



*(Knowledge for Development)*

# **KIBABII UNIVERSITY**

**UNIVERSITY EXAMINATIONS**

**2021/2022 ACADEMIC YEAR**

**SECOND YEAR FIRST SEMESTER**

**MAIN EXAMINATION**

**FOR THE DEGREE OF BACHELOR OF SCIENCE IN  
COMPUTER SCIENCE AND INFORMATION TECHNOLOGY**

**COURSE CODE: STA 205**

**COURSE TITLE: STATISTICS AND PROBABILITY**

**DATE: 26/01/2022**

**TIME: 2:00 PM - 4:00 PM**

---

## **INSTRUCTIONS TO CANDIDATES**

Answer Question One and any other TWO Questions

TIME: 2 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over. ►

Question 1

(6 marks)

- a. Define the following terms as used in this course
- Conditional probability
  - Central limit theorem
  - Moment generating function
- b. A researcher is interested in evaluating how well a diagnostic test works for detecting renal disease in patients with high blood pressure. She performs the diagnostic test on 137 patients, 67 with known renal disease and 70 who are known to be healthy. The diagnostic test comes back either positive (the patient has renal disease) or negative (the patient does not have renal disease). Here are the results of her experiment:

Truth	Test Result		Total
	Positive	Negative	
Renal disease	44	23	67
Healthy	10	60	70
Total	54	83	137

- What is the probability that the patient tests positive? (2 marks)
  - What is the probability that a patient has renal disease? (2 marks)
  - What is the probability that a patient tests positive given that they have renal disease? (2 marks)
- c. The Edwards's Theater chain has studied its movie customers to determine how much money they spend on concessions. The study revealed that the spending distribution is approximately normally distributed with a mean of \$4.11 and a standard deviation of \$1.37. What percentage of customers will spend less than \$3.00 on concessions? (3 marks)
- d. A loss for a company has moment-generating function  $M(t) = 0.16/(0.16 - t)$ ,  $t < 0.16$ . An insurance policy pays a benefit equal to 70% of the loss. What is the moment-generating function of the benefit? (5 marks)

Question 2

- a. The length of human pregnancies from conception to birth approximates a normal distribution with a mean of 266 days and a standard deviation of 16 days. What proportion of all pregnancies will last between 240 and 270 days (roughly between 8 and 9 months)? (6marks)
- b. Let  $X \sim B(n, p)$  with  $E(X) = 2$  and  $\text{Var}(X) = 4/3$ . Find  $p(X > 4)$  (6 marks)
- c. A random variable Y has probability density function

$$f(y) = \begin{cases} \frac{y}{4}, & 1 \leq y \leq 3 \\ 0, & \text{elsewhere} \end{cases}$$

(8 marks)

Find:

- $E(y)$ ,
- $E(2y - 3)$ ,
- $\text{Var}(y)$
- $\text{Var}(2y - 3)$ .

Question 3

- a. State four properties of the normal curve (4marks)
- b. Consider a computer system with Poisson job-arrival stream at an average of 2 per minute. Determine the probability that in any one-minute interval there will be
- 0 jobs; (2 marks)
  - exactly 2 jobs; (2 marks)
  - at most 3 arrivals. (2 marks)
  - more than 3 arrivals (2 marks)
- c. A quality control engineer is in charge of testing whether or not 90% of the DVD players produced by his company conform to specifications. To do this, the engineer randomly selects a batch of 12 DVD players from each day's production. The day's production is acceptable provided no more than 1 DVD player fails to meet specifications'. Otherwise, the entire day's production has to be tested.
- What is the probability that the engineer incorrectly passes a day's production as acceptable if only 80% of the day's DVD players actually conform to specification? (4marks)
  - What is the probability that the engineer unnecessarily requires the entire day's production to be tested if in fact 90% of the DVD players conform to specifications? (4marks)

Question 4

- a. Show that if  $\bar{x}$  is the mean of n independent random variables, then
- $$M_{\bar{x}}(t) = [M_x(\frac{t}{n})]^n \quad (6 \text{ marks})$$
- b. The monthly salaries of Bungoma County are approximately normally distributed with a mean of 50,000 Kenyan shillings and a standard deviation of 10,000 Kenyan shillings. If a random sample of 50 employees is taken, what is the probability that their average salary is;
- less than \$45,000? (3marks)
  - between \$45,000 and \$65,000? (4 marks)
  - more than \$70,000 (3marks)
- c. Given a probability distribution of X as below,

x	0	1	2	3
P(X=x)	1/8	1/4	3/8	1/4

Find the mean and standard deviation of X (4 marks)

Question 5

- a. Define the term hypothesis (2marks)