Exercise 2.1

B. practical problems

(1) A Coca-Cola distributor buys the bottles for Rs 6 & sell them for Rs 10 each. Any bottle left over are worthless. His daily sales of cold drinks are never less than 10 and not more than 12. prepare payoff table & Regret ~~value~~ table.

→ Here,

$CP = Rs\,6$, $SP = Rs\,10$, $MP = SP - CP = 10 - 6 = Rs\,4$

When there is no salvage value, we have,

$ML = CP = Rs\,6$

S = no. of Coca-cola drinks supplied

D = no. of Coca-cola drinks sold

$S - D$ = " " " unsold

Here daily sales of cold drinks are never less than 10 & not more than 12.

$S_1 = 10$, $S_2 = 11$, $S_3 = 12$

$D_1 = 10$, $D_2 = 11$, $D_3 = 12$.

Payoff value = MP × no. of cold drinks supplied if $S < D$

$= 4S$

Payoff value = MP × no of cold drinks sold − ML × no of cold drinks unsold if $(S > D)$

$= 4D - 6(S - D)$

$= 10D - 6S$, if $S > D$

Pay off table

S \ D	$D_1 = 10$	$D_2 = 11$	$D_3 = 12$
$S_1 = 10$	$P_{11} = 40$	$P_{12} = 40$	$P_{13} = 40$
$S_2 = 11$	$P_{21} = 34$	$P_{22} = 44$	$P_{23} = 44$
$S_3 = 12$	$P_{31} = 28$	$P_{32} = 38$	$P_{33} = 48$

Regret table

S \ D	$D_1 = 10$	$D_2 = 11$	$D_3 = 12$
$S_1 = 10$	0	4	8
$S_2 = 11$	6	0	4
$S_3 = 12$	12	6	0

P_{11} = Pay off value when $S_1 = 10$, $D_1 = 10$, if $S \leq D$, $= 4S_1 = 4 \times 10 = 40$

P_{12} = Pay off value when $S_1 = 10$, $D_2 = 11$ if $S < D$, $4S_1 = 4 \times 10 = 40$

P_{13} = Pay off value when, $S_1 = 10$, $D_3 = 12$, if $S < D$, $4S_1 = 4 \times 10 = 40$

P_{21} = pay off value when $S_2 = 11$, $D_1 = 10$ if $S > D$,

$= 10D_1 - 6S_2 = 10 \times 10 - 6 \times 11$

$= 34$

P_{22} = Pay off value when, $S_2 = 11$, $D_2 = 11$, if $S \leq D$

$= 4 \times S_2 = 4 \times 11 = 44$

P_{23} = Pay off value when, $S_2 = 11$, $D_3 = 12$, if $S \leq D$

$= 4 \times S_2 = 4 \times 11 = 44$

P_{31} = pay off value when $S_3 = 12$, $D_1 = 10$ if $S > D$

$= 10D_1 - 6S_3 = 10 \times 10 - 6 \times 12 = 28$

P_{32} = Pay off value when $S_3 = 12$, $D_2 = 11$ if $S > D$

$= 10D_2 - 6S_3 = 10 \times 11 - 6 \times 12$

$= 38$

P_{33} = pay off value when $S_3 = 12$, $D_3 = 12$ if $S \leq D$.

$= 4S_3$

$= 4 \times 12$

$= 48$

② A beer distributor buys kegs for Rs 8 each & sells them for Rs 12 each. All the kegs left at the end of the days are worthless. The sales of kegs in the past have not been less than 20 & not more than 22. Prepare payoff tables & Regret (loss) table.

⇒ Here,

$CP = Rs\,8,\ SP = Rs.\,12,\ MP = SP - CP = 12 - 8 = 4$

where, there is no salvage value, we have.

$$ML = CP = Rs\,8$$

S = no. of kegs of beer supplied

D = no. of kegs of beer sold, then

S − D = no of kegs of beer unsold.

The sales of the past have not been less than 20 & not more than 22.

$S_1 = 20,\ S_2 = 21,\ S_3 = 22$

$D_1 = 20,\ D_2 = 21,\ D_3 = 22$

Payoff value = MP × no. of kegs of beer supplied, if $S \le D$

$= 4 \times S$

Payoff = MP × no. of kegs of beer sold − ML × no of kegs of beer unsold, if $S > D$

$= 4D - 8(S - D)$

$= 4D - 8S + 8D$

$= 12D - 8S$ if $S > D$.

Payoff table

S \ D	$D_1=20$	$D_2=21$	$D_3=22$
$S_1=20$	80	80	80
$S_2=21$	72	84	84
$S_3=22$	64	76	88

Regret (loss) table

S \ D	$D_1=20$	$D_2=21$	$D_3=22$
$S_1=20$	0	4	8
$S_2=21$	8	0	4
$S_3=22$	16	8	0

(3) A distribution of past daily sales of a commodity is as follows:

Daily sales (units) : 1000 1200 1400

If sales price per unit is Rs 40 & cost price per unit is Rs 25 & salvage price is Rs 5, construct payoff table & regret (loss) table.

