

CERTIFIED PUBLIC ACCOUNTANT FOUNDATION LEVEL 1 EXAMINATION <u>F1.1: BUSINESS MATHEMATICS AND</u> <u>QUANTITATIVE METHODS</u> DATE: THURSDAY 29, FEBRUARY 2024 MARKING GUIDE AND MODEL ANSWERS

QUESTION ONE

Buryohe Company Limited (BCL):

Marking Guide

Qn	Description	Marks	Total Marks
a (i)	Maximax Criterion:	CPARE 12	2120 AP 120 FEB PE
02410 10PA	Decision for Maximax criterion	HOLBRUNED!	EBARUACPATICPAT
2026BR	Reason for the decision of Maximax criterion	PARE CRI	2
a (ii)	Minimax Criterion:	212024101	ARUAR BRUAR ARI
UARY 202	Calculation for the regrets under high demand $(0.5*3)$	1.5	OPAGART V2021202
RUPARIA	Calculation for the regrets under Moderate demand $(0.5*3)$	1.5	AIC, UNITUA BRUNIA
2412 120 A	Calculation for the regrets under Low demand (0.5*3)	1.5	ARTE ART BEED 024
EU FEBRUA	Identification of maximum regrets (0.5*3)	1.5	02410 ATOPLAR UAR
REEPBRI	Decision for Minimax criterion	0.5	RY20FEBLEEDARTE
PART201	Reason for the decision of Minimax criterion	0.5	CPALOPDALOPA 78
a (iii)	Hurwitz Criterion:	ALARTDO24	120, RV2 202 EBR EB
ARTOPAR	Computation for the payoff of each product (1*3)	UNPR3	RUAKPARDPARDPARD
02 UICEAR	Decision for Hurwitz criterion	0.5	612401202 8120 PAK
52410PA	Reason for the decision of Hurwitz criterion	0.5	UNERU 202 NE4
b	Expected Monetary Value (EMV):	Y20EBP FE	AREQUARAUTO24120
CPAROPA	Computation for the EMV of each product (1*3)	Merce 3	FEBY20 ARVUARRY
	Decision for Expected Monetary Value	0.5	RUNEBREEEBBRUICE
	Reason for the decision of EMV	0.5	A 4
C24120	Expected Value of Perfect Information (EVPI):	2410,0241	02410UAR DUAR BRUARBA
RUARBRI	Formula	UNRRUMIE	REP ART CPARED
PARFEB	Calculation of expected value under certainty	REPEBRAT	CALC'202 ALC'LAR RU
	Calculation of EVPI	PAR 20 RT	UN CONTRACTOR OF 3
BRUEBR	Total Marks	UM BRUEED	<u>20</u>

Model Answers

- a) Determination of the best product through the following criteria
- i) Maximax criterion

UARY ART CPATCP	Demand Condi	Maximax		
Products	High Demand	Moderate Demand	Low Demand	Maximum
Ineza Juice	40,000,000	70,000,000	20,000,000	70,000,000
Kera Juice	50,000,000	30,000,000	10,000,000	50,000,000
Kabuto Juice	45,000,000	35,000,000	(15,000,000)	45,000,000

The decision under Maximax criterion is to choose Ineza Juice because FRW 70,000,000 is the maximum of the maximum payoffs from the table above.

ii) Minimax criterion

02×120 8 02×10	P. AP. AK. RUIAP. R	Regret 1 a	Die 24 AU UNUMBRO	AP 20 241 AV BR EP VI
UAR BRUARY 2020ER	Demand Condi	AREA BREEDARD PAREED OF		
Products	High Demand	Moderate Demand	Low Demand	Maximum
Ineza Juice	10,000,000	0	0	10,000,000
Kera Juice	C 20 BR C 0	40,000,000	10,000,000	40,000,000
Kabuto Juice	5,000,000	35,000,000	35,000,000	35,000,000

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The decision under Minimax criterion is to choose Kera Juice because FRW 40,000,000 is the maximum of the minimum regrets as shown from the table above.

iii) Hurwitz criterion (Alpha = 0.6)

