SHAH
EDUCATIONAL ACADEMY
Bandra West | Vile Parle West

H. O. : Shop No. 5, Hill Crest Society, 16th Road, Bandra (W), Mum: 50. Ph: 26051635 / 9820422953

Branch : Avon Arcade, Shop No. A/121, 1st Fl.,Vile Parle (W), Mumbai: 56. Ph: 9820418533

FYBCOM/ Sem I *Maths & Stats* **Marks: 100 Time: 3 Hrs.**

Q. 1 Attempt Any 4 from the following: (20)

1. If the market price of a share with face value ₹ 100 is ₹ 130, how many shares of the company can be bought for ₹ 3,263, brokerage being 0.4%.
2. Smooth Writing Industry issued some shares of face value ₹ 10 each. A dividend of ₹7,500 was declared by the company at 2.5% per share. Find number of shares issued by the company.
3. Neil purchased 1,200 units of a mutual fund by investing ₹ 60,000. If the entry load was 2%, find NAV on the date of purchase.
4. Nihar invested ₹ 40,000 in a mutual fund on 14-2-2012 when its NAV was ₹ 13.65, a divided of ₹ 3 per unit was given on 20-4-2012. Afterwards he sold all the units on 20-8-2012 when NAV was ₹ 16.85. Find his gain if there is no entry and exit load.
5. An investor joined the SIP scheme for a mutual fund under which he would invest ₹15,000 for 5 months. If the NAVs for each month are ₹ 42.6, ₹ 45, ₹ 47, ₹ 47.5 and ₹ 60, find the average cost using rupee cost averaging method, the entry load being 2.5% throughout for these months.

Q. 2 Attempt any 4 from the following: (20)

1. From 4 professors and 6 students, a committee of 4 is to be formed. In how many ways the committee can be formed such that it contains only one professor?
2. How many numbers of 5 digits can be formed using the digits 1, 2, 3, 4, 5, 6 such that
   (a) No digit is repeated
   (b) Repetition of digits is allowed
3. How many ways out of 11 members of a cricket team choose a Captain, Vice-captain and wicket-keeper from among themselves?
4. Solve the linear programming problem graphically.
   Minimize $10x + 7y$
   Subject to, $2x + y \geq 2$,
   $x + 3y \geq 3$,
   $x, y \geq 0$.
5. A cracker manufacturer produces two types of crackers, rockets and bombs packed in boxes of hundreds in its two factories. Factory I performs the basic assembly operation. Factory II performs the finishing operation. For financial reason, Factory I has only 180 hours available per week and factory II has 120 hours available. Factory I needs 3 hours on each box of rockets and 10 hours on each box of bombs. Factory II needs 6 hours on box of rockets and 4 hours on box of bombs.
   The profit of the company is ₹ 45 per box of rockets and ₹ 55 per box of bombs.
   Formulate the LPP to maximize the profit.

SECTION – II

Q. 3 Attempt any 4 from the following: (20)

(a) Find the median and the fifth decile for the following frequency distribution.

Class Interval	5 – 10	15 – 20	25 – 30	35 – 40
Frequency	16	14	13	17

(b) Write merits and demerits of mean and mode.

(c) Draw a histogram and hence locate the mode graphically for the following distribution of marks.

Marks	20 – 30	30 – 40	40 – 50	50 – 60
No. of Students	11	15	24	14

(d) From the following frequency distribution, calculate the standard deviation.

X	5	6	7	8	10
Frequency	3	7	4	2	4

(e) For the following data, find the combined mean. Also find which group has more variation.

	Group I	**Group II**
Number of Articles	70	90
Mean	75	82
Variance	16	49

Q. 4 Attempt any 4 from the following: (20)

(a) Define the following terms with examples:
(i) Complementary event (ii) Sample space

(b) Two unbiased dice are thrown. Find the probability that
(i) Number on first die is less than number on second die.
(ii) Sum of number on the two dice is 8.

