ASSOCIATION OF ACCOUNTANCY BODIES IN WEST AFRICA
ACCOUNTING TECHNICIANS SCHEME, WEST AFRICA
PART II EXAMINATIONS – MARCH 2022

QUANTITATIVE ANALYSIS

Time Allowed: 3 hours

SECTION A: PART I MULTIPLE-CHOICE QUESTIONS (30 Marks)

ATTEMPT ALL QUESTIONS

Write ONLY the alphabet (A, B, C, D or E) that corresponds to the correct option in each of the following questions/statements:

1. The number of people infected by a deadly virus in a locality comprises 5 divisions: A, B, C, D & E are presented in a pie chart. If 150 infected people are from division B with an angular representation of 60° on the pie chart, then the population of infected people in the locality is

   A. 600
   B. 750
   C. 900
   D. 1,050
   E. 1,200

2. Which of the following is normally used to draw a frequency polygon?

   A. Ogive
   B. Histogram
   C. Bar graph
   D. Lorenz curve
   E. Z- chart

3. Which of the following sampling techniques allows fair representation of various categories without biases?

   A. Systematic Sampling
   B. Quota Sampling
   C. Stratified Sampling
   D. Cluster Sampling
   E. Simple Random Sampling

4. The authority of a particular local government area distributes cash relief packages to some aged individuals residing in 5 wards of the council during a lockdown. The following pieces of information were gathered from the council's accountant and presented in the table below:

Ward	A	B	C	D	E
Number of aged individuals	30	20	25	20	35
Amount given per person(₦'000)	10	12	11	12	7

What is the mean amount spent by the authority on one aged person?

A. ₦8, 666.67
B. ₦ 10,000
C. ₦ 11,000
D. ₦ 12,000
E. ₦ 25,000

5. Given that the variance of a set of scores is 81 and the coefficient of variation is 2.25%, find the mean

A. 1
B. 2
C. 3
D. 4
E. 5

6. The numbers of chartered accountants among the graduates of accounting programme from 6 different universities in a particular year are given as follows: 15, 12, 10, 11, 13, and 17. What is the mean deviation of this data?

A. 0
B. 1
C. 2
D. 3
E. 4

7. Which of the following is **NOT** a basic step in formulating a linear programming problem?

A. Identify the objective function
B. Identify the slack variables

C. Identify the constraints
D. Identify the decision variables
E. Identify the linearity of the objective function and constraints

8. The following pieces of information are obtained from 5 pairs of data set (x, y) :
$\sum x = 50$, $\sum y = 100$, $\sum x^2 = 502$, $\sum y^2 = 1854$ and $\sum xy = 1001$. If the fitted simple linear regression equation is $y = a + bx$, then the estimated value of a is

A. 0
B. 0.5
C. 15
D. 20
E 25

9. Which of the following is **NOT** true of Least Squares Method in Time series analysis?

A. It can be used for forecasting
B. It is free from subjective error
C. Extreme values are not lost
D. Effect of cyclical fluctuations is completely removed if it is equal to
the average period of cycles
E. It is good for linear trend

10. If the price of milk in 2009 was ₦250 and the price in 2015 was ₦350, using 2009 as the base year, the price relative index is

A. 100%
B. 110%
C. 120%
D. 130%
E. 140 %

11. Which of the following statements best describes mutually exclusive outcomes of events A and B ?

A. A and B are dependent events
B. A and B are independent events

C. The occurrence of event A excludes the possibility of event B from happening
D. Events A and B happen at the same time
E. Occurrence of an event A has a significant effect on event B

12. Which of the following does **NOT** necessitate the use of Z-test in statistical hypothesis testing?

A. n is equal to or greater than 30.
B. sampling distribution is normally distributed
C. n< 30
D. sampling distribution is approximately normal
E. standard deviation of the population is known or unknown

13. Find the range of values of x which satisfy the inequality $\frac{2x+1}{x+3} < \frac{2}{3}$.

A. $x < \frac{3}{5}$
B. $x > \frac{3}{5}$
C. $x < -\frac{3}{4}$
D. $x < \frac{3}{4}$
E. $x > \frac{3}{4}$

14. If $x - 2y = 4$ and $x + 2y = 6$, *then* $3x$ *is*

A. 5
B. 10
C. 15
D. 20
E. 30

15. Suppose the total monthly revenue (Le'00,000) of FAFAWA Limited. for a commodity is described by the function $R(x) = 125{,}000{,}000(0.2)^x$, where x (in Le'0,000) is the total amount spent on overheads. If the total revenue of the company for the month of April is Le200,000, then the amount spent on overheads is

A. Le 10,000
B. Le 12,500
C. Le 20,000
D. Le 40,000

E. Le 62,500

16. Which of the following does **NOT** depict break-even point of a firm?

A. Total revenue is equal to total cost
B. Difference between revenue and cost is zero
C. Profit function is equal zero
D. Sales level is equal to profit level
E. $q = \frac{Fixed\ Cost}{Selling \quad price - average\ variable\ cost}$

17. Find the simple interest on ₦450 for 9 months at 3.5% per annum

A. ₦9.81
B. ₦ 11.81
C. ₦ 13.81
D. ₦ 14.81
E. ₦ 15.81

18. The present worth of an investment is L$500,000. If it is estimated to grow at the rate of 20% per annum, then its worth in the 6th year is

