

# CERTIFIED PUBLIC ACCOUNTANT FOUNDATION LEVEL 1 EXAMINATION F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS DATE: THURSDAY, 28 JULY 2022

MARKING GUIDE AND MODEL ANSWERS

F1.1 Page 1 of 20

# Marking guide

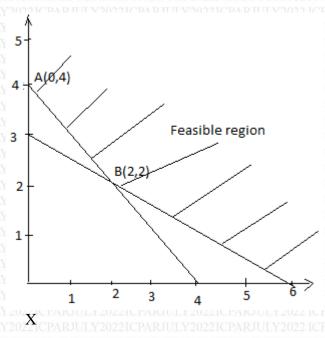
	PA Criteria 2 CPARJULY 2022 ICPARJULY 2022 ICPARJULY 2022 ICPARJULY 2022 ICPARJULY 2022 ICPARJULY 2022 Marks
a) 210	PARIULY2022 ICPARIULY2022 ICPA
	Constraints (1Mark for each constraint maximum 2)
	Graph and feasible solution (0.5 Marks for each coordinate maximum 2)
	Identification of feasible area
	solutions at corner points (1Mark for each max 3)
	CPA Optimal solution LY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJ
	Maximum Marks PAROLYZOZZI PARJULY2022 ICPARJULY2022 ICPARJULY202 ICPARJULY202 ICPARJULY202 ICPARJULY202 ICPARJULY2
b)	Construction of network (0.5 Marks for each demand max 2)
	Calculation for feasible solutions (1 Mark each step max 6) 6
	Calculation of optimum solution Y2022 ICPARJULY2022 ICPARJ
	Maximum Marks 10
	rpa <b>Total</b> 20221cParjuly20221cPa

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

Subjected to vit A constraint  $5x + 5y \ge 20$ vit B constraint  $5x + 10y \ge 30$ Non negativity constraint  $x, y \ge 30$ 

## Graphical method





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

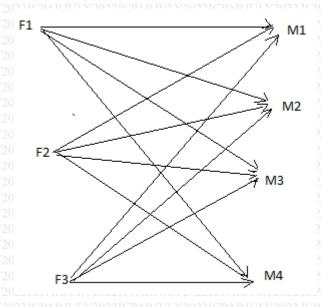
At A, 
$$f = 2,000(0) + 3,000(4) = 12,000$$

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



F1.1 Page 3 of 20

## 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.

2022 ICPARJU	M1	M2	M3	M4	dummy	Total	Penalties
2022 ICPAR II	II Y2022ICPAR	III Y2022 ICPA	R II II Y2022 IO	PARILITY	2022 ICPARII	supply	RILITY2022ICPA
2F121CPARJU	LM10221CPAR	120 2022 ICPA	R <b>J</b> ULY2022 I	18 RJULY	20 <b>Q</b> ICPARЛ	1500221CPA	(7-0)=7210PA
F2 ICPARJU 2022 ICPARJU 2022 ICPARJU	21 22 ICPAR I Y2022 ICPAR I Y2022 ICPAR	16 <sup>2022ICPA</sup> ULY2022ICPA	10	12	0* <mark>30</mark>	40- 30=10	(10-0)=10
2F321CPARJU	82022ICPAR	. U <b>12</b> 2022 ICPA	R18_Y2022 IO	19RJULY	20 <b>.0</b> ICPARJU	L <b>70</b> 0221CPA	(8-0) = 8
Total demand	30	25 2022 ICPA ULY 2022 ICPA ULY 2022 ICPA	35 RJULY2022 IO	40	30- 30=0	160/160	RJULY2022ICPA RJULY2022ICPA RJULY2022ICPA
Penalties	(11-8)=3	(16-12)=4	(10-7)=3	(9- 8)=1	200 ICPARJU 2022 ICPARJU 2022 ICPARJU	LY2022ICPA LY2022ICPA	RJULY2022ICPA RJULY2022ICPA

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. ICPARJULY2022ICPARJULY202

2022 ICPARJUL	$M1^{PARJULY2}$	M2	M3	M4	JI Y2022ICPA	Penalties
F1 ICPARIUI	Y2021 1 CPAR II II Y2	20	22 CPARJULY	8 CPARI	50 DA	(8-7)=1
F2 ICPARJUL	Y2021CPARJULY2	0221 <b>16</b> ARJULY20	22 10 ARJULY	112 CPARJU	Л <b>У10</b> 221СРА	(12-10)=2
F3	8 PARJULY2	12* <mark>25</mark>	18	20221CPARJU 20221CPARJU	70-	(9-8)=1
2022ICPARJUL 2022ICPARJUL	30	25-25=0	2 1CPARJULY 2 35 ARJULY	40	25=45	R. ULY2022ICPA R. ULY2022ICPA
Penalties	(11-8)=3	(16-12)=4	(10-7)=3	(9-8)=1	Л <u>Ү2022ICPA</u> ЛҮ2022ICPA	R. ULY 2022 ICPA R. ULY 2022 ICPA

Step 3 Calculate penalty and we enter to the row or column with the highest penalty which is M3 CPARIULY2022 ICPARIULY2022 ICPARIULY202 ICPARIULY202 ICPARIULY202 ICPARIULY202 ICPARIULY202 ICPARIULY202 ICPARIULY202 ICPARIULY202 ICPARIULY202