Formula	Payoff = α^* (Maximum value) + (1 - α) *(Minimum value)				
Ineza Juice	Payoff= 0.6(70,000,000) + [(1-0.6) *20,000,000]	Maximum Payoff			
RUAR UNE BRUAR	Payoff= 42,000,000 + 8,000,000 = FRW 50,000,000	FRW 50,000,000			
Kera Juice	Payoff= $0.6(50,000,000) + [0.4) * 10,000,000]$	ACRUMBED AUCEARCEARCE			
202410Preverence	Payoff= 30,000,000 + 4,000,000 = FRW 34,000,000	10000000000000000000000000000000000000			
X20 REPARE TOPARE	202 A COLOR DO BE STREED BRUCE A COLOR A COLOR DO NE RUNARD	FEBARECPAERUNAU 2020 2120			
Kabuto Juice	Payoff= 0.6(45,000,000) + [0.4) *-15,000,000]				
BRUAY20 REEPAREN	Payoff= 27,000,000 - 6,000,000 = FRW 21,000,000	2024 REEBARE CPAREED AUT			
BR024102410224	UNE UNE QUE NE CONCEPTED AND C				

The decision under Hurwitz criterion is to choose Ineza Juice because FRW 50,000,000 is the maximum payoff as shown from the table above.

PALICE ARY 20 ARY	Demand Conditions (FRW)				
Products	High Demand	Moderate Demand	Low Demand		
Ineza Juice	40,000,000	70,000,000	20,000,000		
Probability	0.40	0.50	0.10		
Kera Juice	50,000,000	30,000,000	10,000,000		
Probability	0.60	0.30	0.10		
Kabuto Juice	45,000,000	35,000,000	(15,000,000)		
Probability	0.50	0.30	0.20		

b) Expected Monetary Value (EMV)

Computation

Formula	EMV =Summation of the product of outcome and probability	Maximum EMV
Ineza Juice	EMV = (40,000,000*0.40) + (70,000,000*0.50) + (20,000,000*0.10)	CO2AICPAICARUARU 21 02AICPAICARUARU 2024EBRUARUARU
PARCE REPERTAN	EMV = 16,000,000 + 35,000,000 + 2,000,000 = FRW 53,000,000	FRW 53,000,00 0
Kera Juice	EMV = (50,000,000*0.60) + (30,000,000*0.30) +(10,000,000*0.10)	NECONTROVAL
UARDY CONBREARED RUBBAREDUCEALORAD	EMV = 30,000,000 + 9,000,000 + 1,000,000 = FRW 40,000,000	20 ARI 200 RUAR CUARUARUAR SE FERRESERVA
Kabuto Juice	EMV = (45,000,000*0.40) + (35,000,000*0.50) +(- 15,000,000*0.10)	21 CPA NRT 120 02 PAO DA BRUAT 22 PAO BRUAT 24 OFT BREAR BRUAT
PARY201220018 PUARY201220018 RUARY201220018 RUARY201220018	EMV = 18,000,000 + 17,500,000 - 1,500,000 = FRW 34,000,000	2 41020-410204 20 812020-410204 812020-688-68

The decision under Expected Monetary Value is to choose Ineza Juice because FRW 53,000,000 is the maximum expected monetary value as shown from the table above.

c) Expected Value of Perfect Information (EVPI)

EVPI = Expected value under certainty - Expected value under riskExpected value under certainty = (50,000,000*0.60) + (70,000,000*0.5) + (20,000,000*0.10) Expected value under certainty = 30,000,000 + 35,000,000 + 2,000,000 = FRW 67,000,000

Expected value under risk is the maximum expected monetary value which is FRW 53,000,000

Expected Value of Perfect Information = FRW 67,000,000 - FRW 53,000,000 = **FRW** 14,000,000

QUESTION TWO

Girinzu Company Limited:

Marking Guide

Qn	Description	Marks	Total Marks
a	Network Diagram:	ARCART CPARERY2	2120 ARY 20 FEBRE
	Each correct activity drawn and labeled (0.5*10)	RY202 HC BRUNRUN	EBIRUA OPALICE 5
bash	Critical path and project duration:	ARY PARTER PARTICIPAL	842 84202 BY202
	Identification of the critical path	2022 22202 28P	BRUFEBRONDPAU
JAP X2	Calculation of the project duration	R BRUAR ARTAL	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
PC PAR	Total Floats for B, C, D, and H Activities:	2FEB140102410202	ALCRUARUA BRUNA
	Formula for total float	RY20AB RUNNER IS	ARTPARTER 2024
	Calculation of total float for activity B	EBREFE EBRUIC 14	02410 HOPUARUAN
	Calculation of total float for activity C	CLER 20 RANK	RY20FEBLEEPARTE
	Calculation of total float for activity D	241 UNBROEBROU	CPATCP 241CT CPATC
	Calculation of total float for activity H	CRAR CLAIMARTOOL	20 82 202 6B2 53
d	Rules for drawing a network diagram:	202 02 VARARUA	RUAL PAR PAROPANOF
	Each correct rule explained (1*4)	ARY OF BARFER ARE	224 202 220 24
e	Advantages of network analysis:	CPA10 2410 PAR	QUAR BRUNDO2 MARTO
202 FE	Each correct advantage explained (1*4)	Y20 ART Y20 EBRORE	ARTEUARAUL 244
CPALO	Total Marks	3h RUN ARUCPA 241	20

