

KASNEB REVISION KIT

BUSINESS  
MATHEMATICS AND  
STATISTICS

REVISION KIT

MASOMO MSINGI

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**KASNEB**

**ATD**

**DCM**

**LEVEL II**

**REVISION KIT**

**PAST EXAMINATION PAST PAPERS WITH  
SUGGESTED ANSWERS**

**Updated with November 2020 Examination Past paper**

## **KASNEB SYLLABUS**

### **PAPER NO. 7 BUSINESS MATHEMATICS AND STATISTICS**

#### **GENERAL OBJECTIVE**

This paper is intended to equip the candidate with the knowledge, skills and attitudes that will enable him/her to apply the principles of management in practice.

#### **7.0 LEARNING OUTCOMES**

A candidate who passes this paper should be able to:

- Apply linear, quadratic and simultaneous equations to solve business problems
- Solve business problems using matrix algebra
- Solve business problems involving commercial mathematics
- Present statistical data in form of tables, graphs and curves
- Calculate measures of location, dispersion, skewness and kurtosis
- Apply basic probability concepts
- Compute simple, general and weighted index numbers.

#### **CONTENT**

##### **7.1 Equations**

- Linear equations; solving and graphs
- Simultaneous equations; solving
- Quadratic equations; solving and graphs
- Basic calculus; simple differentiation and integration
- Total revenue, total cost and profit equations
- Break-even analysis
- Application of errors; absolute/relative

##### **7.2 Sequences and series**

- Arithmetic progression(A.P): nth term, sum of first n terms
- Geometric progression (G.P): nth term, sum of first n terms

##### **7.3 Matrices**

- Introduction: order of matrices, types of matrices
- Addition, subtraction and multiplication of matrices
- Determinants of 2x2 matrices
- Inverses of 2x2 matrices
- Application of matrices in solving business problems

#### **7.4 Commercial mathematics**

- Buying and selling; discounts, profit and loss, margins and mark-ups
- Wages and salaries; piece and hourly rates, commissions, gross and net pay
- Statutory deductions; PAYE, NHIF, NSSF
- Simple and compound interest
- Depreciation and appreciation of assets
- Hire purchase
- Foreign exchange rate transactions

#### **7.5 Introduction to statistics**

- Introduction: definitions and branches of statistics
- Methods of data collection: primary and secondary data,
- Sampling techniques

#### **7.6 Presentation of statistical data**

- Tables
- Diagrams: bar charts and pie charts
- Graphs: time series graphs, Z-charts, Lorenz curves and semi-logarithmic graphs
- Frequency distribution tables
- Histogram and frequency polygons
- Cumulative frequency curve (ogive) and its application

#### **7.7 Descriptive statistics**

- Measures of central tendency: mean: arithmetic mean, weighted arithmetic mean; geometric mean, harmonic mean, median and mode.
- Measures of dispersion: range, quartile, deciles, percentiles, mean deviation, standard deviation and coefficient of variation
- Measures of skewness: pearsons coefficient of skewness, product coefficient of skewness
- Measures of kurtosis: pearsons coefficient of kurtosis, product coefficient of kurtosis.

### 7.8 Set theory

- Introduction to set theory
- Types of sets: universal, empty/null, subsets, finite and infinite
- Operation of sets: unions, intersections, complements and set difference
- Venn diagrams

### 7.9 Basic probability theory

- Introduction to probability: definitions, events, outcomes, sample space
- Types of events: simple, compound, independent, mutually exclusive, mutually inclusive, dependent events
- Rules of probability: additive and multiplicative rules
- Introduction to counting techniques, combinations and permutations
- Baye's Theorem
- Elementary probability trees

### 7.10 Index numbers

- Construction of index numbers
- Purpose of index numbers
- Simple index numbers; fixed base method and chain base method
- Weighted index numbers; Laspeyre's, Paasche's, Fisher's ideal and Marshall Edgeworth's methods (both price and quantity index numbers)
- Consumer Price Index (CPI)
- Applications of CPI
- Limitations of index numbers

### 7.11 Emerging issues and trend

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**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY, 24 November 2020.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Highlight four data collection methods. (4 marks)
- (b) The data below shows the performance of 144 students (in %) in a Business Statistics examination at Bidii College:

<b>Marks (%)</b>	<b>Number of students</b>
0— 10	5
10 — 20	8
20 — 30	15
30 — 40	18
40 — 50	20
50 — 60	32
60 — 70	23
70 — 80	12
80 — 90	9
90 — 100	2

**Required:**

- i) Construct a "less than" Ogive curve to represent the above data. (5 marks)

- ii) Determine the median mark from the Ogive curve in (b) (i) above. (2 marks)
- iii) Determine the quartile deviation from the Ogive curve in (b) (i) above. (3 marks)

(c) The average retail prices (in thousands of shillings) of wheat sold by Kilimo Industries (in tonnes) during the years 2014 - 2019 are given in the table below:

Year	Average retail price per tonne Sh. "000"
2014	14.95
2015	14.94
2016	15.10
2017	15.65
2018	16.28
2019	16.53

**Required:**

- (i) Using 2017 as the base, compute the price relatives corresponding to the years 2014 to 2019. (3 marks)
- (ii) Highlight three applications of the consumer price index. (3 marks)

**(Total: 20 marks)**

**QUESTION TWO**

a) Capricon Limited has analysed its operating conditions, prices and costs and has developed the following functions:

Total revenue       $R = 800q - 8q^2$

Total cost           $C = 2q^2 + 20q + 60$

Where: q is the number of units sold.

The firm wishes to maximise profit.

**Required:**



- (i) The number of units sold required to maximise profit. (3 marks)
- (ii) The selling price per unit required to maximise profit. (2 marks)
- (iii) The maximum profit. (2 marks)
- b) The following schedule shows the rates charged by Maji Limited to the residents of Laini Tatu Town for the supply of water:

Fixed monthly charge	Sh.250
<b>Number of units</b>	<b>Cost per unit (Sh.)</b>
First 300	10
Next 400	15
Above 700	20

**Required:**

- (i) The water bill to be paid by a household whose consumption in the month of April 2020 was 840 units. (2 marks)
- (ii) The number of units consumed by a household whose water bill was Sh.22,550 in April 2020. (2 marks)
- c) Ambrose Wafula is the Assistant Audit Manager of Buba Limited. He earns Sh.1,645 per official working day of 8 hours. He earns overtime of Sh.325 per hour per official working day and also on Saturdays.

In the month of March 2020, Ambrose Wafula worked for 23 official working days, 3 hours overtime for each official working day and 4 Saturdays (where he worked for 5 hours for each Saturday).

**Required:**

- (i) Total taxable income for the month of March 2020. (3 marks)
- (ii) Net pay in the month of March 2020 assuming that income tax is calculated according to the following schedule:

Monthly taxable pay (Sh.)	Tax rate (%)
1 — 12,894	10
12,895 — 25,788	15
25,789 — 38,682	20
38,683 — 51,576	25
Excess over 51,576	30

Personal relief per month is Sh.1,436.

(6 marks)

**(Total: 20 marks)**

### QUESTION THREE

(a) You are given the following matrices:

$$A = \begin{pmatrix} 8 & 6 \\ 5 & 4 \end{pmatrix}, \quad B = \begin{pmatrix} 3 & 2 & 7 \\ 11 & 0 & 4 \end{pmatrix}, \quad C = \begin{pmatrix} 9 & 2 \\ 6 & 5 \\ 3 & 1 \end{pmatrix}$$

**Required:**

Evaluate:

(i)  $B C$ . (2 marks)

(ii)  $C + B^T$  (2 marks)

(iii)  $A^{-1} B$ . (3 marks)

(b) The total cost of water incurred by Palm Properties Limited per month is given by a linear function of the form of  $y = a + bx$ .

Where:

$y$  = Total cost of water.

$a$  = Monthly fixed charges for water.

$b$  = The cost of water per cubic metre ( $m^3$ ).

$x$  = The number of cubic metres ( $m^3$ ) of water consumed.

During the month of January 2020, the company consumed  $1,000\text{m}^3$  of water at a total cost of Sh.60,000.

During the month of February 2020, the company consumed  $1,500\text{m}^3$  of water at a total cost of Sh.80,000.

**Required:**

- (i) The cost of water per cubic metre ( $\text{M}^3$ ). (2 marks)
  - (ii) The monthly fixed charges for water. (2 marks)
  - (iii) The number of cubic metres ( $\text{M}^3$ ) of water consumed in the month of March 2020 given that Palm Properties Limited incurred a total cost of Sh.88,000. (2 marks)
- (c) Anthony and Bill, American citizens, left the United States (US) to tour African countries each having 27,860 United States Dollars (USD). Anthony proceeded to Kenya while Bill proceeded to South Africa. The return air ticket expenses were 1,800 USD and 1,900 USD for Anthony and Bill respectively.