A. L$600,000
B. L$1,100,000
C. L$1,500,000
D. L$1,244,160
E. L$1,492,992

19. The following are the main stages involved in Operations Research, **EXCEPT**

A. Identification of problems and objectives
B. Construction of a model
C. Identification of variables
D. Documentation of result
E. Implementation of result

20. The feasible region houses the

A. Initial Solution
B. Slack Solution
C. Feasible Solution
D. Linear Solution
E. Problem Solution

21. Find the minimum value of Z in the following linear programming problem:
Minimise: $Z = 40a + 50b$

$$\begin{aligned} \textit{Subject to} \qquad 3a + 5b &\geq 70 \\ a + b &\geq 20 \\ a, b &\geq 0 \end{aligned}$$

A. 1500
B. 950
C. 850
D. 800
E. 700

22. How many corner points are there in a graphical solution of an unbounded feasible region of a minimisation linear programming problem with three linear constraints?

A. 6
B. 5
C. 4
D. 3
E. 2

23. The annual demand for a commodity is 128,245 units and the cost of an order is Le34. If the annual holding cost per commodity is Le6.00, the average stock for the commodity (to the nearest whole number) is

A. 108
B. 275
C. 317
D. 603
E. 620

24. In a typical inventory control problem, Q = 3,000, d = 150,000, c = Le 400 and h = Le 60 (where all the symbols bear their usual meanings). What is the total annual cost?

A. Le 80,000
B. Le 90,000
C. Le 100,000
D. Le 110,000
E. Le 120,000

25. Which of the following is **NOT** a reason for holding stock?

A. It enables production processes to flow smoothly and efficiently
B. It acts as a buffer for variations in demand new usage
C. It ensures that the store is filled up at all times
D. It absorbs variations in production and demand
E It takes advantage of bulk purchasing discount

26. The maximum time that any non-critical activity may overrun without impacting on the critical path is called

A. Float
B. Free Float
C. Critical
D. Slack
E. Duration

27. The table below shows the Earliest Finish Times (EFT), Latest Finish Times (LFT), Earliest Start Times (EST), Latest Start Times (LST) and durations of a project:

Activity	**EFT**	**LFT**	**EST**	**LST**	**Duration**
P	3	3	0	0	3
Q	8	8	3	3	5
R	8	8	3	3	2
S	14	15	8	8	6
T	16	16	8	8	8
U	16	16	14	15	1
V	22	22	14	15	5
W	22	22	16	16	6

Identify the critical path of the project

A. P, Q, R, T, U, V, W
B. P, Q, T, W
C. P, Q, R, S, T, W
D. Q, R, S, T, W
E Q, T, W

28. A component used in an electronic circuit camera has different failure rates because the component life time is limited. The cumulative percentages of failures and months after replacement are given in the table below:

Months after replacement	1	2	3	4
Cumulative percentage of failures	20	55	85	100

What is the monthly average life of the component?

A. 1.20
B. 2.40
C. 4.00
D. 5.40
E 7.85

29. Calculate the present value of an annuity of Le60,000 for 12 years at 8.5% compounded annually

A. Le400,872.35
B. Le420,682.35
C. Le430,682.35
D. Le440,682.35
E. Le450,682.35

30. Which of the following is **NOT** a method of obtaining solution of a transportation problem?

A. Least Cost Method
B. Vogel's Approximation Method
C. NWCM
D. Simplex Method
E. Stepping Stone Method

SECTION A: PART II SHORT-ANSWER QUESTION (20 MARKS)

ATTEMPT ALL QUESTIONS

Write the correct answer that best completes each of the following questions/statements

1. The type of correlation that exists between two variables when an increase in one variable is associated with a decrease in the other variable is called .....

2. The deposits (₦'000) of a certain group of customers in a microfinance bank on a particular day are 13, 19, 16, 15, 14, 26 and 16. The average of the mean and the median deposits is .....

3. The probability of rejecting the null hypothesis when it is true is .....

4. The coefficient of skewness is ..... for a symmetrical or normal distribution while it is ..... for an Asymmetrical distribution.

5. In a competitive market, the supply price is $P_1 = 3 + \frac{1}{4}q$ and demand price is $P_2 = 15 - \frac{3}{4}q.$ Determine the market price at equilibrium.

6. An arrangement whereby a fixed amount of money is paid in exchange for regular amounts to be received at fixed interval for a specific period is called .....

7. An activity which does not link into the completion overall activities of the project is called.....

8. To solve a Linear Programming problem, using simplex method, the two variables that are used to convert an INEQUALITY constraint to an EQUALITY constraint are ..... and .....

9. A solution in which there are at most $\boldsymbol{m}$ zero values in a linear programming problem that has $\boldsymbol{n}$ variables and $\boldsymbol{m}$ constraints ($\boldsymbol{m}<\boldsymbol{n}$). is known as the .....

10. An inventory model in which all factors are known with certainty is called.....

11. The type of data involving the record of the number of passengers on a train is called .....

12. The total monthly revenue of Layink enterprise (in Naira) is given by the equation $R = 300{,}000(0.5)^{0.7x}$, where x(₦'000) is the amount spent on overheads. What is the maximum revenue?

13. The variables involved in any Operations Research technique can be grouped into ..... and .....

14. The process of eliminating the trend from the observed series is called

15. The aim of the marginal function is to measure the extra amount of resources it takes to produce .....

16. If every item is replaced during a single stoppage whether it has failed or not, then the process is called.....

17. In transportation problem analysis, the condition that arises when the number of filled (occupied)cells is less than the number of rows (**m**) plus the number of columns (**n**) minus one, is known as .....