2022ICPARJULY	M1	M3	M4	Y2022ICPARJU	Penalties
<sub>2</sub> F <sub>12</sub> <sub>1</sub> CPARJULY	20221 <b>21</b> ARJULY2	7* <mark>35</mark>	2822 ICPARJUI	y2 50 <sub>CPARIL</sub>	(8=7)=3
F2 ICPARJULY	2021 <b>121</b> ARJULY2	010CPARJUL	212 ICPARJUI	Y2 10CPARJU	LY202 (12=10)=2 022 ICP
F3	8	18 PARIUL	9	45	(9=8)=1
2022ICPARJULY	2021 1 <b>30</b> Arjuly2	35-35=0	240 ICPARJUI	Y2)22ICPARJU	ILY2022ICPARJULY2022ICPA
Penalties	(11=8)=3	(10=7)=3	(9=8)=3	Y2)22ICPARJU	LY2022ICPARJULY2022ICPA

F1.1 Page 4 of 20

Step. 4. Parjuly20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJU

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

2022ICPARJU	M1 CPARJUI	Y2022IC PM4 ILY2022 I	ICPARJULY2022ICPA	Penalties 1 V20221CPA
2 <b>F1</b> 2ICPARJU	IY <b>1</b> (P2ICPARJUI	Y2022ICP <b>8</b> RJULY20221	CPARI 1520221CPA	RJULY 0321CPARJULY 20221CPA
F2	21 21 CPARTUI	12*10	CPAR 10 2022 ICPA	RJULY 10 21 CPARJULY 2022 I CPA
F3 ICPARJU	Ly8)221CPARJUI	Y2022ICP <b>9</b> RJULY20221	CPAR. 45 2022 ICPA	RJULY20 <b>1</b> 2ICPARJULY2022ICPA
2022 ICPARJU	30 <sup>2</sup> ICPARJUI	Y2022ICP40 ULY2022	ICPARJULY2022ICPA	RJULY2022ICPARJULY2022ICPA
Penalties	$\frac{3}{1}$	Y 20221CPARJULY 2022 1 Y 20221CPARJULY 2022 1	ICPARJULY2022ICPA	RJULY 2022ICPARJULY 2022ICPA RJULY2022ICPARJULY2022ICPA

## Step 5

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

2022ICPARJUI	M1CPARJULY2022	ICPARI M4022 ICPARJU	LY2022ICPARJULY2022IC	Penalties
F1	V10271CPAR II II V2022	CPARI 18V2022 ICPARIU	15 AR II II V202210	(11=8)=3
2F321CPARJUI	y (8* <mark>30</mark> arjiiy2022	ICPARJ J <b>9</b> Y2022 ICPARJU	13202 45-30=15202210	PARJ (9=8)=1 PA
2022ICPARJUI	30-30=0	CPAR 30 022 ICPAR I	LY2022ICPARJULY2022IC	PARJULY2022ICPA
Penalties	(11=8)=3	(9=8)=3	LY2022ICPARJULY2022IC	PARJULY2022ICPA

## Step 6

2022ICPARJULY2022	M40221CPARJ	ULY2022 ICPARJULY202	Penalties RJULY2022ICPA
F1 ICPAR II II Y 2022	8 * <mark>15</mark>	15 <sub>ARIII</sub> 2022	ZICPARJULY ZUZZICPARJULY ZUZZICPA 21CPAR III I Y2022 ICPAR II II Y2022 ICPA
F321CPARJULY2022	21CPARJ 19* <mark>15</mark> 221CPARJ	ULY2022 1 <b>15</b> ARJULY202	2ICPARJULY2022ICPARJULY2022ICPA
20221CPARJULY2022	30 <sup>2022</sup> 1CPARJ	ULY2022 ICPARJULY202	ZICPARJULY2022ICPARJULY2022ICPA
Penalties	21CPARJULY20221CPARJ	ULY2022 ICPARJULY202 ULY2022 ICPARJULY202	ZICPARJULY2022ICPARJULY2022ICPA 2ICPARJULY2022ICPARJULY2022ICPA

# 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 = FRW 1160,000

F1.1 Page 5 of 20

## **QUESTION TWO**

## y2022 (CPARJULY2022) CPARJULY2022 (CPARJULY2022) CPARJULY2022 (CPARJULY2022) CPARJULY2022 (CPARJULY2022) CPARJ **Marking guide**) 22 (CPARJULY2022) CPARJULY2022 (CPARJULY2022) CPARJULY2022 (CPARJULY2022) CPARJULY2022 (CPARJULY2022) CPARJULY2022