(c) If P (A) = 1/2, P (B) = 1/3, P (A $\cup$ B) = 1/6. Find P(A') and P(A $\cap$ B).

(d) The following table shows a Probability Distribution of a Random Variable X.

X	-1	0	1	2	3
P(X)	0.1	0.25	0.25	0.2	0.2

Find (i) P (X > 1) (ii) E (X) (iii) V(X)

(e) Four cards are to be selected from a pack of well shuffled 52 playing cards. Find the probability that
(i) All are black
(ii) Only one is king.

Q. 5 Attempt any 4 from the following: (20)

(a) For the following pay off table, suggest the best decision by using.

(i) Maximax criterion

(ii) Maximin criterion

(iii) Laplace criterion

Course of Action	States of Nature			
	S_1	S_2	S_3	S_4
A_1	57	24	37	50
A_2	24	28	32	13
A_3	12	34	26	44

(b) Draw a decision tree for the following decision making problem and suggest the best decision.

Course of Action	States of Nature		
	S_1	S_2	S_3
A_1	34	20	18
A_2	14	16	12
Probability	0.2	0.3	0.5

(c) Define the following along with examples:

(i) Acts

(ii) States of Nature

(d) The following is demand distribution of a certain product:

No. of units demanded	10	11	12
Probability	0.35	0.40	0.25

The product is sold at ₹ 100 per unit with cost price ₹ 70 per unit. Prepare a payoff table and decide the best decision. The unit not sold is wasted.

(e) For the following pay-off table, suggest the best decision by EOL method.

Course of Action	States of Nature		
	S_1	S_2	S_3
A_1	14	16	10
A_2	12	15	16
A_3	20	18	14
Probability	0.4	0.3	0.3

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FYBCOM/ Sem I *Maths & Stats* **Marks: 100 (Solution)**

SECTION - I

1. (a) Market Value per Share = 130

Brokerage = 0.4% of 130 = 0.52

Total Purchase Price = 130 + 0.52 = 130.52

No. of Shares = 3,263 / 130.52 = **25**

(b) Dividend received per share = 10 × 2.5% = 0.25

No. of Shares = 7,500 / 0.25 = **30,000**

(c) Purchase price of a unit = Amount invested / No. of units

= 60,000 / 1,200 = **50**

Let NAV be x

So purchase price = NAV + Entry load

$\therefore 50 = x + 2\%$ of $x = 1.02x$

$\therefore x = 50 / 1.02 = 49.0196$

NAV = 49.0196

(d) No. of units purchased = 40,000 / 13.65 = **2930.4029**

Total Dividend = 3 × 2930.4029 = **₹ 8791.2088**

Total Sales = Units × NAV

= 2930.4029 × 16.85

= **49377.2889**

Total Gain = Sales + Dividend – Purchase

= 49377.2889 + 8791.2088 – 40000

= **₹ 18,168.4977**

(e)

Month	NAV	Entry Load 2.5%	Total Price	No. of Units = 15,000/ Total Price
1	42.6	1.065	43.665	343.5246
2	45	1.125	46.125	325.2033
3	47	1.175	48.175	311.3648
4	47.5	1.1875	48.6875	308.0873
5	60	1.5	61.5	243.9024
Total				1532.0824

Average Cost = Total amount / Total units

= 75000 / 1532.0824 = **₹ 48.953**

2. (a) Only 1 professor, no. of ways = ${}^4C_1 \times {}^6C_3 = 4 \times 6 \times 5 \times 4 / 6 =$ **80**

(b) (i) No digit is repeated, total no. = 6 × 5 × 4 × 3 × 2 = **720**

(ii) Repetition of digits allowed, total no. = 6 × 6 × 6 × 6 × 6

= **7776**

(c) No of ways = 11 × 10 × 9 = **990**

(d) **LPP :** To minimise $Z = 10x + 7y$

Consider the equations $2x + y = 2$ and $x + 3y = 3$.