Model Answers

a) Network diagram



Earliest Start Time (EST)

Latest Start Time (LST)

Or

Earliest Tail Time (ETT)

Latest Head Time (LHT)

b) Critical path is A - E - F - G - I - JProject Duration is 18 weeks

c) Floats of B, C, D, H

Total Float = Latest Finish Time (LFT) – Earliest Start Time (EST) – Activity Duration Or

Total Float = Latest Head Time (LHT) – Earliest Tail Time (ETT) – Activity Duration.

For Activity B, the duration is 3 weeks, LFT is 9 weeks, EST is 0 weeks Total Float = 9 weeks - 0 weeks - 3 weeks = 6 weeks

For Activity C, the duration is 4 weeks, LFT is 9 weeks, EST is 1 weeks Total Float = 9 weeks - 1 week - 4 weeks = 4 weeks

For Activity D, the duration is 2 weeks, LFT is 7 weeks, EST is 1 weeks Total Float = 7 weeks - 1 week - 2 weeks = 4 weeks

For Activity H, the duration is 3 weeks, LFT is 12 weeks, EST is 5 weeks Total Float = 12 weeks - 5 week - 3 weeks = 4 weeks

d) Rules of drawing a network diagram

- i) Each activity is represented by one and only one arrow. This implies that no single activity can be represented twice in the network.
- ii) Not two activities can be identified by the same end events. This implies that there must be no loops in the network.
- iii) Only one activity may connect any two nodes. This rule is necessary so that an activity can be specified by giving the numbers of its beginning and ending nodes.
- iv) Every node must have at least one activity preceding it and at least one activity following it except for the very beginning and at the very end of the network. The beginning node has no activities before it and the ending node has no activities following it.

- v) Use dummies freely in rough draft but final network should not have any redundant dummies.
- vi) Arrows pointing in opposite direction must be avoided.
- vii) Arrows should be kept straight and not curved or bent. And avoid arrows which cross each other.

e) Advantages of network analysis

- i) Network analysis helps to determine the objective of the project.
- ii) The method enforces planning, because data from many sources must be collected and collated before being logically put together to give the network.
- iii) Areas of responsibility are specifically defined, the relationship between activities is clearly shown and the network reveals the interactions of all participants.
- iv) The technique provides for simple communication and, therefore, easy to apply because the network diagrams and charts are easily understood by non-specialists.
- v) Control is simplified, because network analysis permits the use of management by exception, where by the management need act only when the situation is out of control.
- vi) The technique is equally applicable to large-scale and small-scale operations.
- vii) The system lends itself easily to computers and many computer manufacturers provide standard packages of network analysis routines with their equipment.

Qn	Description	Marks	Total Marks
are	Presentation of probability distribution tables:	SFEB BRUCE	ALCPO2ALCPARY20
	Each value in the table for Quantitative methods (1*6)	6	UAR 120 BROFFBA
	Labeling titles in the table – random variable and probability (1*2)	Cherry 2	8
b	Expected values:	24 OLAR UNR	UAL BRUIAR ARTELAR
	Formula for expected value	2FEBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB	RED241024202
024 20	Calculation of Expected Value	2 2	AR RUABRUA3
ic 22	Variance:	AL PLOEBR	PER PAR PER AICION
	Formula for variance	CPM AIGO	ALCPARY 2UAR BRUP
UART2U UARBRI REEBRI	Calculation of variance	ELERUNE3	4
deau	Standard deviation:	RT20242920	ARY REE PARTOPAR
AUICPAR AUICPAR	Formula for standard deviation	EBARFER P	10P1241020204101 AF
	Calculation of standard deviation	Con all	2
e	Assumptions of binomial probability distribution (1*3)	BRUNEBR	BROCK AND 3
PT PAT	Total Marks	CPAL ALCPER	<u>20</u>

QUESTION THREE

Marking scheme:

Model Answers

a) **Presentation of probability distribution tables for both papers** Ouantitative Methods