	PARJULY2022ICPARJULY2022ICPARJULY2022 ICPARJULY2022ICPARJULY2022ICPARJUI PAR <b>Criteria</b> CPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJU	Marks	72022ICPAR 72022ICPAR
72022IC	PAR Computation totals from the table (1 Mark each, max 5) JULY20221CPARJUI	Y2022IC <b>5</b> ARJULY	Y2022ICPAR
(a) 210	Computation of means of x and y	Y2022ICJARJULY	/2022ICPAR
	Formula for correlation coefficient	Y2022ICPARJULY	/ 20221CPAR / 2022ICPAR
	PAR Calculation of correlation coefficient CPARIULY2022 ICPARIULY2022 ICPARIULY	Y2022IC <b>2</b> ARJULY	Y2022ICPAR
	Maximum marks 2022 ICPARJULY 2022 IC	Y2022 <b>12</b> ARJULY	/2022ICPAR
b)	State the equation 1022 (CPARILLY 2022) (CPARILLY 2022) (CPARILLY 2022) (CPARILLY 2022)	0.5	r 2022 I CPAR r 2022 I CPAR
	PAR Calculation of slope 22 ICPARJULY 2022 ICPARJUL	Y2022ICI <mark>I</mark> ARJULY	Y2022ICPAR
	Calculation of intercept	Y2022ICPARJULY	/2022ICPAR
	PAR Writing the equation   CPARTHY 2022   CPARTHY 2	$_{ m Y2022}0.5$	r 2022 ICPAR r 2022 ICPAR
	PAR Maximum marks <sup>2022</sup> ICPARJULY2022 ICPARJULY2022ICPARJULY2022ICPARJU	Y2022IC <b>3</b> ARJULY	Y2022ICPAR
c)	Stating the value of Y using the equation	Y2022ICPARJULY	/2022ICPAR
d)	Formula and calculation of coefficient of determination	$_{ m Y2022}0.5$	120221CPAR 12022ICPAR
	PAR Interpretation JULY2022 ICPARJULY2022 ICPARJULY202 IC	Y20220.5ARJULY	72022ICPAR
	Maximum marks	Y2022ICPARJULY	(2022ICPAR
e) 2 (	Calculation of contribution of other factors	Y2022ICPARJULY	Y2022ICPAR
f)2210	PAR Formula of standard error RIULY2022 ICPARIULY2022 ICPARIULY202 ICPA	Y2022IC¶ARJULY	/2022ICPAR
	Applying the formula and calculation	Y2022ICPARJULY	/2022ICPAR
	PAR <b>Maximum marks</b> 2022 ICPARJULY 2	Y2022ICPARJULY	Y2022ICPAR
	$PAR_{f Total}$   221CPARJULY 2022 ICPARJULY 2022	Y20221 <b>20</b> \RJULY	72022ICPAR

## **Model answers**

SN	X	Y	(X-Xm)	(Y-Ym)	$(X-Xm)^2$	$(Y-Ym)^2$	(X-Xm)(Y-Ym)
2 <b>1</b> 221CP	4ULY	213101	-6.06667	-17.9333	2 ICPA 36.80444	321.6044	21CPARJU 108.7956
2	17	47	6.933333	16.06667	48.07111	258.1378	111.3956
3221CP	3	24	-7.06667	-6.93333	49.93778	48.07111	16 PART 48.99556
4221CP	21	41	10.93333	10.06667	119.5378	101.3378	110.0622
5,221CP	10	29	-0.06667	-1.93333	0.004444	3.737778	0.128889
6221CP	8 ULY	33	-2.06667	2.066667	2 ICPA4.271111	4.271111	21CPARJUI-4.27111
2 <del>7</del> 221CP/	4	28	-6.06667	-2.93333	36.80444	8.604444	17.79556
8221CP	9	38	-1.06667	7.066667	1.137778	49.93778	-7.53778
922ICP	13 1	46	2.933333	15.06667	8.604444	227.0044	44.19556
10	12	32	1.933333	1.066667	3.737778	1.137778	2.062222
2 <b>11</b> 21CP	2ULY	2(14)()	-8.06667	-16.9333	2 ICPA 65.07111	286.7378	21CPARJU 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
2142 ICP	8ULY	21101	-2.06667	-9.93333	2 ICPA4.271111	98.67111	20.52889
15	19	50	8.933333	19.06667	79.80444	363.5378	170.3289
Total	R151	464	ARJULY2022	CPARJULY202	498.9333	1876.933	771.0667

