CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION LEVEL 1 EXAMINATION

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

DATE: THURSDAY, 28 JULY 2022

MARKING GUIDE AND MODEL ANSWERS

QUESTION ONE

Marking guide

	Criteria	Marks
a)	Formulation of objective	1
	Constraints (1Mark for each constraint maximum 2)	2
	Graph and feasible solution (0.5 Marks for each coordinate maximum 2)	2
	Identification of feasible area	1
	solutions at corner points (1Mark for each max 3)	3
	Optimal solution	1
	Maximum Marks	**10**
b)	Construction of network (0.5 Marks for each demand max 2)	2
	Calculation for feasible solutions (1 Mark each step max 6)	6
	Calculation of optimum solution	2
	Maximum Marks	**10**
	Total	**20**

Model Answers

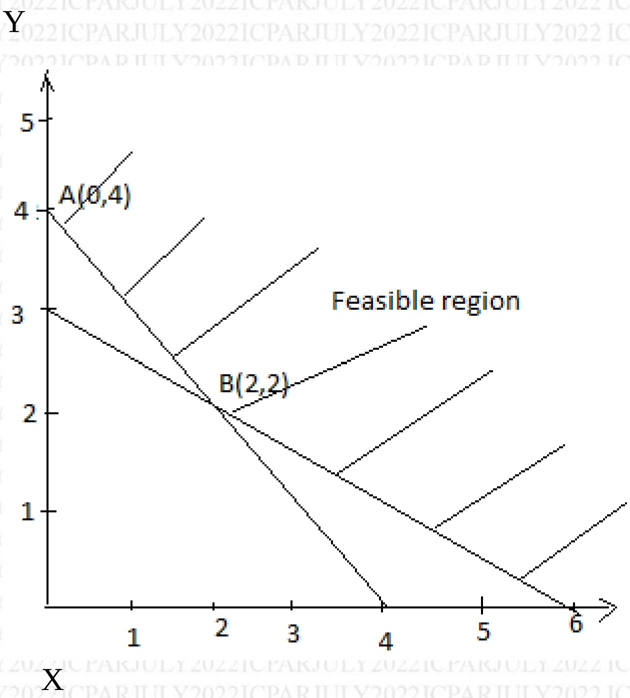
a) Objective, min $f = 2000x + 3000y$

Subjected to vit A constraint $5x + 5y \geq 20$

vit B constraint $5x + 10y \geq 30$

Non negativity constraint $x, y \geq 0$

Graphical method



The extreme points of the feasible region are A (0,4), B (2,2), C (6,0).

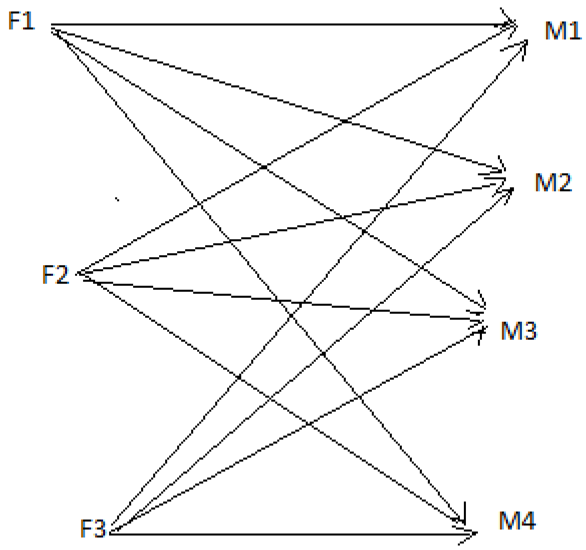
At A, $f = 2{,}000(0) + 3{,}000(4) = 12{,}000$

At B, $f = 2{,}000(2) + 3{,}000(2) = 10{,}000$

At C, $f = 2{,}000(6) + 3{,}000(0) = 12{,}000$

Hence point B gives the least cost combination. 2 breads and 3 omelettes should be served in the breakfast to minimize the total cost. And the minimum cost is FRW 10,000 per person.

B) i) Network model of transportation problem



ii) Vogel's Approximation Method

Step 1

We need firstly to create a dummy supply to balance the problem and calculate the first penalty and we enter to the row or column with the highest penalty.

Note: We have to put the cost for every shipment (From i supply to j demand) on the arrow.