18. The probabilities of candidate **A** and candidate **B** passing an interview are respectively 0.6 and 0.75. The probability that only one will pass the interview is .....

19. If two coins and a die are tossed together, then the number of elements in the sample space is .....

20. The simulation method developed on the basis of the principle of experiments, which makes use of sampling and probability distribution theories, is called .....

SECTION B: ATTEMPT ANY FOUR QUESTIONS (50 MARKS)

QUESTION 1

The following table shows the cost per bag and number of bags of five types of food stuff supplied by a food vendor to a private school with boarding facility for two consecutive months in year 2019:

	June		**July**	
	Price		**Price**	
Food stuff	(per bag) (₦'00)	Quantity (No of bags)	(per bag) (₦'00)	Quantity (No of bags)
Rice	120	10	125	12
Beans	155	5	160	6
Garri	80	10	85	11
Flour	110	6	105	7
Yam flour	135	9	130	10

By using June as the base month, calculate the

a. Simple Aggregate Price Index ($2^1/_2$ Marks)

b. Simple Aggregate Quantity Index ($2^1/_2$ Marks)

c. Marshall Edgeworth's Index ($7\ ^1/_2$ Marks)

(Total $12^1/_2$ Marks)

QUESTION 2

a. The following data represent scores of 50 students in a Statistics test:

73	73	94	71	60	79	75	66	74	81
58	68	73	58	84	77	75	57	69	68
75	77	80	73	62	73	74	77	68	49
72	54	68	66	100	84	70	62	73	69
66	52	76	69	76	67	78	62	65	75

i. Prepare the frequency distribution table with the first class having a lower class of 40 and a class width of 10. (4 Marks)

ii. Draw the histogram for this data set and use it to estimate the mode ($4^1/_2$ Marks)

b. The following table shows the monthly profits of 100 randomly selected small scale enterprises in some West African cities in thousands of Leone:

Profit (inLe'000)	**Number of Enterprises**
150 – 169	8
170 - 189	19
190 - 209	34
210 - 229	24
230 - 249	10
250 - 269	5

Construct the ogive for the data (4 Marks)

(Total $12^1/_2$ Marks)

QUESTION 3

The estimated average cost function of a manufacturing company for a commodity is $AC = q^2 - 15q - \frac{810{,}000}{q}$ and the demand function for the commodity is

$P = \frac{4}{3}q^2 - 30q - 5{,}400$, where q denotes the quantity produced and sold.

Calculate:

a. The marginal revenue, the marginal cost and hence, the production level that maximises the company's profit ($6^1/_2$ Marks)

b. The maximum profit (3 Marks)

c. The price elasticity of demand at the production level that maximises profit and comment on your result in (c) (3 Marks)

(Total $12^1/_2$ Marks)

QUESTION 4

A manufacturing company has the annual demand of 120,000 units, the handling and phoning costs each time the order is made amount to ₦100 with the unit price of ₦150 together with the storage cost including (insurance premium) of 20 ½ % of unit price.

Determine the

a. Optimum units to keep per time ($7^1/_2$ Marks)

b. Total cost of ordering (5 Marks)

(Total $12^1/_2$ Marks)

QUESTION 5

The palliative loan, due to the Covid-19 pandemic, is being given to small scale traders by GJG bank in Lagos and Abuja. The level of the loan and the number of traders in each branch are summarised in the table below:

Loan Amount (₦'000)	**No of traders**	
	Lagos	**Abuja**
14 less than 18	11	19
18 less than 22	37	30
22 less than 26	69	25
26 less than 30	77	41
30 less than 34	56	35

You are required to:

a. Compute the mean and standard deviation of the loan given to the traders in Lagos and Abuja. (10 Marks)

b. Estimate the coefficients of variation for the two cities. (2 Marks)

c. Comment on the relative dispersion between the distributions based on your answers in (b). ($^1/_2$ Mark)

(Total $12^1/_2$ Marks)

QUESTION 6

a. A pharmaceutical company has decided to make a chart to know the minimum amount of fats, carbohydrates, and proteins which a man needs on a daily basis to fulfil his requirement for medical awareness. The choice is to be made from four different types of foods: P, Q, R and S. The yields per unit for different types of foods are given as follows:

Type of food	**Yield per unit**			**Cost per unit (Le)**
	Fats	**Carbohydrates**	**Proteins**	
P	2	13	12	147
Q	5	5	6	130
R	8	7	12	162
S	16	13	7	130
Minimum requirement	2600	430	1800	

You are required to formulate the given problem as a standard Linear Programming Problem. (6 Marks)

b. A manufacturer produces three types of plastic fixtures 1, 2 and 3. In order to obtain a maximum profit (Z), he decided to formulate the problem as a linear programming problem as follows:

Maximise : $Z = 11x_1 + 16x_2 + 12x_3$

Subject to:

$$x_1 + 5x_2 + 2x_3 \leq 8{,}000$$
$$8x_1 + 2x_2 + 3x_3 \leq 3{,}800$$
$$4x_1 + 6x_2 + 7x_3 \leq 4{,}200$$
$$x_1, x_2, x_3 \geq 0$$