Random Variable (x)	Probability P(x)
0 5 20 20 RS 20 BE BE REPERED BE OF NOAL OF NOAL OF REPERENCE	10/50 = 0.20
PBRUEBERUCENELOPACCENELOC SELVELOPACCENEL	12/50 = 0.24
2 c^{p} b^{2} c^{p} b^{2} c^{p} b^{2}	10/50 = 0.20
3. 2016 82 668 EV 26 12 6 10 10 10 10 10 10 10 10 10 10 10 10 10	8/50 = 0.16
$4^{\circ} \mathcal{C}^{\circ} \mathcal{C} \mathcal{C}^{\circ} \mathcal{C}^{\circ} \mathcal{C}^{\circ} \mathcal{C}^{\circ} \mathcal{C}^{\circ} \mathcal{C}^{\circ}$	6/50 = 0.12
5 20 0 AU AS BE TELEVALE REPORT OF A SEED AS TO A SEED AS UNCONSTRUCTION	4/50 = 0.08
OTHER FED PARTOR REPORTED ON A JOINT BETERS AND AND A	220 ALCUNERU REPORTUNOPACE ALCE PARTINE LAR ARE

b) Calculation of expected value

Expected value = $\mu = \Sigma[x^*P(x)]$ Expected Value = (0*0.20) + (1*0.24) + (2*0.20) + (3*0.16) + (4*0.12) + (5*0.08) Expected Value = 0 + 0.24 + 0.40 + 0.48 + 0.48 + 0.40 = 2.00

c) Calculation of variances

Variance = $\Sigma(x - \mu)^2 P(x)$ Variance = $[((0 - 2)^2 0.20) + [((1 - 2)^2 0.24) + [((2 - 2)^2 0.20) + [((3 - 2)^2 0.16) + [((4 - 2)^2 0.12 + [((5 - 2)^2 0.08))]]$ Variance = [(4 * 0.20) + (1 * 0.24) + (0 * 0.20) + (1 * 0.16) + (4 * 0.12 + (9 * 0.08))]Variance = 0.80 + 0.24 + 0 + 0.16 + 0.48 + 0.72 = 2.4

d) Calculation of standard deviation

Standard Deviation = $\sqrt{variance} = \sqrt{\Sigma(x - \mu)2P(x)}$ Standard Deviation for Quantitative Methods = $\sqrt{2.4} = 1.549$

e) Assumptions of binomial probability distribution

- Fixed number of trials, i.e. sample size represented as n.
- Each trial has two possible outcomes, a "success" and a "failure".
- Probability of success indicated as p (and thus: Probability of failure as (1-p), for all trials.
- The trials are independent, which means that the outcome of one trial does not affect the outcomes of any other trials.

QUESTION FOUR

Marking guide

Qn	Description	Marks	Total Marks
a (i)	Time Series Decomposition:	EBBRO241Ct	UIC 0241CPRUAERU
	Definition of time series decomposition	APARYORU	RY20 REP ARTORN
a (ii)	Computation of trend component from times series equation	PARFEBRI	0.5
a	Centred Moving Trend Values:	HCPAUARUA	R BRUNART ARTOPART
(iii)	Computation of 4 Quarterly Moving Averages (0.5*9)	4.5	JFB/024102422002
	Computation of 4 centered moving Averages (0.5*8)	4.0	8.5
b (i)	Branches of statistics:	RY20EEBE	PARTER DO241024
	Identification of each branch (1*2)	10° A10° 2	HICPUNRUARUAU
	Explanation of each branch (1*2)	aune 2	4
b (ii)	Application of statistics:	EBRUICPA	02410 HOPPARUAR
REEBE	Statement of each application (1*3)	POR BUS	RY20 REEARER PARTE
PARY20	Explanation of each application (1*3)	BEELEB3	6
REFE BIN	Total Marks	CPAR 202	<u>20</u>

Model Answers

a) i) Times series decomposition is the separation of the overall series into basic components that are more likely to have recognizable and more predictable patterns. These components can be projected in the future and be combined to form a forecast. Basically, there are four components: trend, cyclic, seasonal and random irregular). Decompositions assume that these components act independently. It is also assumed that what caused them to can in the past will continue to operate in the same way even in the future.

The time series decomposition can be used to separate or decompose a time series into trend, seasonal and irregular components. Decomposition method can be used for forecasting and also to get a better understanding of the time series. Many business and government agencies use time series decomposition to create de - seasonalized time series.

ii) Trend component can be decomposed under multiplicative model by dividing the time series values by the other component.

