CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATION

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

DATE: THURSDAY 29, MAY 2025

MARKING GUIDE AND MODEL ANSWER

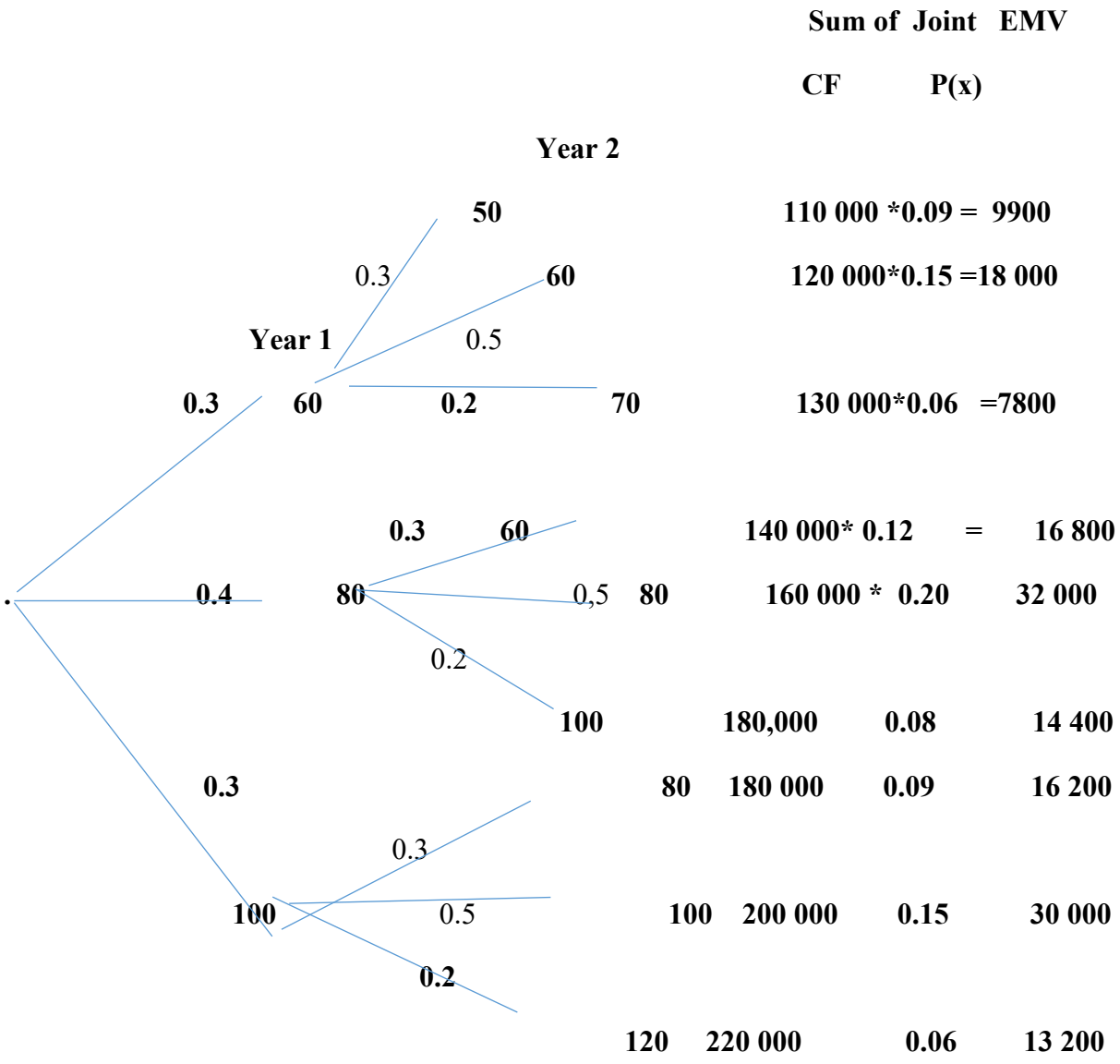
QUESTION ONE

Marking Guide

	Marks
a) Expected Monetary Value (EMV):	
-A well assigned probability on decision tree for year1 cash flow	1.5
-A well assigned probability on decision tree for year2 cash flow	1.5
-Multiplication of each cash flow (CF) and probability (px) (0.5 x9)	4.5
-Summing up all expected EMV	0.5
Max	**8**
b)NPV	
- Award 1 Mark for Formula	1
-Award 0.5 marks for each discounting factor and 0.5 for correct PV	3
-Award 1 Mark for NPV	1
-Award 1 Mark to conclusion	1
Max	**6**
c) award 1 mark for equation and 1 marks for the answer	**2**
d) Clarification of merits and demerits of decision tree	
Merits of decision tree a mark for each	2
Demerits of decision tree, a mark for each	2
Max	**4**
Total marks	**20**
Abbreviation used: P(x) probability CF = cash flow EMV= Economic Value added	

Model Answer

a



EMV=158 300

b)

$$PV = \frac{CF}{(1+r)^t}$$

Year	Disc factor@12%	Cash flows (Frw)	PV (Frw)
0	1	- 100,000	- 100,000
1	0.893	80,000	71,440
2	0.797	78,300	62,405
NPV		58,300	33,845

NPV > 0 → Project is financially viable.

c)

NPV=1*(100,000) + 0.893(80,000) +0.797X=0

X= (100,000 - 71,440)/0.797 = Frw 35,845

d)

Merits of decision tree are:

1. It clearly brings out the implicit assumptions and calculations for all to see. so that they may be questioned and revised.
2. The decision tree allows maker to visualize assumptions and alternatives in graphic form, which is usually much easier to understand than more abstract, analytical form.

