



**UNIVERSITY OF ENERGY AND NATURAL RESOURCES, SUNYANI, GHANA**

**SCHOOL OF SCIENCES**

**DEPARTMENT OF MATHEMATICS AND STATISTICS**

**LEVEL 300 MID-SEMESTER EXAMINATIONS 2021/2022**

**(AGRIC ENG, CIVIL ENG, COMPUTER ENG, EEE, ENV ENG, MECH ENG, PET ENG & REE)**

**STAT 309: PROBABILITY AND STATISTICS FOR ENGINEERS**

**4<sup>th</sup> April, 2022**

**Time: 1 hour**

**Materials Required:**

- **Calculators**

**Instructions**

- **This paper consists of one section, answer all the questions.**
- **All answers must be done on the question paper and all rough work must be done in the answer booklets provided.**
- **Write your programme of study and index number on the space provided.**

**INDEX NUMBER: .....**

**PROGRAMME: .....**

1. A class contains 8 boys and 7 girls. The teacher selects three of the children at random and without replacement. Calculate the probability that the number of boys selected exceeds the number of girls selected.  
**a. 36/65**  
 b. 3/65  
 c. 54/65  
 d. 33/65
2. How many functions defined on a set with n-points are possible if each functional value is either 0 or 1.  
**a.  $2^n$**   
 b.  $n^2$   
 c.  $2n$   
 d. n

### EXHIBIT 1

Consider an experiment of rolling a balanced die **5 times**.

Use this preamble to answer question 3-5

3. How many possible outcomes are there in the outcomes space?  
 .....**7776**.....
4. How many elements are in the event of getting different numbers without repetitions?  
 .....**720**.....
5. How many elements are in the event of getting different numbers without repetitions but the second number must be a 4?  
 .....**120**.....
6. The important characteristics for describing, exploring, and comparing data sets include all the following EXCEPT  
**a. Data size**  
 b. Centre  
 c. Distribution  
 d. Variation
7. The three common measures of central tendency are?  
 ... **Mean, median and mode**.....

8. If the mean and coefficient of variation of a given data set are 15% and 48% respectively, then find the value of standard deviation.
- 6.2
  - 7.2**
  - 8.2
  - 9.2
9. The time taken (in minutes) to complete a homework by 8 students in a day are given by 38, 40, 47, 44, 46, 43, 49, 53. Find the standard deviation.
- 4.53**
  - 6.54
  - 7.11
  - 8.43
10. Given that events A and B are independent, then all the following are true EXCEPT
- $P(A \setminus B) = P(A)$
  - $P(A \cap B) = P(A) * P(B)$
  - $P(A \cup B) = P(A) + P(B)$**
  - $P(A \cup B) = P(A) + P(B) * P(\bar{A})$

## EXHIBIT 2

Construct probability distribution for the random experiment of the difference between the results of two fair dice rolled together. Let  $X$  be the random variable for the distribution.

Use the probability distribution to determine questions 11 to 15.

11.  $P(X > 1) = \dots\dots\dots$ **0.556** $\dots\dots\dots$
12.  $P(X < 3) = \dots\dots\dots$ **0.667** $\dots\dots\dots$
13.  $P(0 \leq X \leq 5) = \dots\dots$ **1** $\dots\dots\dots$
14.  $P(X < 5 | X > 0) = \dots\dots$ **0.933** $\dots\dots\dots$
15.  $P(X > 2 | X < 6) = \dots\dots$ **0.333** $\dots\dots\dots$

### EXHIBIT 3

Semiconductor lasers used in optical storage products require higher power levels for write operations than for read operations. High-power-level operations lower the useful life of the laser. Lasers in products used for backup of higher speed magnetic disks primarily write, and the probability that the useful life exceeds five years is 0.95. Lasers that are in products that are used for main storage spend approximately an equal amount of time reading and writing, and the probability that the useful life exceeds five years is 0.995. Now, 25% of the products from a manufacturer are used for backup and 75% of the products are used for main storage. Let  $A$  denote the event that a laser's useful life exceeds five years, and let  $B$  denote the event that a laser is in a product that is used for backup.

Use the information above to determine the probabilities from question 16 to 20

- 16.  $P(B) = \dots\dots\dots 0.25 \dots\dots\dots$
- 17.  $P(A|B) = \dots\dots\dots 0.95 \dots\dots\dots$
- 18.  $P(A|B') = \dots\dots\dots 0.05 \dots\dots\dots$
- 19.  $P(A \cap B) = \dots\dots\dots 0.2375 \dots\dots\dots$
- 20.  $P(A \cap B') = \dots\dots\dots 0.0375 \dots\dots\dots$

### EXHIBIT 4

Consider the following data: 2.92, 4.20, 5.26, 7.98, 8.23, 8.84, 9.79, 10.94, 15.95, 16.05

Use it to answer questions 21 to 23.