They each converted their money into the respective local currencies.

They each paid for accommodation in the local currency for 10 days at the equivalent rates of 450 USD and 620 USD per day for Anthony and Bill respectively.

They each incurred camping expenses, entertainment and transport charges in local currency equivalent to 8,800 USD.

They also each bought jewellery and souvenirs in local currency of amounts equivalent to 4,900 USD. Before they returned to the United States, they converted their remaining respective local currency amounts into United States dollars (USD).

The exchange rates during their visits were as follows:

$$1 \text{ US dollar} = \text{Ksh.98.}$$

1 US dollar = SA Rand 14.

**Required:**

The amount in US Dollars that Anthony and Bill each got after exchanging their respective currencies. (7 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) Distinguish between the following terms as used in statistics:
- (i) "Inferential statistics" and "descriptive statistics". (2 marks)
  - (ii) "A census inquiry" and "a sample inquiry". (2 marks)
- (b) The following data relates to two samples of invoices (in shillings) from two suppliers X and Z:

Supplier	N	Mean	Median	Standard Deviation	Min	Max	Q1	Q3	Mode
X	30	522.50	489.50	138.70	289.00	877.50	426.00	615.00	423.50
Z	30	507.60	488.00	86.90	332.00	805.00	463.00	541.00	448.80

Where: N = sample size      Q1 = First quartile  
 min = minimum              Q3 = Third quartile  
 Max = maximum

**Required:**

Determine the following for each supplier:

- (i) Range. (2 marks)
- (ii) Semi-interquartile range. (2 marks)
- (iii) Coefficient of variation. (2 marks)

- (c) A housing co-operative society intends to build 15 houses for sale on a piece of land. The costs of the project have been estimated as follows:

	Sh.
Land	5,000,000
Materials	3,000,000 $\pm$ 10%
Labour	900,000 $\pm$ 10%
Overheads	2,400,000 $\pm$ 5%

The management of the society intends to sell each house at Sh.1,200,000  $\pm$  50,000.

**Required:**

Determine the range of profits that the housing co-operative could make. (8 marks)

- (d) Jane Atieno made a deposit of Sh.25,000 into an account that pays interest at the rate of 5% per annum.

**Required:**

The balance in the account at the end of 5 years assuming that the interest is compounded monthly. (2 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Explain the following terms in relation to sets and set theory:

- (i) Finite set. (2 marks)
- (ii) Infinite set. (2 marks)
- (iii) Equal sets. (2 marks)

- (b) A company which has 5 regular customers stocks products r, s, t, u, v, w, x and y. Customer A buys products r, s, t and v only and this is represented in set form as  $A = \{r, s, t, v\}$ . Similarly, customers B, C, D and E buy products represented by the following sets:  $B = \{r, t, v, w, x\}$ ,  $C = \{r, t, x\}$ ,  $D = \{r, v, w\}$  and  $E = \{r, v, w, x\}$ .

**Required:**

Specify the elements of each of the following sets:

- (i)  $C \cup D$ . (1 mark)
- (ii)  $(A \cup C) \cap B'$ . (2 marks)
- (iii)  $A \cap B \cap C \cap D \cap E$ . (2 marks)

- (c) A company has tendered for two contracts, A and B.

The probability of winning contract A is  $\frac{2}{5}$  and the probability of winning contract B is  $\frac{1}{3}$ .

**Required:**

- (i) The probability of winning no contract. (1 mark)
- (ii) The probability of winning at least one contract. (2 marks)
- (iii) The probability of winning contract A or B. (1 mark)
- (iv) The probability of winning contract A and B. (1 mark)

- (d) A trader bought goods worth Sh.81,000 on hire purchase terms. He paid an initial cash deposit of 30%. A flat rate of interest of 20% was charged on the outstanding balance. The outstanding balance plus interest is payable in 12 equal monthly instalments. Any purchase on cash basis attracts a discount of 15%.

**Required:**

- (i) The monthly instalments payable by the trader. (2 marks)
- (ii) The amount the trader would have saved assuming that he bought the goods on cash basis. (2 marks)

**(Total: 20 marks)**

**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 21 November 2019.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- a) Outline four limitations of index numbers. (4 marks)
- b) The following data relate to the production of sugar (in metric tonnes) in Kenya for the first six months of the year 2019:

Month	January	February	March	April	May	June
Production (metric tonnes)	4,563	4,245	4,841	4,644	5,290	5,166

**Required:**

- i. Fixed-base relative index numbers (March = 100). (4 marks)
  - ii. Chain-base relative index numbers. (4 marks)
  - iii. Compare the results obtained in (b) (i) and (b) (ii) above. (2 marks)
- c) Jennifer Kwamboka deposited money in a fixed deposit account that pays interest at the rate of 10% per annum for 5 years. She also deposited a certain amount of money in an investment account that pays interest at the rate of **15%** per annum for the same period.

At the end of 5 years, Jennifer Kwamboka received Sh.31,285 and Sh.68,070 from the fixed deposit account and the investment account respectively.

**Required:**

The amount of money invested in each account based on:

- i. Simple interest. (2 marks)
- ii. Compound interest. Assume interest is compounded quarterly. (4 marks)

**(Total: 20 marks)**

## QUESTION TWO

- a) Explain the following terms in relation to matrices:
  - i. Null matrix. (2 marks)
  - ii. Transpose matrix. (2 marks)
- b) A company produces two types of products namely; Product A and Product B. The cost of producing 10 units of Product A and 8 units of Product B is Sh.4,060. The cost of producing 4 units of Product A and 7 units of Product B is Sh.2,840. The company allows a markup of 20% and 30% on Product A and Product B respectively.

### Required:

- i. The cost of producing one unit of Product A and one unit of Product B using matrix algebra. (4 marks)
  - ii. The selling price of one unit of Product A and one unit of Product B. (2 marks)
- c) The marginal output of a certain production machine in a factory is given by the following function:  
$$MP = 4x^3 + 3x^2 + \frac{1}{x} + 15$$
 within the production interval of  $4 \leq x \leq 15$   
Where: MP is the marginal output

X is the output in thousands of bags

### Required

- i. Total production function (2 marks)
  - ii. The total output within the stated production limits (3 marks)
- d) KLN Airlines operates daily flights from Nairobi in Kenya to Amsterdam in the Netherlands. On these flights, 40% of the passengers are white while the rest are black. Further scrutiny of the records indicates that 25% of the white passengers are female and 30% of the black passengers are male.



One passenger is to be selected for a free ticket for the next flight.

**Required:**

- i. The probability that the selected passenger is male. (1 mark)
  - ii. The probability that the selected passenger is white or female. (2 marks)
  - iii. The probability that the selected passenger is white given that she is a female. (2 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- a) Identify the type of sampling method that has been used in each of the following situations:
  - i. A car maker conducts a marketing study by interviewing potential customers who request test drives at a local show room. (1 mark)
  - ii. A sample of products obtained by selecting every 100<sup>th</sup> item on the assembly line. (1 mark)
  - iii. Random numbers generated by a computer were used to select serial numbers of voters to be interviewed in an opinion poll. (1 mark)
- b) The following data shows the number of different types of insurance policies issued in the month of September 2019 by four insurance companies: Wyed Ltd., Xed Ltd., Yed Ltd. and Zed Ltd.:

Type of policy	Insurance company			
	Wyed Ltd.	Xed Ltd.	Yed Ltd.	Zed Ltd.
Life	20	5	35	40
Accident	150	120	220	100
Fire	200	80	180	150
Maritime		2	8	5
Burglary	120	100	250	200

**Required:**

Present the above data using a component bar chart. (6 marks)

- c) The following table shows the marks scored by students of Elimu College in a financial mathematics examination:

Marks (%)      Number of students

0-10	150
10 — 20	140
20 — 30	100
30 — 40	80
40 — 50	80
50 — 60	70
60 — 70	30
70 — 80	<b>14</b>

**Required:**

- i. The mean of the marks scored. (2 marks)
- ii. The standard deviation of the marks scored. (3 marks)
- iii. The median of the marks scored. (2 marks)
- iv. The coefficient of skewness of the marks scored. (3 marks)
- v. Comment on the results obtained in (c) (iv) above. (1 mark)

**(Total: 20 marks)**

**QUESTION FOUR**

(a) Explain the following terms as used in probability theory:

- (i) Random variable. (2 marks)
- (ii) Sample space. (2 marks)

(b) (i) The sum of the first six terms of an arithmetic progression (AP) is 21. The 7th term is three times the sum of the third and fourth terms.