	M1	M2	M3	M4	dummy	Total supply	Penalties
F1	11	20	7	8	0	50	(7-0)= 7
F2	21	16	10	12	0*30	40-30=10	(10-0)=10
F3	8	12	18	9	0	70	(8-0) =8
Total demand	30	25	35	40	30-30=0	160/160	
Penalties	(11-8)=3	(16-12)=4	(10-7)=3	(9-8)=1	0		

From the table F2 has highest penalty so we allocate 30 units from F2 to dummy market

Step 2 Calculate penalty and we enter to the row or column with the highest penalty which is M2.

	M1	M2	M3	M4		Penalties
F1	11	20	7	8	50	(8-7)=1
F2	21	16	10	12	10	(12-10)=2
F3	8	12*25	18	9	70-25=45	(9-8)=1
	30	25-25=0	35	40		
Penalties	(11-8)=3	(16-12)=4	(10-7)=3	(9-8)=1		

Step 3 Calculate penalty and we enter to the row or column with the highest penalty which is M3

	M1	M3	M4		Penalties
F1	11	7*35	8	50	(8=7)=3
F2	21	10	12	10	(12=10)=2
F3	8	18	9	45	(9=8)=1
	30	35-35=0	40		
Penalties	(11=8)=3	(10=7)=3	(9=8)=3		

Step 4

Calculate penalty and we enter to the row or column with the highest penalty which is F2

	M1	M4		Penalties
F1	11	8	15	3
F2	21	12*10	10	9
F3	8	9	45	1
	30	40		
Penalties	3	1		

Step 5

Calculate penalty and we enter to the row or column with the highest penalty which is M1

	M1	M4		Penalties
F1	11	8	15	(11=8)=3
F3	8***30**	9	45-30=15	(9=8)=1
	30-30=0	30		
Penalties	(11=8)=3	(9=8)=3		

Step 6

	M4		Penalties
F1	8 *15	15	
F3	9*15	15	
	30		
Penalties			

Calculation of the optimum solution

The optimum transportation cost is $= 12{,}000(25) + 7{,}000(35) + 12{,}000(10) + 8{,}000(30) + 8{,}000(15) + 9{,}000(15)$

$$= 300{,}000 + 245{,}000 + 120{,}000 + 240{,}000 + 120{,}000 + 135{,}000 = \text{FRW } 1160{,}000$$

QUESTION TWO

Marking guide

	Criteria	Marks
a)	Computation totals from the table (1 Mark each, max 5)	5
	Computation of means of x and y	4
	Formula for correlation coefficient	1
	Calculation of correlation coefficient	2
	Maximum marks	**12**
b)	State the equation	0.5
	Calculation of slope	1
	Calculation of intercept	1
	Writing the equation	0.5
	Maximum marks	**3**
c)	Stating the value of Y using the equation	**1**
d)	Formula and calculation of coefficient of determination	0.5
	Interpretation	0.5
	Maximum marks	**1**
e)	Calculation of contribution of other factors	**1**
f)	Formula of standard error	1
	Applying the formula and calculation	1
	Maximum marks	**2**
	Total	**20**

Model answers

SN	X	Y	(X-Xm)	(Y-Ym)	$(X\text{-}Xm)^2$	$(Y\text{-}Ym)^2$	(X-Xm)(Y-Ym)
1	4	13	-6.06667	-17.9333	36.80444	321.6044	108.7956
2	17	47	6.933333	16.06667	48.07111	258.1378	111.3956
3	3	24	-7.06667	-6.93333	49.93778	48.07111	48.99556
4	21	41	10.93333	10.06667	119.5378	101.3378	110.0622
5	10	29	-0.06667	-1.93333	0.004444	3.737778	0.128889
6	8	33	-2.06667	2.066667	4.271111	4.271111	-4.27111
7	4	28	-6.06667	-2.93333	36.80444	8.604444	17.79556
8	9	38	-1.06667	7.066667	1.137778	49.93778	-7.53778
9	13	46	2.933333	15.06667	8.604444	227.0044	44.19556
10	12	32	1.933333	1.066667	3.737778	1.137778	2.062222
11	2	14	-8.06667	-16.9333	65.07111	286.7378	136.5956
12	6	22	-4.06667	-8.93333	16.53778	79.80444	36.32889
13	15	26	4.933333	-4.93333	24.33778	24.33778	-24.3378
14	8	21	-2.06667	-9.93333	4.271111	98.67111	20.52889
15	19	50	8.933333	19.06667	79.80444	363.5378	170.3289
Total	**151**	**464**			**498.9333**	**1876.933**	**771.0667**

