Marks

Q.2 (a)

$$\frac{x+6}{5} - \frac{2x-1}{2} = 3$$

Multiply by 10

$2(x+6) - 5(2x - 1) = 30$

$2x + 12 - 10x + 5 = 30$

$-8x = 30 - 12 - 5$

$-8x = 13$ — 2.0

$x = -13/8$ Ans — 2.0

(b) The total weekly revenue equations for the two products are:

$R_1 = (130 - 2x)\,x = 130x - 2x^2$ — 0.5

$R_2 = (320 - 4y)\,y = 320y - 4y^2$ — 0.5

$G = R_1 + R_2 - C$

$= 130x - 2x^2 + 320y - 4y^2 - (40x + 2xy + 2y^2 + 2000)$

$= 90x - 2x^2 + 320y - 6y^2 - 2xy - 2000$ — 1.5

The partial derivative are

$\frac{\partial G}{\partial x} = 90 - 4x - 2y$ $\frac{\partial G}{\partial y} = 320 - 12y - 2x$ — 2.0

For the maximum profit, we need to find the stationary point of the function, for which the partial derivatives are equated to zero. Thus

$90 - 4x - 2y = 0$ then $4x + 2y = 90$ -------------------- Eq. (1) — 1.0

$320 - 12y - 2x = 0$ then $2x + 12y = 320$ -------------------- Eq. (2) — 1.0

By simultaneously solving equation (1) & (2) we have

$x = 10$ & $y = 25$ — 2.0

Now we can calculate the weekly profit with the help of profit equation:

$G = 90x - 2x^2 + 320y - 6y^2 - 2xy - 2000$

$= (90 \times 10) - 2(10)^2 + 320 \times 25 - 6(25)^2 - 2 \times 10 \times 25 - 2000 =$ Rs. 2,450 — 1.0

Conclusion: A maximum profit of Rs. 2,450 is produced when 10 units of the first Product and 25 units of the second product are produced weekly. — 0.5

(c) a=? $a_n = 900{,}000$ $S_n = 6{,}500{,}000$ $n = 10$ — 1.0

$a_n = a + (n - 1)d$ — 0.5

$900{,}000 = a + (10 - 1)\,d$ or $900{,}000 = a + 9d$ -----------------Eq.(1) — 1.0

	Marks
$S_n = n/2\ \{2a + (n - 1)d\}$	0.5
or $6{,}500{,}000 = 5\{2a + 9d\}$ or $1{,}300{,}000 = 2a + 9d$ ---------------------------------------Eq. (2)	1.0
By simultaneously solving equation (1) & (2) we have	
$a = 400{,}000$ $d = 55{,}555.55$	1.0
Initial Salary is Rs. 400,000 p.a.	1.0

Q.3 (a) (i) Units to be Produced:

	Marks
Revenue = $R = f(q) = pq$	0.5
$q = 100{,}000 - 200p \Rightarrow p = 500 - 0.005q$	
$R = (500 - 0.005q)q$	
$= 500q - 0.005q^2$	1.0
Profit = $P = f(q) = R - C$	0.5
$P = 500q - 0.005q^2 - (150{,}000 + 100q + 0.003q^2)$	
$P = -0.008q^2 + 400q - 150{,}000$	2.0
1. Find First Derivative $P' = -0.016q + 400$ 2. Take $P' = 0$ and find q $q = 25{,}000$	1.0
3. Find 2nd Derivative $P'' = -0.016$ 4. Find $P''(25{,}000)$ Since $P''(25{,}000) = -0.016 < 0$ Profit of the firm is Maximize when 25,000 units are produced each year.	1.0

(ii) Price to be Charged:

	Marks
$p = 500 - 0.005q = 500 - 0.005(25{,}000)$	1.0
= Rs. 375	1.0

(iii) Annual Profit Expected to Equal:

	Marks
$P = -0.008q^2 + 400q - 150{,}000 = -0.008\ (25{,}000)^2 + 400\ (25{,}000) - 150{,}000$	1.0
= Rs. 4,850,000	1.0