**Required:**

Determine the first term and the common difference. (6 marks)

(ii) Given that 75, x, 12, . . . . is a geometric progression (GP);

Determine the possible values of x and the possible values of the fifth term of the geometric progression (GP). (4 marks)

- c) A salesman earns a commission of 6% on the sale of cement and a commission of 10% on the sale of iron sheets. The selling price of a bag of cement is Sh.700 while that of an iron sheet is Sh.1,500. During the month of August 2019, the number of bags of cement sold by the salesman was more than the number of iron sheets sold by 80. The salesman received a total commission of Sh.76,320 in the month of August 2019.

**Required:**

- i. The number of bags of cement and iron sheets sold in the month of August 2019. (4 marks)
  - ii. The commission received on the sale of both cement and iron sheets. (2 marks)
- (Total: 20 marks)**

**QUESTION FIVE**

- a) Identify three applications of set theory in business. (3 marks)
- b) Outline two advantages and two disadvantages of the observation method of collecting primary data (4 marks)
- c) The recent continental athletics games were attended by 380 athletes from three regions namely Eastern, Western and Southern.

The following information relates to the athletes who attended the games:

- 200 athletes represented the Eastern region.
- 160 athletes represented the Western region.
- 180 athletes represented the Southern region.
- 70 athletes represented both the Eastern and Western regions.
- 66 athletes represented both the Western and Southern regions.
- 96 athletes represented both the Eastern and Southern regions.
- 15 athletes represented all the three regions.

**Required:**

- i. A Venn diagram to represent the above information. (4 marks)
  - ii. The number of athletes that were not representing any of the three regions. (2 marks)
  - iii. The number of athletes that represented only one region. (1 mark)
  - iv. The number of athletes that represented two regions only. (1 mark)
  - v. The number of athletes that represented at least two regions. (1 mark)
- d) Angela Nkirote intends to buy a car worth Sh.2,300,000. She embarks on a savings scheme which follows an arithmetic progression (AP) in which she saves

Sh.150,000 in the first month and increases her subsequent savings by Sh.20,000 each month.

**Required:**

The amount she will need to borrow in order to achieve her dream by the time she has saved for 8 months.

(4 marks)

**(Total: 20 marks)**

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**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 21 May 2019.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

(a) Differentiate between the following terms with respect to statistical inquiry:

(i) “Census inquiry” and “sample inquiry”. (2 marks)

(ii) “Open inquiry” and “confidential inquiry”. (2 marks)

(b) State four properties of a good measure of dispersion. (4 marks)

(c) The 10<sup>th</sup> term of a geometric series is 177,147 and the 6<sup>th</sup> term of the same series is 2,187:

**Required:**

(i) The common ratio. (2 marks)

(ii) The value of the first term. (2 marks)

(d) Bundacho Employment Bureau has shortlisted 7 male and 4 female applicants for interview. There are only 3 job positions available for employment.

**Required:**

(i) Represent the above information in a tree diagram. (2 marks)

(ii) The probability that the three employees selected are of the same gender. (2 marks)

**(20 marks)**

**QUESTION TWO**

(a) (i) Distinguish between “primary data” and “secondary data”. (2 marks)

(ii) Explain three methods that could be used in the collection of primary data. (6 marks)

(b) The following table shows the quantities of four types of construction materials sold and their unit prices in the years 2017 and 2018:

Type of construction material	Year 2017	Year 2018		
	Price (Sh.)	Quantity (Units)	Price (Sh.)	Quantity (Units)
Tiles	500	100	800	120
Roofing sheets	800	140	1,000	120
Steel bars	400	150	800	110
Timber	500	100	900	100

**Required:**

Using the year 2017 as the base year, calculate:

(i) Laspeyre’s price index. (4 marks)

(ii) Paasche’s price index. (4 marks)

(iii) Fisher’s ideal price index. (4 marks)

**(Total: 20 marks)**

**QUESTION THREE**

(a) Giving an example in each case, differentiate between a “scalar matrix’ and an “identity matrix”. (4 marks)

(b) A certain company produced 20 units of product P and 40 units of product Q at a total cost of Sh. 10,800 in the month of March 2010. The company also produced 30 units of product P and 25 units of product Q at a total cost of Sh.9,200 in the month of April 2019.

**Required:**

Using matrix algebra, calculate the cost of producing a unit of product P and a unit of product Q. (Use Cramer's method). (6 marks)

(c) A businessman acquired a second-hand pickup at a cost of Sh. 1,100,000. The estimated useful life of the pickup was 5 years and its scrap value was Sh.300,000.

**Required:**

(i) The annual rate of depreciation using the reducing balance method. (4 marks)

(ii) The net book value of the pickup after the third year using reducing balance method. (2 marks)

(iii) The difference between the net book values of the pickup after the 4th year using reducing balance method and the straight line method. (4 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

(a) The table below shows the salaries earned by 104 employees of Excel Ltd. in the month of April 2019:

Monthly salary Sh. "000"	Number of employees
10 and under 15	10
15 and under 20	34
20 and under 25	42
25 and under 30	6
30 and under 35	6
35 and under 40	4
40 and under 50	2

**Required:**

(i) The mean monthly salary. (4 marks)

- (ii) The standard deviation of the monthly salary. (4 marks)
- (iii) The coefficient of variation of the monthly salary. (4 marks)

(b) A quadratic function is given as  $y = 2x^2 - 5x - 12$ .

The domain of  $x$  values is in the range of  $-2 < x < 5$ .

**Required:**

- (i) A graphical representation of the above quadratic function within the given range of  $x$  values. (6 marks)
- (ii) Using the graphical representation in (b) (i) above, solve the equation  $2x^2 - 5x - 12 = 0$ . (2 marks)
- (iii) Using the graphical representation in (b) (i) above, solve the equation  $2x^2 - 5x - 7 = 0$ . (2 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Using an illustration in each case, define the following terms as used in set theory:
- (i) Union of a set. (2 marks)
- (ii) Intersection of a set. (2 marks)
- (b) Use the elimination method to solve the following simultaneous equations:

$$4x + 3y = 26$$

$$2x - y = 8$$

(4 marks)

(c) A machine costs Sh.850,000 on cash basis. On hire purchase terms, an initial deposit of 20% of the cash price is required. A simple interest of 10% is charged on the outstanding balance for 5 years. Customers who purchase the machine on cash basis are granted a 4% discount on the cash price.

**Required:**



The amount saved by a customer who purchases the machine on cash basis. (6 marks)

(d) A firm has analysed its prices and costs for a certain product and has developed the following functions:

$$R = 400q - 4q^2$$

$$C = q^2 + 10q + 30$$

Where,

R = Total revenue

C = Total cost

q = Units produced and sold

**Required:**

(i) The profit function. (2 marks)

(ii) The number of units produced and sold in order to maximise profits. (2 marks)

(iii) The maximum profit. (2 marks)

**(Total: 20 marks)**

**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 27 November 2018.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) State four characteristics of a good questionnaire. (4 marks)
- (b) Explain three advantages of the interview method of data collection. (6 marks)

(c) Hamisi Ali bought a baking machine at a cash price of Sh. 100,000 on hire purchase terms. He paid an initial deposit of 20% of the cash price. An interest of 15% per annum is charged on the outstanding balance for the period of repayment. The balance plus the interest was to be paid in 24 equal monthly instalments. A customer who purchases the machine on cash basis is given a 15% discount on the cash price.

**Required:**

The amount of money Hamisi Ali would have saved if he had bought the baking machine on cash basis. (4 marks)

(d) A manufacturer produces two commodities x and y. In September 2018, the manufacturer produced 5 units of commodity x and 6 units of commodity y at a cost of Sh.24,400. In October 2018, the manufacturer produced 7 units of commodity x and 9 units of commodity y at a cost of Sh.35,600.

**Required:**

- (i) Form simultaneous equations to represent the above information. (2 marks)

- (ii) Using matrix algebra, compute the cost of producing each unit of commodity x and commodity y. (4 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Define the following terms as used in set theory:

(i) Universal set. (2 marks)

(ii) Null set. (2 marks)

(iii) Subset. (2 marks)

- (b) Distinguish between the following terms:

(i) Ratio and proportion. (2 marks)

(ii) Discrete variables and continuous variables. (2 marks)

(c) The probability that a student will pass a Mathematics examination is  $\frac{2}{3}$  and the probability that he will fail an English examination is  $\frac{5}{9}$ . The probability that he will pass at least one examination is  $\frac{4}{5}$ .