RJULY2022ICPAR RJULY2022ICPAR

F1.1 Page 6 of 20

Mean of x (xm) = 
$$\frac{1}{n} \sum x = \frac{151}{15} = 10.06667$$
  
Mean of Y (ym) =  $\frac{1}{n} \sum y = \frac{464}{15} = 30.93333$ 

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

SN	X221CPARJULY 202	2 Y PARJULY 2022 2 Y PARJULY 2022	xy	$\mathbf{x}^2$	$\mathbf{y}^2$
21221CPARJUI	Y2022ICPARJULY 4)2	21CPARJULY2132	CPARJULY2052	PARJULY20216	ARJULY2022 <b>169</b> 4
2 <sup>22</sup> ICPARJUI	Y20221CPARJULY70	47	799	289	2209
23221CPARJUI	Y2022ICPARJULY3	21CPARJULY 24	ICPARJULY2072	PARJULY2022191	аклицу202 576
2422ICPARJUI	Y2022ICPARJUL 2102	2ICPARJULY2412	CPARJULY 861	PARJULY204411	ARJULY201681
25221CPARJUI	V2022ICPARIII 10	29	290	100	841
26221CPARJUI	Y2022ICPARJULY 8/2	2ICPARJULY 332	CPARJULY 264	PARJULY202 641	ARJULY201089
2 <del>9</del> 221CPARJUI	Y2022ICPARJULY 4)	28	CPARJULY 112	PARJULY202 16	784
8221CPARJUI	Y20221CPARJULY 9	38	342	PARJULY202 81	1444
2 <b>9</b> 221CPARJUI	Y2022ICPARJULM3	21CPARJULY 462	CPARJULY 598	PARJULY201691	ARJULY202116
10 ICPARJUI	Y2022ICPARJUL 12	32	384	144	1024
21121CPARJUI	Y2022ICPARJULY2	21CPARJULY2142	CPARJULY2028	PARJULY202214	ARJULY202 196
212 ICPARJUI	Y2022ICPARJULY 6	21CPARJULY222	ICPARJULY 132	PARJULY20236	484
2022 ICPAR 13	V20221CPARJUL 15	26	390	225	676
2022ICPAR <b>14</b> I	Y2022ICPARJULY 802	2ICPARJULY:212	ICPARJULY 168	PARJULY202 641	ARJULY202:441
<sup>2022</sup> ICPAR 15	Y20221CPARJUL 1912	50	950	361	2500
2022 ICPAR 15	Y2022ICPARJU151	21CPARJUT (464)	CPARJU 5442	PARILITY 2019	16230

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

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

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

$$r = 0.7967$$

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

$$\begin{split} \widehat{Y}_t &= b + a\widehat{X}_t + \mathcal{E}_t \\ \mathbf{b} &= \frac{n\sum xy - (\sum x \times \sum y)}{n\sum x^2 - (\sum x)^2} \\ b &= \frac{15 \times 5442 - (151 \times 464)}{(15 \times 2019) - (151)^2} = \frac{81,630 - 70,064}{30,285 - 22,801} = \frac{11,566}{7,484} = \mathbf{1}.\mathbf{54544} \\ \mathbf{a} &= \frac{\sum xy - b\sum x}{n} \\ \mathbf{a} &= \frac{5442 - (1.5454 \times 151)}{15} = \frac{464 - 233.23354}{15} = \frac{230.76646}{15} = \mathbf{15.38} \\ \widehat{Y}_t &= 15.38 + 1.54543\widehat{X}_t \end{split}$$

c) For X = 45 million Rwandan francs,

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

F1.1 Page 8 of 20

## **OUESTION THREE**

## Marking guide

	PAR Criteria CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY Marks
(a) 210	PARJ Formulation of Hypothesis JULY2022 ICPARJULY2022 ICPARJULY202 ICP
	Obtained and expected frequency 4
	PAR Chi-square formula 221CPARJULY2022 ICPARJULY2022 ICPARJULY202 IC
	PAR Calculation of Chi-square RJULY2022 ICPARJULY2022 ICPARJULY202 ICPA
	PAR Maximum Par July 2022 ICPARJULY
b)210	Drawing a decision tree diagram (0.5 marks for each branch max 6)
	Calculation of income and expenses for installation of new machine 2
	Calculation of income and expenses for use of overtime
	PAR Decision CPARJULY2022 ICPARJULY2022 ICPARJULY202 ICPA
	PAR Maximum AD H.H. V2022 ICPARJULY2022 ICPARJULY202 I
	par jTotal) 221 CPARJULY 2022 ICPARJULY 2022 ICPARJ

## 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

2022ICPARJULY20	Company A	Company B	Other competitors	Total
Obtained	102 гли у 2022 ІСРАК	82 2022 ICPARIU V2	16 PARJULY2022ICP	200
frequency 13/201	221CPARJULY20221CPAF	JULY2022 ICPARJULY2	0221CPARJULY20221CP/	RJULY2022IC
Expected frequency	$\frac{45}{100} * 200 = 90$	$\frac{40}{100} * 200 = 80$	$\frac{15}{100} * 200 = 30$	200

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

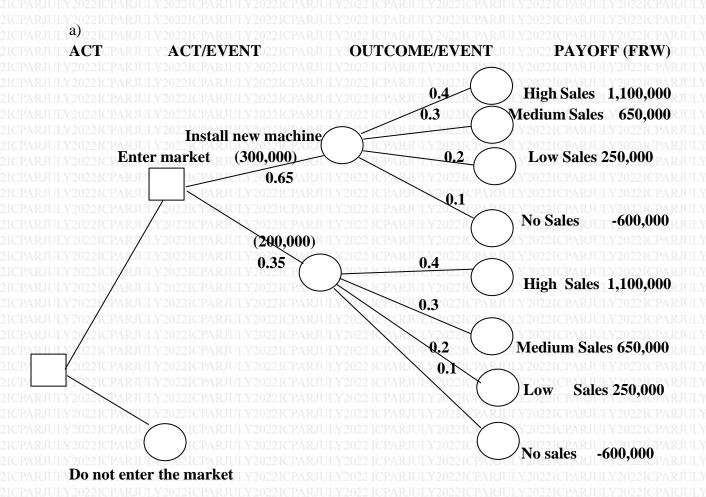
$$= 1.6 + 0.05 + 6.53 = 8.18$$

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

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

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

F1.1 Page 9 of 20



## **Entering the market and installation of new machine**

Total income = 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 625,000Expenses = 0.65\*300,000 = FRW 195,000