Trend component = Time series/ (Seasonal variation*cyclic variation*irregular variation)

ARTEBRUAR ARTEBRUAR ARTEBRUAR ARTEBRUAR ARTEBRUAR	Quarter	Coffee Production (thousand tons)	4 Quarterly Moving Totals	4 Quarterly Moving Averages	4 Centred Moving Averages
2021	E UP AL OP AL	97	BRUAR REPERTUNER	OLEEBREERE CEARE	1024U12024U0PA
ALAICI PART	2	125	202410284286668820110 202410284286668820110	AC 202 CP UNEUN	BRUARDAR CRAE
ARTOPATOP	2AU 202 ARY RUAK	2022 RUNBRUMEBRUM	472	118	RUAR RUAR ARDAR
ARY20288	SPR 3 P	137	OPAROPAROPAROPAROPARO	ARY20 ARY20 FEBRER	118.875
RUALARAIOP	0241CPARAFET20241	202 NEV20241 OPAREY20	479	119.75	CPUARUAR UAL
LAR RUARY	0 2410 4 BRUN	RUNE 113 COBR	SEBRUNCPALOPD241C	ARY20ARYRUAR BRUNARYARY	121.125
REERUAR	ART CPART CPART	EBRUAROPAROPAROPATOPAT	490	122.5	024 BRUARUA
2022	SARY OF TOPAC	104	BROFEBRAICPAINCH	ALCOPARY & ARUANA	123.750
RUARRUATER	RUAR 202 AICH RU	BRUNEBBRUAL PARCEA	500	125	202412020241URUA
ART CPAREE	2	136	BRUEBARE BLAUP	4102410 LARY UNA	127.000
04UICIARHER	18-02-1202 AR 20	EBRUEBBRAREELBRUCPAT	516	129	02401020284200PAP
202410Pruh	STORE 3 CONF	147	REVERBRUCKER PARTER	1010241002410 ARI	130.500
Y20 REPART	CARET 202 RY 201	21202 EBBRUEBRUEBRUEBRUEBRUEBRUEBRUEBRUEBRUEBR	528	132	EBR/202 EV202 EV2
2024120240	4	129	2UARARY2 FEBRERE ARE	FED 410,024,200 PMP	131.500
BRUARYEAR	P 24 CPART 202	20 APT 20 EBRUEEBBEE	524	131	RICPAL PART 2024 20
2023	1202 BRUEBRUE	116	RUARI UAR VAREED ARE	CPAE BRUD ATU 024 20 CPEBRUD 2410 024 20	130.750
3RUA BAUA	PAUPAL OPAL	20 ARYUAR RY 20 EBK REE	522	130.5	2FD ARTOPPART20
PARED 024		132	UARY UAR BRUD 02 ARE	PARTCPARTER 2024120	130.000
BRUABRUEB	BEURPAIC PAIC PRAIC	OPAL PLOUAR UNER 200	518	129.5	UAL ARTOPATION
PALOPHART	3	145	202 RARTUAR RUAL BRUCH	PARTY ART OPPARTY O	REPUBRICAR PROPERTY
PARTOPATOP	S BOOM 4 WAR	125	24 CPAL CP 202 202 02 02 02 02 02 02 02 02 02 02 0	20 AR 20 BRUEBL	PERBICIPIANO2

iii) Trend values from 4 centred moving averages

b) i) Branches of statistics

1. Descriptive statistics: This is a branch of statistics which deals with methods of collection of data, its presentation and organization in various forms, such as distribution tables, graphs (e.g., Ogive, Lorenz curves, etc.), diagrams (e.g., pie charts) and finding measures of central tendency and measures of dispersion or spread which are used in the description of data. Managers and CEOs make use of descriptive statistics in presenting their annual reports, financial accounts and bank statements. Descriptive statistics is used to present the data in an understandable way, so that a meaningful description can be made.

2. Inferential or predictive statistics: This is a branch of statistics which deals with techniques used for analysis of data, making estimates that lead to predictions and drawing conclusions or inferences from limited information taken on sample basis and testing the reliability of the estimates or predictions.