⇒ Here,

$CP = Rs\ 25,\ SP = Rs\ 40 \quad MP = SP - CP = 40 - 25 = 15$

There is salvage value Rs 5

then,

$ML = CP - \text{salvage} = 25 - 5 = Rs\ 20$

Here,

S = no. of units supplied

D = no. of unit sold

$S-D$ = no. of unit unsold

where,

$S_1 = 1000,\ S_2 = 1200,\ S_3 = 1400$

$D_1 = 1000,\ D_2 = 1200,\ D_3 = 1400$

Pay off value = MP × no. of unit supply If $S \le D$
$= 15 \times S$

Pay off value = MP × no of unit sold − ML × no. of unit unsold if $S > D$

$= \cancel{MP \times S - M}$
$= 15 \times D - 20 \times (S - D)$
$= 15D - 20S + 20D$
$= 35D - 20S$

Pay off table

S \ D	$D_1 = 1000$	$D_2 = 1200$	$D_3 = 1400$
$S_1 = 1000$	15000	15000	15000
$S_2 = 1200$	11000	18000	18000
$S_3 = 1400$	7000	14000	21000

Regret (loss) table.

S \ D	$D_1 = 1000$	$D_2 = 1200$	$D_3 = 1400$
$S_1 = 1000$	0	3000	6000
$S_2 = 1200$	4000	0	3000
$S_3 = 1400$	8000	4000	0

(1) The following matrix gives the payoff (in Rs lakh) of different strategies S_1, S_2 and S_3 against different condition N_1, N_2, N_3 N_4

Strategy (supply) \ State of nature (demand)	High demand (N_1)	Moderate demand (N_2)	Low demand (N_3)	Failure (N_4)
Expand (A_1)	6500	3000	-2000	-5000
Build (A_2)	9000	5000	-3000	-10000
Subcontract (A_3)	3000	1500	-1000	-2000

Indicate the decision taken under the following approaches:-

(i) Optimistic criterion.

Payoff table.

D \ S	D_1	D_2	D_3	D_4	maximum payoff of each Row	Minimum payoff of each Row
S_1	6500	3000	-2000	-5000	6500	-5000
S_2	9000	5000	-3000	-10000	9000	-10000
S_3	3000	1500	-1000	-2000	3000	-2000

~~Decision~~ Decision maker would select S_2 (build) which gives maximum payoff value Rs 9000 among all the selected maximum-payoff value 6500, 9000, 3000

(ii) maximin

Decision make would select S_3 (subcontract) which gives maximum payoff value Rs -2000 among all the selected minimum payoff value -5000, -10000, -2000

(iii) minimax regret

S\D	D_1	D_2	D_3	D_4	maximum regret value at each row	expected payoff
S_1	2500	2000	1000	3000	3000	
S_2	0	0	2000	8000	8000	
S_3	6000	3500	0	0	6000	

Decision maker would select S_1 (expand) which give minimum regret value RS 3000 among all the maximum regret val RS 3000, 8000, 6000

(iv) Laplace criterion

S\D	D_1	D_2	D_3	D_4	Expected profit	α × maximum payoff	(1−α) × minimum payoff
S_1	6500	3000	−2000	−5000	1250	5200	−1000
S_2	9000	5000	−3000	−10000	250	7200	−600
S_3	3000	1500	−1000	−2000	375	24000	−400

Decision maker would select the (S_1) Expand which give maximum profit RS 1250 among all RS 1250, RS 250, RS 375

(v) use ~~α = 0.80~~ Hurwitz criterion, if the coefficient of optimism is 0.

H for S_1 = 5200 − 1000 = 4200

H for S_2 = 7200 − 600 = 6600

H for S_3 = 2400 − 400 = 2000

Decision maker would select Build (S_2) which give maximum H RS 6600

(5) The market manager has to decide one of the type of shampoo to be launched under the following estimated payoffs (in Rs.) for various levels of sales.

Expected profit	Types of shampoo	Estimated levels of sale			maximum payoff of each row	minimum payoff of each row
		15000	10000	5000		
$\frac{20+10+10}{3}=16.67$	Egg shampoo	30	10	10	30	10
$\frac{40+15+5}{3}=20$	Clinic shampoo	40	15	5	40	5
$\frac{55+20+3}{3}=26$	Deluxe shampoo	55	20	3	55	3

(i) maximax

⇒ The decision maker would select Deluxe shampoo which gives maximum payoff value RS 55 among all the selected maximum payoff value RS 30, 40, 55.

(ii) maximin

⇒ The decision maker would select Egg shampoo which gives maximum payoff value RS 10 among all the selected minimum payoff value RS 10, 5, 3

(iii) Minimax regret

⇒ Regret value

Types of shampoo	Estimated levels of sale			maximum regret value of each row
	15000	10000	5000	
Egg shampoo	~~30~~ 25	~~10~~ 10	~~10~~ 0	~~25~~
Clinic shampoo	~~40~~ 15	~~15~~ 5	~~5~~ 5	15
Deluxe shampoo	~~55~~ 0	~~20~~ 0	~~3~~ 7	7

Here, Decision maker would select Delux Shampoo which give minimum regret value Rs = 7 among all the maximum regret value Rs 25, 15, 7.