**Required:**

The probability that the student will pass both Mathematics and English examinations.

- (d) The following data show the distribution of daily wages in a certain company:

Wages (Sh.)	Number of workers
40-50	20
50-60	25
60-70	36
70-80	72
80-90	51
90-100	40

**Required:**

The harmonic mean of the above data. (6 marks)

**(Total: 20 marks)**

**QUESTION THREE**

(a) John Otieno has recently been employed by Baraka Ltd. as an accountant. He has been offered a starting salary of Sh.720,000 per annum with an annual increment of 10 per cent on the previous year's salary.

Assume that John Otieno has a 35-year working life.

**Required:**

- (i) John Otieno's annual salary in the 35<sup>th</sup> year of his working life. (3 marks)
- (ii) The total amount that John Otieno will have earned during his 35-year working life. (3 marks)

(b) A certain salesman is paid a monthly basic salary and a commission on the sales made. The salesman earns a commission at the rate of  $x$  per cent on the first Sh.300,000 of sales made and  $y$  per cent for any additional sales made above Sh.300,000.

During the months of January, February and March 2018, the salesman made sales and gross earnings as shown in the table below:

Month	January	February	March
	2018	2018	2018
Sales (Sh.)	800,000	1,200,000	200,000
Gross earnings (Sh.)	63,000	79,000	37,000

**Required:**

- (i) The rates of commission ( $x$  and  $y$ ) applied to the sales made. (6 marks)
- (ii) Basic salary of the salesman. (2 marks)
- (iii) Gross earnings for the month of April 2018 if the salesman made sales of Sh. 1,500,000. (2 marks)

(c) A Kenyan businessman imported 15,000 gold chains from the USA at a cost of 75 US dollars per chain. The businessman incurred additional expenses as follows:

Freight charges                      Ksh.40,000  
 Insurance on consignment      Ksh.90,000

Customs duty per chain      Ksh. 150

Assume 1 US dollar = Ksh.95

**Required:**

- (i) The total cost of the gold chain consignment in Kenya Shillings.                      (2 marks)
- (ii) The price at which the businessman should sell each chain to make a profit of 15% on the total cost of the consignment.                      (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

(a) The following are the weights in Kilogrammes of 88 students in the Business Mathematics and Statistics class at Gombajeri College:

Weights of students (Kilogrammes)	Number of students
45-49	4
49-53	8
53-57	12
57-61	15
61-65	21
65-69	13
69-73	8
73-77	5
77-81	2

**Required:**

- (i) Coefficient of variation of the weights of the students.                      (8 marks)
- (ii) Median weight of the students.                      (2 marks)
- (iii) Modal weight of the students.                      (2 marks)

(b) A firm that produces metal locks has an estimated demand function of  $P = 7.5x - 150$  (in thousands of shillings) and a total cost function of  $TC = 15x^2 - 1050x - 750$  (also in thousands of shillings) where x is the quantity of metal locks produced in units.

**Required:**

- (i) The break-even number of metal locks. (4 marks)
- (ii) The maximum profit of the firm. (4 marks)

**QUESTION FIVE**

(a) Differentiate between an "arithmetic progression" and a "geometric progression". (4 marks)

(b) The data below show the monthly output of maize in thousands of Kilogrammes from a maize miller for the years 2016 and 2017:

Month	2016 Output in thousands of Kilogrammes	2017 Output in thousands of Kilogrammes
January	23	25
February	21	29
March	16	27
April	15	30
May	12	26
June	10	18
July	9	15
August	9	10
September	12	8
October	16	12
November	14	16
December	18	20

**Required:**

- (i) Construct a Z-chart to represent the above data. (14 marks)
- (ii) Comment on the output trend of the maize miller as illustrated by the Z-chart in (b)(i) above. (2 marks)

**(Total: 20 marks)**

**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 22 May 2018.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

(a) Highlight five applications of mathematical functions in business. (5 marks)

(b) State four advantages of a hire purchase system in business. (4 marks)

(c) (i) Willy Bushuti bought a house at the beginning of year 2002 at Sh.40,000,000. The value of the house has been increasing at the rate of 4% per annum.

**Required:**

The value of the house at the end of year 2017. (3 marks)

(ii) Lucy Mwangudza bought a personal car for Sh.2,800,000 at the beginning of January 2017. The value of the car depreciates by 1% per month.

**Required:**

The expected value of the car at the end of December 2018. (3 marks)

(d) The following data show the performance of 50 students in a Business Statistics examination.

Number of students	Marks scored (%)
8	37
14	52
21	67
6	82

**Required:**

Geometric mean for the above data.

(5 marks)

**(Total: 20 marks)**

**QUESTION TWO**

(a) Name four types of measurement scales used in data collection. (4 marks)

(b) Muungano Partnership shared profits among its five partners namely; Jane, Peter, Zainabu, Kioko and Linturi. Zainabu got  $\frac{11}{60}$  of the total amount while the rest of the amount was shared among Jane, Peter, kioko and Linturi in the ratio 12:12:15:10 respectively. Zainabu received Sh. 132,000.

**Required:**

The amount of money that was received by each of the remaining four partners.

(4 marks)

(c) XYZ Ltd. has availed the following data:

Units produced	$360 \pm 20\%$
Selling price (Sh.)	$1,400 \pm 5\%$
Material cost(Sh.)	$280,000 \pm 10\%$
Labour cost (Sh.)	$120,000 \pm 4\%$

**Required:**

Maximum profit made by the company.

(4 marks)

(d) The table below shows prices and quantities of three commodities for the years 2014 and 2015:

Item	Year 2014		Year 2015	
	Price (Sh.)	Quantity (Bags)	Price (Sh.)	Quantity (Bags)
Maize	70	30	120	25



Wheat	1 10	10	140	12
Beans	180	8	360	5

**Required:**

Price index using the Marshall - Edgeworth method. (8 marks)

**(Total: 20 marks)**

**QUESTION THREE**

(a) Explain the following terms as used in probability theory:

- (i) Compound events. (2 marks)
- (ii) Mutually exclusive events. (2 marks)
- (iii) Complementary events. (2 marks)

(b) A trader purchased 125 books at a total cost of Sh. 11,400. The trader wishes to make a profit of 40% on the selling price.

**Required:**

The selling price per book. (3 marks)

(c) Adrian Advertising Agency has 2,000 clients who use different advertising methods.

- 830 clients use television advertising
- 700 clients use radio advertising
- 560 clients use newspaper advertising
- 350 clients use both television and radio advertising
- 360 clients use both radio and newspaper advertising
- 330 clients use both television and newspaper advertising
- 75p clients use none of the three advertising methods

**Required:**

- (i) Present the above information in a Venn diagram. (4 marks)
- (ii) The number of clients that use at least two of the three advertising methods.

- (3 marks)
- (iii) The number of clients that use television advertising only. (2 marks)
- (iv) The number of clients that use television or radio but not newspaper method of advertising. (2 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

- (a) State four principles used in construction of tables in statistics. (4 marks)
- b) The data below show the number of students enrolled for a computer packages course at Digital College for the years 2016 and 2017:

Month	Year	
	2016	2017
January	40	42
February	48	45
March	42	60
April	58	64
May	60	58
June	80	70
July	75	80
August	60	75
September	55	60
October	50	48
November	60	55
December	90	95

**Required:**

Construct a Z - chart to represent the above data. (10 marks)

(c) Dena Ltd. offers credit to individuals who wish to buy cars. Anderson Charo wishes to acquire a car and has approached Dena Ltd. The terms of sale for the car are Sh.4,425.000 cash or Sh. 1.800.000 deposit and Sh. 195.000 per month for 24 months. Dena Ltd. can repossess the car in case Anderson Charo is unable to pay all the monthly installments.

**Required:**

- (i) The hire purchase price of the car. (2 marks)

- (ii) The compound interest rate at which Sh.4,425,000 can be invested for 20 months to yield the hire purchase price of the car. (4 marks)

**(Total: 20 marks)**

### QUESTION FIVE

- (a) Summarise three advantages and three disadvantages of the arithmetic mean as a measure of central tendency. (6 marks)
- (b) Solve the following equations by matrix algebra:

$$5x + 9y = -30$$

$$6x - 2y = 28$$

(5 marks)

- (c) Solve the following equation by a quadratic formula:

$$4x^2 - x - 3 = 0$$

(4 marks)

- (d) Solve the following simultaneous equations by substitution method:

$$4x + 3y = 7$$

$$3x - 2y = 9$$

(5 marks)

**(Total: 20 marks)**

**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 28 November 2017.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

(a) Define the following terms as used in index numbers:

- (i) Simple index number. (2 marks)
- (ii) Chain base method. (2 marks)
- (iii) Stock market index. (2 marks)
- (iv) Consumer price index. (2 marks)

b) Samson Mbango has invested a certain amount of money in a bank. He shared the amount invested as follows:

- $\frac{7}{10}$  of the money to his eldest son.
- $\frac{1}{5}$  of the remainder to his youngest son.
- The balance to his wife.