Inferential statistics is used to make comparisons or predictions about a larger group, known as population, using information gathered about a small part of that population called a sample.

ii) Applications of statistics Applications

- Statistics plays an important role in administration. Statistical data is widely used in making administrative decisions. Every administrator must have sets of program and policies which are formulated in order to meet the targeted objective plans. These plans depend on the correct and sound statistical data. Therefore, statistics is used as a tool for planning.
- Statistics is vital in economics. Statistics is very vital in developing and proving the laws and principles of economics. Knowledge of statistics is very useful in assessing and understanding the economic terminologies and problems, such as economic growth. Inflation rate, population growth rates, unemployment, supply and demand and National Income, that is, GDP, GNP, income per capita.
- Statistics is essential in business. For the smooth operation of a business, statistical data is very useful. It expresses facts in a definite form and simplifies the complex nature of business. Statistics helps the business people to plan according to market demand, that is, taste of the customers, supply, price, quality of the products, etc., hence making decisions after studying the pattern of events say forecasting sales, expenses, advertising for the products, financial resources, location of the business, to mention but a few.
- Statistics plays a central role in banking. The banks use statistics in various ways. The banks apply the principle that all the people, companies, organizations or institutions who deposit their money do not withdraw it at the same time. They use statistical methods based on probability to estimate the number of depositors, how much can be loaned and withdrawn on a certain day.
- Statistics plays an important role in accounting. Accounting is impossible without exactness. Accountants use statistics to provide information to shareholders and other business stakeholders regarding business liability.
- Statistics is essential in auditing. Auditing uses the sampling techniques to determine whether books of accounts have been prepared and trace sources of errors.
- Statistics is useful in medicine. Medicine deals with treatments that work often but not always, so treatment success entirely depends on probability. Doctors keep clinical records on a daily basis and, hence, refer to them when a related case reoccurs. In case of an epidemic, appropriate statistical comparisons and clarity of exposition are made

QUESTION FIVE

Marking guide:

Qn	Description	Marks	Total Marks
a	Decision making environments:	PAR AND	AR 20 REED REPART
PUARI	Correct statement of the environment (1*3)	BR BE 31	AICPAULO2ANOPAL
REEDA	Correct explanation of environment (1*3)	CP RE 3	20 NB 20 686
b	Advantages of decision trees:	ICI RUARUP	EBRUAL PAR OPAL
20 BEBE	Each correct advantage stated (1*2)	CPARALCEA	2
C	Drawing the decision tree:	212024188	BRUFEBRUNCPAU
UNP 22	Each correct event drawn and labeled (0.5*9)	4.5	CPAR REP. 202 V201 RY
RUALAR	Each correct decision alternative drawn and labeled (0.5*3)	1.5	AIC RUARUA BRUNDA
2410120	Formula	1.0	ELARFE ARE BEEDO24
UM BRI	Computation of each EMV (1*3)	3.0	02410 10Ph APUAP
REEBE	Decision for expected monetary value	1.0	2120FEBLEEBLEEBLEFBL
PARty2	Reason for the decision of expected monetary value	1.0	12
RUABRI	Total Marks	ARAR BOOM	<u>20</u>

Model Answers

a) Decision making environments

1. Decision-Making under Certainty

In this case, the decision-maker knows with certainty the consequences of every alternative or decision choice. The decision-maker presumes that only one state of nature is relevant for his purpose. He identifies this state of nature, takes it for granted and presumes complete knowledge as to its occurrence.

2. Decision-Making Uncertainty

When the decision-maker faces multiple states of nature but he has no means to arrive at probability values to the likelihood of occurrence of these states of nature, the problem is a decision problem under uncertainty. Such situations arise when a new product is introduced in the market or a new plant is set up. In business, there are many problems of this 'nature'. Here, the choice of decision largely depends on the personality of the decision-maker. The following choices are available before the decision-maker in situations of uncertainty.

- (a) Maximax Criterion
- (b) Minimax Criterion
- (c) Maximin Criterion
- (d) Laplace Criterion (Criterion of equally likelihood)
- (e) Hurwitz Alpha Criterion (Criterion of Realism)

3. Decision-Making under Risk

In this situation, the decision-maker has to face several states of nature. But he has some knowledge or experience which will enable him to assign probability to the occurrence of each state of nature. The objective is to optimize the expected profit, or to minimize the opportunity loss.

For decision problems under risk, the most popular methods used are Expected Monetary Value (EMV) criterion, Expected Opportunity Loss (EOL) criterion or Expected Value of Perfect Information (EVPI).

