



NATIONAL OPEN UNIVERSITY OF NIGERIA  
University Village, Plot 91, Cadastral Zone, Nnamdi Azikwe Express Way, Jabi-Abuja

FACULTY OF SCIENCES  
2021\_2 Examinations.

Course Code: STT 311

Course Title: Probability Distributions II

Credit Unit: 3

Time Allowed: 3 Hours

Total: 70 Marks

Instruction: Answer Question One (1) and Any Other 4 Questions

**Question 1 (Compulsory)**

- (a) State the weak law of large numbers (3 marks)
- (b) State the strong law of large numbers (3 marks)
- (c) A pair of fair dice is rolled once in a statistical experiment. Determine the sample space for this experiment. (3 marks)
- (d) Based on the experiment described in (c) above, determine the probability of getting a sum of 11. (3 marks)
- (e) An experiment involved throwing a die 5 times and observed the number that came in each trial. Based on your knowledge of binomial probability distribution, determine the probability of obtaining
  - (i) exactly a six (3 marks)
  - (ii) exactly two sixes (3 marks)
  - (iii) at least two sixes (4 marks)

**Question 2**

The probability distribution of a discrete random variable  $x$  is given as follows

$x$	0	1	2	3	4
$P(x)$	0.25	0.125	0.125	0.25	0.25

- (a) Compute the mathematical expectation for the random variable  $x$  (4 marks)
- (b) Compute the variance for the random variable  $x$  (6 marks)
- (c) Hence or otherwise, determine the associated standard deviation (2 marks)

### Question 3

Tuyil Pharmaceutical Company has three machines marked P, Q and R in her factory in Lagos State and they produce 50%, 30% and 20% of the entire COVID-19 vaccine for West Africa respectively. The Chief Quality Assurance Officer reported that the percentages of defective vaccine of the machines are respectively 3%, 4%, and 5%. If a vaccine is selected at random and it is discovered to be defective, what is the probability that it was produced by machine P? **(12 marks)**

### Question 4

$$\text{Given that } f(x) = \begin{cases} cx, & 0 \leq x \leq 3 \\ 0, & \text{otherwise} \end{cases}$$

- i. Determine the value of  $c$  such that the  $f(x)$  is a density function **(3 marks)**
- ii. Compute  $\Pr(1 \leq x \leq 2)$  **(3 marks)**
- iii. Evaluate the mean of  $x$  **(3 marks)**
- iv. Evaluate the variance of  $x$  **(3 marks)**

### Question 5

An experiment involved selection of balls from two urns, labeled **A** and **B**. Urn **A** had 2 green balls and 1 yellow ball while urn **B** had 1 green ball and 3 yellow balls. A coin was flipped to determine which of the urns to be chosen. If the coin showed head, urn **A** was chosen and a ball was drawn but if the coin showed tail, urn **B** was chosen and a ball was drawn. Determine the probability of selecting a green ball. **(12 marks)**

### Question 6

A candidate sitting for 2020 UTME finds a particular question which was asked the previous year. The question has 4 alternative answers of which only one is correct. If the candidate has practiced with the previous year's question, he is certain to identify the correct answer, otherwise he chooses an answer at random. Let **A** denote the event that the candidate had practiced with the particular question with probability  $p$  and **B** denote the event that he answers the question correctly.

- (a) Find the conditional probability  $P(\mathbf{A}|\mathbf{B})$  in terms of  $p$ . **(6 marks)**
- (b) Hence, find  $P(\mathbf{A}|\mathbf{B})$  if  $p = 3/5$ . **(6 marks)**