Total Income – Expenses (enter the market) = 625,000 - 195,000 = FRW 430,000

## Entering the market and use overtime

Total income= FRW 625,000 Expenses = 0.35 \* 200,000 = FRW 70,000

Total Income – Expenses (enter the market) = 625,000 - 70,000 = 555,000

**Decision:** The best strategy is to use overtime.

F1.1 Page 10 of 20

# **QUESTION FOUR**

# Marking guide 221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221C

	PAR <b>Criteria</b> ICPARJULY2022ICPARJULY2022 ICPARJULY2022ICPARJULY2022ICPARJU	Marks
i)	Calculation of expected time (0.5 marks for each activity, max 5)	Y2022IC5A
ii)	Calculation of Earliest time and Latest time (0.5 for each event max 4.5)	4.5
	PARNetwork diagram (0.5 marks for each activity drawn, max 5.5) 221CPARJUI	Y2022 <b>5.5</b> A
iii)	PARFinding the critical path PARHILLY2022 ICPARHILLY2022 ICPARHILLY202 ICPARHI	Y2022ICIA
iv)	Calculation of variance	1.5
	Calculation of standard deviation	y2020 0.5
	PARCalculation of z-score ICPARJULY2022 ICPARJULY202 ICPA	Y2022ICIA
	Finding the probability from the Z table	Y2022ICPA
	par <b>Maximum</b> arjuly20221cParjuly20221cParjuly20221cParjuly20221cParjul	Y2022IC4
	PAR <b>Total</b> )22ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJUL	Y20221 <b>20</b> \

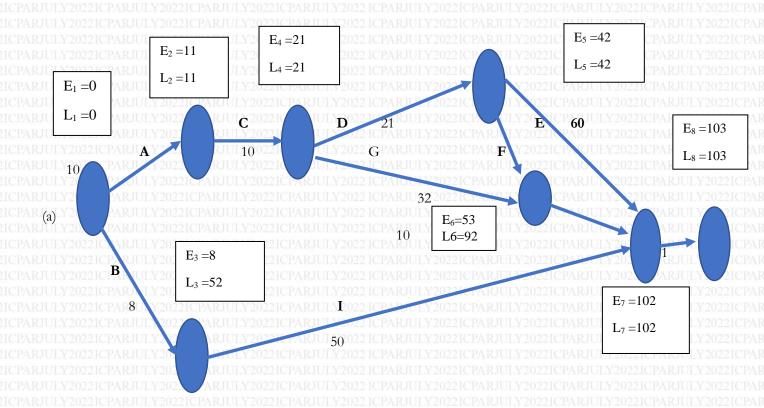
# Model Answers 21CPARJULY20221CPARJULY20221CPARJULY202

i) Calculation of the expected time for the project   
Expected Time (t<sub>e</sub>) = 
$$\frac{t_o + 4t_m + t_p}{6}$$

Activity	Immediate predecessor	Pessimistic time (t <sub>p</sub> )	Mostly likely time (tm)	Optimistic time (t <sub>0</sub> )	Expected time
2 <b>A</b> 21CPARJ	UL¥2022ICPARJUL	Y2022ICPARJUI $21_{ m 0}$	22 ICPARJUL <b>10</b> )	2ICPARJULY252	ICPARJULY2022I
B <sub>21</sub> CPARJ	ULY2022ICPARJUL	Y <sup>2022</sup> ICPARJUL <b>15</b> 0	22 ICPARJULY 7	2 ICPARJULY 25	ICPARJULY2022IC8
2( <b>C</b> 2ICPARJI	L' <b>A</b> 0221CPARJUL	Y20221CPARJUI 120	22 ICPARJUL 10	2ICPARJULY281	ICPARJULY2022110
$\mathbf{D}^{21\mathrm{CPARJ}}$	CO221CPARJUL	40	20	<sup>2</sup> (CPAR) 6	ICPARJULY2022 21
2(E21CPARJ	$\mathbf{D}_{20221\text{CPARJUE}}$	y20221CPARJUJ <b>90</b> 0	22 ICPARJUL 60	21CPARJULY30	ICPARJULY2022 60
2022 CPARJ	D <sup>2</sup> 022ICPARJUL	Y2022 ICPARJUL <b>13</b> 0	10	2ICPARJULY272	ICPARJULY2022I10
$G_{2}$ ICPARJ	$C_{20221CPARJUL}$	Y2022ICPARJUI <b>52</b> 0	22 ICPARJUL <b>30</b> )	21CPARILI (20)	ICPARJULY2022132
2H2ICPARJ	E, F, G	Y2022ICPARJUI12	22 ICPARJUL 10	2ICPARJULY28	ICPARJULY2022I10
2022 ICPARЛ 2 <b>d</b> 22 ICPARЛ	B <sub>2022</sub> ICPARJUL	Y2022ICPARJUJ 66	22 ICPARJUJ 50)	21CPARILIT \ 34	HCPARJULY2022150
2 <mark>j</mark> 22ICPARJ	H, I <sup>2</sup> ICPARJUL	Y2022ICPARJULYPO	22 ICPARJULY 10	2ICPARJULY292	ICPARJULY2022IC