Demerits:

i) The decision tree can become more and more complicated as more alternatives are included
ii) It cannot be used dependent variables

QUESTION TWO

Marking Guide

	Marks
a) - Determining total mines output per day	1
- Determining total production plant capacity	1
- Proving whether there is introduction of dummy mine	1
Award 0.5 marks for each allocation. Max 9 marks	9
Award 0.5 marks for each optimum allocation. Max 1.5	1.5
Total cost	0.5
Maximum marks	**14**
b) Effect on allocation	1
Total cost	1
Maximum marks	**2**
c)	
Allocation determination	1
Increasing cost	1
Maximum marks	**2**
d)	
Award 1 mark on each clearly explained implication. Max 2 marks	**2**
Total	**20**

Model Answer

Matrix transportation

a)

Five mines supply three preparation plants

The total mines output per day = 650 tonnes/day

The total preparation plant capacity = 700 tonnes/day

Therefore introduce a dummy mine to indicate which plant will not be fully used.

The unit costs for each combination of mine and preparation plant comprise:

Unit variable production cost at the plant

+ unit operating cost at the plant

+ Unit transport cost

The values shown in the following tableau. Vogel's penally cost method is used to find the first allocation and the MODI method to test for optimality.

Total Cost/tonne = Production + Operating + (Distance × 0.5)

We calculate **transportation cost matrix** as:

Total Costij=Production Costi+Operating Costj+(0.5×Distanceij).

Constructing the Cost Matrix

Let's compute all cost values (rounded):

For Mine 1:

- To A: 25 + 2 + 0.5×22 = 38
- To B: 25 + 3 + 0.5×18 = 36
- To C: 25 + 3 + 0.5×44 = 50

For Mine 2:

- To A: 29 + 2 + 0.5×3 = 32.5
- To B: 29 + 3 + 0.5×28 = 45
- To C: 29 + 3 + 0.5×24 = 44

For Mine 3:

- To A: 34 + 2 + 0.5×44 = 58
- To B: 34 + 3 + 0.5×52 = 63
- To C: 34 + 3 + 0.5×42 = 58

For Mine 4:

- To A: 26 + 2 + 0.5×24 = 40

- To B: 26 + 3 + 0.5×16 = 37
- To C: 26 + 3 + 0.5×48 = 53

For Mine 5:

- To A: 28 + 2 + 0.5×16 = 38
- To B: 28 + 3 + 0.5×22 = 42
- To C: 28 + 3 + 0.5×32 = 47

Cost Table for Transportation

Mine \ Plant	**A**	**B**	**C**	**Supply**
1	38	36	50	120
2	33	45	44	150
3	58	63	58	80
4	40	37	53	160
5	38	42	47	140
Demand	300	200	150	

Therefore, the assignment is:

	To prep plant A	B	C	Tons/day available	Penalty costs	MODI
1	38 70_5	37 50_4	50 *15-	120,70,0	1 12_5	u_1=0
2	53 *12-	40 150_3	48 *11-	150 0	8_3	u_2=3
3 From mine	49 40	49 *1-	45 40	80 0	4	u_3=11
4	54 +13-	50 *10-	37 160_2	160 0	13_2	u_4=3
5	42 140	55 *14-	42 *4-	140 0	0	u_5=4
Dummy	0 50_1	0 *1-	0 *4-	50 0	0	u_6=-38
Tones/day required	300,250, 180,40, 0	200 50 0	200 40 0			
Penalty costs	38_1 4 7	37 3 12_4	37 5 3			
	V_1=38	V_2=37	V_3=34			

There must be (m-n-1) =8 entries for a basic solution. There are 8 entries. All the shadow costs are positives. Therefore, this is the optimum allocation.

- Mine 1 supply 70 tonnes per day to A and 50 to B;
- Mine 2 supplies 150 tonnes per day to B;
  Mine 3 supplies 40 tonnes per day to A and 40 to C;
- Mine 4 supplies 160 tonnes per day to C;
  and mine 5 supplies 140 tonnes per day to A.

Preparation plant A has 50 tonnes per day spare capacity even though it has cheapest operating costs.

The total costs of the above allocation are:

70*38+50*37+150*40+40*49+40*45+160*37+140*42 =FRW 26,070/day

(b) Production costs at mine 3 fall from Frw 34 to Frw 30 per tonne

. All mine is already taken by the plants and production costs are like a fixed cost and do not affect allocation,

Therefore, total costs will be reduced by 80*4=Frw 320 per day

(c) Mine 5 plants to increase output by 40 tonnes per day from 140 to 180.

All of mine 5's output is allocated to plant A which has 50 tonnes per day spare capacity.

The extra 40 tonnes per day output will go from mine 5 to plant A,

increasing costs by 40 *42= Frw 1, 680 per.

(d)

Implications of the transportation model in real business:

1. **Reduces Transportation Costs:** It identifies the most economical ways to move goods.
2. **Improves Efficiency:** It optimizes resource allocation and streamlines logistics operations.
3. **Enhances Customer Satisfaction:** Timely deliveries are facilitated through better planning.
4. **Supports Strategic Decisions:** It informs choices about facility location and supplier selection.
5. **Scalability:** Transportation models can be scaled and adapted for long-term logistics planning, helping businesses prepare for changes in production levels, market expansion, or disruptions in the supply chain.