- b) Advantages of decision trees
- i) They are simple to understand and interpret. Decision trees are generally quite intuitive to understand and easy to interpret.
- ii) The layout of events makes alternative courses of action clearer.
- iii) They do not require normalization of data
- iv) They do not require scaling of data as well
- v) Compared to other algorithms, decision trees require less effort for data preparation during pre processing
- c) Decision tree



EMV = (0.5*FRW 40,000,000) + (0.3*FRW 15,000,000) +(0.2*FRW -35,000,000) EMV = FRW 16,000,000 + FRW 4,500,000 - 7,000,000 = **FRW 13,500,000**. **Sub contraction:** EMV = (0.5*FRW 20,000,000) + (0.3*FRW 20,000,000) +(0.2*FRW 1,000,000) EMV = FRW 10,000,000 + FRW 6,000,000 - 200,000 = **FRW 15,800,000**.

Starting overtime production:

EMV = (0.5*FRW 10,000,000) + (0.3*FRW 60,000,000) +(0.2*FRW -2,000,000) EMV = FRW 5,000,000 + FRW 18,000,000 - 400,000 = **FRW 22,600,000**.

Advice

The right decision is to start an **overtime production** because it has the highest expected monetary value of **FRW 22,600,000**

QUESTION SIX

Marking guide:

Qn	Description	Marks	Total Marks
a RUARA	Computation of Break – even units and sales value:	BREEBEBRU	CPATCH 241 OPPAR
	Formula for contribution per unit	PAPAR 2010	20 ART 20 FEBLEB
	Computation of contribution per unit	RUALBRUE	RUNCPAICPAICPAIC
O UNO	Formula for break – even units	ART CRAILES	024 20 R 210 PM
02 ALC	Computation of break – even units	024141CK 18	RUAL BRU 202 RARTER
×20 2FE	Formula for break – even sales value	STOREBK RIE	ARTRUATAUTO24120
(CPAIC)	Computation of break – even sales value	Phatcho21	6
BRUAR	Definition of margin of safety:	20 ARY ALOPI	RUIEBAREEBRUIO
	Correct definition	PLOP ALC	J2410 ACTA BY UAP RI
C.F.	Calculation of margin of safety in units and %:	O'REY NE	20 EBR FEBRAREB
BREED	Formula for margin of safety in units	EBBRULP	10PA1410PA120
PAREL	Calculation of margin of safety in units	Ref 02 h	ART 202 BRUNEBR
RUNK	Formula for margin of safety in %	JAPRUMB	RUARAREDPARATOPA
	Calculation of margin of safety in %	REPARTE	64 02 22 02 4V
d	Calculation of sales units with target profit	2ª NOP RET	UAR BRUIAR BEEDAR
	Formula	PEBROFF,	REFEBRAICP MAIL 202
	Calculation of sales units	CP 2	Province June 3
e 201 201 201 201 201 201 201 201	Calculation of sales units with target profit and changes in costs:	ARY 2024BR	CPARTER CONTRACTOR
	Calculation of increase in direct material cost per unit	ALC OLANDO	2410 UAR RUABARI
	Calculation of increase in direct labour cost per unit	AR RUANT	FEBARE CPAREED
	Calculation of sales units required to achieve the desired profit	2	4 2020 2020 2020 2020 2020 2020 2020 20
fall	Limitations of break – even analysis (1*2)	GBR FEBR	2
P. OP	Total Marks	CPA REDO	20

Model Answers

Break – even in units and break – even in sales a)

Contribution per unit = selling price per unit - variable cost per unit (Variable cost + direct material+ direct labour)

Contribution per unit = FRW 320/unit - FRW (84 + 80 + 36)/unitContribution per unit = FRW320/unit - FRW 200/unit = FRW 120/unit **Fixed overhead** Break - even (in units) = contribution per unit Break – even (in units) = $\frac{4,000 \text{ units } * FRW24 \text{ per unit}}{FRW120 \text{ per unit}} = \frac{FRW 96,000}{FRW120 \text{ per unit}} = 800 \text{ units}$

Break – even in sales value = Break – even units * selling price per unit Break – even in sales value = 800 unit * FRW 320 per unit = FRW 256,000

b) Margin of safety

The margin of safety is defined as the excess of normal or actual sales over sales at break- even point. It may be expressed in terms of sales volume or sales revenue.