Mean of x (xm) = $\frac{1}{n}\sum x = \frac{151}{15} = 10.06667$

Mean of Y (ym) = $\frac{1}{n}\sum y = \frac{464}{15} = 30.93333$

a) $r = \frac{\sum(x-xm)(y-ym)}{\sqrt{\sum(x-xm)^2} * \sqrt{\sum(y-ym)^2}} = \frac{771.0667}{\sqrt{498.9333} * \sqrt{1876.933}} = 0.796794$

The result shows that there is a high relationship between variable.

Alternatively

SN	X	Y	xy	x^2	y^2
1	4	13	52	16	169
2	17	47	799	289	2209
3	3	24	72	9	576
4	21	41	861	441	1681
5	10	29	290	100	841
6	8	33	264	64	1089
7	4	28	112	16	784
8	9	38	342	81	1444
9	13	46	598	169	2116
10	12	32	384	144	1024
11	2	14	28	4	196
12	6	22	132	36	484
13	15	26	390	225	676
14	8	21	168	64	441
15	19	50	950	361	2500
15	**151**	**464**	**5442**	**2019**	**16230**

$$r = \frac{n\sum xy - (\sum x \times \sum y)}{\sqrt{[(n\sum x^2 - (\sum x)^2)] \times [(n\sum y^2 - (\sum y)^2)]}}$$

$$= \frac{(15 \times 5442) - (151 \times 464)}{\sqrt{[(15 \times 2019) - (151 \times 151)] \times [(15 \times 16230) - (464 \times 464)]}}$$

$$= \frac{81{,}630 - 70{,}064}{\sqrt{(30{,}285 - 22{,}801) \times (243{,}450 - 215{,}296)}}$$

$$= \frac{11{,}566}{\sqrt{7484 \times 28{,}154}}$$

r = 0.7967

Interpretation: There is a strong direct relationship between expenditure and sales.

b) $Y_t = \beta_0 + \beta_1 X_t + \mu_t$

$\beta_1 = \frac{\sum(x-xm)(y-ym)}{\sum(x-xm)^2} = \frac{771.0667}{498.9333} = 1.54543$

$\beta_0 = Ym - \beta_1 * Xm = 30.9333 - (1.54543 * 10.06667) = 15.376$

$\widehat{Y_t} = 15.376 + 1.54543\widehat{X_t}$

Alternatively

$\widehat{Y_t} = b + a\widehat{X_t} \ + \ \varepsilon_t$

b= $\frac{n\sum xy-(\sum x\times\sum y)}{n\sum x^2-(\sum x)^2}$

$b = \frac{15\times5442-(151\times464)}{(15\times2019)-(151)^2} = \frac{81{,}630-70{,}064}{30{,}285-22{,}801} = \frac{11{,}566}{7{,}484} = \mathbf{1.5454}$

a= $\frac{\sum xy - b\sum x}{n}$

a= $\frac{5442-(1.5454\times151)}{15} = \frac{464-233.23354}{15} = \frac{230.76646}{15}$=**15.38**

$\widehat{Y_t} = 15.38 + 1.54543\widehat{X_t}$

c) For X= 45 million Rwandan francs,

$15.376 + 1.54543 * 45\, million = FRW\ 84.9203(\,in\ million)$

d) Coefficient of determination= $R^2 = r^2 = 0.634881$ This means that 63.4881% of sales are determined by the advertisement

e) The contribution of other factors is explained by the sales at $1 - 0.634881 = 0.365119$

Which correspond to 36.5119%

f) The standard error $\delta_e = \sqrt{(1-R^2)var(y)}$= $\sqrt{(1-0.796794^2)(\frac{1876.933}{15})} = 6.75921$

QUESTION THREE

Marking guide

	Criteria	Marks
a)	Formulation of Hypothesis	2
	Obtained and expected frequency	4
	Chi-square formula	1
	Calculation of Chi-square	3
	Maximum	**10**
b)	Drawing a decision tree diagram (0.5 marks for each branch max 6)	6
	Calculation of income and expenses for installation of new machine	2
	Calculation of income and expenses for use of overtime	1
	Decision	1
	Maximum	**10**
	Total	**20**