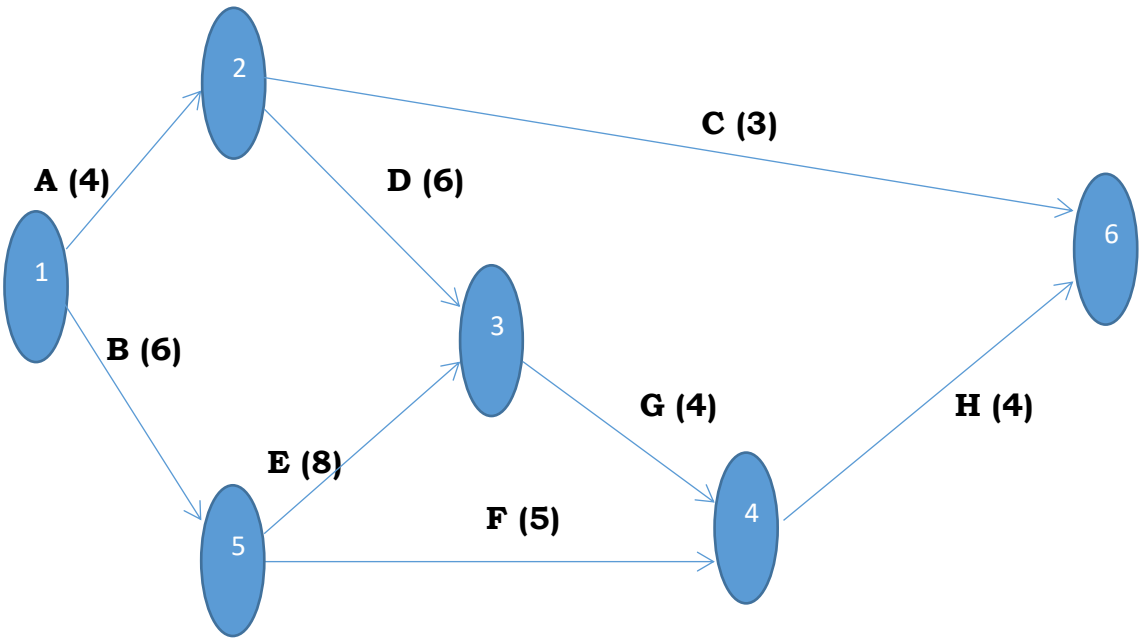
QUESTION THREE

Marking Guide

	Marks
a) Drawing the network project network and labeling lines (0.5 mark each, max 4)	4
b) Critical path and project duration (1 mark each, max 2)	2
c) Computation of the slack time (0.5 marks each, max 4)	4
d) Crashing the project's duration to 17 months	
Computation of slope (1 marks each, max 8)	8
Crashing activities G and E (1 mark each, and 1 mark on total cost max 2)	2
Total marks	**20**

