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UNIVERSITY EXAMINATIONS 2022/2023

FOURTH YEAR, SECOND SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATION
FOR DEGREE OF BACHELOR OF SCIENCE IN STATISTICS

SMS 3171: INTRODUCTION TO BUSINESS AND SOCIAL STATISTICS

DATE: AUGUST 2023

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Describe the following measures.

- i) Mean
- ii) Variance
- iii) Interquartile deviation
- iv) Kurtosis
- v) Skewness

(5 Marks)

b) Calculate the arithmetic mean of the marks from the following table:

Marks :	0-10	20-Oct	20-30	30-40	40-50	50-60
No.of students	12	18	27	20	17	6

(5 Marks)

c) The average salary of male employees in a firm was Rs.520 and that of females was Rs.420. The mean salary of all employees was Rs.500. Find the percentage of male and female employees.

(5 Marks)

d) A car hire firm has two cars which it hires out day by day. The number of demands for a car on each day is distributed as Poisson variate with mean 1.5. Calculate the proportion of days on which.

- i) neither car is used, and
- ii) some demand is refused.

(5 Marks)

- e) Consider p as a proportion of defectives in a manufacturing process. To test $H_0 : p \leq \frac{1}{4}$ versus $H_a : p > \frac{1}{4}$, a random sample of size 5 is taken from the process. If the number of defectives is 4 or more, the null hypothesis is refuted. What is the probability of rejecting H_0 if $p = \frac{1}{5}$? (5 Marks)
- f) Let X_1, X_2, \dots, X_{11} be a random sample of size 11 from a normal distribution with unknown mean μ variance $\sigma^2 = 9.9$. If $\sum_{i=1}^{11} x_i = 132$, what is the 95% CI for μ ? (5 Marks)

QUESTION TWO (20 MARKS)

- a) Calculate the mean and standard deviation for the following table giving the age distribution of 542 members using the idea of working mean of 55.

Age in years	20-30	30--40	40-50	50-60	60-70	70-80	80-90
No. of members	3	61	132	153	140	51	2

(10 Marks)

- b) Obtain Karl Pearson's measures of skewness for the following data;

(10 Marks)

Values	Frequency
5 to 10	6
15-Oct	8
15-20	21
20-25	21
25-30	15
30-35	11
35-40	2

QUESTION THREE (20 MARKS)

Suppose that the time in minutes that a person has to wait at a certain station for a train is found to be a random phenomenon, a probability function specified by the distribution function,

$$F(x) = \begin{cases} 0 & \text{for } x \leq 0 \\ \frac{x}{2} & \text{for } 0 \leq x < 1 \\ \frac{1}{2} & \text{for } 1 \leq x < 2 \\ \frac{x}{4} & \text{for } 2 \leq x < 4 \\ 1 & \text{for } x \geq 4 \end{cases}$$

- a) Is the Distribution Function continuous? If so, give the formula for its probability density function? (3 Marks)
- b) What is the probability that, a person will have to wait (9 Marks)
- more than 3 minutes
 - less than 3 minutes, and
 - (iii) between 1 and 3 minutes?
- c) What is the conditional probability that the person will have to Wait for a train for (8 Marks)
- More than 3 minutes, given that it is more than 1 minute
 - less than 3 minutes given that it is more than 1 minute.

QUESTION FOUR (20 MARKS)

- a) X is normally distributed with the mean of X being 12 and S.D. is 4. (10 Marks)

I. Find out the probability of the following:

- $X \geq 20$
- $X \leq 20$
- $0 \leq X \leq 12$

II. Find x' when $P(X > x') = 0.24$

- b) The mean yield for one-acre plot is 662 kilos with a s.d. 32 kilos. Assuming normal distribution, how many one-acre plots in (10 Marks)
- Batch of 1000 plots would you expect to have yield.
 - Over 700 kilos,
 - Below 650 kilos
 - What is the lowest yield of the best 100 plots?

QUESTION FIVE (20 MARKS)

- a) Suppose an experimenter wishes to test the hypothesis that;

$$H_0 : \mu = 100$$

versus

$$H_1 : \mu \neq 100$$

At the $\alpha = 0.05$ level of significance and wants $1 - \beta$ equal to 0.06 when $\mu = 103$.

What is the smallest (ie cheapest) sample size that will achieve the objective.

(8 Marks)

- b) As part of “math for the twenty first century” initiative, the seku high school was chosen to participate in the evolution of a new statistical inference curriculum. In the recent past, seku students would be considered “typical”, having earned scores on standardized exams that were very consistent with national averages.

Two years ago, a cohort of eighty-six seku sophomores all randomly selected were assigned to a special set of classes that integrated hypothesis into a statistical inference. According to the results that have just been released, those students averaged 502 on the paper 1 national wide seniors averaged 494 with a standard deviation of 124.

- i) Test at $\alpha = 0.05$ level of significance whether the new curriculum had an effect
(6 Marks)
- ii) Given that $H_0 : \mu = 494$ is being tested against $H_1 : \mu \neq 494$, what p -value is associated with the calculated test statistic $z = 0.60$ and how should it be interpreted?.

(6 Marks)