(iv) Equal likelihood (Laplace criterion)

→ Decision maker would select the ~~decision~~ Deulax Shampoo which gives maximum profit Rs 26 among all Rs 16.67, 20, 2

(v) Criterion of realism if coefficient of optimum is 0.60

$\alpha = 0.60$

$H = \alpha \times$ maximum pay off in row $+ (1-\alpha) \times$ minimum pay off

$= 0.60 \times$

(6) Julie has the table below as a historical representation of profits given certain sales and buying level combinations.

Weekly sales of natural yogurt	Action: Buy 200	Buy 300	Buy 400	maximum payoff of each row	minimum payoff of each row
200	\$50	\$25	\$0	\$50	\$0
300	\$50	\$75	\$50	\$75	\$50
400	\$50	\$75	\$100	\$100	\$50

(a) Using the maximax decision criterion what advice can you give Julie about quantities of yogurt to buy for next week

→ Decision maker would select the yogurt to buy weekly sales 400 where maximum payoff value of ~~\$100~~ is \$100 among all the ~~payoff~~ of maximum payoff value is \$50, \$75, \$100.
∴ Rs 400 yogurt to buy for next week.

(7) Payoff table. where $\alpha = 0.60$

Action \ Event	A	B	C	D	maximum payoff of each row	minimum payoff of each row	Expected profit	$\alpha \times$ maximum payoff of each row	$1-\alpha \times$ maximum payoff each row
S_1	8	0	-10	6	8	-10	1	4.8	-4
S_2	-4	22	18	-2	18	-4	6	10.8	1.6
S_3	14	9	9	8	14	8	10	8.4	3.2

(i) Maximax

→ Decision maker would select S_2 which give maximum payoff value Rs 18 among all the maximum payoff value Rs 8, Rs 18, Rs 14

(ii) maximin

→ Decision maker would select S_3 which give maximum payoff value RS 8 among all the minimum payoff value RS -10, RS -8, RS 8

(iii) Minimax regret

S\D	A	B	C	D	maximum regret value of each row
S_1	5	12	28	2	28
S_2	18	0	0	10	18
S_3	0	3	9	0	9

Decision maker would select S_3 which give minimum regret value RS 7 among all the maximum regret values RS 9, 18, 28

(iv) Laplace criterion

⇒ Decision maker would select the S_2 which gives maximum profit RS 10 among all RS 1, RS 6, RS 10.

(v) Hurwitz criterion if the coefficient of pessimism is 0.60

H =

H for S_1 = 4.8 − 4 = 0.8

H for S_2 = 10.8 − 1.6 = 9.2

H for S_3 = 8.4 − 3.2 = 5.2

Decision maker would select S_2 which give maximum H RS 9.2

(8) Here, CP = Rs 5, SP = Rs 10, MP = SP − CP = 10 − 5 = 5

If the unsold paper don't have any value
ML = CP = Rs 5

S = no. of paper supplied
D = no. of paper sold
S − D = no. of paper unsold

Here,
The vendor knows that he cannot sell more than 20 paper in a day and the minimum sale would not be less than 18.
~~How many paper should he buy~~ based on.

$S_1 = 18, S_2 = 19, S_3 = 20$
$D_1 = 18, D_2 = 19, S_3 = 20$

Payoff value = MP × no of paper supply if S ≤ D
= 5 × S

Payoff value = MP × no. of paper sold − ML × no. of paper unsold
if S > D = 5 × D − 5(S − D)
= 5D − 5S + 5D
= 10D − 5S

Payoff table

S\D	$D_1 = 18$	$D_2 = 19$	$D_3 = 20$	maximum	mini
$S_1 = 18$	90	90	90	90	90
$S_2 = 19$	85	95	95	95	85
$S_3 = 20$	80	90	100	100	80

Loss (regret) table

maximum loss value	S\D	$D_1 = 18$	$D_2 = 19$	$D_3 = 20$
10	$S_1 = 18$	0	5	10
5	$S_2 = 19$	5	0	5
10	$S_3 = 20$	10	5	0

(i) maximum criterion

→ Here, Decision maker would select Decision alternative $S_3 = 20$ which give maximum payoff RS 100 among all the selected maximum payoff value is RS 90, 95, 100.

(ii) maximin criterion

→ Here, Decision maker would select Decision alternative $S_1 = 18$ which gives maximum payoff RS 90 among all the selected ~~max~~ minimum payoff value is RS 90, ~~85~~, 80

(iii) minimax regret criterion

→ Here, Decision maker would select Decision alternative ~~A~~ $S_2 = 19$ which give ~~maximum~~ minimum loss value of RS. 5 among all the selected maximum loss value. RS 10, RS 5, RS 10

② Expected opportunity loss (EOL) criterion.

→ Under condition of expected opportunity loss criterion the following steps are used to select decision alternative.

(i) Construct regret table
(ii) Assign the probability of each state of nature.
(iii) Find Expected loss of each decision alternative by using following formula.

EL = Regret value X probability

(iv) find the sum of Expected loss which gives expected opportunity loss (EOL) of each decision alternative

EOL = ΣRegret value X probability

(v) Select that decision alternative which gives minimum EOL

Exercise-2

(B) (I)

	Hot snack stall	Ice cream stall
cool summer	RS 5000	" 1000
hot summer	RS 1000	" 6500

- Probability of Hot snack stall = 0.6 cool summer
- probability of Ice cream stall = 0.4 hot summer

EMV of hot snack stall = Σ payoff X probability
= (5000 X 0.6 + 1000 X 0.40)
= RS 3400

EMV of Ice creame stall = $\sum$ payoff × probability

$= (4000 \times 0.6 + 0.6) + 6500 \times 0.4$

$=$ RS. 3200

Since EMV for hot snack stall > EMV for Ice cream stall. we should run hot snack stall less ice creame stall.