You are required to:

i. Set up the initial simplex tableau for the problem. (5 Marks)

ii. Identify the entering variable, leaving variable and the pivot ($1^1/_2$ Marks)

(Total $12^1/_2$ Marks)

FORMULAE

Sample variance, s^2 = $\dfrac{\sum(x-\bar{x})^2}{n-1}$

Economic Order Quantity

Q = $\sqrt{\dfrac{2cd}{n}}$

Z_{cal} = $\dfrac{\bar{x}-\mu}{\dfrac{\sigma}{\sqrt{n}}}$

Slope of a regression equation

b = $\dfrac{n\sum xy-\sum x\sum y}{n\sum x^2-\left(\sum x\right)^2}$

Elasticity of demand, $e=\left(-\dfrac{p}{q}\right)\left(\dfrac{dq}{dp}\right)$

The 95% confidence interval for μ

$=\bar{x}\pm t_{\frac{\alpha}{2},n-1}\dfrac{s}{\sqrt{n}}$

The trend equation, y = a + bt, where t = x_i - x_m

b = $\dfrac{\sum ty}{\sum t^2}$. **a =** $\bar{y}-bx_m$, **x_m = median of x values**

SARPI = $\dfrac{\sum\left(\dfrac{P_n}{P_o}\times 100\right)}{N}$

SAPI = $\dfrac{\sum P_{ni}}{\sum P_{oi}}\times 100$

$t = \dfrac{p}{\sqrt{\dfrac{pq}{n}}}$

EOQ with stock-out

$$Q = \sqrt{\frac{2cd}{h}} \times \sqrt{\frac{h + c_s}{c_s}}$$

$$LPI = \frac{\sum p_1 q_o}{\sum p_o q_o} \times 100$$

$$Z = \frac{p - \hat{p}}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}}$$

$$Q_i = L_{Q_i} + \left(\frac{\frac{iN}{4} - \sum f_{Q_i}}{f_{Q_i}} \right) c$$

$$D_i = L_{D_i} + \left(\frac{\frac{iN}{10} - \sum f_{D_i}}{f_{D_i}} \right) c$$

$$P_i = L_{P_i} + \left(\frac{\frac{iN}{100} - \sum f_{P_i}}{f_{P_i}} \right) c$$

Spearman's rank correlation coefficient

$$r = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

EOQ with gradual replenishment

$$Q = \sqrt{\frac{2cd}{h\left(1 - \frac{d}{r}\right)}}$$

$$\text{Length of Inventory cycle} = \frac{Q}{d}$$

$$\text{Number of } productionruns = \frac{d}{Q}$$

$$\text{Production cost} = Ordering\,\text{cost} + Holdering\,\text{cost}$$

$$Mode = L_{mo} + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2} \right) c$$

SOLUTION TO QUESTIONS

MULTIPLE- CHOICE (MCQ)

1. C
2. B
3. B
4. B
5. D
6. C
7. B
8. C
9. D
10. E
11. C
12. C
13. D
14. C
15. D
16. D
17. B
18. D
19. D
20. C
21. E
22. C
23. D
24. D
25. C
26. A
27. B
28. B
29. D
30. D

WORKINGS (MCQ)

1. Let x be the population of infected people

$$\frac{60°}{360°} \times x = 150$$

$$x = \frac{150 \times 360°}{60°}$$

$$x = 900 \qquad \text{(C)}$$

4. $mean = \dfrac{\sum fx}{\sum f}$

$$mean = \frac{(30\times10)+(20\times12)+(25\times11)+(20\times12)+(35\times7)}{30+20+25+20+35}$$

$$mean = \frac{(30\times10)+240+275+240+245}{130}$$

$$mean = \frac{1300}{130} = 10$$

The mean amount is ₦ 10,000 (B)

5. $Correlation of variation = \dfrac{Standard\ deviation}{mean}$

$$= \frac{\sqrt{variance}}{mean}$$

$$2.25 = \frac{\sqrt{81}}{mean}$$

$$2.25 = \frac{9}{mean}$$

$$mean = \frac{9}{2.25} = 4 \qquad (A)$$

6. $\bar{x} = \dfrac{\sum x}{n} = \dfrac{15+12+10+11+13+17}{6} = \dfrac{78}{6} = 13$

$$Mean\ deviation, MD = \frac{\sum |x - \bar{x}|}{n}$$

$$MD = \frac{|15-13|+|12-13|+|10-13|+|11-13|+|13-13|+|17-13|}{6}$$

$$MD = \frac{2+1+3+2+0+4}{6} = \frac{12}{6} = 2 \qquad \text{(C)}$$

8. $$a = \frac{\sum y}{n} - b\frac{\sum x}{n}$$

$$where \quad b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x\right)^2}$$

$$b = \frac{5(1001) - (50)(100)}{5(502) - (50)^2} = \frac{5005 - 5000}{2510 - 2500} = \frac{5}{10} = 0.5$$

$$\Rightarrow \quad a = \frac{100}{5} - 0.5\left(\frac{50}{5}\right) = 20 - 5 = 15 \qquad \text{(C)}$$

10.

$$P_o = baseyear$$

$$Pricerelativeindex = \frac{P_n}{P_o} \times 100 = \frac{350}{250} \times 100 = 140\ \% \qquad (E)$$

13.

$$\frac{2x+1}{x+3} < \frac{2}{3}$$
$$= 3(2x+1) < 2(x+3)$$

$$6x + 3 < 2x + 6$$
$$4x < 3$$
$$\therefore x < \frac{3}{4} \qquad (D)$$

14.