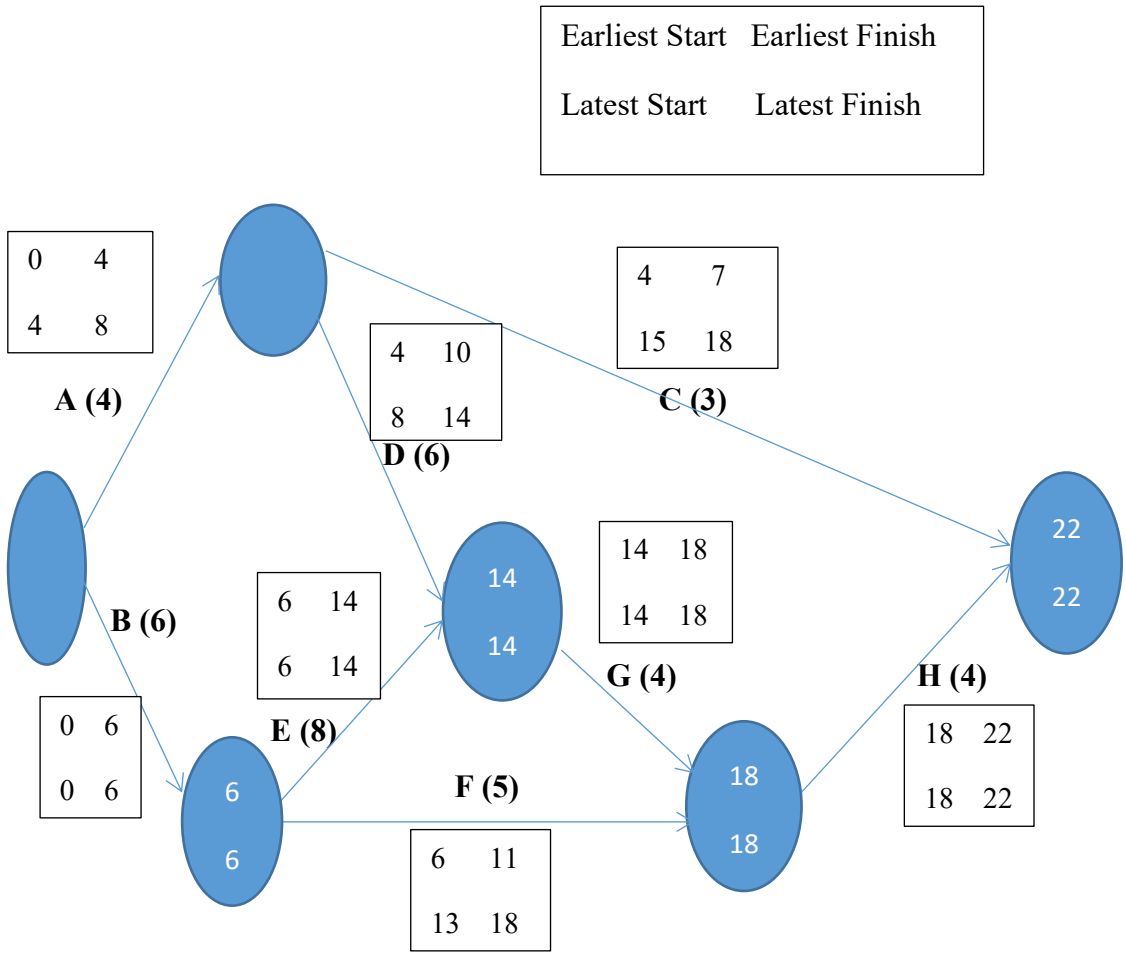
Model Answer

i. The network diagram for the project.



ii. The critical path is B – E – G – H
The project duration is 22 months

iii. Slack times for each activity of the project.



Slack time = latest start time – earliest start time

Or

Slack time = latest finish time – earliest finish time

Taking start times, we find the slack for the activities as below;

A; Slack time = 4 – 0 = 4. There is a slack time of 4 months because this is a non-critical activity

B; Slack time = 0 – 0 = 0. There is no slack time since this is a critical activity

C; Slack time = 15 – 4 = 11. There is a slack time of 11 months because this is a non-critical activity

D; Slack time = 8 – 4 = 4. There is a slack time of 4 months because this is a non-critical activity

E; Slack time = 6 – 6 = 0. There is no slack since this is a critical activity

F; Slack time = 13 – 6 = 7. There is a slack time of 7 months because this is a non-critical activity

G; Slack time = 14 – 14 = 0. There is no slack since this is a critical activity

H; Slack time = 18 – 18 = 0. There is no slack since this is a critical activity

Activity	ES	EF	LS	LF	Slack
A	0	4	7	11	**7**
B	0	6	0	6	**0**
C	4	7	11	14	**7**
D	4	10	12	18	**8**
E	6	14	6	14	**0**
F	6	11	17	22	**11**
G	14	18	14	18	**0**
H	18	22	18	22	**0**

iv. Determine the cost of reducing the project's duration to 17 months.

Activity	**Predecessors**	**Normal Time (months)**	**Crash Time (months)**	**Normal Cost (FRW)**	**Crash Cost (FRW)**	**Change in time**	**Change in cost**	**Cost Slope**
A	-	4	2	200,000	380,000	2	180,000	90,000
B	-	6	4	640,000	800,000	2	160,000	80,000
C	A	3	2	100,000	200,000	1	100,000	100,000
D	A	6	4	390,000	580,000	2	190,000	95,000
E	B	8	5	600,000	780,000	3	180,000	60,000
F	B	5	4	300,000	370,000	1	70,000	70,000
G	C,E	4	2	680,000	780,000	2	100,000	50,000
H	D,G	4	3	260,000	400,000	1	140,000	140,000
Total				**3,170,000**				

Normal project cost is FRW 3,170,000
Normal project duration is 22 months
Crashing starts with the critical path and the paths with the lowest cost.

Path	duration
A – C;	4+3 = 7
A – D – G – H;	4+6+4+4 =18
B – E – G – H;	6+8+4+4 =22
B – F – H;	6+5+4 =15

Activity G will be crashed 2 times and followed by activity E which will be crashed 3 times making a reduction of 5 months from the normal project duration of 22 months to 17 months. (22 – 5 = 17)

Duration (months)	Activities crashed	Direct Cost change (FRW 000)	Direct cost (FRW 000)	Total cost (FRW 000)
22	Critical	0	3,170	3,170
20	Crash G by 2 months	50 *2=**100**	3,170 +100	**3,270**
17	Crash E by 3 months	60 *3=**180**	3,270 +180	**2,450**

Reduce by 5 months from critical path: B (6→4), E (8→5), G (4→2), H (4→3)

Crash B (2 months) = 800K–640K = 160K

Crash E (3 months) = 780K–600K = 180K

Crash G (2 months) = 780K–680K = 100K

Crash H (1 month) = 400K–260K = 140K

Total crash cost: 160K + 180K + 100K + 140K = **580,000**

Total normal cost: sum of all normal costs = 200K + 640K + 100K + 390K + 600K + 300K + 680K + 260K = **3,170,000**

Final cost after crash = **3,170,000 + 580,000 = 3,750,000**

QUESTION FOUR

	Item	**Marks**
a)	(i) Calculation of total cost	1
	Calculation of total revenue	1
	Calculation of total profit	1
	(ii) Formula of break-even point (in units)	1
	Computation of break-even in units	1
	Computation of break-even in revenue	2
	(iii) Formula of break-even from target profit	1
	Calculation of break-even given target profit	1
	(iv) Formula of margin of safety	1
	Computation of margin of safety	1
Maximum marks		**11**
b)	Award 1 mark on Objective function	1
	Award 0.5 marks for each constraint	2
	Award 0.5 marks on each point labelled on the graph	3
	Award 1 for shading solution region	1
	Award 0.5 marks on cost of each possible solution	1.5
	Award 0.5 marks on choosing optimum solution	0.5
Maximum marks		**9**
Total Maximum Marks (a + b)		**20**

Model Answer

a)

- Total cost C = (7,500*2,700) + 150,000 = **FRW 20,400,000**
- Total revenue = Price * Quantity

  Total revenue = 8,500 * 2,700 = **FRW 22,950,000**
- Total profit = Total revenue – total cost

  Total profit = FRW 22,950,000 – FRW 20,250,000 = **FRW 2,550,000**

i)

Break-even point (in units) = $\frac{\text{Fixed cost}}{\text{Contribution}}$

Contribution = selling price per unit – variable cost per unit

Price per unit = FRW 8,500 Variable cost per unit = FRW 7,500, Fixed cost = FRW 150,000.