(3)

	A	B	Pay off of trade A	B
successful	0.70	0.40	Rs 30000	RS 50000
Not successful	0.30	0.60	Rs -20000	RS -20000

EMV of A $= \{3000 \times 0.70 - 20000 \times 0.3\} = 18000$

EMV of B $= \sum 50000 \times 0.4 - 20000 \times 0.6 = 8000$

Since EMV of A > EMV for B trade should adapt A.

(2) Here,

	will stock of commodity (x)	will stock of commodity (y)	Payoff table X	Y
success	0.80	0.60	200	400
Failure	0.20	0.40	-500	-300

EMV $= \sum$ payoff × probability

(i) EMV of stock of commodity (X) $= (200 \times 0.80 - 500 \times 0.20) = 60$

EMV of stock of commodity (Y) $= (400 \times 0.80 - 300 \times 0.20) = 260$

(ii) Here, EMV of stock of commodity (X) < EMV of stock commodity (Y)

~~So, stock commod~~

Business ment should stock commodity Y.

2A

(4) Here,

states of nature

Event	Action 1	Action 2	Action 3	Probability
A	4	−2	7	0.25
B	0	6	3	0.25
C	−5	9	2	0.25
D	3	1	4	0.25

Now,

EMV for action 1 = $\sum$ Payoff × probability

$= 4 \times 0.25 + 0 \times 0.25 - 5 \times 0.25 + 3 \times 0.25$

$= 0.5$

EMV for action 2 = $\sum$ payoff × probability

$= -2 \times 0.25 + 6 \times 0.25 + 9 \times 0.25 + 1 \times 0.25$

$= 3.5$

EMV for action 3 = $\sum$ payoff × probability

$= 7 \times 0.25 + 3 \times 0.25 + 2 \times 0.25 + 4 \times 0.25$

$= 4$

∴ Since, EMV for action 3 > EMV for action 2 > EMV for action 1

∴ we should take action 3.

(1). Let,

$CP = Rs\,3,\ SP = Rs\,8,\ MP = SP - CP = 8 - 3 = Rs\,5$

there is no salvage value, so

$ML = CP = Rs\,3$.

A vendor sell cakes not less than 4 cakes, 4 & not more than 8 every

$S_1 = 4,\ S_2 = 5,\ S_3 = 6,\ S_4 = 7,\ S_5 = 8$

$D_1 = 4,\ D_2 = 5,\ D_3 = 6,\ D_4 = 7,\ D_5 = 8$.

now

Payoff = cakes, S = no. of cake supplied

D = no. of cake sold

S − D = no. of cake unsold

Pay off value = MP × no. of cake supply if $S \le D$

$= 5 \times S$

Pay off value = MP × no. of cake sold − ML × no. of cake unsold

$= 5D - 3(S - D)$

$= 5D - 3S + 3D$

$= 8D - 3S$

Pay off table

Stock S \ D	$D_1=4$	$D_2=5$	$D_3=6$	$D_4=7$	$D_5=8$	probability
$S_1=4$	20	20	20	20	20	0.10
$S_2=5$	17	25	25	25	25	0.20
$S_3=6$	14	22	30	30	30	0.40
$S_4=7$	11	19	27	35	35	0.20
$S_5=8$	8	16	24	32	40	0.10
prob	0.10	0.20	0.40	0.20	0.10	

Use EMV for Decision making

EMV for stock 4 = 20 × 0.10 + 20 × 0.20 + 25 × 0.40 + 20 × 0.20 + 28 × 0.10
= 24

~~EMV for stock 5 = 18 × 0.10 + 25 × 0.20 + 22 × 0.40 + 19 × 0.20 + 10 × 0.10~~
= 27 × 0.10 + 25 × 0.20 + 28 × 0.40 + 25 × 0.20 + 20 × 0.10
= 24.5

EMV for stock 6 = ~~20 × 0.10 + 28 × 0.20 + 30 × 0.40 + 27 × 0.20 + 24 × 0.10~~
= 19 × 0.10 + 22 × 0.20 + 30 × 0.40 + 30 × 0.20 + 30 × 0.10
= 27.4

EMV for stock 7 = ~~20 × 0.10 + 25 × 0.20 + 30 × 0.40 + 35 × 0.20 + 32 × 0.10~~
= 21 × 0.10 + 19 × 0.20 + 27 × 0.40 + 35 × 0.20 + 31 × 0.10
= 26.2

EMV for stock 8 = ~~20 × 0.10 + 25 × 0.20~~ + 30 × 0.40 + ~~35~~ × 0.20 + ~~40~~ × 0.10

= 8 × 0.10 + 16 × 0.20 + 24 × 0.40 + 32 × 0.20 + 40 × 0.10
= 24

7) ii

(i) ~~cakes should~~ He should ~~stock~~ stock 6 cakes each day

(ii) Maximum expected profit ~~24.5~~ 27.4

~~135~~
11 - 180
12 - 2~~17~~5
13 - 245
14 → 260

Q) $SP = ₹50$, $CP = ₹30$, $MP = SP - CP = 50 - 30 = ₹20$.
No salvage value, $ML = CP = ₹30$

Payoff = MP × no. of copies supply if $S \le D = 20S$
Payoff = MP × no. of copies sold − ML × no. of copies unsold
$= 20D - 30(S-D) = 50D - 30S$.