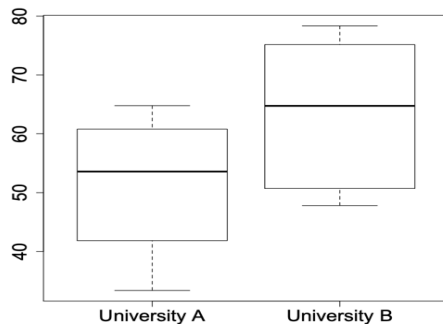
- 21. What is the sample mean (to 2 decimal place)?
  - (a) 9.01
  - (b) 9.02**
  - (c) 9.03
  - (d) 9.04
- 22. What is the sample variance (to 2 decimal place)?
  - (a) 17.80
  - (b) 23.92
  - (c) 19.78**
  - (d) 25.71
- 23. What is the sample first quartile (to 3 decimal place)?
  - (a) 4.465
  - (b) 4.601
  - (c) 4.730
  - (d) 4.995**

24. Suppose you have the following data: 1, 2, c, d, 6 where c and d are unknown. If you know that the sample mean is 2 and the sample variance is 6 what are the values of c and d?  
[Hint: When computing the sample variance, use the formula

$$s^2 = \frac{1}{n-1} (\sum_{i=1}^n x_i^2 - n \bar{x}^2)$$

- (a)  $c = \frac{1}{2} + \frac{\sqrt{5}}{2}$ ,  $d = \frac{1}{2} - \frac{\sqrt{5}}{2}$   
 (b)  $c = 1 + \frac{\sqrt{5}}{2}$ ,  $d = 1 - \frac{\sqrt{5}}{2}$   
 (c)  $c = 2 + \frac{\sqrt{5}}{2}$ ,  $d = 2 - \frac{\sqrt{5}}{2}$   
 (d)  $c = \frac{1}{2} + \frac{\sqrt{5}}{4}$ ,  $d = \frac{1}{2} - \frac{\sqrt{5}}{4}$

25. Students from two universities were asked to sit the same exam. The box plot below shows the distribution of marks from the two groups. Study the box plot and answer the question below.

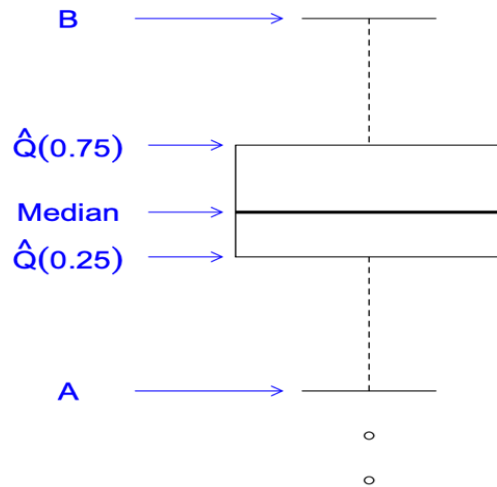


Which of the following can be concluded from the figure above?

- (i) The lowest mark in University A is smaller than the lowest mark in University B.  
 (ii) The highest mark in University A is greater than the lowest mark in University B.  
 (iii) The median mark in University A is greater than the lower quartile in University B.

- (a) All of the above  
 (b) Only (iii)  
 (c) Only (ii)  
 (d) Only (i) and (ii)

26. Study the box plot below.



Which of the following statements about the box plot is true?

- (i) A corresponds to the sample minimum
- (ii) B corresponds to the sample maximum

- (a) Both (i) and (ii)
- (b) Only (i)
- (c) Only (ii)**
- (d) Neither

### EXHIBIT 5

The distribution function of a random variable  $X$  is given. Use it to answer questions 27 to 30

$$F_{(x)} = \begin{cases} 0 & x < 0 \\ \frac{x}{2} & 0 \leq x < 1 \\ \frac{2}{3} & 1 \leq x < 2 \\ \frac{11}{12} & 2 \leq x < 3 \\ 1 & 3 \leq x \end{cases}$$

27. What is the probability that  $X$  less than 3, i.e.  $P(X < 3)$ ?

- (a)  $\frac{2}{3}$
- (b)  $\frac{3}{2}$
- (c)  $\frac{1}{2}$
- (d)  $\frac{11}{12}$**

28. What is the probability that X equals 1, i.e.  $P(X = 1)$ ?
- (a)  $\frac{2}{3}$
  - (b)  $\frac{1}{6}$
  - (c)  $\frac{1}{2}$
  - (d)  $\frac{1}{7}$
29. What is the probability that X exceeds  $\frac{1}{2}$ , i.e.  $P(X > \frac{1}{2})$ ?
- (a)  $\frac{1}{2}$
  - (b)  $\frac{1}{4}$
  - (c)  $\frac{3}{4}$
  - (d)  $\frac{3}{5}$
30. Compute  $P(2 < X \leq 4)$ ?
- (a)  $\frac{1}{12}$
  - (b)  $\frac{11}{12}$
  - (c) 1.0
  - (d)  $\frac{2}{12}$