Break-even point (in units) = $\frac{150{,}000}{8{,}500-7{,}500} = \frac{150{,}000}{1{,}000}$ = 150 shoes

KL should produce 150 shoes in order to break even

Break-even point (in FRW) = Break even shoes * Price per shoe

Break-even point (in FRW) = 150 shoes * FRW 8,500 = FRW 1,275,000

Alternatively

Contribution Margin Ratio = Contribution / Price per shoe = 1,000/8,500 = 0.117647

Break even in revenue = Fixed cost /Contribution margin ratio=150,000/0.117647= FRW 1,275,000

ii) Break-even point (in units) = $\frac{\text{Fixed cost+Target profit}}{\text{Contribution}}$

Break-even point (in units) = $\frac{150{,}000+6{,}500{,}000}{1{,}000}$ = 6,650 shoes.

iii) Margin of safety = budgeted level output - break-even output

Margin of safety = 185 – 150 = 35 shoes

It can be calculated as percentage

Margin of safety = (budgeted output – breakeven)/budgeted output *100

Margin of safety = (185 – 150)/185*100 = 20%

b) Linear programming model

Describe the decision variable

Let x be the kilograms of Chia seeds to be produced and y be the kilograms of Sesame seeds to be produced.

Define the objective function

The objective is minimize cost

The objective function is given by Z = FRW 4,000x + FRW 2,000y

Identify the constraints

There are only two constraints

$40x + 30y \geq 480$ (ONGERA Constraint)

$50x + 100y \geq 900$ (UNGUKA Constraint)

$5x \geq 15$ (MUSARURO Constraint)

$x, y \geq 0$ (Non- negativity Constraint)

Find coordinates from the constraints

All inequalities are changed into equations

$40x + 30y = 480$

Let x = 0, then y = 16 (0, 16)

Let y = 0, then x = 12 (12, 0)

$50x + 100y = 900$

Let x = 0, then y = 9 (0, 9)

Let y = 0, then x = 18 (18, 0)

$5x = 15$ $x = 3$ (3, 0)

Find the coordinates of an intersection of two equations $40x + 30y = 480$ and $50x + 100y = 900$ and therefore the coordinates should be obtained by solving simultaneously.

$40x + 30y = 480$

$4x + 3y = 48$……. (i)

$50x + 100y = 900$

$x + 2y = 18$ ……. (ii)

Taking equation (ii), using substitution we get $x = 18 – 2y$…… (iii)

Substitute $x = x = 18 – 2y$ into equation (i) and get $y = 4.8$

Then by substituting $y = 4.8$ into equation (iii), we will obtain $x = 8.4$

Therefore the coordinates are (8.4, 4.8). This is point B.

Intersection of $5x = 15$ and $40x + 30y = 480$

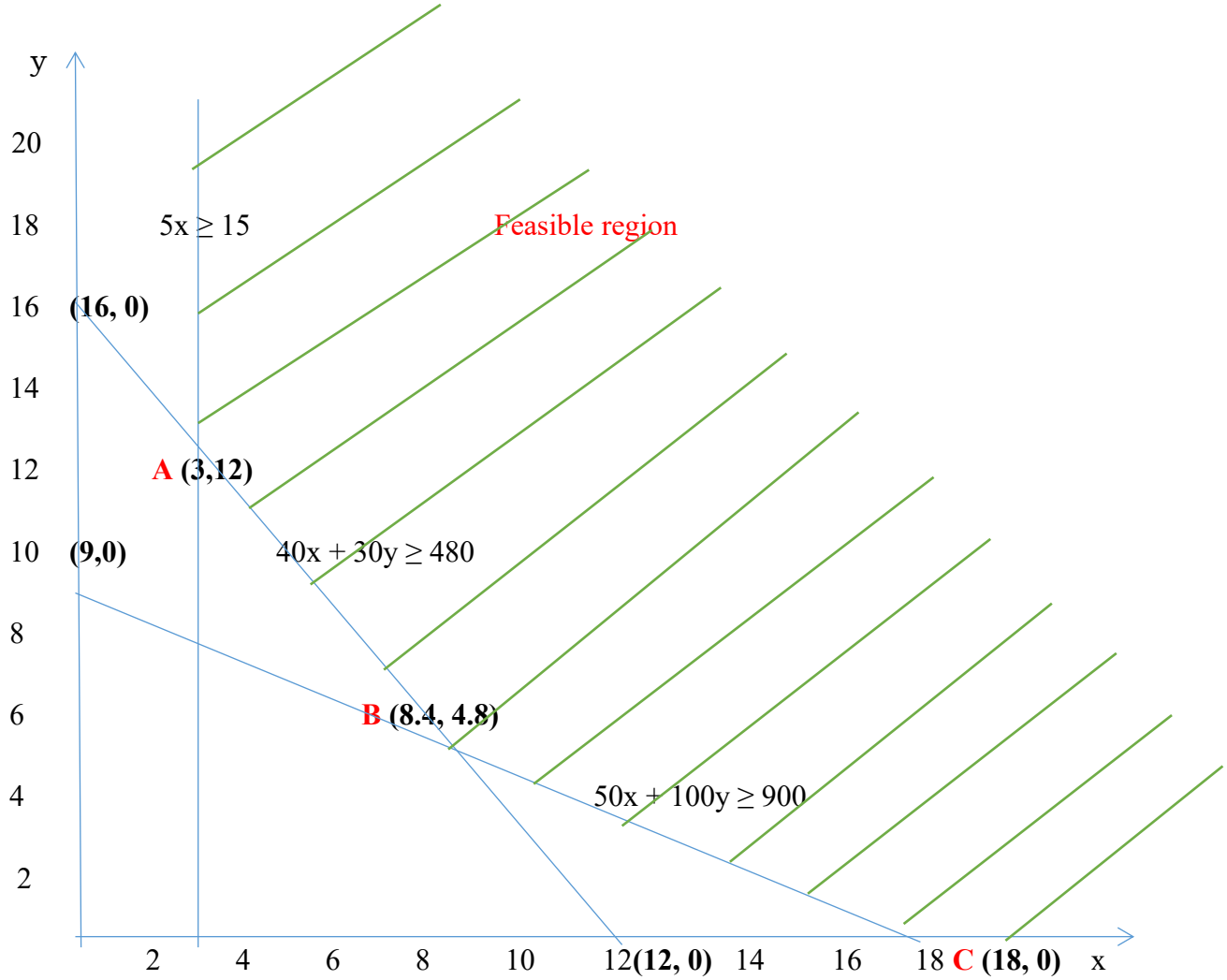
$x = 3$ …… (i)