Margin of safety is how much output or sales level can fall before a business reaches its breakeven point.

c) Margin of safety in units = Budgeted sales units – Break - even units Margin of safety = 4,400 units - 800 units = 3,600 units

Margin of safety in % = $\frac{\text{Budgeted sales units} - \text{Break} - \text{even units}}{\text{Budgeted sales units}} *100$ Margin of safety in % = $\frac{4,400 - 800}{4,400} *100 = \frac{3,600}{4,400} *100 = 81.82$ % d) Calculation of sales units required to achieve a target profit of FRW 564,000 Sales units = $\frac{\text{Fixed overhead + Target profit}}{\text{Fixed overhead + Target profit}}$ contribution per unit Sales units = $\frac{96,000 + FRW 564,000}{120}$ Sales units = $\frac{FRW 660,000}{120} = FRW 5,500$ units e) Sales units if direct material cost per unit increases by 6% and direct labour cost per unit

increases by 5% and a desired profit is FRW 480,000. Increase in the direct material cost per unit = FRW 84 + (6% * FRW 84) = FRW 89.04/unit Increase in the direct labour cost per unit = FRW 80 + (5% * FRW 80) = FRW 84.00/unit

Sales units = $\frac{FRW 96,000 + FRW 480,000}{(200, (200, 100))} = \frac{FRW 96,000 + FRW 480,000}{FRW 480,000}$ (320 - (89.04 + 84.00 + 36.00) = (320 - (89.04 + 84.00 + 36.00))

Sales units = $\frac{FRW 576,000}{209.04}$ = FRW **2,755 units**

f) Assumptions of break – even analysis

1. Breakeven analysis assumes that the selling price of the product never changes. This is not correct. If a customer placed a very large order, he would expect a quantity discount on the normal selling price.

2. Most businesses sell more than one product, so break-even for the business becomes a lot more complicated to work out.

3. Breakeven assumes that sales and output (the number of products the business makes) are the same -i.e. – the business sells everything that it makes. This is unrealistic. It does not take into account the build-up of stocks.

4. Variable costs do not always stay the same. For example, as output rises, the business may benefit from being able to buy ingredients at lower prices (quantity discount), which would reduce the variable cost per unit.

QUESTION SEVEN The Rights of Employees Agency (REA):

Marking guide:

Qn	Description	Marks	Total Marks
(i)	Presentation of data in a frequency table:	2RUABRODU	CPARCPANOPARE
	Correct tabulation of classes (0.5*6)	ARTRE 31	202 2120024 BRUB
	Correct tabulation of frequencies (0.5*6)	Cher 3	RUARARAREPARTOP
	Correct tabulation of class boundaries (0.5*6)	Second 3	9
(ii)	Drawing the Histogram:	22410 PAR	20 ARBRUAT 202 AREE
	Each correct bar drawn and labeled (1*6)	6	ARTRUAROUCO AND
	Correct naming of the vertical axis	PALANCY 021	FELRIQUARDUAL
	Correct naming of the horizontal axis	PUBRY AND	PUTEBLE REEDBRUICH
	Title of the graph	et 20 AP	ALC 81 20 29
(iii)	Frequency polygon:	024120221	202 RUABRUFEB
	Definition of a frequency polygon	UMBRUNK	REPARMOPARE 20
	Circumstance when a frequency polygon can used in place of a histogram	PARTER ARY	2
	Total Marks	OF BRORE	<u>20</u>

Model Answers

i) Presentation of data using a histogram

Class (FRW"000")	Frequency (F)	Class Boundaries
100 - 199	2 MAIO DA LOP NET ARE RUN RE 20 M RE 20 PM DE C	99.5 - 199.5
200 - 299	16 - 20 - 18 - 18 - 18 - 18 - 18 - 18 - 18 - 1	5 199.5 - 299.5
300 - 399	22	299.5 - 399.5
400 - 499	10 20 NB 20 BB 200 NB 20 00 4 C 2 A 10	399.5 - 499.5
500 - 599	2612 321 CP 12 CP 12 20	499.5 - 599.5
600 - 699	2 NP 20 PT NP 20 5 BP 5 6 2 RE 5 BP 4 0 2	599.5 - 699.5
ETERART PARTERS 024002 RV20201	Under the several of	REAL TRANSFERRENCE AND



iii) Definition of a frequency polygon

A frequency polygon is the graph joining of the mid-points of the tops of the adjoining bars. The mid-points of the first and the last classes are joined to the mid-points of the classes preceding the first and succeeding the last respectively at zero frequency to complete the polygon.

Circumstance where a frequency polygon is used in place of a histogram;

Frequency polygons can always be used in place of histogram, but are particularly useful:

- When there are many classes in the distribution; or
- If two or more frequency distributions need to be compared

END OF MARKING GUIDE AND MODEL ANSWERS