The wife invested  $\frac{2}{3}$  of her share in another bank and remained with Sh.250,000 in cash.

**Required:**

The amount received from Samson Mbango by the:

- (i) Wife. (4 marks)

(ii) Eldest son. (1 mark)

(iii) Youngest son. (1 mark)

(c) A wholesaler sold 105 packets of sugar and 224 packets of salt at a total sale of Sh.61,320 on a certain day. On the same day, the wholesaler supplied 245 packets of sugar and 96 packets of salt to a local supermarket making a total sale of Sh.40,680.

**Required:**

Using matrix algebra, determine the selling price of a packet of sugar and a packet of salt. (6 marks)

**(Total: 20 marks)**

**QUESTION TWO**

(a) The cash price of a washing machine is Sh.980,000. A buyer pays a deposit of Sh.255,000 and pays the balance in eighteen monthly instalments of Sh.51,000 each and a final payment of Sh.46,000.

**Required:**

The amount of money the buyer would save by paying the cash price for the washing machine. (4 marks)

(b) XYZ Ltd. manufactured 800 items at a total cost of Sh.985,600. The company has a policy of 20% profit margin on every item.

**Required:**

The unit selling price charged on the items by XYZ Ltd. (4 marks)

(c) A research study of 200 households in a certain county yielded the following information about travel plans of the households for the next New Year celebrations:

- 70 households plan to travel to Mombasa.
- 76 households plan to travel to Nakuru.
- 68 households plan to travel to Kisumu.
- 26 households plan to travel to both Mombasa and Nakuru.
- 22 households plan to travel to both Mombasa and Kisumu.
- 32 households plan to travel to both Nakuru and Kisumu.
- 10 households plan to travel to Mombasa, Nakuru and Kisumu.

**Required:**

- (i) A venn diagram to represent the above information. (2 marks)
- (ii) Number of households who will travel to exactly one destination. (2 marks)
- (iii) Number of households who will travel to more than one destination. (2 marks)
- (iv) Number of households who will travel to at least one destination. (2 marks)

(d) The probability that a woman aged 55 years will be alive in 2045 is  $\frac{6}{8}$  while the probability that her husband now aged 65 years will be alive in 2045 is  $\frac{5}{6}$

**Required:**

The probability that at least one of them will be alive in 2045. (4 marks)

**(Total: 20 marks)**

**QUESTION THREE**

(a) Define the following terms:

- (i) Geometric mean. (2 marks)
- (ii) Skewness. (2 marks)
- (iii) Kurtosis. (2 marks)

(b) The following is the age distribution of 1,000 people working in an organisation:

Age (years)	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65
Frequency	30	160	210	180		105	70	60	

During the ongoing labour negotiations, the organisation has agreed with the labour union to reduce the manpower requirements to 75% of the present number due to continuous losses and impending wage increment according to the following schemes:

1. Retrench the first 15% from the lower age group due to inexperience.
2. Retire 10% from the highest age groups.

**Required:**

- (i) The new age groups and their frequencies after the above schemes are implemented. (5 marks)
- (ii) The mean age of the retained workers. (2 marks)
- (iii) The standard deviation of the ages of the retained workers. (5 marks)
- (iv) The coefficient of variation. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) Distinguish between the following terms:
  - (i) Compensating errors and systematic errors. (4 marks)
  - (ii) Discrete data and continuous data. (4 marks)
- (b) The value of a car when new is Sh.3,800,000. In its first year, the car depreciates in value to Sh.2,660,000. In the second year, it depreciates to Sh.2,128,000. In the third year, the depreciation of the car is 8% of its value at the beginning of the second year.

**Required:**

The value of the car at the beginning of the fourth year. (4 marks)

- (c) A farmer has harvested 580 bags of maize. The costs incurred by the farmer are estimated as follows:

Rent for the land	Sh.240,000
Cost of inputs	Sh. 150,000 ± Sh. 1,000
Labour	Sh.80,000 ± 4%
Transportation costs	Sh.45,000 ± 5%

The farmer intends to sell all the bags of maize at Sh. 1,200 ± Sh.100 each.

**Required:**

- (i) The minimum profit the farmer can make. (4 marks)

(ii) The maximum profit the farmer can make. (4 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

(a) Distinguish between “deciles” and “percentiles”. (4 marks)

(b) The distribution of weekly wages of 600 workers in a certain farm is as follows:

Weekly wages (Sh.)	1,025-1,100	1,100-1,175	1,175-1,250	1,250-1,325	1,325-1,400	1,400-1,475
Number of workers	72	168	192	72	60	36

**Required:**

(i) The median weekly wage. (2 marks)

(ii) A percentage cumulative frequency curve. (6 marks)

(iii) The limits of weekly wages that lie between first and third quartiles. (5 marks)

(iv) Estimate graphically the percentage of workers earning weekly wages of between Sh. 1,175 and Sh. 1,400.

(3 marks)

**(Total: 20 marks)**



**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 23 May 2017.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

(a) Explain the following terms as used in probability:

- (i) Addition law of probability. (2 marks)
- (ii) Multiplication law of probability. (2 marks)
- (iii) Baye's theorem. (2 marks)

(b) Nairobi residents were surveyed to determine the readership of newspapers available. 50% of the residents read the Newsera newspaper. 60% of the residents read the Newsupdates newspaper. 20% of the residents read both newspapers.

**Required:**

The probability that a resident selected at random reads either the Newsera or Newsupdates or both newspapers. (3 marks)

(c) A retail shop sold two types of goods namely; X and Y in a given month totalling to 430 goods. The cost of selling type X good is Sh.300 per item while the cost of selling type Y good is Sh.425 per item. During the month, the total sales of type X and type Y goods amounted to Sh. 15 1,500.

**Required:**

Using matrix algebra, determine the number of goods of type X and type Y sold.  
(4 marks)

(d) An importer buys goods from his supplier based in Britain at a cost of 7.20 Sterling pounds per unit. Freight charges and insurance on transit amount to 20% of total cost. Customs duty was charged at Ksh. 150 per unit and other expenses amounted to Ksh. 194.400.

**Additional information;**

Cost of all units at source = Ksh.2,088,000  
1 Sterling pound - Ksh.145.00

**Required:**

- (i) The number of units the importer bought. (2 marks)
- (ii) The selling price per unit, if the importer has to make a profit of 25% on cost. (4 marks)
- (iii) The profit margin. (1 mark)

**(Total: 20 marks)**

**QUESTION TWO**

(a) The following data relate to the height of students

Height (Centimetres)	Frequency
150 and under 155	1
155 and under 160	1
160 and under 165	2
165 and under 170	3
170 and under 175	6
175 and under 180	2
180 and under 185	4
185 and under 190	<u>1</u>
	<u><b>20</b></u>

**Required:**

The standard deviation of the height of students.

(b) A dry cleaning business in the city finds that its variable cost (V) is a function of the number of houses cleaned each month (M) and is given by:

$$V = 240H - 20H^2$$

Its monthly fixed cost is Sh.30,000.

Customers are charged a price of Sh.640 per house cleaned.

**Required:**

- (i) The total profit function. (2 marks)
- (ii) The profit during a month when 50 houses were cleaned. (4 marks)
- (iii) The break-even level for the business. (4 marks)

(c) A certain health club specialises in take away “Breakfast Special” packed in 500 grammes. Each package sells for Sh.320. It costs the club Sh.105 per package for materials and labour and sh.37 for packaging each package. Daily transport costs amount to Sh.47,850.

The demand is high and all the "Breakfast Special” produced is sold the same day. Current production is 2,500 packages per day. The club’s fixed cost is Sh.94,225.

