



MASENO UNIVERSITY
UNIVERSITY EXAMINATIONS 2013/2014

**FIRST YEAR SECOND SEMESTER EXAMINATIONS FOR THE
DEGREE OF BACHELOR OF SCIENCE IN INFORMATION
TECHNOLOGY
(MAIN CAMPUS)**

CIT 107: PROBABILITY AND STATISTICS

Date: 15th July 2014

Time: 8.30 - 10.30 am

INSTRUCTIONS :

- SECTION A: Attempt ALL questions in this section.
- SECTION B: Attempt ANY TWO questions .
- Write your registration number on all sheets of the answer book used.
- Observe further instructions on the answer booklet.



SECTION A

QUESTION ONE (Compulsory - 30 marks)

- a) Briefly explain the meaning of the following terms:
- (i) Mutually exclusive events
 - (ii) Independent events
 - (iii) Conditional probability **[3 marks]**
- b) Describe FIVE important functions of statistics **[5 marks]**
- c) Email users are advised not to click on links in email from unknown senders. A study shows that 15% of email users do not follow this advice. A hacker sends emails containing malicious links to 20 users. Find the probability that at least 4 of these users will click on the links. **[3 marks]**
- d) Let random variable X denote the time (in years) it takes to develop a software product. Suppose that X has the following probability density function:

$$f(x) = \begin{cases} \frac{x}{2} & 0 < x < 2 \\ 0 & \text{otherwise} \end{cases}$$

- (i) Compute the probability that it takes more than 6 months to develop the software. **[3 marks]**
 - (ii) Compute the expected number of years it takes to develop the software. **[3 marks]**
- e) Unauthorized attempts to log into a certain computer system occur according to a Poisson process with the rate of one attempt every five days. What is the probability of at least 3 unauthorized attempts during the next week? **[5 marks]**
- f) Suppose a researcher claims that the mean age of founders of ICT companies in Nairobi is less than 30 years. To test his claim, he randomly selected 7 ICT companies and obtained the following data on the age of their founders: 27, 28, 32, 33, 24, 28, and 31 years. Test at 5% level of significance whether there is significant evidence that the mean age of founders is less than 30 years. Assume normal distribution for the age random variable. **[8 marks]**

SECTION B

QUESTION TWO (Optional 20 marks)

- a) In a certain firm, it was reported that 25.7 percent of manufactured computer chips are defective. Suppose you select a random sample of 20 computer chips from the production line in this firm. Using a Binomial distribution, find the probability that the number of defective computer chips in the sample will be
- i) exactly three. [2 marks]
 - ii) at least three. [2 marks]
 - iii) fewer than four. [2 marks]
 - iv) between three and seven, inclusive. [2 marks]
 - v) How many defective computer chips would you expect to find in the sample of 20? [2 marks]
 - vi) What is the variance of the number of defective computer chips in the sample of 20? [2 marks]
- b) In a certain NGO, the average number of computer failure has been 10 over a period of several years. What is the probability that during the current year (use Poisson distribution):
- i) Exactly seven computers will fail? [2 marks]
 - ii) Ten or more computers will fail? [3 marks]
 - iii) There will be no machine failure? [1 mark]
 - iv) What are the mean and standard deviation of the number of computer failures? [2 marks]

QUESTION THREE (Optional 20 marks)

- a) Suppose that there are two websites, *A* and *B*, for renting books. The site *A* receives 60% of all orders. Among the orders placed on site *A*, 75% arrive on time. Among the orders placed on site *B*, 90% arrive on time. Given that an order arrived on time, determine the probability that the order was placed on site *B*. [7 marks]
- b) Consider the following set of data:
- | | | | | | | | | | |
|---|---|----|----|----|----|----|----|----|----|
| x | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| y | 6 | 11 | 11 | 14 | 22 | 23 | 32 | 29 | 32 |
- i) Calculate the correlation coefficient between *x* and *y*, and interpret your result. [6 marks]
 - ii) Determine the regression line *y* on *x*. Hence, predict the value of *y* when *x* is 8. [7 marks]

QUESTION FOUR (Optional 20 marks)

- a) Let the random variable X denote the severity of a virus attack on a scale of zero to one. Suppose X follows a continuous distribution with probability density function

$$f(x) = \begin{cases} (\theta + 1)x^\theta & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$

where $\theta > -1$ is an unknown parameter. The severity of the last four virus attacks are as follows:

0.10, 0.30, 0.50, 0.20

Use these data to estimate θ using the method of moments. Assume that the virus attacks are independent. **[6 marks]**

- b) Each computer in a lab has a 15% chance to be infected with a virus. If a computer is infected, an antivirus software finds the virus with probability 0.9. If a computer is not infected, the software will still generate a false alarm and report a virus with probability 0.10. If the antivirus software reports a virus, what is the probability that indeed, the computer is infected? **[5 marks]**
- c) Let X be the random variable that counts the number of files tested until the infected one is found. Suppose that the probability that a given infected file is 0.4. What is the probability that at least six files are tested before the infected one is found? **[4 marks]**
- d) An insurance company pays hospital claims. The number of claims that include emergency room or operating room charges is 85% of the total number of claims. The number of claims that do not include emergency room charges is 25% of the total number of claims. The occurrence of emergency room charges is independent of the occurrence of operating room charges on hospital claims. Calculate the probability that a claim submitted to the insurance company includes operating room charges. **[5 marks]**

QUESTION FIVE (Optional 20 marks)

- a) Consider a random variable X which takes the following values 0, 1, 2, 3, 4 according to the following probability distribution;

x	0	1	2	3	4
$P(X=x)$	0.1	0.4	a	0.2	b

Suppose $E(X) = 1.8$. Find the values of a and b . **[4 marks]**

- b) Suppose A and B are events in a sample space such that
 $P(A) = \frac{1}{4}$, $P(B) = \frac{2}{5}$ and $P(A|B) = \frac{3}{8}$

Determine

- i) $P(A \text{ and } B)$. **[2 marks]**
 - ii) $P(A \text{ or } B)$. **[2 marks]**
 - iii) State whether A and B are mutually exclusive. Why? **[2 marks]**
- c) In a class of 40 students there are 25 students from district A and 15 students from district B. The mean mark of students from district B is 52 and the mean mark of students from district A is 60, in a recent National Exam given to the class. The standard deviations are 4 for those from district A and 6 for district B. Calculate the mean and standard deviation of the marks for the whole class. **[10 marks]**