Page 11 of 20

- ii) Network diagram for the project
- E Earliest Start Time, L- Latest Start Time



- **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 <sup>22</sup>ICPARJULY2022

Criteria Y 2022 I CPARJULY 202	Marks
21CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY	
Formula for profit	2022ICPARJULY 2022ICPAE
	2022ICPARJULT 2022ICPAR 2022ICPAR II II V2022ICPAI
Formula for revenue III y 2022 ICPARIIII y 2022 ICPARIII y 2022 ICP	20221CF <b>1</b> RJULY20221CFAF
Computation of profit LY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	2022ICPARJULY2022ICPAF
21CPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	
Derivative of profit UULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	2022ICPARJULY2022ICPAF
21CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY	2022ICPARJULY2022ICPAF
Computation of output that maximizes profit	20221CP2RJULY 20221CPAE
2021 AN ION 12022 ICHARIO EN 2022 ICHARIO EN 2 12031 AN ION 1200 EN DAN INTERNA DE LA PRIMITA VA 1000 ICHARIO EN 2022 ICHARIO	2022 ICPAR ILII V2022 ICPAR
Calculation of maximum profit 21CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY	2022ICPARJULY2022ICPAF
Maximum <sup>2</sup> 0221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY	2022ICP <del>†</del> RJULY2022ICPAF
.2ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	2022ICPARJULY2022ICPAF
Formula of average cost	2022I 0.5 RJULY 2022I CPAR
Calculation of average cost	20221 0.5 RIGHT V20221 CPAR
2LCPARJIJLY2022ICPARJULY2022ICPARJULY2022 ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	2022ICPARJULY2022ICPAF
Derivative of average cost	20221CPAF
21CPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	2022ICPARJULY2022ICPAF
Output that minimizes average cost My2022 ICPARIULY2022 ICPARIULY2022 ICPARIULY	2022ICP <sup>2</sup> RJULY2022ICPAF
Minimum average cost	20221CPARJULY20221CPAR
	20221GPAR II II V20221CPAR
	2022ICPARJULY2022ICPAF
21CFAN-01_F20221CFAN-01_F20221CFAN-01_F20221CFAN-01_F20221CFAN-01_F20221CFAN-01_F	2022ICPARJULY2022ICPAF
Calculation of output that equates marginal cost to average cost ULY2022ICPARJULY	2022ICP $2$ RJULY2022ICPAF
Maximum 20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY	2022ICP <mark>3</mark> RJULY2022ICPAF
Calculation of three-year moving totals (0.5 marks each year, max 3)	2022 ICPARJULY 2022 ICPAF 2022 ICP <b>3</b> R II II V2022 ICPAF
	20221CP <b>3</b> RJULY2022ICPAF
Calculation of three-year moving averages (0.5 marks each year, max 5)	2022ICPARJULY2022ICPAR
Maximum marks RJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	2022ICP6RJULY2022ICPAF
2ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	2022ICPARJULY2022ICPAF
Total JULY2022ICPARJULY202ICPARJULY202ICPARJULY202ICPARJULY202ICPARJULY202ICPARJULY202ICPARJULY202ICPARJULY202ICPARJULY202ICPARJULY202I	2022IC <b>20</b> RJULY2022ICPAF
	Derivative of profit  Computation of output that maximizes profit  Calculation of maximum profit  Maximum  Formula of average cost  Calculation of average cost  Output that minimizes average cost  Minimum average cost  Maximum  Finding marginal cost from total cost  Calculation of output that equates marginal cost to average cost  Maximum  Calculation of three-year moving totals (0.5 marks each year, max 3)  Calculation of three-year moving averages (0.5 marks each year, max 3)  Maximum marks

F1.1 Page 13 of 20

## **Model answers**

- i) Level of output that results in maximum profit.

$$P(x) = R(x) - C(x)$$

Revenue = Price \* Quantity,

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

$$R(x) = (22.2 - 1.2x) x$$

$$R(x) = 22.2x - 1.2x^2$$

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

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

$$P(x) = -1.6x^2 + 19.2x - 40$$

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

$$-3.2x + 19.2 = 0$$
  $x = 6$ 

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 
$$P(6) = -1.6(6)^2 + 19.2(6) - 40 = 17.6$$

ii) Level of output at which average cost is minimized

The average cost is total cost divided by output

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

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

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

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

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	2011221	2012	2013 ARJUI	2014 CPARJU	2015 CP	2016	2017	2018
Profit in (FRW Bn)	15,420	15,470	15,520	21,020 V2022 ICPARI V2022 ICPARI	26,500	31,950	35,600	43,900
Three Years moving total	ULY202210 ULY202210 ULY202210 ULY202210 ULY202210	46,410	52,010	63,040	79,470	94,050	111,450	720221CP/ 720221CP/ 720221CP/ 720221CP/ 720221CP/
Three years moving average	ULY202210 ULY202210 ULY202210 ULY202210 ULY202210	15,470	17,336.66	21,013.333 2022 ICPARJU 72022 ICPARJU 72022 ICPARJU 72022 ICPARJU	26,490	31,350	37,150 221CPARJUL 221CPARJUL 221CPARJUL 221CPARJUL	72022ICP/ 72022ICP/ 72022ICP/ 72022ICP/ 72022ICP/