S \ D	$D_1 = 10$	$D_2 = 11$	$D_3 = 12$	$D_4 = 13$	$D_5 = 14$	Probability
$S_1 = 10$	300	300	300	300	300	0.10
$S_2 = 11$	170	220	220	220	220	0.15
$S_3 = 12$	140	190	240	240	240	0.20
$S_4 = 13$	110	160	210	260	260	0.25
$S_5 = 14$	80	130	180	230	280	0.30
Probability	0.10	0.15	0.20	0.25	0.30	

EMV = Σ payoff × prob.

EMV for $S_1 = 10$ =

(7) Let, $CP = RS\ 6$, $SP = 10$, $MP = SP - CP = 10 - 6 = 4$

there, No salvage value,

$ML = CP = RS\ 6$

Now,

S = no. of quantity buy/brought

D = no. of quantity sold

$S - D$ = no of quantity unsold

Payoff = mp × no. of quantity supplied/bought if $S \leq D$

$= 4 \times S$

Payoff = mp × no. of quantity sold − ML × no of quantity unsold

$= 4D - 6(S - D)$ if $S > D$

$= 4D - 6S + 6D$

$= 10D - 6S$

Payoff table

Decision information \ State of nature	$D_1 = 20$	$D_2 = 25$	$D_3 = 40$	$D_4 = 60$
$S_1 = 20$	80	80	80	80
$S_2 = 25$	50	100	100	100
$S_3 = 40$	−40	10	160	160
$S_4 = 60$	−160	−110	40	240
Probability	0.10	0.30	0.50	0.10

EMV for $S_1 = 20$ = Σ payoff x probability
= $80 \times 0.10 + 80 \times 0.30 + 80 \times 0.50 + 80 \times 0.10$
= Rs 80

EMV for $S_2 = 25$ = $50 \times 0.10 + 100 \times 0.30 + 100 \times 0.5 + 100 \times 0.10$
= Rs 95

EMV for $S_3 = 40$ = $-40 \times 0.10 + 10 \times 0.30 + 160 \times 0.50 + 160 \times 0.10$
= Rs 95

EMV for $S_4 = 60$ = $-160 \times 0.10 + 110 \times 0.30 + 40 \times 0.5 + 240 \times 0.1$
= Rs -5

Since,
(i) EMV ($S_2 = 25$) and ($S_3 = 40$) have same maximum value, the optimum quantity bought is either 25 unit or 40 unit

(ii) EPPI = Σ diagonal payoff x probability

= ($80 \times 0.10 + 100 \times 0.3 + 160 \times 0.5 + 240 \times 0.10$)
= Rs 142

(iii) Maximum EMV under uncertainty = Rs 95

EVPI = EPPI − Maximum EMV under uncertainty
= 142 − 95
= Rs 47

Solution of Boys - Costerfields.

(8) $CP = Rs4, SP = Rs5$, $MP = SP - CP = 5 - 4 = Rs1$
No salvage value,
$ML = CP = Rs4$

~~Payoff~~ S = no of magazine supplie
D = no of magazine sold
S-D = no. of magazine unsold

Payoff = MP × no. of magazine supply
= 1 × S
Payoff = mp × no. of magazine sold − ML × no of magazine unsold
= D − 4S + 4D
= 5D − 4S.

Payoff table

S \ D	$D_1=1$	$D_2=2$	$D_3=3$	$D_4=4$
$S_1=1$	1	1	1	1
$S_2=2$	−3	2	2	2
$S_3=3$	−7	−2	3	3
$S_4=4$	−11	−6	−1	4
Prob.	0.40	0.30	0.20	0.10

(2) EMV for $(S_1=1) = 1×0.40 + 1×0.30 + 1×0.20 + 1×0.10$
$= 1$

EMV for $(S_2=2) = -3×0.40 + 2×0.30 + 2×0.20 + 0.10×2$
$= 0$

EMV for $[S_3=2] = -7×0.40 - 2×0.30 + 3×0.20 + 3×0.10$
$= -2.5$

EMV for $(S_4=4)$ = $\cancel{0}$ -11×0.40 $\cancel{6}\times0.30$ $\cancel{=}$ $1\times0.20+4\times0.40$
= 6

(a) $\therefore$ EMV for S_1 => have maximum value, The optimal number of the newspaper ~~stocked~~ is 1 demand stock

(b) Expected profit with perfect Information (EPPI) = Σ Payoff under perfect $\times$ prob
$= 1\times0.40+2\times0.30+3\times0.20+4\times0.10$
= Rs 2

(c) maximum EMV under uncertainty = Rs 1

Expected value with perfect information (EVPI) = EPPI − max EMV under uncertainty.
= Rs 2 − Rs 1
= Rs 1