$4x + 3y = 48$ …. (ii)

Substitute $x = 3$ into equation (ii) $y = 12$ $\quad$ (3, 12). This is point A.

Sketch the graph from the coordinates

A graph of Sesame seeds (y) against Chia seeds (x)



Feasible solution

Points	**Coordinates**	**Objective Function,** Z = FRW 4,000x + FRW 2,000y
A	(3, 12)	FRW 36,000
B	(8.4, 4.8)	FRW 43,200
C	(18, 0)	FRW 7,2000

The optimal solution is (3, 12) and the minimum cost is FRW 36,000

Therefore 3 kgs of Chia seeds and 12 kgs of Sesame seeds should be produced at a minimum cost of FRW 36,000

QUESTION FIVE

		Marks
Question Five - Part a)	(i) Types of hypothesis testing (1 mark each, max 2	2
	(ii) Conducting a hypothesis test	
	Stating the hypotheses (1 mark each, max 2)	2
	Stating the level of significance	1
	Stating the test statistic	1
	Finding the critical value from the table	1
	Stating the formula for standardized value	1
	Computation of z score	1
	Decision	1
Maximum marks		**10**
Question Five - Part b)	(i)	
	Computation of totals from the table (0.5 marks each, max 2)	2
	Stating the formulas (0.5 marks each, max 1)	1
	Computation of the value of b	2
	Computation of the value of a	1
	Stating the linear equation	1
	(ii) Computation of the expected salary from equation	1
	(iii) Uses of linear regression (max 2)	2
Maximum marks		**10**
Total marks for Question Five		**20**

Model Answer

a) i)

- A null hypothesis (H_0). This is any hypothesis which is to be tested for possible rejection or nullification under the assumption that is true.
- An alternative hypothesis (H_1/H_A). This is any other hypothesis which we are willing to accept when the null hypothesis H_0 is rejected.

ii) Hypotheses

Null hypothesis: H_0: μ (mean run time) = 6 hours

Alternative hypothesis: H_A: μ (mean run time) > 6 hours

Level of significance

The level of significance is 5%

Test statistic

The test statistic is the sample mean of the run time of the electric battery, = 6.25 hours.

Critical value

The critical value of the one tailed test at 5% level of significance is 1.65.

This value is read from the normal distribution table.

The standardized value of the sample mean

The standardized value is calculated as z = $\frac{\overline{X} - \mu}{S_{\overline{x}}}$ $S_{\overline{x}}$ $\frac{s}{\sqrt{n}}$

= 6.25 hours, μ = 6 hours, s = 0.50 hours, n = 50 electric batteries, z is the standard value to be computed

$$z = \frac{6.25-6}{\frac{0.5}{\sqrt{50}}} = \frac{0.25}{0.071} = 3.52$$

Decision

Since 3.52 is greater than 1.65, the null hypothesis is rejected and the alternative hypothesis accepted at 5% level of significance. This means that the run time of the electric battery of the supplier is significantly more than 6 hours.

b)

SN	Years of experience, x	Salary, y (FRW '000')	x2	xy
1	5	10,000	25	50000
2	6	13,500	36	81000
3	7	15,700	49	109900
4	10	22,100	100	221000
5	12	24,500	144	294000
6	15	28,000	225	420000
7	18	34,500	324	621000
8	22	39,700	484	873400
Total	**95**	**188000**	**1387**	**2670300**

y = a + bx

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

$$b = \frac{(8*2670300) - 95*188{,}000}{(8*1387) - (95*95)} \qquad a = \frac{188{,}000 - 1691.164*95}{8}$$

$$= \frac{21{,}362{,}400 - 17{,}860{,}000}{11{,}096 - 9025} \qquad a = 3417.42$$

$$= \frac{3{,}502{,}400}{2071}$$

b = 1691.164

The linear equation is y = 3417.42 + 1691.164 x

i) y = 3417.42 + 1691.164 x. x = 30 years

y = 3417.42 + 1691.164 *30 = 54,152.34

The expected salary of person with 30 years of experience would be FRW 54,152,340

ii) Uses of linear regression

- Linear regression can be used in business to evaluate trends and make estimates or forecasts.
- Linear regression can also be used to assess risks in financial services or insurance domains.
- Linear regression can also be used to analyze the marketing effectiveness, pricing and promotions on sales of a product.