**Required:**

The club’s daily profit. (4 marks)

**(Total: 20 marks)**

**QUESTION THREE**

(a) A survey of 500 pupils taking the early childhood skills of Reading, Writing and Arithmetic revealed the following number of pupils who excelled in various skills:

Reading	329	Reading and Writing	83
Writing	186	Reading and Arithmetic	217
Arithmetic	295	Writing and Arithmetic	63

**Required:**

- (i) A Venn diagram for the above information. (5 marks)

- (ii) The number of pupils who excelled in all the skills. (2 marks)
- (iii) The number of pupils who excelled in two skills only. (3 marks)
- (iv) The number of pupils who excelled in Reading or Arithmetic but not both. (2 marks)
- (v) The number of pupils who excelled in Arithmetic but not Writing. (2 marks)
- (b) The probability of A winning a game is  $\frac{1}{2}$  while the probability of B winning a game is  $\frac{1}{3}$ . However, the probability of having a tie is  $\frac{1}{6}$ . A and B agree to play a tournament consisting of 3 games.

**Required:**

The probability that:

- (i) A wins all the games. (2 marks)
- (ii) Two games end in a tie. (2 marks)
- (iii) B wins at least one game. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) The following data relate to prices and quantities of three items over the years 2014 - 2016:

Year Item	2014		2015		2016	
	Price (Sh.)	Quantity	Price (Sh.)	Quantity	Price (Sh.)	Quantity
X	300	20,000	375	24,000	525	20,000
Y	375	12,000	375	16,000	150	20,000
Z	1,500	3,000	3,000	2,000	3,000	3,000

- (i) Paasche's price index for the years 2015 and 2016 using 2014 as the base year. (6 marks)
- (ii) Laspeyre's price index for the years 2015 and 2016 using 2014 as the base year. (6 marks)

b) Realtime Products Limited deals in product X. The average revenue (AR) and average cost (AC) functions of product X are as follows:

$$AR = 60 - 1x$$

$$AC = 24 - 3x + x^2 + \frac{15}{x}$$

Where;

*AR = Average revenue function in million of shillings*

*AC = Average cost in million of shillings*

*X = Units of product X.*

**Required:**

- (i) The total profit function. (4 marks)
- (ii) The maximum profit. (4 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

(a) Distinguish between the following terms as used in sampling:

- (i) "Sample frame" and "stratification". (4 marks)
- (ii) "Cluster sampling" and "quota sampling". (4 marks)

(b) Explain the purpose of a Lorenz curve. (2 marks)

(c) The following distribution represents weekly earnings of different employees in a hotel establishment:

Income (Sh.)	4,000-4,200	4,200 - 4,400	4,400 - 4,600	4,600 - 4,800	4,800 - 5,000	5,000 - 5,200
Number of employees	14	22	44	50	40	30

**Required:**

- (i) A frequency polygon. (5 marks)
- (ii) From your frequency polygon obtained in (c) (i) above, estimate the mode.

(1 mark)

(d) An insurance agent receives a monthly commission on insured property as follows:

5% on the first Sh.200,000 of property insured.

3% on the remainder of the property insured.

The agent received a total commission of Sh.79,000 in a given month.

**Required:**

The value of property insured.

(4 marks)

**(Total: 20 marks)**

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**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 22 November 2016.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Highlight four applications of linear functions. (4 marks)
- (b) Distinguish between “marginal cost function” and “marginal revenue function”. (4 marks)
- (c) Dorcas and Gladys visited a supermarket to purchase some items. Dorcas bought 9 jackets and 12 sweaters for Sh.21.000. Gladys bought 14 jackets and 6 sweaters for Sh.900 more than Dorcas.

**Required:**

Using matrix algebra, determine the cost of a jacket and a sweater. (6 marks)

- (d) An engineering firm intends to invest in a project whose profit function is given by  $y = 28x - x^2 - 11$  where:

y is profit in Sh. “000”.

x is the running time of the project in weeks.

The project can run for at most 24 weeks.

**Required:**

- (i) The initial cost of the project. (1 mark)
- (ii) The break-even time of the project in weeks. (3 marks)

(iii) The best time to end the project. (2 marks)

**(Total: 20 marks)**

**QUESTION TWO**

(a) The total revenue function of a certain product Q is quadratic in nature. The following data show the number of units of the product sold and their corresponding sales revenue:

Number of units of Q sold:	15	20	30
Sales revenue, R Sh. ("000"):	2,325	2,900	3,750

**Required:**

(i) The total revenue function. (4 marks)

(ii) The maximum revenue. (3 marks)

(iii) The revenue, when the number of units of Q sold is 50 units. (2 marks)

(b) The table below shows the grouped frequency distribution of marks obtained by 50 candidates in a zonal mathematics contest:

<b>Marks</b>	24-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
<b>Frequency</b>	2	5	X	9	Y	8	5	3

**Required:**

(i) The values of X and Y, given that the mean of the distribution is 61.20 marks. (8 marks)

(ii) The variance of the marks. (3 marks)

**QUESTION THREE**

(a) Explain the following terms:

(i) Relative dispersion. (2 marks)

(ii) Coefficient of relative dispersion. (2 marks)



(b) The following information shows the number of insurance claims made by a company on behalf of its employees by age over the last 5 years:

<b>Age in years</b>	10-20	20-30	30-40	40-50	50-60	60-70
<b>Claims in Sh. “million”</b>	10	64	46	44	18	10

**Required:**

- (i) Represent the information in a histogram. (5 marks)
- (ii) Use the histogram obtained in (b)(i) above to determine the approximate modal age of claimants. (2 marks)
- (iii) The mean age of claimants of the company. (4 marks)
- (iv) Using your results in (b)(ii) and (b)(iii) above, approximate the median age of claimants. (3 marks)
- (v) Given that the standard deviation of the claims is 13.12, determine the skewness of the data. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

(a) Citing a suitable example in each case, explain the following terms:

- (i) Mutually exclusive events. (2 marks)
- (ii) Complementary events. (2 marks)

(b) The table below shows the daily wage of 66 labourers in a certain flower farm:

<b>Wages in Shillings</b>	<b>Number of labourers</b>
350-450	4
450-550	7
550-650	10
650-750	14
750-850	20
850-950	8
950-1,050	3

**Required:**

- (i) The average wage. (2 marks)
- (ii) The modal wage. (2 marks)
- (iii) The median wage. (2 marks)
- (iv) The standard deviation of the wage distribution. (2 marks)
- (v) The coefficient of variation of the wage distribution. (2 marks)
- (c) A tourist left United States of America with US dollars (\$) 6,770 where he paid \$400 for his flight to Kenya.

Upon arrival in Kenya, he converted \$4,000 to Kenyan Shillings at a rate of \$1 = Ksh.90 and paid a commission of 2% to the Kenyan agent.

The tourist booked into a hotel for 15 days at Ksh.8,000 per night.

He booked a cab at Ksh.4,500 per day for 15 days.

He paid for a trip to the Masai Mara game reserve at a cost of \$ 100 per day for 5 days.

He purchased 6 carvings at a cost of Ksh.7,000 each and jewellery at a cost of \$1,200.

He was to travel to Uganda for a conference. He paid for his flight to Uganda at Ksh.25,000.

Upon arrival in Uganda, he converted all his monies to Ugandan shilling.

\$ 1 = Ush.2,500

Ksh. 1 = Ush.25.

**Required:**

The amount of money in Ugandan shillings the tourist had in Uganda upon arrival.

(6 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

(a) The consumer price index (CPI) for the years 2010-2015 are given as follows:

Year	2010	2011	2012	2013	2014	2015
CPI	138.6	142.8	148.3	152.4	156.6	160.3

**Required:**

The purchasing power of the shilling for each of the six years. (3 marks)

- (b) The probability that a school bus picks school children on time along route X is  $\frac{1}{6}$ . Another school bus picks children along route Y with a probability of  $\frac{1}{3}$  of being on time. The two events are independent events.

**Required:**

- (i) Represent the above information using a tree diagram. (3 marks)
- (ii) The probability that the two buses are both on time. (1 mark)
- (iii) The probability that only one of the two buses arrives on time. (2 marks)
- (iv) The probability that neither of the two buses arrives on time. (2 marks)

(c) A salesman earns a basic monthly salary plus 5% commission on the first Sh.200,000 sales made and X% rate of commission on any other extra sales made.

In September 2016, he earned a total of Sh.30,000 when the total sales were Sh.350,000.

In October 2016, he earned a total of Sh.37,500 when sales made were Sh.600,000.

**Required:**

- (i) The basic monthly salary. (3 marks)
- (ii) The value of X% being the rate of earning commission. (3 marks)
- (iii) The total earnings in the month of November 2016 given that the total sales are Sh.850,000. (3 marks)

**(Total: 20 marks)**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**TUESDAY: 24 May 2016.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

(a) State four advantages and four disadvantages of closed-ended questions in a questionnaire. (8 marks)

(b) Bundacho Bakery, produces two types of cakes, namely; queen cake and blackforest. The cost of producing 10 queen cakes and 8 blackforest is Sh.4,060. The cost of producing 4 queen cakes and 7 blackforest is Sh.2,840. The bakery makes a mark-up of 20% and 30% on queen cakes and blackforest respectively.