(10) CP Rs = 25, SP = Rs 40, MP = SP − CP = 40 − 25 = ₹15
Scheme salvage price = Rs 5
ML = CP − salvage
= 25 − 5
= Rs 20

S = no of unit supply
D = no of unit sold
S − D = no of unit unsold

Payoff = MP × no. of unit supply − If S < D
= 15S
D ≥ S
Payoff = MP × no of unit sold − ML × no of unit unsold
= 15D − 20 (S − D)
= 35D − 20S

Pay off table

S \ D	D_1 = 1000	D_2 = 1200	D_3 = 1400	D_4 = 1600	D_5 = 1800
S_1 = 1000	15000	15000	15000	15000	15000
S_2 = 1200	11000	18000	18000	18000	18000
S_3 = 1400	7000	14000	21000	21000	21000
S_4 = 1600	3000	10000	17000	24000	24000
S_5 = 1800	−1000	6000	13000	20000	27000
Prob	0.05	0.15	0.35	0.30	0.15

EMV for S_1 = 1000 = 15000 × 0.05 + 15000 × 0.15 + 15000 × 0.35 + 15000 × 0.30 + 15000 ...
= Rs 15000

EMV for ($S_2 = 1200$) $= 11000 \times 0.05 + 18000 \times 0.15 + 18000 \times 0.35 + 18000 \times 0.30 + 18000 \times 0.15$
$= ₹17650$

EMV for ($S_3 = 1400$) $= 7000 \times 0.05 + 18000 \times 0.15 + 21000 \times 0.35 + 21000 \times 0.30 + 21000 \times 0.15$
= Rs 19,250

EMV for ($S_4 = 1500$) $= 3000 \times 0.05 + 10000 \times 0.15 + 17000 \times 0.35 + 24000 \times 0.30 + 24000 \times 0.15$
$= ₹18,400$

EMV for ($S_5 = 1600$) $= -1000 \times 0.05 + 6000 \times 0.15 + 18000 \times 0.35 + 20000 \times 0.30 + 27000 \times 0.15$
= Rs 15450

(i) EMV for $S_3 = 1400$ have maximum value, the optimum quantity is 1400

(ii) The maximum expected profit is Rs 19250

(iii) EPPI = Σ Diagonal payoff $\times$ probability
$= 15000 \times 0.05 + 18000 \times 0.15 + 21000 \times 0.35 + 24000 \times 0.30 + 27000 \times 0.15$
= Rs 22,050

EVPI = EPPI $-$ Maximum EMV under uncertainty
$= 22,050 - 19250$
= Rs 2,800

(11) let, CP = Rs 50, SP = Rs 80 MP = SP − CP = 80 − 50 = Rs 30
Salvage value = Rs 20
ML = CP − salvage = 50 − 20 = Rs 30

S = no of icecream supply
D = no of icecream sold
S − D = no of icecream unsold

payoff = MP × no. of icecream supply
= 30S
payoff = MP × no of icecream sold − ML × no of icecream unsold
= 30D − 30S + 30D
= 60D − 30S

Payoff value

S \ D	$D_1 = 15$	$D_2 = 16$	$D_3 = 17$	$D_4 = 18$
$S_1 = 15$	450	450	450	450
$S_2 = 16$	420	480	480	480
$S_3 = 17$	390	450	510	510
$S_4 = 18$	360	420	480	540
prob	0.10	0.20	0.40	0.30

EMV for ($S_1 = 15$) = 450×0.10 + 450×0.20 + 0.40×450 + 450×0.30
= 450

EMV for ($S_2 = 16$) = 420×0.10 + 480×0.20 + 480×0.40 + 480×0.30
= 474

EMV for ($S_3 = 17$) = 390×0.10 + 450×0.20 + 510×0.40 + 510×0.30
= ~~$\cancel{}$~~ 486

EMV for $(S_4=20) = 360 \times 0.20 + 420 \times 0.20 + 480 \times 0.40 + 540 \times 0.30$
$= 474$

(a) EMV for $S_3 = 17$ have maximum value. At quantity of 17 icecream each day bought to maximize expected profit

(b) maximum EMV under uncertainty = Rs 486

EPPI = Σ Diagonal payoff $\times$ probability
$= 450 \times 0.10 + 480 \times 0.20 + 510 \times 0.40 + 540 \times 0.30$
$=$ Rs 507

(c) Cost of uncertainty (EVPI) = EPPI − maximum EMV under uncertainty
$= 507 - 486$
$=$ Rs 21

(12) CP = Rs 12, SP = Rs 18, MP = 18 − 12 = Rs 6, Salvage value = Bargain − cost of holding
$= 9 - 1 =$ Rs 8
ML = CP − Salvage = 12 − 8 = 4
Payoff = MP × no. of units supply if $S \le D$; = 6S
Payoff = MP × no. of unit sold − ML × no. of unit unsold if $S > D$; = 10D − 4S

Pay off table.