Solving these simultaneously,

$$\begin{array}{rcrcr} 6x & + & 3y & = & 6 \\ + \; x & + & 3y & = & + \; 3 \\ - & & - & & - \\ \hline 5x & & & = & 3 \end{array}$$

$x = 0.6$, substituting

$0.6 + 3y = 3$, $y = 2.4 / 3 = \mathbf{0.8}$

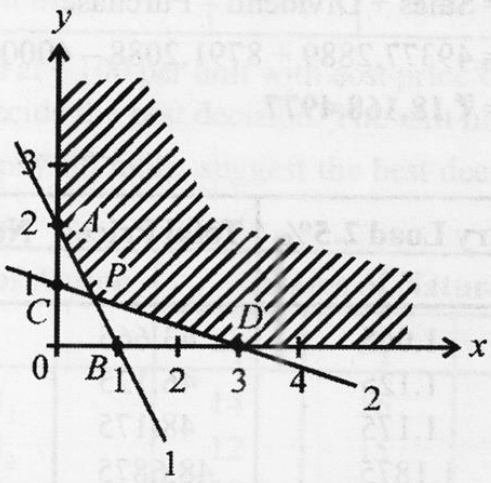
Point of intersection, $P\,(0.6, 0.8)$

Consider points on the line $2x + y = 2$ ... (1)

as $A\,(0, 2)$, $B\,(1, 0)$

Consider points on the line $x + 3y = 3$ ... (2)

as $C\,(0, 1)$, $D\,(3, 0)$



The shaded region APD is feasible region.

Consider $Z = 10x + 7y$ at these points

at $A\,(0, 2)$, $Z = 0 + 14 = \mathbf{14}$

at $P\,(0.6, 0.8)$, $Z = 6 + 5.6 = \mathbf{11.6}$

at $D\,(3, 0)$, $Z = 30 + 0 = \mathbf{30}$

So, Z is minimum at $\boldsymbol{P}$ **(0.6, 0.8)** and the minimum value is **11.6**.

(e) Prepare the following table :

Let x, y be the no. of boxes of rockets and bombs to be produced.

	Rockets (x)	**Bombs (y)**	**Maximum Availability**
Factory I	3 hours	10 hours	180 hours
Factory II	6 hours	4 hours	120 hours
Profits	₹ 45	₹ 55	

The profit function Z is to be maximised, where

$Z = 45x + 55y$

Subject to constraints,

Factory I, $3x + 10y \leq 180$

Factory II, $6x + 4y \leq 120$ and

$x \geq 0,\ y \geq 0$

This is the formulation of LPP.

SECTION - II

3. (a)

Class	**Class Bounds**	**Frequency**	**Cum. Frequency**
5-10	2.5 - 12.5	16	16
15-20	12.5 - 22.5	14	30
25-30	22.5 - 32.5	13	43
35-40	32.5 - 42.5	17	60
Total		60	

For median, consider $N/2 = 60/2 = 30$, as 43 is the first c.f. > 30, the required class is 22.5 – 32.5.

Median $= l_1 + (l_2 - l_1)\,(N/2 - \text{c.f.}) / \text{f}$

$= 22.5 + (32.5 - 22.5)\,(30 - 30) / 13$

$= 22.5 + 0 = \mathbf{22.5}$

For fifth decile, D_5, consider $5N/10 = 5 \times 60/10 = 30$, as 43 is the first c.f. > 30, the required class is **22.5 – 32.5**.

