UNIVERSITY OF ENERGY AND NATURAL RESOURCES, SUNYANI, GHANA

SCHOOL OF SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

LEVEL 300: END OF FIRST SEMESTER EXAMINATION, 2017/2018

Bachelor of Science:

(COMP ENG III, PET III, ENV ENG III, AGRIC ENG III/IV, MECH III, and REE III)

STAT 309: PROBABILITY AND STATISTICS FOR ENGINEERS

6^{th} December, 2017 **Time: 2 Hours and 30 Minutes**

Materials required: Distribution tables

Instructions:

1. Attempt all questions in **SECTION A**, answer questions 5 and 6 and any other question in **SECTION B**, answer two (2) questions in **SECTION C** and one (1) question in **SECTION D.**
2. Write clearly and precisely in your answer booklet.
3. Start answer to each question, under **SECTION C** and **SECTION D**, in a new page.

December 2, 2017

SECTION A (25 Marks)

ATTEMPT ALL QUESTIONS IN THIS SECTION

1. The focusing mechanism on Ron's camera is bust, so that he can only take pictures of people at distance 2 meters, so he only take pictures of 3 people at a time. How many different pictures are possible if 9 people are present (**5 marks**)?

2. Your focus is to form a research group consisting of a number of engineers and computer programmers. From 8 engineers and 5 computer programmers, in how many ways can one select a research group of

(a) 3 engineers and 2 computer programmers (**4 marks**)?

(b) 5 people, with condition that the research group contains at least 2 computer programmers and at least two engineers (**5 marks**)?

3. The probability that a microchip is manufactured perfectly is 0.98 and the probability that the microchip is installed correctly is 0.93. What is the probability that the installed chip functions perfectly (**5 marks**)?

4. The random variable X has a probability mass function $\Pr(X = x)$ defined as

$$\Pr(X = x) = \begin{cases} \frac{k}{x!}, & x = 0, 1, 2, 3, 4. \\ 0 & \text{Otherwise.} \end{cases}$$

(a) For what value of k is $\Pr(X = x)$ a probability mass function (**4 marks**)?

(b) Find $\Pr[X \leq 2]$ (**2 mark**).

SECTION B (25 Marks)

ANSWER QUESTIONS 5 AND 6 AND ANY OTHER QUESTION IN THIS SECTION

5. A TV manufacturer is supplied with a certain components by a specialist producer. Each incoming consignment of the components is subject to the following quality control procedure. A random sample of 10 components is individually tested. If there are one or more defective components among the 10 tested, the entire consignment is rejected. If there are no defectives components in the sample, the consignment is accepted.

(a) What is the probability of a consignment being rejected if the true proportion of the defective components are

i. 1% (**5 marks**)?

ii. 10% (**5 marks**)?

6. The population variance of the amount of cool drink supplied by a vending machine is known to be $\sigma^2 = 115$ ml.

A%	z^*
90%	1.64
95%	1.96
98%	2.33
99%	2.58

$\binom{10}{x}$

(a) The machine was activated 61 times, and the mean amount of cool-drink supplied on each occasion was 185 ml . Find a 95% confidence interval for the mean (**5 marks**).

(b) What size samples are required if the estimated mean is required to be within (i) 1 ml of the true value, with probability 0.99 (**5 marks**)?

7. Suppose the random variable X has probability density function $f(X = x)$ defined as

$$f(X = x) = \begin{cases} 6x(1-x) & 0 \leq x \leq 1 \\ 0 & \text{Otherwise.} \end{cases}$$

$8C_3 \times 5C_2 + 8C_2 \times 5C_3$

Find

(a) the mean and (**2 marks**)

$\left(\bar{x} - z * \frac{\sigma}{\sqrt{n}}\right)$

(b) the variance (**3 marks**)

8. Beercans are randomly tossed alongside the national road, with an average frequency of 3.2 per km.

(a) What is the probability of seeing no bearcans over a 5km stretch (**2 marks**)?

(b) What is the probability of seeing at least one bearcans over a 200m (**3 marks**)?

SECTION C (25 Marks)

ANSWER ONLY TWO QUESTIONS IN THIS SECTION

9. A well is drilled as part of an oil exploration programme. The probability of the well passing through shale is 0.4. If the well passes through shale, the probability of striking oil is 0.3. If it does not pass through shale, the probability drops to 0.1. Given that oil was found, what is the probability it did not pass through shale (**12.5 marks**)?

10. A t-shirt manufacturer knows that the measurements of his customers are normally distributed with mean 92cm and standard deviation 5cm. He makes his t-shirts in small sizes (fit size range 80-87cm) and medium sizes (fit size range 87-94). What proportion of customers fit into the small and medium sizes (**12.5marks**)?

11. The probability that a hole is properly drilled through a vending machine is 1/3 and the probability that the hole is 6 cm is 3/4. The probability that the hole is either properly drilled or is 6 cm is 11/12.

(a) Find the probability that the hole is properly drilled and is 6cm (**5 marks**).

(b) Given that the hole is 6cm, what is the probability that the hole is properly drilled (**7.5 marks**)?

SECTION D (25 Marks)

ANSWER ONE QUESTION IN THIS SECTION

12. A research is conducted to establish the relationship between escaping hydrocarbons and tank temperature. Data on the amount of escaping hydrocarbons are shown in Table 1. The amount escaping hydrocarbons (**H**) is a function of the tank temperature (**T**).

(a) Plot the data to show the relationship between **H** and **T** and also explain the relationship (**3 marks**).

(b) Determine and interpret your correlation coefficient (**12.5 marks**).

$1-0.4-0.6$

0.1×0.6

$.1\times0.6+0.4\times0.3$

(c) Test for the association or correlation between the two variables at 5% level of significance (**5 marks**).

(d) Give the regression equation $\mathbf{H}_i = \beta_0 + \beta_1 \times \mathbf{T}_i + \epsilon_i$. Find the line of the best fit. [**Hint**: find β_0 and β_1 and then substitute back into the regression equation] (**3.5 marks**).

(e) So if **T** is 33 predict the corresponding amount of escaping hydrocarbons (**H**) (**1 marks**).

Table 1: Hydrocarbons escaping data

H	T
29	33
24	31
26	33
22	37
27	36
21	35
33	59
34	60
32	59
34	60
20	34
36	60

13. The miners are out on strike, with a list of demands. Negotiators reckon that if management meets one of the demands, the probability that the strike will end is 0.85. However, if the demand is not meet, the probability that the strike will continue is 0.92. You assess that the management will agree to meet the demand as 0.3. Later you heard that the strike has ended, show how you will estimate the probability that the demand was met (**25 marks**).

The End!