Any other relevant use that is not presented can be marked.

1. Sales Forecasting

- **Use**: Predict future sales based on factors like advertising spend, seasonal trends, or pricing.
- **Example**: A company might use past sales data and marketing expenses to predict next quarter's sales.

2. Revenue and Profit Forecasting

- **Use**: Estimate future revenues or profits based on variables such as number of units sold, market demand, or operating costs.
- **Example**: A retailer may use linear regression to estimate monthly profit based on historical sales and cost data.

3. Demand Forecasting

- **Use**: Predict customer demand for a product or service over time.
- **Example**: A manufacturer could forecast product demand based on previous orders, seasonality, and economic indicators.

4. Price Estimation

- **Use**: Determine the optimal price of a product by analyzing the relationship between price and demand.
- **Example**: A hotel may use regression to estimate how room prices affect occupancy rates.

5. Inventory Management

- **Use**: Forecast inventory needs by predicting product turnover rates.
- **Example**: A supermarket might forecast the weekly demand for perishable goods to optimize inventory levels and reduce waste.

6. Cost Estimation

- **Use**: Estimate future costs of production, labor, or operations.
- **Example**: A construction firm might use linear regression to forecast total project cost based on labor hours and material costs.

7. Customer Lifetime Value (CLV) Prediction

- **Use**: Predict how much revenue a customer will bring over time based on their purchasing history.
- **Example**: E-commerce platforms can use regression to forecast the long-term value of different customer segments.

8. Financial Market Forecasting

- **Use**: Predict stock prices, interest rates, or other financial indicators.
- **Example**: An investment analyst might forecast the future price of a stock based on earnings reports and macroeconomic indicators.

9. Employee Performance or Retention Prediction

- **Use**: Predict employee turnover or performance based on factors like salary, years of service, and job satisfaction.
- **Example**: HR departments may use regression models to identify employees at risk of leaving.

10. Budgeting and Resource Allocation

- **Use**: Forecast future resource needs (e.g., staff, capital) for effective planning.
- **Example**: A company may use linear regression to project future staffing needs based on business growth rates.

QUESTION SIX

		Marks
a)	Formula of EQL	1
	Calculation of three EOL (1 mark to each)	3
	best choice of alternative for a good choice	1
	Reason	1
Max		**6**
b)	i) finding minimum corresponding to each alternative	1
	best decision	1
	ii) finding maximum corresponding to each alternative	1
	best decision	1
	iii) calculation of average	1
	best decision	1
	iv)Award 1 mark for each clearly explained element	3

Max		**9**
c)	construction of a payoff table 0.5 for entry	1
	calculation of expected value of Peter	1
	calculation of expected value of John	1
	best decision	1
	calculation of value of the game	1
Max		**5**
Total marks		**20**

a)

i) ECL = Probability of Default (PD) x Loss Given Default (LGD)

$$EOLProject\ A = 0.2(0) + 0.5(2{,}000) + 0.3(5{,}980) = 2{,}794$$

$$EOLProject\ B = 0.2(4{,}075) + 0.5(1{,}750) + 0.3(0) = 1{,}690$$

$$EOLProject\ C = 0.2(1{,}575) + 0.5(0) + 0.3(1{,}705) = 826.5$$

ii)The best alternative is project C, since is the one with the minimum EOL

b)

	S1	S2	S3	Max(min)	Max(max)	Average
A	14	22	6	6	22	14
B	19	18	12	12	18	16.33
C	12	17	15	12	17	14.67

i) Using Maximin, the best alternative is B or C

ii) Maximax, the best alternative is A

iii) Principle of insufficient reason, the best alternative is B

iv) Elements of decision making

- **Decision variables:** These are the choices or alternatives available to the decision maker. They are controllable variables which are within the domain of the decision makers and can be changed or manipulate. Different values can be assigned to a decision variable to give a decision maker different courses of action to choose from. Example in case of making a decision about an investment, the decision variable would be different areas in which to invest, the amount to invest and the timing of such investment
- **Uncontrollable variables:** These are states of nature which are not under the control of a decision maker. Uncontrollable variables are all factors whose situation are beyond control of the decision maker example may be price of competitor's products, costs of raw materials, political nature, inflation, etc
- **Payoff:** Payoff is an output variable that results from the efforts of the decision maker. Payoff is needed to compare each combination of decisions alternatives and state of nature.

c)The information may be transformed into the following payoff matrix:

Peter		
	B1(H)	B2(T)
A1(A)	8	-3
A2(T)	-3	2
	John	

Since the maximum is not equal to minimax, payoff matrix does not possess any saddle point. The players shall, therefore, use mixed strategies. Let John assign probabilities p to A1 and (1-p) to A2 and Peter assign the probabilities q to B1 and (1-q) to B2.