Model answers

Ho: $P_A = P_B = P_{OTHER}, \ \ P = Proportion$

H1: $P_A \neq P_B \neq P_{OTHER}, or\ at\ least\ one\ \ p\ is\ not\ equal\ to\ its\ specified\ value$

	Company A	Company B	Other competitors	Total
Obtained frequency	102	82	16	200
Expected frequency	$\frac{45}{100} * 200 = 90$	$\frac{40}{100} * 200 = 80$	$\frac{15}{100} * 200 = 30$	200

$$X_{ob}^2 = \sum \frac{(f_o - f_e)^2}{f_e} = \frac{(102-90)^2}{90} + \frac{(82-80)^2}{80} + \frac{(16-30)^2}{30} = \frac{114}{90} + \frac{4}{80} + \frac{196}{30}$$

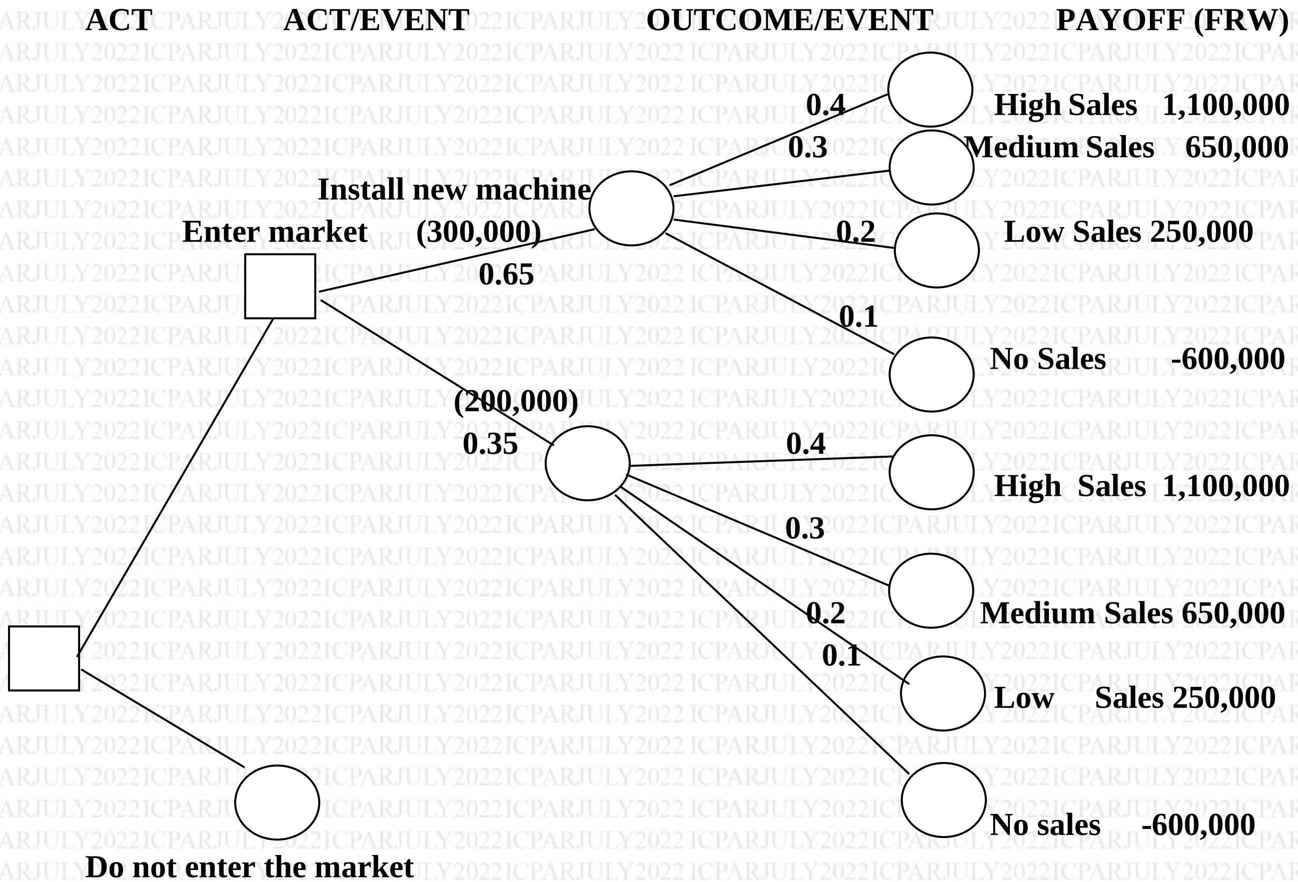
$= 1.6 + 0.05 + 6.53 = 8.18$

$DF = K - 1 = 3 - 1 = 2$

$X_C^2(df = 2, \alpha = 0.05) = 5.9914$

Since $X_{ob}^2 > X_C^2$, Ho is rejected. This means that customer preference changed.