**Required:**

- (i) Using matrix algebra, determine the cost of producing a queen cake and a blackforest. (4 marks)
- (ii) The selling price of a queen cake and a blackforest. (2 marks)

(c) James Wanigonda bought a television set on hire purchase terms. The deposit was indicated as Sh.35,000 and the balance payable in 12 equal instalments of Sh.4,500. As a policy of the company, a customer who defaults on an instalment is charged a penalty of 5% on the outstanding balance payable in the next month. James Wanigonda defaulted in the fifth month instalment and the ninth month instalment.

**Required:**

The total cost of the television set bought by James Wanigonda. (6 marks)

**(Total: 20 marks)**

**QUESTION TWO**

(a) Highlight three applications of break-even analysis in a business environment. (3 marks)

(b) In a certain manufacturing company, the total cost of production is given by the following function:

$$TC = -3q^2 - r 12q - 2 \text{ where:}$$

$TC = \text{Total Cost}$

$q = \text{Quantity produced in units.}$

The selling price per unit is Sh.5 Required:

- (i) The revenue function. (1 mark)
- (ii) The profit function. (2 marks)
- (iii) The break-even point in units. (3 marks)
- (iv) The level of production that would earn a profit of Sh.22,000, (3 marks)

(c) An international economic forum was attended by 190 invited guests from three continents namely; Africa. Asia and America.

The following information relates to the guests who attended the forum:

100 guests represented Africa.

80 guests represented Asia.

90 guests represented America.

35 guests represented both Africa and Asia.

33 guests represented both Asia and America.

48 guests represented both Africa and America.

15 guests represented all the three continents.

**Required:**

- (i) A venn diagram to represent the above information. (2 marks)
- (ii) The number of guests that were not representing any of the three continents. (2 marks)
- (iii) The number of guests that represented only one continent. (1 mark)
- (iv) The number of guests that represented two continents only. (1 mark)

- (v) The number of guests that represented at least two continents. (2 marks)  
**(Total: 20 marks)**

**QUESTION THREE**

(a) Katama Insurance Company categorises its insurance claims by regions and the nature of claim as follows:

Nature of claim	Regions			
	Eastern	Southern	Northern	Western
Minor injuries treatment	75	128	29	52
In-patient treatment	233	514	104	251
Outpatient treatment	100	326	65	99

Determine the probability that:

- (i) A claim chosen at random is from Northern region. (2 mark)  
 (ii) A claim chosen at random is from Eastern region. (2 mark)  
 (iii) A claim chosen at random is either from Northern region or Southern region. (1 mark)  
 (iv) A claim chosen at random is for minor injuries treatment. (1 mark)  
 (v) A claim chosen at random is from Southern region, given that it is for minor injuries treatment. (1 mark)  
 (vi) A claim chosen at random is for outpatient treatment, given that it is from Western region. (2 mark)  
**(Total: 20 marks)**

(b) The following data show the sales levels achieved by a salesman over a six month period together with the expenditure on fuel consumed over the same period:

Month	Sales level (Sh. "000")	Expenditure on fuel (Sh. "000")
January	250	30.00
February	180	20.00
March	315	30.25
April	225	27.50
May	345	28.75
June	500	42.60

**Required:**

The coefficient of variation for:

(i) Monthly sales level. (4 marks)

(ii) Monthly expenditure on fuel. (4 marks)

**(Total: 20 marks)**

#### QUESTION FOUR

(a) Distinguish between the following terms:

(i) Measures of central tendency and measures of dispersion. (4 marks)

(ii) Nominal rate of interest and effective rate of interest. (4 marks)

(b) Agness Mwanyalo bought goods for sale worth Sh.90,000. She projected to make a profit of 25% on the selling price. Required:

The price to be charged for the goods. (4 marks)

(c) The following data relate to the weekly output of production and the number of employees in a company:

Weekly Output in units ("000")	Number of employees
100 – 160	1
160 – 180	5
180 – 200	10
200 – 220	35
220 – 240	55
240 – 260	74
260 – 300	20

**Required:**

(i) The arithmetic mean of the weekly output. (4 marks)

(ii) The median weekly output. (4 marks)

**(Total: 20 marks)**

#### QUESTION FIVE

(a) The following are the indices of a country for the years 2011 - 2015:

Year	2011	2012	2013	2014	2015
Index	108	114	106	118	122

**Required:**

The constant base indices using 2010 as the base year (2010 = 100). (5 marks)

(b) The table below shows the number of services offered and prices charged per service for a small rural dental clinic during the last three quarters of year 2015:

Type of Service	Price (Sh.)	Quantity (Services)				
	April-June	July-Sept	Oct-Dec	Apr-June	July-Sept	Oct-Dec
Tooth extraction	800	900	1,200	300	275	400
Tooth tilling	600	750	900	400	320	280
Tooth cleaning	450	600	800	700	660	800

**Additional information:**

Base period = April - June

**Required:**

- (i) The Laspeyre's price indices for the quarters July - September and October - December. (8 marks)
- (ii) The Paasche's price indices for the quarters July - September and October - December. (7 marks)

**(Total: 20 marks)**



**KASNEB**

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**WEDNESDAY: 18 November 2015.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Explain three challenges that might be faced during statistical sampling. (6 marks)
- (b) The cash price of a television set is Sh. 18,000. If the television is bought on hire purchase terms, a deposit of 25% of the cash price is required. A flat interest rate of 15% per annum is charged on the remaining balance for two years.

**Required:**

The amount of monthly instalment on hire purchase terms. (4 marks)

The following information relates to the expenditure of a certain family during the years 2013 and 2014:

Item	Year 2013		Year 2014	
	Quantity in "000" units	Price per unit (Sh.)	Quantity in "000" units	Price per unit (Sh.)
A	120	6	160	8
B	60	12	80	10
C	80	10	40	16
D	200	4	300	4
E	40	14	20	20

**Required:**

- (i) Laspeyre's price index. Interpret your answer. (5 marks)

(ii) Paasche's price index. Interpret your answer.

(5 marks)

**(Total: 20 marks)**

## QUESTION TWO

(a) A manufacturer finds that the variable cost ( $V$ ) in thousands of shillings of a product  $B$  is given by the equation  $V = 2B^2 - 30B$ , where  $B$  is the number of units of product  $B$  produced per month. The overhead cost in thousands of shilling is Sh. 1,000 per month. Customers are charged a price of  $P = 60$  (thousand shillings) per unit of product  $B$ .

### Required:

(i) The total revenue function. (2 marks)

(ii) The total cost function. (2 marks)

(iii) The break-even sales level of product  $B$ . (4 marks)

(iv) The level of profits/losses when 10 units of product  $B$  are produced and sold. (2 marks)

(b) Uyombo Ltd. uses three machines in its production department. Machine  $X$  produces 3% defective items, machine  $Y$  produces 5% defective items and machine  $Z$  produces 10% defective items. Of the total output from the three machines, 60% of the items are produced by machine  $X$ , 30% by machine  $Y$  and 10% by machine  $Z$ .

One item is selected at random from a day's production.

### Required:

(i) A tree diagram showing the joint probabilities from the machines. (5 marks)

(ii) The probability that the item is defective. (2 marks)

(iii) The probability that the item was produced by machine  $X$  or by machine  $Z$ ; given that the item is defective. (3 marks)

**(Total: 20 marks)**

## QUESTION THREE

(a) Explain the following terms as used in set theory:

- (i) Complement of a set. (2 marks)
- (ii) Union of sets. (2 marks)
- (iii) Intersection of sets. (2 marks)

(b) An American tourist visited Kenya with US dollars S38,700. He exchanged all his dollars to Kenyan shillings Ksh., paying a bank charge of 2%. During his stay in Kenya, he spent Ksh.2,000,000 and paid Ksh.200,000 as air ticket. When leaving the country, he converted the remaining balance into US dollars without paying any bank charges.

Use exchange rate of 1 \$ = Ksh. 103.72

**Required:**

The amount of money the tourist received at the end of his visit in US dollars. (4 marks)

(c) Tsuma Electronics Ltd. deals exclusively with three types of calculators namely A, B and C series. During the month of January, the company's purchases of calculators in units amounted to 50 A series, 75 B series and 36 C series.

The company has two sources of buying the calculators, X and Y whose unit cost prices are Sh.2,800, Sh.4,650, Sh.6,275 and Sh.2,640, Sh.4,250, Sh.6,450 respectively for A series, B series and C series calculators.

