Clearly describe all the findings from the graph constructed in part (iv).

(3) The probability that a child in a school has blue eyes is 0.27 and the probability he/she has blonde hair is 0.35. The probability that the child will have blonde hair or blue eyes, or both is 0.45. A child is chosen at random from the school.

(i) Find the probability that the child has blonde hair and blue eyes.

(ii) What is the probability that the child has blonder hair but not blue eyes.

(iii) Find the probability that the child has neither feature.

(iv) Let A be the event that the child has blue eyes. Let B be the event that the child has blonde hair.

a) Are A and B independent? Justify your answer.

b) Are A and B exhaustive events? Justify your answer.

(4)

(i) Let A and B be any two events and A' and B' be the complementary events of A and B respectively. Show that $P(A' \cap B) = P(A')P(B)$.

(ii) Show that If A, B and C are any three events then,

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C).$$

(iii) Let C and D are two events and $P(C|D) = \frac{1}{3}$, $P(C|D') = \frac{1}{5}$ and $P(D) = \frac{1}{4}$.

a) Find $P(C \cap D)$,

b) Find $P(C \cap D')$,

c) Find $P(D'|C)$.

(5) In a factory, machines *A, B* and *C* are all producing metal rods of the same length. Machine *A* produces 35% of the rods, machine *B* produces 25% and the rest are produced by machine *C*. Of their production of rods, machines *A, B* and *C* produce 3%, 6% and 5% defective rods respectively.

(i) Draw a tree diagram to represent the above information.

(ii) Find the probability that the randomly selected rod is produced by machine *A* and is defective.

(iii) Find the probability that the randomly selected rod is defective.

(iv) Given that a randomly selected rod is defective, find the probability that it was produced by the machine *C*.

(6) Consider a random variable *X* that represents the outcome of drawing a number from a box with four slips of paper, each labeled with the numbers 1, 2, 3, and 4. The probability of drawing each number is given by:

$$P_X(x) = \frac{(3x-1)}{26} \quad ; \quad x = 1, 2, 3, 4.$$

(i) Create a Probability Distribution Table that shows each possible value of *x* and the corresponding probability *p(x)*.

(ii) Find the probability that the number drawn is at least two.

(iii) Calculate the expected value *E(X)* of the number you are likely to draw.

(iv) Show that the variance *Var(X)* = 0.92 of the number you drawn.

(v) If a new rule changes the number on each slip to *Y= 1 – 3X*, find the variance *Var(Y)* for this new setup.

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