a)



Entering the market and installation of new machine

Total income $= \mathbf{0.4(1,100,000) + 0.3(650,000) + 0.2(250,000) + 0.1(-600,000) = 440,000 + 195,000 + 50,000 - 60,000 = FRW\ 625,000}$

Expenses = 0.65 * 300,000 = FRW 195,000

Total Income – Expenses (enter the market) $= \mathbf{625,000 - 195,000 = \mathit{FRW}\ 430,000}$

Entering the market and use overtime

Total income= FRW $\mathbf{625,000}$ Expenses = 0.35 * 200,000 = FRW 70,000

Total Income – Expenses (enter the market) $= \mathbf{625,000 - 70,000 = 555,000}$

Decision: The best strategy is to use overtime.

QUESTION FOUR

Marking guide

	Criteria	Marks
i)	Calculation of expected time (0.5 marks for each activity, max 5)	5
ii)	Calculation of Earliest time and Latest time (0.5 for each event max 4.5)	4.5
	Network diagram (0.5 marks for each activity drawn, max 5.5)	5.5
iii)	Finding the critical path	1
iv)	Calculation of variance	1.5
	Calculation of standard deviation	0.5
	Calculation of z-score	1
	Finding the probability from the Z table	1
	Maximum	**4**
	Total	**20**

Model Answers

i) Calculation of the expected time for the project

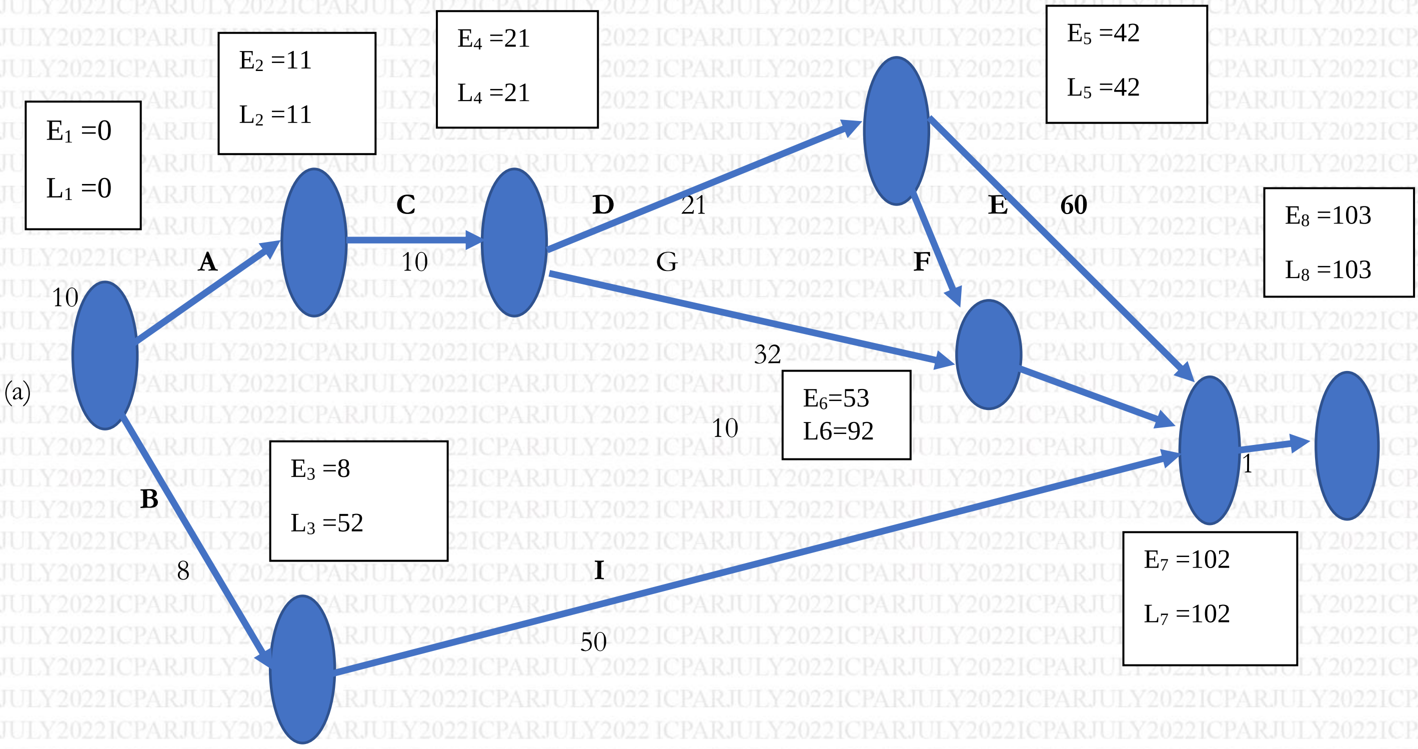
Expected Time (t_e) = $\frac{t_o+4t_m+t_p}{6}$