$D_5 = 22.5 + (32.5 - 22.5)\,(30 - 30) / 13$

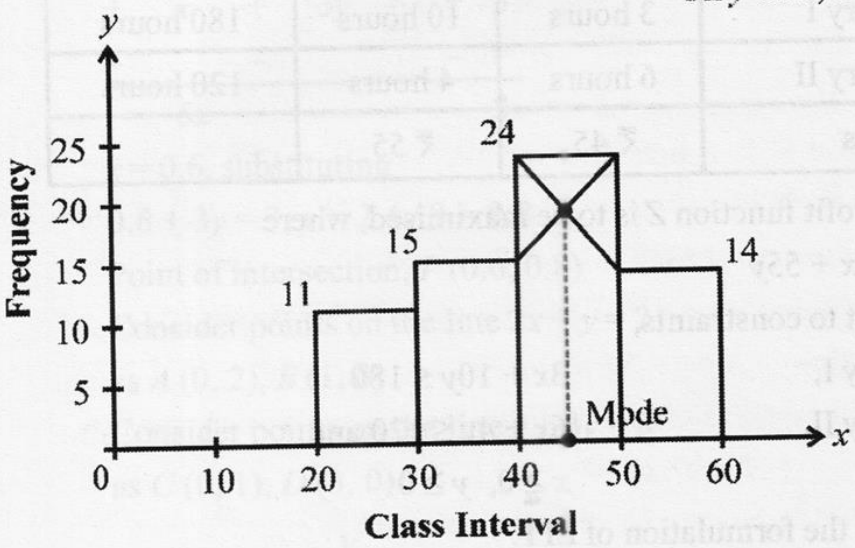
$= 22.5 + 0 = \mathbf{22.5}$

Note that the values of D_5 and Median are same because 5th Decile coincides with Median.

(b) ***Refer Chapter 4, Merits and Demerits of Mean (Pgs. 135 and 136) and Mode (Pg. 181)***

(c) Histogram

Scale : On x-axis, 1 cm = 10 units
On y-axis, 1 cm = 5 units



From Histogram, Mode = **45**

(d)

x	5	6	7	8	10	Total
f	3	7	4	2	4	20
fx	15	42	28	16	40	141
fx^2	75	252	196	128	400	1051

Here mean, $\bar{x} = \Sigma fx / \Sigma f = 141 / 20 = 7.05$

Standard deviation,

$$\sigma = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \bar{x}^2}$$

$$= \sqrt{\frac{1051}{20} - (7.05)^2} = \sqrt{52.55 - 49.7025}$$

$$= \sqrt{2.8475} = \mathbf{1.6875}$$

(e) Here $n_1 = 70,\ \bar{x}_1 = 75,\ \sigma_1 = 4$

$n_2 = 90,\ \bar{x}_2 = 82,\ \sigma_2 = 7$

Combined Mean, $\bar{x} = \dfrac{(n_1\bar{x}_1 + n_2\bar{x}_2)}{(n_1 + n_2)}$

$= \dfrac{70 \times 75 + 90 \times 82}{70 + 90}$

$= \dfrac{5250 + 7280}{160} = \dfrac{12630}{60}$

$= \mathbf{78.9375}$

For Group I, coefficient of variation = $CV_1 = (4 / 75) \times 100 = \mathbf{5.33}$

For Group II, coefficient of variation = $CV_2 = (7 / 82) \times 100 = \mathbf{8.5366}$

As $CV_2 > CV_1$, group II has more variation.

4. (a) (i) ***Refer Chapter 6, Complementary Events (Pg. 241)***

(ii) ***Refer Chapter 6, Sample Space (Pg. 240)***

(b) The following are the sample points when 2 dice are thrown.

(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6)

(2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6)

(3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6)

(4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6)

(5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6)

(6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)

Probability (no. on first die is < no. on second dice)

$= \dfrac{5 + 4 + 3 + 2 + 1}{36} = \dfrac{15}{36} = \mathbf{0.4167}$

Probability (sum of numbers is 8) = 5 / 36 = **0.1389**

(c) $P(A) = 1/2, P(B) = 1/3, P(A \cup B) = 1/6$

$P(A') = 1 - P(A) = 1 - (1/2) = 1/2 = \mathbf{0.5}$

Now, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$(1/6) = (1/2) + (1/3) - P(A \cap B)$

