



**MASENO UNIVERSITY**  
**UNIVERSITY EXAMINATIONS 2016/2017**

**FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE  
DEGREE OF BACHELOR OF SCIENCE IN INFORMATION  
TECHNOLOGY**

**MAIN CAMPUS**

**CIT 102/CIM 104: PROBABILITY AND STATISTICS**

Date: 6<sup>th</sup> June, 2017

Time: 8.30 - 11.30am

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**INSTRUCTIONS:**

- Answer Question ONE and any other TWO.

QUESTION ONE (30MKS)

- a) In a survey the masses of 50 apples were noted and recorded in the following table. Each value was given to the nearest gram.

|     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|
| 86  | 101 | 114 | 118 | 87  | 92  | 93  | 116 |
| 105 | 102 | 97  | 93  | 101 | 111 | 96  | 117 |
| 100 | 106 | 118 | 101 | 107 | 96  | 101 | 102 |
| 104 | 92  | 99  | 107 | 98  | 105 | 13  | 100 |
| 103 | 108 | 92  | 109 | 95  | 100 | 103 | 110 |
| 113 | 99  | 106 | 116 | 101 | 105 | 86  | 88  |
| 108 | 92  |     |     |     |     |     |     |

- i) Construct a frequency distribution, using equal class intervals of width 5g and taking the first intervals as 85-89. (4mks)

Use the table to :

- ii) Find the mean (4mks)

Estimate:

- iii) Median (4mks)

- iv) Interquartile range (4mks)

- b) Two fair dice are rolled and face values are noted.

- (i) What is the probability space? [2mks]  
 (ii) What is the probability that the sum of the numbers showing is 7? [2mks]  
 (iii) What is the probability that both dice show number 2? [1mk]

- c) Find

- i)  $E(X)$  [2mks]  
 ii)  $E(X^2)$  [2mks]  
 iii)  $Var(X)$  [2mks]

For the probability distribution below.

|            |               |               |               |               |                |
|------------|---------------|---------------|---------------|---------------|----------------|
| $X$        | 8             | 12            | 16            | 20            | 24             |
| $P(X = x)$ | $\frac{1}{8}$ | $\frac{1}{6}$ | $\frac{3}{8}$ | $\frac{1}{4}$ | $\frac{1}{12}$ |

- d) For a given of data  $\sum x = 15$ ,  $\sum x^2 = 55$ ,  $\sum y = 43$ ,  $\sum y^2 = 397$

$$\sum xy = 145, \quad n = 5$$

Find the equation of the regression lines  $y$  on  $x$ .

(4mks)

#### QUESTION TWO (20MKS)

- a) For given set of data  $\sum x = 680$ ,  $\sum y = 996$ ,  $\sum x^2 = 20154$ ,  $\sum y^2 = 34670$ ,  
 $\sum xy = 24844$ ,  $n = 30$ . Find the product-moment correlation coefficient (4mks)
- b) For a period of three years accompany monitors the number of units of output per quarter and the total cost of producing the units. The table below shows their results.

| Units | total cost |
|-------|------------|
| (x)   | (y)        |
| 14    | 35         |
| 29    | 50         |
| 55    | 73         |
| 74    | 93         |
| 11    | 31         |
| 23    | 42         |
| 47    | 65         |
| 69    | 86         |
| 18    | 38         |
| 36    | 54         |
| 61    | 81         |

(Use  $\sum x^2 = 28740$ ,  $\sum xy = 38286$ )

i) Draw a scatter diagram of these data(3mks)

ii) Calculate the equation of the regression line of  $y$  on  $x$  (6mks)

iii) draw this line on your scatter diagram.(3mks)

c) The number of births announced in the personal column of local weekly newspaper may modeled by a Poisson distribution with mean 2.4.

Find the probability that in a particular week

i) Three or fewer births will be announced (2mks)

ii) Exactly four births will be announced. (2mks)

### QUESTION THREE (20MKS)

A random variable  $X$  is said to have a Binomial distribution if the probability function of  $X$ ,  $f(x)$  is given as  $P(X = x) = f(x) = \binom{n}{x} p^x (1 - p)^{n-x}$   $x = 0, 1, 2, \dots, n$  where  $p$  is the probability of success and  $q = 1 - p$ .

(a) Show that the moment generating function of  $X$ ,  $M_x(t)$  is given by;

$$M_x(t) = (q + pe^t) \quad [5mks]$$

(b) Comment of the distribution of  $X$  when  $n = 1$  [2mks]

(c) Use your generating function above to verify that,

(i) The expected value of  $X$ ,  $E(X) = np$  [4mks]

(ii) The variance of  $X$ ,  $Var(X) = npq$  [5mks]

(d) At sellite Supermarket, 60% of customers pay by credit card. Find the probability that in a randomly selected sample of ten customers

(i) Exactly two pay by credit card [2mks]

(ii) More than seven pay by credit card [2mks]

### QUESTION FOUR (20 MKS)

a) The probability density function of a random variable  $X$  is given by

$$f(x) = \begin{cases} cx & 0 < x < 4 \\ 0 & \text{otherwise} \end{cases}$$

i) Find  $c$ . [3mks]

ii) Find the distribution function  $F(x)$ . [2mks]

iii) Compute  $P(1 < x < 3)$ . [2mks]

- b) A company that manufactures precision special-alloy steel shafts claims that the variance in the diameters of shafts is no more than 0.0003. A random sample of 10 shafts gave a sample variance of 0.00027. At the 5% level of significance, test whether the company's claim can be substantiated. [6mks]
- c) The time required to perform a certain job is a random variable having a normal distribution with mean 45 minutes and standard deviation of 10 minutes. Compute the probabilities that;
- i) The job will take more than 75 minutes [2mks]
  - ii) The job will take less than 60 minutes [2mks]
  - iii) The job will take between 35 and 60 minutes [3mks]

**QUESTION FIVE (20MKS)**

- a) A particular brand of drink has an average of 12 ml per can. As a result of randomness, there will be small variations in how much liquid each bottle really contains. It has been observed that the amount of liquid in these bottles is normally distributed with  $\sigma = 0.8$  ml. A sample of 10 bottles of this brand of soda is randomly selected from a large lot of bottles, and the amount of liquid, in ml, is measured in each. Find the probability that the sample mean will be within 0.5 ounce of 12 ounces. [5mks]
- b) Studies have shown that the risk of developing coronary disease increases with the level of obesity, or accumulation of body fat. A study was conducted on the effect of exercise on losing weight. Fifty men who exercised lost an average of 11.4 lb, with a standard deviation of 4.5 lb. Construct a 95% confidence interval for the mean weight loss through exercise. Interpret the result and state any assumptions you have made. [5mks]
- b). Let the population consist of the numbers {1, 2, 3, 4, 5}. Consider all possible samples consisting of three numbers randomly chosen without replacement from this population.
- i) Obtain the distribution of  $\bar{X}$  [6mks]
  - ii) Obtain the mean and variance of  $\bar{X}$  [4mks]