F1.1 Page 15 of 20

## **QUESTION SIX**

## Marking guide

	pa <b>Criteria</b> 21CPARJULY20221CPARJULY2022 ICPARJULY20221CPARJULY20221CPARJULY	Marks
(a) 210	P/Construction of a payoff table	Y2022IC <b>2</b> A
	Construction of a payoff for probabilities	Y2022ICDA
	The expected payoff of Peter	Y20221CPA
	The expected payoff of John WILLY2022 ICPARIULY2022 ICPARIULY202 ICPARI	Y2022IC <b>2</b> A
	The expected value of the game	Y2022IC 2A
	pa <b>Maximum</b> parjuly20221cParjuly2022 icParjuly20221cParjuly20221cParjuly20221cParjul	2022 10
b)210		
i)	Selection of minimum values	0.5
	Choosing the maximum of minimum payoff and decision	2022 0.5
ii)	P Selection of maximum values ULY2022 ICPARIULY2022 ICPARIULY202 ICPARI	Y2022 0.5
	Choosing the maximum of maximum payoff and decision	0.5
iii)	Regret table ARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY	Y2022ICIA
	Choosing the minimum from the maximum regrets and decision PARTUL	Y2022IC <b>I</b> A
iv)	Calculation of average (0.5 marks each average, max 1.5)	1.5
	PADecision ICPARJULY2022ICPARJULY2022 ICPARJULY2022ICPARJULY2022ICPARJULY	Y2022 <b>0.5</b>
(v)210	Calculation of payoffs each alternative (1 mark each alternative, max 3)	Y2022IC <b>3</b> A
	Conclusion	Y 2022 I CPA
	CPA <b>Maximum</b> :PARJULY2022ICPARJULY2022 ICPARJULY2022ICPARJULY2022ICPARJULY	Y2022 104
	CPA <b>Total</b> 2022 ICPARJULY 2022 ICPARJULY 2022 ICPARJULY 2022 ICPARJULY 2022 ICPARJULY 2022 ICPARJUL	Y2022 <b>20</b> \

## Model Answers

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

## Peter

Y2022ICPARJULY2022ICPA	JULY2022 ICPARJULY2022	B1(H) LY2022ICPARJUL	B2(T) ARJULY2022ICPA
John PARJULY2022ICPA	A1(H)	8 18 18 18 18 18 18 18 18 18 18 18 18 18	v <del>2</del> 3221CPARJULY20221CPA
20221CPARJULY20221CPA 20221CPARJULY20221CPA	A2(T) 21(PARJULY 2022	ICPARJULY2022ICPARJUL ICPARJULY2022ICPARJUL	2022ICPARJULY 2022ICPA Z022ICPARJULY 2022ICPA

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

Y2	022ICPARJULY2022ICPAI	UULY2022ICPARJULY2(Pete	PARJULY2022ICPAR.	JULY2022ICPARJULY2022ICPA
Y2	022ICPARJULY2022ICPAF	RJULY2022ICPARJULY2022IC	CPARJULY2022ICPAR.	JULY2022ICPARJULY2022ICPA
Y 2	022ICPARJULY2022ICPAF	ULY2022ICPARJULY2022IG	OPARJULY2022ICPAR	JULY <b>1</b> 0 <del>2</del> 2 <b>q</b> CPARJULY2022ICPA
v o		пп уэлээгсрар п п уэлээ го	PARTITIVADANTOPAR	п п уэлээтсрар п п уэлээтсра

F1.1 Page 16 of 20

2022ICPARJULY2022ICPAI	UPLY2022ICPARJULY202	2 8PARJULY2022ICPARJUL	723221CPARJULY20221CPA
"John Parjuly2022ICPAI	${}^{\text{ULY 2022}}_{\text{UL}}{}^{\text{CPARJULY 202}}_{\text{UL}}$	2 CPARJULY2022ICPARJUL	K <del>20221CPARJULY20221CPA</del>
2022ICPARJULY2022ICPAI		2 C <mark>3</mark> ARJULY2022ICPARJUL	K20221CPARJULY20221CPA

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 + ((-3) \* p + 1 \* (1-p)) \* (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  $-\frac{1}{15}$ 

h)

2022ICPARJULY:	Moderate	CPA high 2022	Very high	Max(min)	Max(max)
Reassign	2022 (50\RJULY2022)	CPA 60 Y2022	ICPAR85 Y2022ICPA	R 150←2221CPA	85 Y 2022 I C
New staff	60	40	60	40	60
Redesign	2022 <b>140</b> RJULY20221	CPA 150 LY 2022	ICPA R <b>90</b> Y2022 ICPA	R 140/20221CPA	90←022101
collection	2022ICPARJULY2022I	CPARJULY2022	ICPARJULY2022ICPA	RIULY2022ICPA	RJULY2022ICI