Activity	Immediate predecessor	Pessimistic time (t_p)	Mostly likely time (t_m)	Optimistic time (t_o)	Expected time
A	-	21	10	5	11
B	-	15	7	5	8
C	A	12	10	8	10
D	C	40	20	6	21
E	D	90	60	30	60
F	D	13	10	7	10
G	C	52	30	20	32
H	E, F, G	12	10	8	10
I	B	66	50	34	**50**
J	H, I	1	1	1	1

ii) Network diagram for the project

E – Earliest Start Time, L- Latest Start Time

(a)



a. Critical path is A - C – D – E – J

iii) Variance of project length = Sum of variance of each critical activity

$$variance\ \sigma^2 = \left(\frac{t_p - t_o}{6}\right)^2$$

$$= \left(\frac{21-5}{6}\right)^2 + \left(\frac{12-8}{6}\right)^2 + \left(\frac{40-6}{6}\right)^2 + \left(\frac{90-30}{6}\right)^2 + \left(\frac{1-1}{6}\right)^2$$

= 7.11 + 0.44 + 32.11 +100+0 = 139.66

$$Standard\ deviation, \sigma = \sqrt{variance} = \sqrt{139.66} = 11.81$$

Thus, $z = \frac{t_s - t_e}{\sigma} = \frac{80-103}{11.81} = -1.94$

By reading the standardized value of Z from the normal distribution table we get 0.2619

For Z = -1.94 Probability of completing the project with 80 days-time i.e., **26.19%.**

QUESTION FIVE

Marking guide

	Criteria	**Marks**
a)i)	Formula for profit	1
	Formula for revenue	1
	Computation of profit	1 1
	Derivative of profit	1
	Computation of output that maximizes profit	2
	Calculation of maximum profit	1
	Maximum	**7**
ii)	Formula of average cost	0.5
	Calculation of average cost	0.5
	Derivative of average cost	0.5
	Output that minimizes average cost	2
	Minimum average cost	0.5
	Maximum	**4**
iii)	Finding marginal cost from total cost	1
	Calculation of output that equates marginal cost to average cost	2
	Maximum	**3**
b)	Calculation of three-year moving totals (0.5 marks each year, max 3)	3
	Calculation of three-year moving averages (0.5 marks each year, max 3)	3
	Maximum marks	**6**
	Total	**20**

Model answers

a)

i) Level of output that results in maximum profit.

Profit = Revenue – Costs   P(x) = R(x) – C(x)

Revenue = Price * Quantity,

Revenue R(x) = p(x) * x

R(x) = (22.2 – 1.2x) x

R(x) = 22.2x – 1.2x^2

Cost C(x) = 0.4x^2 + 3x + 40

P(x) = (22.2x – 1.2x^2) – (0.4x^2 + 3x + 40)

P(x) = - 1.6x^2 + 19.2x – 40

$\frac{dp}{dx}$ = - 3.2x + 19.2 $\frac{dp}{dx}$ = 0

- 3.2x + 19.2 = 0   x =6

Since $\frac{d^2p}{dx^2}$ = - 32 < 0**, the second derivative indicates that maximum profit occurs at x = 6 (thousand) units are produced.**