The expected payoff of Peter is then given by:

$8p + (-3) * (1 - p) = (-3) * p + 1 * (1 - p)$

$p = \frac{4}{15},\ and\ \ 1 - p = \frac{11}{15}$

The expected payoff of John is given by

$8q + (-3) * (1 - q) = (-3) * q + 1 * (1 - q)$

$q = \frac{4}{15}, and\ 1 - q = \frac{11}{15}$

The expected value of the game is $(8p + (-3) * (1 - p)) * q + \big((-3) * p + 1 * (1 - p)\big) * (1 - q)$

$\left(8 * \frac{4}{15} - 3 * \frac{11}{15}\right) * \frac{4}{15} + \left(-3 * \frac{4}{15} + \frac{14}{15}\right) * \frac{11}{15} = -\frac{1}{15}$

Therefore, Peter is in a better position than John.

QUESTION SEVEN

	Marks
a) i) calculation of probability (i)	1
Calculation of probability (ii)	1
Calculation of probability(iii)	1
Maximum marks	**3**
b) Probability both balls are red P(A∩B)	1
First black, second red	1
P(B)	1
Formula of P(B/A)	1
Calculation	1
Maximum marks	**5**
c) For recognizing formula	1
Calculation	1
Maximum marks	**2**
b) i) Award 1 marks for each formula max 2 marks	2
Award 0.5 marks for each cumulative frequency max (3.5 marks)	3.5
Calculation of Median	1

Award 1 mark for each quarter (Q1 and Q3) calculation	2
Substituting in the formula to determine sewed	1
Conclusion	0.5
Total marks	**20**

QUESTION SEVEN

Model Answer

a) Total number of trials = (since there are 300 employees all together).

Number of times a cricket p-layer is chosen= 95(since 95 students play cricket).

Number of times a football player is chosen = 120

Number of times a volley ball player is chosen =80

Number of times a student is chosen who plays no games = 5

(i) Therefore, the probability of getting a player who plays volley ball

$$= \frac{\text{number of times a volley ball player can be chosen}}{\text{Total number of trials}}$$

=80/300=4/15=0.2666666667

(ii) The probability of getting a player volley

$$= \frac{\text{Number of times a cricket or of times a cricket or a volleyball player can be chosen}}{\text{Total Number of trials}}$$

=(95+80) / 300= 175 /300 = 7 :12 = 0.5833333333

(iii)

The probability of getting a player who plays neither football nor volley bally=

$$\frac{\text{Numbers of times an employee can be chosen who do not play football or volleyball}}{\text{Total Number of trial}}$$

=(300-120-80)
=100/300
=1/3 = 0.333333333

b) **Define Events:**

- Let A*A*: First ball drawn is red.
- Let B*B*: Second ball drawn is red.

Calculate P(A∩B)$P(A \cap B)$: Probability both balls are red.

$P(A \cap B)$ = 3/10*2/9 = 6/90=1/15

Calculate P(B)$P(B)$: Total probability that the second ball is red.

- **Case 1:** First red, second red: 3/10×2/9=6/90.
- **Case 2:** First black, second red: 7/10×3/9=21/90

  $P(B)$=6/90+21/90=3/10

Apply Conditional Probability Formula:

$P(A|B)=P(A \cap B)$/P(B)=1/15:3/10 = 2/9

c) Given that P(B)= 4/5 and P(A∩B)=1/2
Then, probability of passing quantitative methods after passing in science =
P(B ⎪ A)=P(A∩B)/P(A)
=1/2:4/5=5/8

d)

Class Intervals and Frequencies:

Class	f	C.F.
1–5	20	20
6–10	27	47
11–15	29	76
16–20	38	114
21–25	48	162
26–30	53	215
31–35	70	285

N = 285
Q1 = N/4 = 71.25 falls in class 11–15
Q3 = 3N/4 = 213.75 falls in class 26–30

Use formula:

$$Q1 = L + (N/4 - CF)\frac{h}{f} = 10.5 + (71.25 - 47)\frac{5}{29} = 10.5 + 4.19 = 14.69$$

$$Q3 = 25.5 + (213.75 - 162)\frac{5}{53} = 25.5 + 4.91 = 30.41$$

→ **Skewness** = Q3 – Q1 = **30.41 – 14.69 = 15.72**
Since Q3 > Q1, distribution is **positively skewed**.

Or

Capital (Frw1,000,000) X	Class boundaries	Number of companies (f)	Cf
1-5	0.5-5.5	20	20
6-10	5.5-10.5	27	47
11-15	10.5-15.5	29	76
16-20	15.5-20.5	38	114
21-25	20.5-25.5	48	162
26-30	25.5-30.5	53	215
31-35	30.5-35.5	70	285
		285	

$$Median = L + \frac{(N/2 - cfb) * \mathrm{c}}{fm}$$

$$Median = 20.5 + \frac{(142.5 - 114) * 5}{48} = 23.4688$$

$$Q1 = L + \frac{(N/4 - cfb) * \mathrm{c}}{fm}$$
$$= 10.5 + \frac{(71.25 - 84) * 5}{48} = 14.6810$$

$$Q3 = L + \frac{(3N/4 - cfb) * \mathrm{c}}{fm}$$
$$= 25.5 + \frac{(213.75 - 162) * 5}{53} = 30.3820$$

$$SK = \frac{(Q3 + Q1 - 2md)}{Q3 - Q1}$$

$$SK = \frac{(30.38 + 14.681 - 2 * 23.4688)}{30.382 - 14.681} = -0.1194$$

Negative Sign indicate negative skewed

Note: Since mean is greater than median skew is positive

End of Marking Guide and Model Answers