$$x - 2y = 4$$
$$x + 2y = 6$$
$$2x = 10$$
$$x = 5$$

Hence , $3x = 3 \times 5 = 15$ (C)

15. $125{,}000{,}000(0.2)^x = 200{,}000$

$$(0.2)^x = \frac{200{,}000}{125{,}000{,}000}$$

$$(0.2)^x = 0.0016$$

$$(0.2)^x = (0.2)^4$$

$$\Rightarrow x = 4$$

The total amount spent on overhead is ₦ 4,000 (D)

16. TC = TR (for break even)

TC= FC + VC

FC + VC = TR

FC = TR – VC

FC = q.SP – q.AVC

FC = q (SP –AVC)

Therefore $q = \frac{FC}{SP-AVC}$ depicts Break-even point.

Hence, option D is the correct option.

17. $9 \text{ months} = \frac{9}{12} yr = 0.75 yr$

$$SI = \frac{PRT}{100} = \frac{450 \times 0.75 \times 3.5}{100} = N11.81 \quad (B)$$

18. This is a geometric progression i.e GP, where

a = 500,000

r = 1+20% =1+0.2 = 1.2

n = 6

$$T_n = ar^{n-1}$$

$$T_6 = 500{,}000(1.2)^{6-1}$$

$$T_6 = 500{,}000(1.2)^5 = ₦1{,}244{,}160 \qquad (D)$$

21. By solving the simultaneous equations

$3a + 5b = 70 \ldots\ldots\ldots (i)$

$a + b = 20 \ldots\ldots\ldots (ii)$

$multiply\ eqn(ii)by\ 3\ gives$

$3a + 3b = 60 \ldots\ldots\ldots (iii)$

$subtract\ eqn(iii)from\ eqn(i)$

$2b = 10$

$b = 5$

$substitute\ for\ b\ in\ eqn\ (ii)$

$a + 5 = 20$

$a = 15$

$Z = 40a + 50b$

$40(15) + 50(5)$

$600 + 250 = 850 \qquad (C)$

23. $\text{Average stock} = \frac{\text{Q}}{2}$

where $\text{Q} = \sqrt{\frac{2C_oD}{C_h}}$

$$\text{Q} = \sqrt{\frac{2 \times 34 \times 128{,}245}{6}}$$

$$\text{Q} = \sqrt{\frac{8{,}720{,}660}{6}}$$

$$\text{Q} = \sqrt{1{,}453{,}443.33}$$

$Q = 1{,}205.588$

$$\text{Average stock} = \frac{1{,}205.588}{2} = 602.79$$

$\text{Average stock} \approx 603$ (D)

24. $\text{Total annual cost} = \frac{cd}{Q} + \frac{Qh}{2}$

$$\text{Total annual cost} = \frac{400 \times 15{,}000}{3{,}000} + \frac{3{,}000 \times 60}{2}$$

$\text{Total annual cost} = 20{,}000 + 90{,}000$

Total annual cost = Le$110{,}000$ (D)

27. Total float = LFT - EST - Duration

Activity	EFT	LFT	EST	LST	Duration	Total float
P	3	3	0	0	3	0
Q	8	8	3	3	5	0
R	8	8	3	3	2	3
S	14	15	8	8	6	1
T	16	16	8	8	8	0
U	16	16	14	15	1	1
V	22	22	14	15	5	3
W	22	22	16	16	6	0

The critical activities are activities with total float of zero, which are P, Q, T, W (C)

28.

Month after replacement	Cumulative Percentage of Failure	Percentage of Failure
1	20%	$20\% = 0.20$
2	55%	$35\% = 0.35$
3	85%	$30\% = 0.30$
4	100%	$15\% = 0.15$

$$Monthly\ average life = (1 \times 0.20) + (2 \times 0.35) + (3 \times 0.30) + (4 \times 0.15)$$

$$Monthly\ average life = 0.20 + 0.70 + 0.90 + 0.60$$

$$Monthly\ average life = 2.40$$ (B)

29. $P = \frac{A\,[1-(1+r)^{-n}]}{r}$

$$P = \frac{60{,}0000\,[\,1-(1+0.085)^{-12}]}{0.085}$$

$$P = \frac{60{,}0000\,[\,1-(1.085)^{-12}]}{0.085}$$

P = ₦ 440,682.35 (D)

SHORT- ANSWER QUESTION (SAQ)

1. Negative correlation
2. ₦ 16,500
3. Significance level
4. Zero, positive/negative (in that order)
5. 6
6. Annuity
7. Dandler
8. Slack, Surplus (either way) Variables
9. Basic Solution
10. Deterministic model
11. Discrete
12. ₦300,000
13. Controllable, uncontrollable (either way)
14. Detrending
15. One more unit/ extra one unit/ Additional unit/ a unit more
16. Group replacement/ Mass replacement
17. Degeneracy
18. 0.45 Accept 0.5
19. 24
20. Monte Carlo Simulation method

WORKINGS (SAQ)

2. $mean = \frac{13+19+16+15+14+26+16}{7} = \frac{119}{7}$

$mean = 17$

Arranging the data in ascending order

13, 14, 15, 16, 16, 19, 26

$median\ position = \left(\frac{n+1}{2}\right)th = \frac{7+1}{2}th = 4th$

$median = 16$

$Average = \frac{mean + median}{2} = \frac{17+16}{2} = \frac{33}{2} = 16.5$

$Average = ₦16{,}500$

5. Demand price = Supply price

15 – 0.75q = 3 + 0.25q

15 – 3 = (0.75 + 0.25)q

q = 12.