Maximum profit is P(6) = - 1.6(6)^2 + 19.2(6) – 40 = 17.6

The maximum profit is FRW 17,000

ii) Level of output at which average cost is minimized

The average cost is total cost divided by output

AC(x) = $\frac{Total\ Cost}{output}$ = $\frac{C(x)}{x}$

AC(x) = $\frac{0.4x2 + 3x + 40}{x}$ = 0.4x + 3 + 40 /x

AC(x) = 0.4x + 3 + 40 /x

Derivative of Average Cost is given as below

$\frac{dAC(x)}{dx}$ = 0.4 - $\frac{40}{x^2}$

$\frac{dAC(x)}{dx}$ = 0

0.4 - $\frac{40}{x^2}$ =0

$\frac{x^2 - 40}{x^2}$ = 0

$x^2 = 100$, x = 10 Since $\frac{d^2p}{dx^2} = \frac{80}{x^3} > 0$, the average cost is minimized when x = 10

The minimum average cost is AC (10) = 0.4(10) + 3 + 40 /10 = 11 The minimum average cost is FRW 11,000

iii) Level of output at which average cost equals marginal cost

Cost C(x) = $0.4x^2 + 3x + 40$

Marginal Cost $\frac{dAC(x)}{dx} = 0.8x + 3$

Average Cost = 0.4x + 3 + 40 /x

Marginal cost = Average cost

0.8x + 3 = 0.4x + 3 + 40 /x

$0.4x = \frac{40}{x}$

$0.4x^2 = 40x = 10$ (thousand) units

The level of output at which average cost is equal to marginal cost is 10, 000 units

b) Calculate the total moving by adding three by three consecutive profit Then calculate the moving average by taking dividing the moving total of each year by three

Year	2011	2012	2013	2014	2015	2016	2017	2018
Profit in (FRW Bn)	15,420	15,470	15,520	21,020	26,500	31,950	35,600	43,900
Three Years moving total		46,410	52,010	63,040	79,470	94,050	111,450	
Three years moving average		**15,470**	**17,336.66**	**21,013.333**	**26,490**	**31,350**	**37,150**	

QUESTION SIX

Marking guide

	Criteria	Marks
a)	Construction of a payoff table	2
	Construction of a payoff for probabilities	2
	The expected payoff of Peter	2
	The expected payoff of John	2
	The expected value of the game	2
	Maximum	**10**
b)		
i)	Selection of minimum values	0.5
	Choosing the maximum of minimum payoff and decision	0.5
ii)	Selection of maximum values	0.5
	Choosing the maximum of maximum payoff and decision	0.5
iii)	Regret table	1
	Choosing the minimum from the maximum regrets and decision	1
iv)	Calculation of average (0.5 marks each average, max 1.5)	1.5
	Decision	0.5
v)	Calculation of payoffs each alternative (1 mark each alternative, max 3)	3
	Conclusion	1
	Maximum	**10**
	Total	**20**

Model Answers

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

Peter

		B1(H)	B2(T)
John	A1(H)	8	-3
	A2(T)	-3	1

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.

Table showing assignment of probabilities

		Peter	
		q	**1 – q**

John	**p**	8	-3
	1 – p	-3	1

The expected payoff of Peter is then given by:

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

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

The expected payoff of John is given by

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

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

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

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

The value of the game is $\boldsymbol{-\frac{1}{15}}$

b)

	Moderate	high	Very high	Max(min)	Max(max)
Reassign	50	60	85	**50**←	85
New staff	60	40	60	40	60
Redesign collection	40	50	90	40	**90**←

i) Using Maximin criteria, the best alternative is Reassigning

The decision under Maximin is to reassign present staff members since the maximum of the minimum payoff is FRW 50,000 (from the payoff table above)

ii) Using Maximax criteria, the best alternative is Redesigning collection

The decision under Maximax is to redesign current practice so that workers can readily collect information since the maximum of the maximum payoff is FRW 90,000 (from the payoff table above)

iii) Regret table

	Moderate	High	Very high	Maximum Regrets
Reassign	10	0	5	**10**←
New staff	0	0	30	30

Redesign collection	20	10	0	20

	Moderate	high	Very high	Average
Reassign	50	60	85	**65←**
New staff	60	40	60	53.33
Redesign collection	40	50	90	60