$\therefore P(A \cap B) = (1/2) + (1/3) - (1/6) = 4/6 = \mathbf{0.6667}$

(d)

x	–1	0	1	2	3	Total
$P(x)$	0.1	0.25	0.25	0.2	0.2	1.0
$x \cdot P(x)$	–0.1	0	0.25	0.4	0.6	1.15
$x^2 \cdot P(x)$	0.1	0	0.25	0.8	1.8	2.95

(i) $P(X > 1) = 0.2 + 0.2 = \mathbf{0.4}$

(ii) $E(X) = \Sigma x \cdot P(x) = \mathbf{1.15}$

(iii) $V(X) = \Sigma x^2 \cdot P(x) - (E(x))^2 = 2.95 - (1.15)^2$

$= 2.95 - 1.3225 = \mathbf{1.6275}$

(e) (i) Probability (all 4 cards are black)

$$= \frac{{}^{26}C_4}{{}^{52}C_4}$$

$$= \frac{\left(\frac{26 \times 25 \times 24 \times 23}{4 \times 3 \times 2 \times 1}\right)}{\left(\frac{52 \times 51 \times 50 \times 49}{4 \times 3 \times 2 \times 1}\right)} = \mathbf{0.0552}$$

(ii) Probability (only one is king)

$$= \frac{{}^{4}C_1 \times {}^{48}C_3}{{}^{52}C_4}$$

$$= \frac{\left(\frac{4 \times 48 \times 47 \times 46}{3 \times 2 \times 1}\right)}{\left(\frac{52 \times 51 \times 50 \times 49}{4 \times 3 \times 2 \times 1}\right)} = \mathbf{0.2556}$$

5. (a) (i) **Maximax Criterion**

For A_1, max = 57, for A_2, max = 32, for A_{36}, max = 44

Now, maximum (**57**, 32, 44) = **57**

So, choose action $\boldsymbol{A_1}$, with value of payoff as **57**.

(ii) **Maximin Criterion**

For A_1, min = **24**

For A_2, min = **13**

For A_3, min = **12**

Now, maximum (**24**, 13, 12) = **24**

So, choose action $\boldsymbol{A_1}$ with payoff as **24**.

(iii) **Laplace Criterion**

For A_1, average pay off = (57 + 24 + 37 + 50) / 4 = **42**

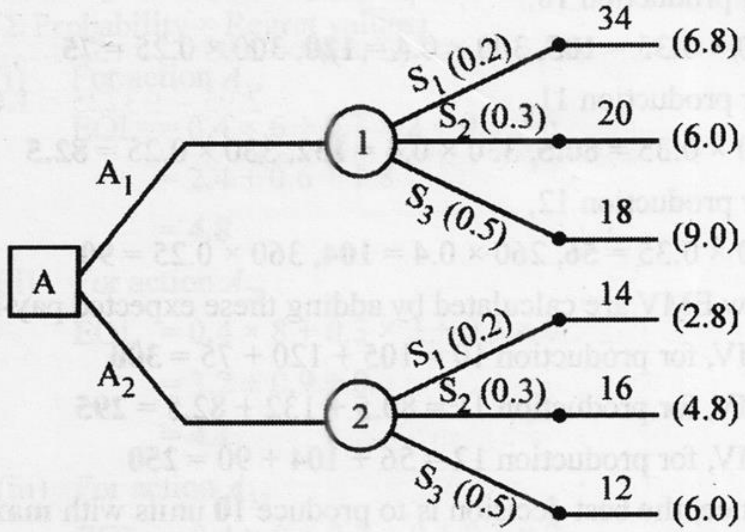
For A_2, average pay off = (24 + 28 + 32 + 13) / 4 = **24.25**

For A_3, average pay off = (12 + 34 + 26 + 44) / 4 = **29**

Max, (**42**, 24.25, 29) = **42**

So, choose action $\boldsymbol{A_1}$, with average pay off **42**.