Hence P = 3 + 0.25(12) = 6

OR

At equilibrium, $P_1 = P_2$

$= 3 + \frac{1}{4}q = 15 - \frac{3}{4}q$

$= \frac{1}{4}q + \frac{3}{4}q = 15 - 3$

q = 12

Hence, market price at equilibrium,

$P = = 3 + \frac{1}{4}(12) = 3 + 3 = 6$

12. $300{,}000(0.5)^{0.7x}$, maximum revenue occurs when nothing is spent on overheads that is;

$x = 0;\ R = 300{,}000(0.5)^{0.6(0)}$

$R = ₦300{,}000$

18. $P(A) = 0.6 \quad , \quad P(A') = 1 - 0.6 = 0.4$

$P(B) = 0.75 \quad , \quad P(B') = 1 - 0.75 = 0.25$

$P(only\ one\ of\ them\ will\ pass) = P(A\ only\ pass) + P(B\ only\ pass)$

$P(only\ one\ of\ them\ will\ pass) = P(A \cap B') + P(A' \cap B)$

$P(only\ one\ of\ them\ will\ pass) = P(A)P(B') + P(A')P(B)$

$P(only\ one\ of\ them\ will\ pass) = (0.6 \times 0.25) + (0.4 \times 0.75)$

$P(only\ one\ of\ them\ will\ pass) = 0.15 + 0.3$

$P(only\ one\ of\ them\ will\ pass) = 0.45$

19.

	1	2	3	4	5	6
HH	HH 1	HH 2	HH 3	HH 4	HH 5	HH 6
HT	HT 1	HT 2	HT 3	HT 4	HT 5	HT 6
TH	TH 1	TH 2	TH 3	TH 4	TH 5	TH 6
TT	TT 1	TT 2	TT 3	TT 4	TT 5	TT 6

$\Rightarrow n(s) = 24$

QUESTION 1

a. Using the month of June as the base month,

Simple Aggregate Price Index, $SAPI = \frac{\sum p_{July}}{\sum p_{June}} \times \frac{100}{1}$

$$SAPI = \frac{125+160+85+105+130}{120+155+80+110+135} \times \frac{100}{1}$$

$$SAPI = \frac{605}{600} \times \frac{100}{1}$$

$$SAPI = 100.83\%$$

b. Using the month of June as the base month,

Simple Aggregate Quantity Index, $SAQI = \frac{\sum q_{July}}{\sum q_{June}} \times \frac{100}{1}$

$$SAQI = \frac{12+6+11+7+10}{10+5+10+6+9} \times \frac{100}{1}$$

$$SAQI = \frac{46}{40} \times \frac{100}{1}$$

$$SAQI = 115\%$$

c. Using the month of June as the base month,

p_0	q_0	p_1	q_1	p_0q_0	p_0q_1	p_1q_0	p_1q_1
120	10	125	12	1,200	1,440	1,250	1,500
155	5	160	6	775	930	800	960
80	10	85	11	800	880	850	935
110	6	105	7	660	770	630	735
135	9	130	10	1,215	1,350	1,170	1,300
				$\sum p_0q_0 =$	$\sum p_0q_1 =$	$\sum p_1q_0 =$	$\sum p_1q_1 =$

4,650 5,370 4,700 5,430

$$\text{Marshall Edgeworth's Index} = \frac{\sum P_1(q_0+q_1)}{\sum P_0(q_0+q_1)} \times \frac{100}{1} = \frac{\sum P_1q_0 + \sum P_1q_1}{\sum P_0q_0 + \sum P_0q_1} \times \frac{100}{1}$$

$$\text{Marshall Edgeworth's Index} = \frac{4,700+5,430}{4,650+5,370} \times \frac{100}{1}$$

$$\text{Marshall Edgeworth's Index} = \frac{10,130}{10,020} \times \frac{100}{1}$$

$$\text{Marshall Edgeworth's Index} = 101.1\%$$

EXAMINER'S COMMENT

This question is on Index Numbers. It tests candidates' knowledge of Price and Quantity indexes.
It is a popular question as about 94% of all the candidates attempted the question. About 97% of these candidates obtained marks in excess of the average score. The part (c) of the question is on Marshall Edgeworth's Index. About 55% of the candidates scored above average.
The only pitfall identified was in the inability of the candidates to differentiate p_o from p_1 and q_o from q_1.

QUESTION 2

a.i.

Class interval	Frequency	Class boundary
40 – 49	1	39.5 - 49.5
50 - 59	5	49.5 - 59.5
60 - 69	16	59.5 - 69.5
70 - 79	22	69.5 - 79.5
80 - 89	4	79.5 - 89.5
90 - 99	1	89.5 - 99.5
100 – 109	1	99.5 - 109.5

b.i.