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

20221CPARJULY20221 20221CPARJULY20221	Moderate 22 ICPARJULY 2022	High ULY202210 ICPARJULY202210	Very high	Maximum Regrets
Reassign	10, HH V2022 ICPAR HH V2022	0 ARJULY 2022 I	5 R II II V 2022 IC	10←√20221CFA
New staff   1 Y 2 0 2 2 1	ORJULY2022ICPARJULY2022	IOPARJULY2022I	30 JULY 2022 IC	A30ULY20221CPA

F1.1 Page 17 of 20

Redesign 2 collection	Quily20221cparju Arjuly20221cparju	LY2022 IOARJULY LY2022 ICPARJULY	20221C1 <mark>0</mark> .RJULY20221C 20221CPARJULY20221C	20 ULY2022 ICP
<del>2022 ICPARJULY 2022 ICP</del> 2022 ICPARJULY 2022 ICP	Moderate	high	Very high	Average
Reassign W2022ICP	ARI 5020221CPARJU	LY20 260 PARJULY	20221 85 JULY 202210	CPA 65←0221CF
New staff	60	40	60	53.33
Redesign collection	ARJ 4020221CPARJUJ	LY20 250PARJULY	20221 <b>90</b> 21111 Y 202210	TPA R 60 Y 2022 I CP

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

2022ICPARJULY.	Moderate	high	Very high	Maximum	Minimum
Reassign	202 50ARJULY2022	60	ICP 85 LY2022 ICP	AT 50 Y2022ICPA	85 Y2022ICP
New staff	2021 <b>60</b> RJULY2022	ICP 40 LY2022	ICPA 60 Y2022ICP	AL 40 Y2022ICPA	60 Y2022ICP
Redesign	40	50	90	40	90
collection	2022ICPARJULY2022	ICPARJULY2022	ICPARJULY2022ICP	ARJULY2022ICPA	IUULY2022ICP

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

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 = FRW 46,000

Redesign; Payoff = 90,000(0.30) + 40,000(0.70) = 27,000 + 28,000 = FRW55,000

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

F1.1 Page 18 of 20

	CI <b>Criteria</b> 0221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJUL	Marks
a)		
	Formula for binomial distribution	Y20221CPA) V20221CPA)
	Applying the formula 0221CPARHULY20221CPARHULY20221CPARHULY20221CPARHUL	Y20221CIAI
	Calculation CPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJUL	Y2022IC <b>h</b> Al
	CPMaximum CPARJULY20221CPARJULY202221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJUL	Y20221C3
b) i)	Determination of the mean number of typing errors per 400 pages	Y20221C]AI Y20221C]AI Y20221CPAI
	CIFormula0221CPARJULY20221CPARJULY20221CPARJULY20221CPARJULY20221CPARJUL	Y2022IC <b>h</b> Al
	Calculation CPARJULY 2022 ICPARJULY	Y 2022 IC 2
	cpMaximum   CPARJULY20221CPARJULY2022   CPARJULY20221CPARJULY20221CPARJUL	Y2022IC <b>4</b>
ii)	CIFormula022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJUL	Y2022IC <b>I</b> [A]
	Calculation CPARJULY 2022 ICPARJULY	Y 2022 IC DA
	ci <b>Maximum</b> icparjuly20221cParjuly2022 icparjuly20221cParjuly20221cParjul	Y20221C <b>3</b>
c)	CIFormula <sup>022</sup> ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJULY2022ICPARJUL	Y2022 0.5
	Computation of product of the weights and grades (1 mark each assessment, maximum 3)	Y20221CPA Y20221C <b>3</b> A) Y20221CPA
	Summation of the product of weights and the grades	Y20221CIA
	Summation of weights 022 ICPARJULY 2022 ICPARJULY 2	Y2022IC <b>I</b> Al
	Calculation of weighted mean	0.5
	CI <b>Maximum</b>   CPARJULY2022   CPARJUL	Y20221C 6
d)	Stating three measures of location and three of variability (0.5 to each)	Y2022IC <b>3</b> A
e)	Providing a good solution and the reason	Y20221CPA
	CP <b>Total</b> y20221CPARIULY20221CPARIUI Y20221CPARIULY20221CPARIULY20221CPARIUI	20

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

$$x = r = 4$$
,  $p = 0.3$ ,  $n = 10$ 

a) Using the binomial probability function 
$$f(x) = C_x^n p^x (1-p)^{n-x} = C_r^n p^r (q)^{n-r}$$
  $x = r = 4, \ p = 0.3, \ n = 10$ 
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 11 y 2022 10 PARTILLY 2022

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

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

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

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

## c) Weighted Mean

2022ICPARJULY2022ICPA	Grade (x)	Weight	Product
Final exam	80 y 2022 ICPARJUI	y2022 50 rjuly2022 icpari	4000 PARJULY2022ICPA
First assignment	95 Y2022 ICPARJUI	LY2022 125 RJULY2022 ICPARJ	UL 2375 PARJULY2022ICPA
Second assignment	85	25 RHH V2022 CPAR	2125
2 <b>Total</b> PARJULY2022ICPA 2022ICPARJULY2022ICPA	ARJULY2022ICPARJUI ARJULY2022ICPARJUI	$\sum w = 100$	$\sum wx = 8500$

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

F1.1 Page 20 of 2