2920/106
COMPUTATIONAL MATHEMATICS
July 2017
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

MODULE I

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO THE CANDIDATES

You should have the following for this examination:
Scientific calculator;
Statistical tables;
Answer booklet.
*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** of the **EIGHT** questions in the answer booklet provided.*
Candidates should answer the questions in English.

This paper consist of 4 printed pages.

Candidates should check the questions paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. (a) Explain each of the following measurement scales as used in the classification of statistical data:

(i) nominal scale;

(ii) ordinal scale;

(iii) interval scale;

(iv) ratio scale. (8 marks)

(b) Given two polynomial functions: $y = 16x - x^2 - 13$, and $y = 2x + 11$:

(i) Determine by calculation the coordinates of their points of intersection; (6 marks)

(ii) Determine the surface area enclosed by the two lines. (6 marks)

2. (a) Distinguish between *interpolation* and *extrapolation* as used in mathematics. (2 marks)

(b) When data is grouped into classes, any measure calculated is merely an estimate no matter how accurate the calculation is. Justify this statement. (2 marks)

(c) The data in Table 1 shows the distribution of heights in cm of 500 male students of a certain secondary school. Use it to answer the questions that follow.

Height in cm	140 - 150	150 - 160	160 - 170	170 - 180	180 - 190	190 - 200	200 - 210
No. of students	15	50	100	160	120	45	10

Table 1

(i) Estimate by calculation the following measures about the height of the students:

I. the median;

II. the standard deviation. (7 marks)

(ii) The coach of the school's basketball team wants to recruit players into the team. However he wants to recruit only among the top 36% in height. Determine the minimum height for a student to qualify to join the basketball team. (2 marks)

(iii) Suppose the basketball coach has set a minimum height of 182 cm for a student to qualify to join the basketball team, determine the proportion of the students who would qualify. (3 marks)

(iv) Construct an *ogive curve* to represent the data. (4 marks)

3. (a) Explain **three** methods that could be used to collect primary statistical data. (6 marks)

(b) Convert each of the following number systems to their respective equivalents showing your working:

(i) 63742_8 to hexadecimal;

(ii) $D8B_{16}$ to octal;

(iii) 8345_{10} to binary. (6 marks)

(c) Six family couples run a business as partners. A delegation of four people is to be chosen to represent the business in a conference. Determine the number of ways in which the delegation can be selected under each of the following conditions:

(i) if a man and his wife cannot both be selected; (4 marks)

(ii) if each sex must be at least one quarter of the total delegation. (4 marks)

4. (a) Explain the term *parity bit* as used in computer data representation. (2 marks)

(b) (i) Using the binomial theorem, expand the binomial expression $(3x + y)^6$ in ascending powers of x. (5 marks)

(ii) Using the expansion in (i), evaluate the expression $(15.1)^6$ (3 marks)

(c) A cubic polynomial function is given by $f(x) = x^3 - 5x^2 + 3x + 8$. Using the Newton-Raphson iterative method, determine the root of the equation rounded off to 4 decimal places. Take the initial root $x_0 = 2.0$. (10 marks)

5. (a) Define each of the following terms as used in numerical analysis:

(i) absolute error;

(ii) relative error. (4 marks)

(b) Explain **three** properties of the *standard deviation* as a measure of dispersion. (6 marks)

(c) Given two matrices **A** and **B** such that:

$$\mathbf{A} = \begin{bmatrix} 5 & 7 \\ 4 & 6 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 6 & 4 \\ 5 & 3 \end{bmatrix},$$

Show that:

(i) $\mathbf{AB} \neq \mathbf{BA}$

(ii) $\det(\mathbf{A}) \times \det(\mathbf{B}) = \det(\mathbf{AB})$

(iii) $\mathbf{A}^{-1}\mathbf{B}^{-1} \neq (\mathbf{AB})^{-1}$ (10 marks)

6. (a) Some of the measures of central tendency are viewed as points of equilibrium. Explain the context in which each of the following statistical measures is considered as a point of equilibrium in a distribution:

(i) the arithmetic mean;

(ii) the median. (4 marks)

(b) Differentiate between a *diagonal matrix* and a *non-singular matrix* as used in mathematics. (4 marks)

(c) Solve the following set of simultaneous equations using the matrix method.

$$3x + 4y = 52$$
$$5x + 8y = 96$$

(4 marks)

(d) A manufacturing company produces ballpoint pens in two colours as follows: blue 75%, and red 25%. The machine is set to produce these colours randomly but maintaining the proportions. A quality assurance officer picks three pens at random one at a time from the production line for inspection.

(i) present this information using a probability tree diagram; (3 marks)

(ii) determine the probability of picking three pens with alternating colours; (3 marks)

(iii) determine the probability of picking three pens of the same colour. (2 marks)

7. (a) (i) Define the term *model* as used in statistics, stating **two** examples. (2 marks)

(ii) Distinguish between an *independent variable* and a *dependent variable*. (4 marks)

(b) With the aid of logical circuits with two inputs, explain each of the following *logic gates*:

(i) OR gate;

(ii) AND gate;

(iii) XOR gate. (9 marks)

(c) A binary arithmetic subtraction operation is given as:

$11001_2 - 1010_2$

Perform this operation using each of the following methods:

(i) one's complement;

(ii) two's complement. (5 marks)

8. (a) (i) Outline **four** disadvantages of the *arithmetic mean* as a measure of central tendency. (4 marks)

(ii) One of the properties of the arithmetic mean is that it is dependent on origin. Explain this property using a suitable illustration. (3 marks)

(b) A curve is defined by the quadratic function $y = 12x - x^2 - 20$.

(i) Determine the roots of the equation using the factorisation method; (3 marks)

(ii) By using calculus techniques, determine the coordinates of the turning point of the curve. (3 marks)

(c) General observation on a certain road indicates that there are 3 potholes for every 240-metre distance along the road. A random length of 900 metres was selected from a section of the road.

(i) Model this problem as a Poisson probability distribution; (2 marks)

(ii) Determine the probability of getting exactly 10 potholes on the selected length. (2 marks)

(iii) Determine the probability of getting between 4 and 6 potholes inclusive on the selected length of the road. (3 marks)

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