UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

FIRST SEMESTER EXAMINATIONS, NOV/DEC 2018

COURSE NO: GM, GL, MN, MR, ES, PE 361.
COURSE NAME: **PROBABILITY AND STATISTICS**
CLASS: GM, GL. MN, MR, ES, PE TIME: 3 HOURS

Name**:** _____Index Number: _____

ANSWER ANY FOUR QUESTIONS

Question 1

a. The owner of a small restaurant decides to change the menu. A trade magazine claims that 40% of all diners choose organic foods when eating away from home. On a randomly chosen day, there are 20 diners eating in the restaurant.

i. Assuming the claim made by the trade magazine to be correct, suggest a suitable model (distribution) to describe the number of diners (X) who choose organic food and write down ***three (3) conditions*** under which the model may be used in a statistical work.

ii. Find p (5 < X < 15)

iii. Find the mean and standard deviation of X. **[19 Marks]**

b. Explain the following terms: **[6 Marks]**
(i) Inferential statistics (ii) Random variable (iii) Events

Question 2

a. Given the function $f(x) = \frac{2x+1}{25}, x = 0, 1, 2, 3, 4$

Find (i) p(X=4) (ii) p(X≤1) p (2≤ X <4) **[12 Marks]**

b. Suppose that the error in the reaction temperature, in ºC for a controlled laboratory experiment is a continuous variable X having the probability density function:

$$f(x) = \begin{cases} \frac{x^2}{3}, & -1 < x < 2 \\ 0 & \text{elsewhere,} \end{cases}$$

i. Sketch the probability density function f(x)

ii. Specify fully the cumulative distribution function of X and use it to evaluate $p(0 < X \le 1)$.

[13 Marks]

Question 3

a. The Ministry of Health is testing the presence of malaria parasites in the blood of the people in an area. The first three to be tested positive will be given free treatment. Suppose it is known that 40% of the people have positive indications of the parasite in their blood, find the probability that ten persons must be tested in order to find three positive. **[10 Marks]**

b. The lifetime (in hours) of a certain equipment is a random variable with a density function given by:

$$f(x)=\begin{cases}4e^{-4x}, & x>0\\ 0, & \text{elsewhere}\end{cases}$$

Find the probability that at least two of the three equipment independently in use will operate for at least 2 hours without failure. **[15 Marks]**

Question 4

a. Explain the following terms: **[6 Marks]**

(i) Degree of freedom (ii) Critical Region (iii) Critical value

b. Duracell manufactures batteries that the CEO claims will last an average of 300 hours under normal use. A researcher randomly selected 20 batteries from the production line and tested these batteries. The tested batteries had a mean life span of 270 hours with a standard deviation of 50 hours. Do we have enough evidence to suggest that the claim of an average lifetime of 300 hours is false? Use the standard significance level of 0.05, and assume a normal population distribution.

[19 Marks]

Question 5

a. An oil exploration firm is formed with enough capital to finance ten (10) explorations. The probability of a particular exploration being successful is 0.6. Suppose the firm has a fixed cost of ₵20 million in preparing equipment prior to doing its first exploration. If each successful exploration costs ₵30 million and each unsuccessful exploration costs ₵15 million, find the expected total cost, to the firm, of its ten explorations. **[8 Marks]**

b. Table 1 lists the history of 940 wafers in a semiconductor manufacturing process. Suppose one wafer is selected at random **[17 Marks]**

Table 1 History of 940 Wafers in a Semiconductor Manufacturing Process

Contamination	Location of Sputtering Tool		Total
	Centre	Edge	
Low (L)	514	68	**582**
High (H)	112	246	**358**
Total	**626**	**314**	**940**

i. What is the probability that the wafer is from the centre of the sputtering tool and contains high levels of contamination?

ii. What is the probability that the wafer is from the centre of the sputtering tool or contains high levels of contamination?

iii. If the wafer is in the centre of the sputtering tool, what is the probability that the wafer contains high level of contamination?

Assoc Prof S. Al-Hassan
Dr E. Broni Bediako