S \ D	$D_1=7$	$D_2=8$	$D_3=9$	$D_4=10$	$D_5=11$
$S_1=7$	42	42	42	42	42
$S_2=8$	38	48	48	48	48
$S_3=9$	34	44	54	54	54
$S_4=10$	30	40	50	60	60
$S_5=11$	26	36	46	56	66
Prob	0.20	0.20	0.25	0.20	0.15

Emv for $(S_1=7) = 42\times0.20 + 42\times0.20 + 42\times0.25 + 42\times0.20 + 42\times0.15$
$= 42$
Emv for $(S_2=8) = 38\times0.20 + 48\times0.20 + 48\times0.25 + 48\times0.20 + 48\times0.15$
$= 46$
Emv for $(S_3=9) = 34\times0.20 + 44\times0.20 + 54\times0.25 + 54\times0.20 + 54\times0.15$
$= 48$
Emv for $(S_4=10) = 30\times0.20 + 40\times0.20 + 50\times0.25 + 60\times0.20 + 60\times0.15$
$= 46.4$
Emv for $(S_5=11) = 26\times0.20 + 36\times0.20 + 46\times0.25 + 56\times0.20 + 66\times0.15$
$= 45$

Emv for $S_3=9$ have maximum (optimum value. So the optimum stock level is 9.

EPPI = Σ Diagonal payoff $\times$ probability

$= 42\times0.20 + 48\times0.20 + 54\times0.25 + 60\times0.20 + 66\times0.15$
$= 53.4$

maximum EMV under uncertainty = 48

Expected value for perfect information (EVPI) = EPPI − maximum Emv under uncertainty
$= 53.4 - 48$
$= 5.4$ #

13 →

Event \ Acts	A_1	A_2	A_3	Prob
E_1	25000	-7000	-18000	0.3
E_2	30000	50000	-8000	0.5
E_3	40000	25000	60000	0.2

Actions = Decision Alternative
Events = state of nature.

(i) EMV for A_1 = 25000×0.3 + 30000×0.5 + 40000×0.2
= Rs 30,500

EMV for A_2 = ~~30000×0.~~ (-7000)×0.3 + 50000×0.5 + 25000×0.2
= Rs 27900

EMV for A_3 = (-18000)×0.3 − 8000×0.5 + 60000×0.2
= Rs 2600

(ii) EPPI = 25000×0.3 + 50000×0.5 + 60000×0.2 = Rs 44500
maximum EMV under certainty = Rs 30,500
EVPI = EPPI − maximum EMV under certainty
= Rs 44500 − 30500
= Rs 14000

(iii) It is advisable to conduct the survey to get net gain of Rs 12000

(14) SP = Rs 75, CP = Rs 40   MP = 75 − 40 = 35
ML = CP = Rs 40

Payoff = 35S, if S ≤ D
payoff = 75D − 40S if S > D

Payoff table

S \ D	D_1=3000	D_2=5000	D_3=8000	D_4=12000	D_5=18000
S_1=3000	105000	105000	105000	105000	105000
S_2=5000	25000	175000	175000	175000	175000
S_3=8000	-95000	55000	280000	2,80,000	2,80,000
S_4=12000	-255000	-1,05000	1,20,000	420,000	4,20,000
S_5=18000	-495000	-345000	-1,20,000	1,80,000	6,30,000
probability	0.05	0.20	0.20	0.40	0.15

Therefore,
cost of uncertainty = Rs 1,37,500
Company should buy the forecasting model to get net Rs 62,500

(15) Payoff table

State of nature	Acts			prob
	X	Y	Z	
A	-120	-80	100	0.30
B	200	400	-300	0.50
C	260	-260	600	0.20

~~Expected~~ Expected monetory value (EMV) for X = $-120 \times 0.30 + 200 \times 0.50 + 260 \times 0.20$
$= ₦116$

EMV for Y = $-80 \times 0.30 + 400 \times 0.50 - 260 \times 0.20$
$= ₦124$

EMV for Z = $100 \times 0.30 - 300 \times 0.50 + 600 \times 0.20$
$= ₦0$

Regret tabel.

State of nater	Acts			Prob
	X	Y	Z	
A	220	180	0	0.30
B	200	0	700	0.50
C	340	860	0	0.20

Expected opportunity loss (EOL) for X = $220 \times 0.30 + 200 \times 0.50 + 340 \times 0.20$
$= ₦234$

~~Expected opp~~ (EOL) = $180 \times 0.30 + 860 \times 0.20$
$= ₦226$

EOL = 700×0.50
$= ₦350$

∴ EMV for Y have high profit & EOL for Y have low loss so Acts Y can be chosen as the best.

(16)

S\D	N_1	N_2	N_3
S_1: New improvement detergent	15	12	18
S_2: supersoft	9	14	10
S_3: Extra wash	13	4	26
probability	0.35	0.45	0.20

