MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

DIPLOMA IN BUILDING AND CIVIL ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING

ECU 0201: ENGINEERING MATHEMATICS V (STATISTICS)

DATE: 30/5/2017 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

1. ***Answer Question* 1 *and any other two questions.***
2. ***You must have the following items for this paper:***
   - ***Statistical tables.***
   - ***Scientific calculator.***

1. (a) Differentiate between each of the following terms as used in Statistics.

   (i) primary data and secondary data;

   (ii) categorical data and numerical data. (6 marks)

   (b) Explain in words the meaning of each of the following terms as used in Statistics:

   (i) mean;

   (ii) median. (4 marks)

   (c) The data given below represents the frequency distribution of sizes of shoes purchased by 250 customers in the month of December 2016.

Shoe size	4	5	6	7	8	9	10	11
No. of customers	6	16	42	64	52	36	24	10

   Determine each of the following measures about the distribution the sizes:

   (i) Median;

   (ii) Mean;

   (iii) Standard deviation. (9 marks)

(d) An building contractor carried out a study on the relationship between the size of a house and the cost of construction. After collection and analysis of the relevant data, the coefficient of correlation between the two variables was found to be $r = 0.7864$

Compute the co-efficient of determination between the size of a house and the cost of construction, and interpret the result obtained. (5 marks)

(e) A box contains 8 blue pens and 4 black pens which are identical in all aspects except colour. A customer picks 2 pens at random from the box one at a time without replacement.

(i) Present this information using a probability tree diagram. (3 marks)

(ii) Hence determine the probability that all the pens picked are of different colours.(3 marks)

2. The table below shows the age distribution of 500 employees working at the headquarters of a county government.

Age (years)	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64
No. of employees	6	20	74	96	120	92	64	24	4

(a) Estimate by calculation each of the following measures about the age of the employees:

i) Mean
ii) Median
iii) Standard Deviation (8 marks)

(b) Due to continuous burden of the huge wage bill, it is desired to reduce the present number of employees according to the following scheme:

- To retrain the first 15% from the lower age group.
- To retain the next 45% in their current workstations.
- To transfer the next 30% to the national government.
- To retrench the 10% from the highest age group.

Determine the age limits of the persons retained and those to be transferred to the national government. (7 marks)

(c) Suppose the employees whose age is between 42 and 52 years are to be transferred to the national government. Determine the proportion of employees who will be transferred. (5 marks)

3. A researcher in the construction industry is interested in investigating the relationship between the distance covered in transporting a construction material from the factory to the point of sale and the retail price paid for the material by the consumer. A survey was carried out in which a random sample of 10 construction materials was taken and the distance from the factory in kilometres and the price paid for the material in thousand Kenya shillings recorded as shown below.

Material	A	B	C	D	E	F	G	H	J	K
Distance	24.6	18.8	15.2	12.5	24.2	32.0	17.4	26.2	15.4	13.8
Price	32	26	24	20	28	35	30	36	21	12

(a) (i) Compute the Pearson's product moment co-efficient of correlation between the distance covered in transporting the material from the factory and the retail price.(9 marks)

(ii) Interpret the result obtained in (a) (i) above. (2 marks)

(b) (i) Determine the least squares regression line of the retail price of material on the distance from the factory. (4 marks)

(ii) Interpret the regression line obtained in (b) (i) above. (3 marks)

(iii) Using the regression line obtained in (b)(i) above, estimate by calculation the retail price for a typical construction material which is sold 20 kilometres away from the factory. (2 marks)

4. (a) A landline phone number system in Nairobi uses 10 digits to assign phone numbers to its subscribers. However, the first three digits must be a 0 (zero), 2 and 0 in that order, while the, the fourth digit must not be a 0 (zero). Determine the maximum number of subscribers which can be accommodated by this coding system. (4 marks)

(b) A market survey was conducted on the popularity of the watching of news on the main television channels in rural Kenya. A random sample of 520 rural residents was taken from some counties and the findings of TV viewing on a certain day were as follows:

- 276 residents watched Nation
- 260 residents watched KTN
- 228 residents watched Citizen
- 120 residents watched Nation and KTN
- 108 residents watched Nation and Citizen
- 104 residents watched KTN and Citizen
- 40 residents did not watch any of the three TV channels

(i) Present this information in a Venn diagram. (6 marks)

(ii) Determine the number of residents in the study who watched:

I. exactly two of the TV channels;

II. Nation or KTN but not Citizen. (4 marks)

(c) Observation in a certain rural region shows that not all residents who are connected to the national electricity grid have TV sets and not all residents who have TV sets are connected to the national electricity grid. After conducting a survey among a random sample of 360 residents in the region, the findings were as follows:

- 144 residents who are connected to the national electricity grid have TV sets;
- 96 residents who are connected to the national electricity grid do not have TV sets;
- 48 residents who are not connected to the national electricity grid have TV sets;
- 72 residents who are not connected to the national electricity grid do not have TV sets.

(i) Present this information in a contingency table.

(ii) A resident who is connected to the national electricity grid is selected at random, determine the probability that he has a TV set.

(iii) A resident in the region who has a TV set is selected at random, determine the probability that he is connected to the national electricity grid. (6 marks)

5. (a) Outline **three** properties of the binomial probability distribution. (3 marks)

(b) An electrical engineer claims that only 40% of the residential buildings in Machakos Town had the electrical fittings done by a registered contractor. Assuming that this claim is true, determine the probability that among 12 such residential buildings randomly selected from Machakos Town, the following had the electrical fittings done by a registered contractor:

(i) between 4 and 6 buildings inclusive;

(ii) at least 3 buildings. (7 marks)

(c) The operational lifespan of a given brand of a laundry machine has been found to be normally distributed with a mean of 4.8 years and a standard deviation of 1.6 years.

(i) Determine the proportion of these laundry machines that will have a lifespan of between 3.8 years and 6.6 years; (4 marks)

(ii) If these laundry machines have a warranty period of 2 years, determine the proportion of original sales which will require replacement through this warranty. (3 marks)

(iii) If the manufacturer of these laundry machines wants only 5% of the machines to be replaced through this warranty, determine the warranty period that should be set to achieve this. (3 marks)