Using Minimax regret criteria, the best alternative is to reassign the present staff members since the minimum of the maximum regrets is FRW 10,000 (the value is from the regret table above)

iv) Using Principle of insufficient reason, the best alternative is **to reassign the present staff members** since it gives the maximum average of FRW 65,000 (from the table below)

v) Hurwitz Criteria

	Moderate	high	Very high	**Maximum**	**Minimum**
Reassign	50	60	85	**50**	**85**
New staff	60	40	60	**40**	**60**
Redesign collection	40	50	90	**40**	**90**

Payoff (P) = $\alpha \times$ maximum outcome + $(1 - \alpha) \times$ minimum outcome

Reassign; Payoff = $85{,}000(0.3) + 50{,}000(0.7) = 25{,}500 + 35{,}000 = FRW\ 60{,}500$

New Staff; Payoff= $60{,}000(0.3) + 40{,}000(0.7) = 18{,}000 + 28{,}000 = \boldsymbol{FRW\ 46{,}000}$

Redesign; Payoff = $90{,}000(0.30) + 40{,}000(0.70) = 27{,}000 + 28{,}000 = \boldsymbol{FRW 55{,}000}$

Using Hurwitz criteria, the best alternative is to redesign the present staff since it gives the highest payoff of **FRW 60,500**

QUESTION SEVEN

Marking guide

	Criteria	Marks
a)		
	Formula for binomial distribution	1
	Applying the formula	1
	Calculation	1
	Maximum	**3**
b) i)	Determination of the mean number of typing errors per 400 pages	1
	Formula	1
	Calculation	2
	Maximum	**4**
ii)	Formula	1
	Calculation	2
	Maximum	**3**
c)	Formula	0.5
	Computation of product of the weights and grades (1 mark each assessment, maximum 3)	3
	Summation of the product of weights and the grades	1
	Summation of weights	1
	Calculation of weighted mean	0.5
	Maximum	**6**
d)	Stating three measures of location and three of variability (0.5 to each)	**3**
e)	Providing a good solution and the reason	**1**
	Total	**20**

Model answers

a) Using the binomial probability function

$f(x) = C_x^n p^x (1-p)^{n-x} = C_r^n p^r (q)^{n-r}$

$x = r = 4, \; p = 0.3, \quad n = 10$

Therefore, $f(4) = P(4) = \frac{10!}{(10-4)!4!}(0.30)^4(0.7)^6$

$= \frac{10!}{4!6!}(0.30)^4(0.7)^6 = 0.2001$

The probability of making exactly 4 sales is 20.01 %

b) Since books has 400 pages, we need to determine the mean number of typing errors per 400 pages

Thus, Mean $\mu = \frac{1.5}{100} * 400 = 6$

i) Thus, we have this time $u = 1.5,\ x = 0$ substituting these values in the formula

$f(x) = \frac{u^x e^{-u}}{x!}$ Given that e is 2.718, we obtain $f(0) = \frac{6^0 e^{-6}}{0!} = \frac{1(e^{-6})}{1} = e^{-6} =$ 0.002478

Thus, the probability that in 400 pages of the book there are no typing errors is 0.002478 (0.2478 %)

ii) We want to determine the probability that a poisson random variable with mean of 6 is equal to 5 or less. That is

$$P(x \leq 5) = P(x = 0) + P(x = 1) + P(x = 2) + P(x = 3) + P(x = 4) + P(x = 5)$$

$$= \frac{6^0 e^{-6}}{0!} + \frac{6^1 e^{-6}}{1!} + \frac{6^2 e^{-6}}{2!} + \frac{6^3 e^{-6}}{3!} + \frac{6^4 e^{-6}}{4!} + \frac{6^5 e^{-6}}{5!}$$

$$= 0.002478 + 0.01487 + 0.04462 + 0.08924 + 0.1339 + 0.1606 = 0.4457$$

c) Weighted Mean

	Grade (x)	Weight	Product
Final exam	80	50	4000
First assignment	95	25	2375
Second assignment	85	25	2125
Total		$\sum w = 100$	$\sum wx = 8500$

The weighted mean = $\frac{\sum wx}{\sum w} = \frac{8500}{100} = 85$

d) Measures of location are: Mean, Mode and Median

Measures of variability are: Range, quartile, Inter quartile, variance, standard deviation, coefficient of variation

e) The best performer is site A because it has less value of standard deviation.

END OF MARKING GUIDE AND MODEL ANSWERS