EMV for $S_1 = 15 \times 0.35 + 12 \times 0.45 + 18 \times 0.20 = 14.25$

EMV for $S_2 = 9 \times 0.35 + 14 \times 0.45 + 10 \times 0.20 = 11.45$

EMV for $S_3 = 13 \times 0.35 + 4 \times 0.45 + 26 \times 0.20 = 11.55$

∴ ~~EMV~~ maximum EMV at S_1 is ~~RS~~ 14.25

regret table

S\D	N_1	N_2	N_3
S_1	0	2	8
S_2	6	0	16
S_3	2	10	0

EOL for $S_1 = 2 \times 0.45 + 8 \times 0.20 = 2.5$

EOL for $S_2 = 6 \times 0.35 + 16 \times 0.20 = 5.3$

EOL for $S_3 = 2 \times 0.35 + 10 \times 0.45 = 5.2$

∴ minimum EOL for S_1 Rs = 2.5

∴ the best alternative is S_1: New improvement detergen

(17) CP = Rs 5, SP = Rs 10, MP = 10 − 5 = Rs 5, no salvage, ML = CP = Rs 5

Payoff = 5S if S ≤ D

Payoff = 10D − 5S if S > D

Pay off table

S \ D	$D_1=20$	$D_2=25$	$D_3=30$	$D_4=35$	$D_5=40$
$S_1=20$	100	100	100	100	100
$S_2=25$	75	125	125	125	125
$S_3=30$	50	100	150	150	150
$S_4=35$	25	75	125	175	175
$S_5=40$	0	25	100	150	200
probability	0.05	0.10	0.20	0.35	0.30

EMV for S_1 = Rs 100

EMV for S_2 = Rs 122.5

EMV for S_3 = Rs 140

EMV for S_4 = Rs 147.5

EMV for S_5 = Rs 135

(i) ⇒ EMV for $S_4=35$ have the maximum value 35 pipes should buy in order of EMV = Rs 147.5

regret table

S \ D	$D_1=20$	$D_2=25$	$D_3=30$	$D_4=35$	$D_5=40$
$S_1=20$	0	25	50	75	100
$S_2=25$	75	0	25	50	75
$S_3=30$	50	25	0	25	50
$S_4=35$	75	50	25	0	25
$S_5=40$	100	100	50	25	0
prob	0.05	0.10	0.20	0.35	0.30

(ii) EOL for S_1 = 68.75
EOL for S_2 = 46.25
EOL for S_3 = 28.75
EOL for S_4 = 21.25
EOL for S_5 = 33.75

$\therefore$ EOL for S_4 has minimum value which gives minimum loss of EOL = Rs = 21.25

(iii) Both obtain same result

(iv)

EPPI = Σ diagonal payoff $\times$ probability
= $100 \times 0.05 + 125 \times 0.10 + 150 \times 0.20 + 175 \times 0.35 + 200 \times 0.$
= 168

Maximum EMV under certainty = 147.5

EVPI = EPPI − Maximum EMV under certainty
= 168 − 147.5
= 20.5

(18) CP = Rs 15, SP = Rs 25, MP = SP − CP = Rs 25 − Rs 15 = Rs 10

~~where~~, salvage value = Rs 5.

ML = ~~CP~~ CP − Salvage value = 15 − 5 = Rs 10

where,

S = no. of magazine supply.

D = no. of magazine sold

S − D = no. of magazine unsold

Payoff = MP × no. of magazine supply = 10S if S ≤ D

Payoff = MP × no. of magazine sold − ML × no. of magazine unsold

= 10D − 10S + 10D if S > D

= 20D − 10S

Payoff table

S \ D	D_1 = 400	D_2 = 410	D_3 = 420	D_4 = 430	D_5 = 440	D_6 = 450
S_1 = 400	4000	4000	4000	4000	4000	4000
S_2 = 410	3900	4100	4100	4100	4100	4100
S_3 = 420	3800	4000	4200	4200	4200	4200
S_4 = 430	3700	3900	4100	4300	4300	4300
S_5 = 440	3600	3800	4000	4200	4400	4400
S_6 = 450	3500	3700	3900	4100	4300	4500
Probability	0.08	0.16	0.25	0.27	0.13	0.11

EMV for S_1 = 4000×0.08 + 4000×0.16 + 4000×0.25 + 4000×0.27 + 4000×0.13 + 4000×0.11 = 4000

EMV for S_2 = 4084

EMV for S_3 = 4136

EMV for S_4 = 4138

EMV for S_5 = 4086

EMV for S_6 = 4008

Payoff table

S \ D	$D_1=400$	$D_2=410$	$D_3=420$	$D_4=430$	$D_5=440$	$D_6=450$
$S_1=400$	0	100	200	300	400	500
$S_2=410$	100	0	100	200	300	400
$S_3=420$	200	100	0	100	200	300
$S_4=430$	300	200	100	0	100	200
$S_5=440$	400	300	200	100	0	100
$S_6=450$	500	400	300	200	100	0
Probability	0.08	0.16	0.25	0.27	0.13	0.11

EOL for $S_1 = 100 \times 0.16 + 200 \times 0.25 + 300 \times 0.27 + 400 \times 0.13 + 500 \times 0.11 = Rs\ 284$

EOL for S_2 = Rs 194

EOL for S_3 = Rs 136

EOL for S_4 = Rs 128

EOL for S_5 = Rs 174

EOL for S_6 = Rs 246

a) 430 copies should vendor buy in order to ~~maximize the prof~~ EMV & EOL criteria

b) EPPI = Σ Diagonal payoff × probability

$= 4000 \times 0.08 + 4100 \times 0.16 + 4200 \times 0.25 + 4300 \times 0.27 + 4400 \times 0.13$
$+ 4500 \times 0.11$

$=$ Rs 4254.

maximum EMV under certainty = 4138

EVPI = EPPI − maximum EMV under certainty

$= 4254 - 4138$

$=$ Rs. 116