All calculators purchased from source X are sold at a profit of 20% while those from source Y are sold at a profit of 25%.

**Required:**

- (i) Represent the quantity of calculators in a row matrix. (1 mark)
- (ii) Represent the price of calculators in a column matrix. (1 mark)
- (iii) The total cost of calculators from each source using matrix algebra. (2 marks)
- (iv) The expected profit for purchasing calculators from each source using matrix algebra. (6 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

(a) Explain the following terms:

(i) Depreciation. (2 marks)

(ii) Annuity. (2 marks)

(iii) Simple interest. (2 marks)

(b) KK Ltd. bought a piece of land for Sh.2,500,000 in January 2012. The value of the land appreciated by 18% per annum in 2012 and 2013. The land further appreciated by 15% in 2014. Due to harsh economic factors, the piece of land dropped in value by 12% during the year ending 2015.

**Required:**

(i) The expected value of the land by the end of year 2015. (3 marks)

(ii) The rate of interest per annum that would have resulted in the land appreciating to the same value after four years. (3 marks)

(c) The following information shows the production of product X and Y in a certain enterprise:

Year	1	2	3	4	5	6	7	8
Product X	238.2	281.2	319.4	352.2	391.0	448.9	479.6	536.0
Product Y	89.4	95.6	108.1	147.2	272.0	427.8	482.7	601.1

**Required:**

Construct on the same scale; a semi-logarithmic graph of each of the products X and Y. (8 marks)

**(Total: 20 marks)**

### QUESTION FIVE

(a) Highlight three advantages and three disadvantages of venn diagrams. (6 marks)

(b) The following data relate to the distribution of lifetimes of 500 light bulbs tested by a compliance standards agency from two manufacturers A and B:

Life time (days)	Number of bulbs tested A	B
500-550	27	22
550-600	50	46
600-650	85	78
650-700	99	88
700-750	94	92
750-800	74	86
800-850	47	52
850-900	24	36

**Required:**

- (i) Mean lifetime of the bulbs from each manufacturer. (6 marks)
- (ii) Median lifetime of the bulbs from each manufacturer. (4 marks)
- (iii) Modal lifetime of the bulbs from each manufacturer. (4 marks)

**ATD LEVEL II**

**DCM LEVEL II**

**BUSINESS MATHEMATICS AND STATISTICS**

**PILOT PAPER**

**September 2015**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

(a) A retailer bought a machine with a cash price of Sh.600,000 on hire purchase terms. He paid an initial deposit of 25 percent of the cash price. An interest of 20 percent is charged on the outstanding balance for the period of repayment. The balance plus the interest is payable in 36 equal monthly instalments. A customer who purchases the machine on cash basis is given a 20% discount on the cash price.

**Required:**

Calculate the amount of money the retailer would have saved had he bought the machine on cash basis. (5 marks)

(b) A salesman earns a fixed salary per month and a commission based on total sales made in a given month. During the month of June and July 2014, the salesman's total earnings were Sh.936,000 and Sh.1,170,000 respectively. The total sales for corresponding months of June and July were Sh. 12,150.000 and Sh.1 8,000,000 respectively.

**Required:**

- (i) Determine the salesman's rate of commission. (3 marks)
- (ii) The salesman's fixed monthly salary. (2 marks)
- (iii) The total sales the salesman has to make in order to earn a total monthly salary of Sh.1.035,000. (2 marks)

(c) A trader intends to purchase a machine worth Sh.255.150 to be paid in two years time. He plans to invest a certain amount of money in a co-operative society such that the sum at the end of the first year amounts to Sh.236,250 and at the end of the second year, the amount will be enough to pay for the machine.

**Required:**

- (i) Calculate the rate of interest if compounding is done annually. (3 marks)
- (ii) Calculate the rate of interest if compounding is done quarterly. (3 marks)
- (iii) Calculate the amount to be invested in two years in order to purchase the machine if interest is compounded quarterly. (2 marks)

**(Total: 20 marks)**

**QUESTION TWO**

(a) The table below shows daily wages of casual employees in an agricultural firm:

Wages (sh.)	Number of employees
500 - 600	8
600 - 700	10
700 - 800	16
800 - 900	14
900 - 1000	10
1000 - 1100	5
1100 - 1200	2

**Required:**

- (i) Using the 3ra class, distinguish between the terms class limit, class interval and class boundary. (3 marks)
  - (ii) Calculate the mean daily wage. (3 marks)
  - (iii) Determine the semi-interquartile range of the employees daily wage. (6 marks)
- (b) State two advantages and two disadvantages of using secondary data as a method of data collection. (4 marks)
- (c) Outline the steps followed in compiling primary data. (4 marks)

**(Total: 20 marks)**

**QUESTION THREE**

(a) Ten new products have been developed by a health foods firm. The management believes that the long run success of the products will depend on superior product characteristics P, consumer satisfaction S and competitive advantage C. The marketing department has indicated that of the ten products, six meet the superior product criteria P, five meet the consumer satisfaction criteria S, while seven meet the competitive advantage C. Three of the products each meet the two of the required criteria.

**Required:**

- (i) Represent the above information in a venn diagram. (7 marks)
- (ii) Using the venn diagram in (i) above, write the event that a product possesses all the desired characteristics. (2 marks)

(b) An electronics company has a new line of product P. Research suggests that the daily sales for the new product is given by the function  $v = P^2 + 120p + 1400$ , where P is the price per unit.

**Required:**

Calculate the maximum daily sales of product P.

(c) Given the following matrices:

$$A = \begin{bmatrix} 1 & -2 \\ 0 & 4 \end{bmatrix} \text{ and } B = \begin{bmatrix} 0 & 5 \\ -3 & 6 \end{bmatrix}$$

**Required:**

- (i) Show that  $AB \neq BA$ . (3 marks)
- (ii) Show that  $AA^{-1} = A^{-1}A = 1$ . (4 marks)

**(Total: 20 marks)**



**QUESTION FOUR**

The table below shows average wholesale prices and production of potatoes, tomatoes and carrots for the years 2012, 2013 and 2014 in a certain county:

	<b>PRICES</b> (shs. per kg.)	<b>QUANTITIES</b> (millions kg.)				
<b>Year</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
Potatoes	40	45	50	960	970	1020
Tomatoes	65	67	59	118	115	125
Carrots	35	46	38	80	75	85

**Required:**

(a) Calculate simple aggregate wholesale price index for the year 2014 using:

- (i) 2012 as the base year. (2 marks)
- (ii) 2013 as the base year. (4 marks)

(b) Compute Lasperyre’s price index and Paasche’s price index using 2012 and 2013 as the base years. (10 marks)

(c) Interpret results obtained in part (b) above. (4 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

(a) An investment analyst collects data on shares and notes whether or not dividends were paid and whether or not the shares increased in price over a certain period.

- Of all the 112 shares that paid dividends, 78 shares had not increased in price.
- Of all the 127 shares that had no price increase, 49 shares did not pay dividends.
- The total number of shares analysed were 246.

**Required:**

Represent this data on a contingency table. (4 marks)

(b) Based on (a) above, determine the probability that:

- (i) A share paid dividends. (2 marks)

(ii) A selected share neither paid dividends nor increased in price. (2 marks)

(iii) A selected share paid dividends given that it had increased in price. (2 marks)

(iv) A selected share either increased in price or paid dividends or both. (2 marks)

c) A real estate specialist believes that during periods of high economic growth, properties will appreciate with a probability of 0.8, in periods of moderate economic growth, 0.30, during periods of low economic growth, 0.20. During any period of time, the probability of high economic growth is 0.30, the probability of moderate growth is 0.50 and the probability of low economic growth is 0.20. During the present period property has been undergoing appreciation.

**Required:**

(i) Determine the probability that the economic growth is high. (4 marks)

(ii) Determine the probability that the economic growth is low. (4 marks)

**(Total: 20 marks)**

**KASNEB**

**NOVEMBER 2020**

**SUGGESTED ANSWERS AND SOLUTIONS**

**QUESTION ONE**

**(a) Data collection methods.**

- Observation
- Questionnaire
- Sampling
- Experimentation
- Interviews

**(b) .**

**i) A "less than" Ogive curve to represent the data.**

Marks (%)	No.of students (f)	Cumulative frequency (cf)
0-10	5	5
10-20	8	13
20-30	15	28
30-40	18	46
40-50	20	66
50-60	32	98
60-70	23	121
70-80	12	133
80-90	9	142
90-100	2	144

$$\sum_f 144$$