Class boundary	F	CF
149.5 - 169.5	8	8
169.5 - 189.5	19	27
189.5 - 209.5	34	61
209.5 - 229.5	24	85
229.5 - 249.5	10	95
249.5 - 269.5	5	100

QUESTION 3

a. $P = \frac{4}{3}q^2 - 30q - 5{,}400$

$\text{Re}venue = price \times quantity$

$R = P \times q$

$R = \left(\frac{4}{3}q^2 - 30q - 5400\right)q$

$R = \frac{4}{3}q^3 - 30q^2 - 5400q$

$Marginal\ \text{Re}venue, MR = \frac{dP}{dq}$

$MR = \frac{dP}{dq} = 4q^2 - 60q - 5400$

$AC = q^2 - 15q - \frac{810{,}000}{q}$

$But, \quad AC = \frac{C}{q}$

$\therefore \quad C = AC \times q$

$C = \left(q^2 - 15q - \frac{810{,}000}{q}\right)q$

$C = q^3 - 15q^2 - 810{,}000$

$Marginal\ Cost, MC = \frac{dC}{dq}$

$MC = \frac{dC}{dq} = 3q^2 - 30q$

$For\ \text{max}imum\ profit,\ MR = MC$

$\Rightarrow \quad 4q^2 - 60q - 5{,}400 = 3q^2 - 30q$

$\Rightarrow \quad 4q^2 - 60q - 5{,}400 - 3q^2 + 30q = 0$

$\therefore \quad q^2 - 30q - 5{,}400 = 0$

Solving by factorization

$$-5{,}400q^2 \Rightarrow -90q, +60q$$

$$q^2 - 90q + 60q - 5{,}400 = 0$$

$$q(q-90) + 60(q-90 = 0$$

$$\Rightarrow \quad (q-90)(q+60) = 0$$

$$\therefore \quad q = 90 \quad \text{or} \quad q = -60$$

Since q cannot be negative

$\therefore$ *The productionlevel that* maximizes *the profit is* $q = 90$

b. Profit funtion, $\prod = R - C$

$$\Rightarrow \quad \prod = \frac{4}{3}q^3 - 30q^2 - 5{,}400q - (q^3 - 15q^2 - 810{,}000)$$

$$\Rightarrow \quad \prod = \frac{4}{3}q^3 - 30q^2 - 5{,}400q - q^3 + 15q^2 + 810{,}000$$

$$\Rightarrow \quad \prod = \frac{1}{3}q^3 - 15q^2 - 5{,}400q + 810{,}000$$

At $q = 90,$

$$\Rightarrow \quad \prod = \frac{1}{3}(90)^3 - 15(90)^2 - 5{,}400(90) + 810{,}000$$

$$\Rightarrow \quad \prod = 243{,}000 - 121{,}500 - 486{,}000 + 810{,}000$$

$$\therefore \quad \prod = ₦445{,}500$$

c. Price elasticity of demand, $e_d = -\frac{1}{\frac{dP}{dq}} \bullet \frac{P}{q}$

$$P = \frac{4}{3}q^2 - 30q - 5{,}400$$

$$\Rightarrow \quad \frac{dP}{dq} = \frac{8}{3}q - 30$$

$$\Rightarrow \quad e_d = -\frac{1}{\frac{8}{3}q - 30} \bullet \frac{\frac{4}{3}q^2 - 30q - 5{,}400}{q}$$

$$\Rightarrow \quad e_d = -\frac{\left(\frac{4}{3}q - 30 - \frac{5{,}400}{q}\right)}{\frac{8}{3}q - 30}$$

At $\quad q = 90,$

$$\Rightarrow \quad e_d = -\frac{\left(\frac{4}{3}(90) - 30 - \frac{5{,}400}{90}\right)}{\frac{8}{3}(90) - 30}$$

$$\Rightarrow \quad e_d = -\frac{(120 - 30 - 60)}{240 - 30}$$

$$\Rightarrow \quad e_d = -\frac{30}{210}$$

$$\Rightarrow \quad e_d = -0.14$$

$$Since \left|e_d\right| = \left|-0.14\right| = 0.14 < 1$$

This implies an inelastic demand i.e an increase in price will cause an increase in revenue

QUESTION 4

a.

$$D = 120,000 units,\ C = N100, H = 0.205 \times 150 = 30.75$$

$$EOQ = \sqrt{\frac{2DC}{H}} = \sqrt{\frac{2 \times 120,000 \times 100}{30.75}}$$

$$= \sqrt{\frac{24,000,000}{30.75}}$$

$$= \sqrt{780,487.8049}$$

$$= 883.45$$

= 884 units.

b.

$$TC = PD + \frac{QH}{2} + \frac{DC}{Q}$$

$$= (150 \text{x} 120,000) + \frac{883.45 \text{x} 30.75}{2} + \frac{120,000 \text{x} 100}{883.45}$$

$$= 18,000,000 + 13,583.04 + 13,583.11$$

$$= N18,027,166,15$$

QUESTION 5

a. For Lagos city:

Loan Amount (Col1)	Mid-point (x) (Col2)	Frequency (f) (Col3)	fx (Col4)	$x-\bar{x}$ (Col5)	$(x-\bar{x})^2$ (Col6)	$f(x-\bar{x})^2$ (Col7)
14 < 18	16	11	176	-10.08	101.6064	1,117.6704
18 < 22	20	37	740	-6.08	36.9664	1,367.7568
22 < 26	24	69	1,656	-2.08	4.3264	298.5216
26 < 30	28	77	2,156	1.92	3.6864	283.8528
30 < 34	32	56	1,792	5.92	35.0464	1,962.5984
		250	6,520			5,030.4000

Since $\text{Mean}\,(\bar{x}) = \dfrac{\sum fx}{\sum f}$,

where $\sum fx = 6{,}520$ (Col4) and $\sum f = 250$ (Col3).