(b) Decision Tree



The EMV for action A_1 = 6.8 + 6.0 + 9.0 = **21.8**

The EMV for action A_2 = 2.8 + 4.8 + 6.0 = **13.6**

So choose **action A_1** with maximum EMV of **21.8**.

(c) ***Refer Chapter 8, Acts and States of Nature (Pg. 286)***

(d) Here profit = ₹ 30 per unit. Calculate the pay-off for each production.

(i) Production 10, demand 10, pay-off = 10 × 30 = **300**

Production 10, demand 11, pay-off = 10 × 30 = **300**

Production 10, demand 12, pay-off = 10 × 30 = **300**

(ii) Production 11, demand 10, pay-off = 10 × 30 – 1 × 70 = **230**

Production 11, demand 11, pay-off = 11 × 30 = **330**

Production 11, demand 12, pay-off = 11 × 30 = **330**

(iii) Production 12, demand 10, pay-off = 10 × 30 – 2 × 70 = **160**

Production 12, demand 11, pay-off = 11 × 30 – 1 × 70 = **260**

Production 12, demand 12, pay-off = 12 × 30 = **360**

Pay-off Table

Product \ Demand	10	11	12
10	300	300	300
11	230	330	330
12	160	260	360

The expected pay-off are

For production 10,

$300 \times 0.35 = \mathbf{105}$, $300 \times 0.4 = \mathbf{120}$, $300 \times 0.25 = \mathbf{75}$

For production 11,

$230 \times 0.35 = \mathbf{80.5}$, $330 \times 0.4 = \mathbf{132}$, $330 \times 0.25 = \mathbf{82.5}$

For production 12,

$160 \times 0.35 = \mathbf{56}$, $260 \times 0.4 = \mathbf{104}$, $360 \times 0.25 = \mathbf{90}$

Now EMV are calculated by adding these expected pay-offs.

EMV, for production 10 = 105 + 120 + 75 = **300**

EMV, for production 11 = 80.5 + 132 + 82.5 = **295**

EMV, for production 12 = 56 + 104 + 90 = **250**

Hence, the best decision is to produce **10** units with **maximum** EMV of ₹ **300**.

(e) Let us calculate regret values for each state of nature.

(i) For S_1, maximum pay-off is **20**, so regret values are :

For action A_1, 20 – 14 = **6**

For action A_2, 20 – 12 = **8**

For action A_3, 20 – 20 = **0**

(ii) For S_2, maximum pay-off is **18**, so regret values are :

For action A_1, 18 – 16 = **2**

For action A_2, 18 – 15 = **3**

For action A_3, 18 – 18 = **0**

(iii) For S_3, maximum pay-off is **16**, so regret values are :

For action A_1, 16 – 10 = **6**

For action A_2, 16 – 16 = **0**

For action A_3, 16 – 14 = **2**

Regret Table

Course of Action	States of Nature		
	S_1	S_2	S_3
A_1	6	2	6
A_2	8	3	0
A_3	0	0	2
Probability	0.4	0.3	0.3

The EOL values are calculated for each action by multiplying the regret values by corresponding probabilities and then by adding such products (Σ Probability × Regret values)

(i) For action A_1,

$$\text{EOL} = 0.4 \times 6 + 0.3 \times 2 + 0.3 \times 6$$
$$= 2.4 + 0.6 + 1.8$$
$$= \mathbf{4.8}$$

(ii) For action A_2,

$$\text{EOL} = 0.4 \times 8 + 0.3 \times 3 + 0.3 \times 0$$
$$= 3.2 + 0.9 + 0$$
$$= \mathbf{4.1}$$

(iii) For action A_3,

$$\text{EOL} = 0.4 \times 0 + 0.3 \times 0 + 0.3 \times 2$$
$$= 0 + 0 + 0.6$$
$$= \mathbf{0.6}$$

Since EOL is minimum, **0.6** for action A_3, the best decision is to choose action A_3, with **minimum EOL**.

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