Therefore, $\bar{x} = \dfrac{6{,}520}{250}$

$$\bar{x} = 26.08$$

Hence, the mean loan amount for Lagos = $\text{N}\,26.08 \times 1000 = \text{N}\,26{,}080$

Since $\text{Standard Deviation}\,(\sigma) = \sqrt{\dfrac{\sum f(x-\bar{x})^2}{\sum f}}$

where $\sum f(x-\bar{x})^2 = 5{,}030.40$ (Col7) and $\sum f = 250$ (Col3).

Therefore, $\sigma = \sqrt{\dfrac{5{,}030.40}{250}}$

$$\sigma = \sqrt{20.1216}$$

$$\sigma = 4.4857$$

Hence, the standard deviation loan amount for Lagos = N 4.4857×1000= N 4,485.7

For Abuja city:

Loan Amount (Col1)	Mid-point (x) (Col2)	Frequency (f) (Col3)	fx (Col4)	$x-\bar{x}$ (Col5)	$(x-\bar{x})^2$ (Col6)	$f(x-\bar{x})^2$ (Col7)
14 < 18	16	19	304	-9.15	83.7225	1,590.7275
18 < 22	20	30	600	-5.15	26.5225	795.6750
22 < 26	24	25	600	-1.15	1.3225	33.0625
26 < 30	28	41	1,148	2.85	8.1225	333.0225
30 < 34	32	35	1,120	6.85	46.9225	1,642.2875
		150	3,772			4,394.775

Since $\text{Mean}\,(\bar{x}) = \dfrac{\sum fx}{\sum f}$,

where $\sum fx = 3{,}772$ (Col4) and $\sum f = 150$ (Col3).

Therefore, $\bar{x} = \dfrac{3{,}772}{150}$

$$\bar{x} = 25.1467$$

Hence, the mean loan amount for Lagos = N 25.1467×1000= N 25,146.7

Since $\text{Standard Deviation}\,(\sigma) = \sqrt{\dfrac{\sum f(x-\bar{x})^2}{\sum f}}$

where $\sum f(x-\bar{x})^2 = 4{,}394.775$ (Col7) and $\sum f = 150$ (Col3).

Therefore, $\sigma = \sqrt{\dfrac{4{,}394.775}{150}}$

$$\sigma = \sqrt{29.2985}$$

$$\sigma = 5.4128$$

Hence, the standard deviation loan amount for Abuja = N5.4128×1000= N 5,412.8

b. Since Coefficient of variation

$$\text{Coefficient of Variation } (CV) = \frac{\text{Standard Deviation}}{\text{Mean}}$$

For Lagos city, $\text{Standard Deviation} = 4.4857$ and $\text{Mean} = 26.08$.

$$CV = \frac{4.4857}{26.08} \times 100\%$$

$$CV = 17.20\%$$

For Abuja city, $\text{Standard Deviation} = 5.4128$ and $\text{Mean} = 25.1467$.

$$CV = \frac{5.4128}{25.1467} \times 100\%$$

$$CV = 21.52\%$$

c. The results obtained for the coefficients of variation in Lagos and Abuja in (b) show that the relative dispersion between the distributions is not too wide because, there is no significant difference between the means of the distributions.

QUESTION 6

a. Let x_1, x_2, x_3, x_4 be the decision variables. That is, the number of units of food types P, Q, R and S respectively.

The main objective is to minimize the cost.

Therefore, the objective function is

Minimize $Z = Le\ (147x_1 + 130x_2 + 162x_3 + 130x_4)$

Constraints are on the fulfillment of daily requirements of the various constituents.

The standard Linear Programming Problem is formulated as follows:

Minimize $Le\ (147x_1 + 130x_2 + 162x_3 + 130x_4)$

Subject to

Fats requirement:	$2x_1 + 5x_2 + 8x_3 + 16x_4 \geq 2600$
Carbohydrates requirement:	$13x_1 + 5x_2 + 7x_3 + 13x_4 \geq 430$
Protein requirement:	$12x_1 + 6x_2 + 12x_3 + 7x_4 \geq 1800$
Non-negativity requirement:	$x_1, x_2, x_3, x_4 \geq 0$

b. (i) To set up the initial simplex tableau, we reformulate the problem by introducing the slack variables s_1, s_2 and s_3 as follows:

Maximize Profit $= 11x_1 + 16x_2 + 12x_3 + 0s_1 + 0s_2 + 0s_3$

Subject to

$x_1 + 5x_2 + 2x_3 + s_1 = 8000$

$8x_1 + 2x_2 + 3x_3 + s_2 = 3800$

$4x_1 + 6x_2 + 7x_3 + s_3 = 4200$

$x_1, x_2, x_3, s_1, s_2, s_3 > 0$

The initial simplex table can therefore be set up as shown below:

x_1	x_2	x_3	s_1	s_2	s_3	B	R	Basic Variables
1	5	2	1	0	0	8000	1600	s_1
8	2	3	0	1	0	3800	1900	s_2
4	6	7	0	0	1	4200	700	s_3
-11	-16	-12	0	0	0			

(ii) From the initial simplex tableau set up in (i) above, the

Entering variable is x_2

Leaving variable is s_3

Pivot is 6