Marks

(b) P = 50,000 ; A= 140,000 ; n = 8 Years = 32 Quarters ; i =? 1.0

$A = P(1 + i/m)^{mn}$ 1.0

$140{,}000 = 50{,}000(1 + i/4)^{32}$

$2.8 = (1 + i/4)^{32}$

$\text{Log } 2.8 = 32 \log (1 + i/4)$ 2.0

$0.447158 = 32 \log (1 + i/4)$

$0.013974 = \log (1 + i/4)$

$1 + i/4 = \text{Antilog } 0.013974$

$1 + i/4 = 1.0327$

$i/4 = 1.0327 - 1$

$i/4$ = 0.0327or 3.27% per quarter or 1.0

i =13.08% per annum 1.0

(c)

$$A = \begin{bmatrix} 0 & 3 & 1 \\ 1 & 1 & 0 \\ 2 & 3 & 3 \end{bmatrix}$$

$|A|$ = -3(3 – 0) +1(3 – 2) = -9 +1 = – 8 Non Singular Matrix Inverse Exits 1.0

A11 = +(3 – 0) = 3 A12= - (3 – 0) = - 3 A13= +(3 – 2) = 1

A21 = - (9 – 3) = - 6 A22 = + (0 – 2) = - 2 A23 = - (0 – 6) = 6

A31 = + (0 – 1) = - 1 A32 = - (0 – 1) = 1 A33 = +(0 – 3) = - 3

$$Ac = \begin{bmatrix} 3 & -3 & 1 \\ -6 & -2 & 6 \\ -1 & 1 & -3 \end{bmatrix}$$

$$\text{Adj } A = Ac^{t} = \begin{bmatrix} 3 & -6 & -1 \\ -3 & -2 & 1 \\ 1 & 6 & -3 \end{bmatrix}$$

$$A^{-1} = \frac{AdjA}{|A|} = \begin{bmatrix} 3 & -6 & -1 \\ -3 & -2 & 1 \\ 1 & 6 & -3 \end{bmatrix} / -8$$

$$A^{-1} = \begin{bmatrix} \frac{-3}{8} & \frac{3}{4} & \frac{1}{8} \\ \frac{3}{8} & \frac{1}{4} & \frac{-1}{8} \\ \frac{-1}{8} & \frac{-3}{4} & \frac{3}{8} \end{bmatrix} \text{ Ans}$$ 3.0

Marks

Q.4 (a) (i) With replacement:

$P(K \cap A) = P(K)\,P(A)$

$= \frac{4}{52} \times \frac{4}{52}$

$= \frac{1}{169}$ 2.0

(ii) Without replacement:

$P(K \cap A) = P(K)\,P(A)$

$= \frac{4}{52} \times \frac{4}{51}$

$= \frac{4}{663}$ 2.0

(b) p = 0.5, q = 0.5 , n = 10, x = 5 1.0

$b(x::n,p) = {}^{n}Cx\ p^{x}\ q^{n-x}$ 1.0

$b(5:10,5) = {}^{10}C_5\ 0.5^5\ 0.5^5$ 1.0

= 252 x 0.03125 x 0.03125 1.0

= 0.24609 2.0

Q.5 (a) n=10, Sample Mean $\bar{x}$ = 65, s^2 = 20 Find 98% Confidence Interval for μ 1.0

Confidence Interval for μ

$t_{\alpha/2} = t_{0.01,9} = 2.821$

$\bar{x} \pm t_{\alpha/2}\ s/\sqrt{n}$ 1.0

$65 \pm 2.821 \times 4.472/\sqrt{10}$ 1.0

65 ± 3.989 1.0

61.011, 68,989

$61.011 < \mu < 68.989$ 1.0

Marks

(b)

x	y	xy	x^2	y^2
50	22			
54	25			
56	34			
60	28			
62	26			
61	30			
65	33			
408	198	11,621	23,942	5,714

2.0

Coefficient of Correlation = r = $\frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}}$ 0.5

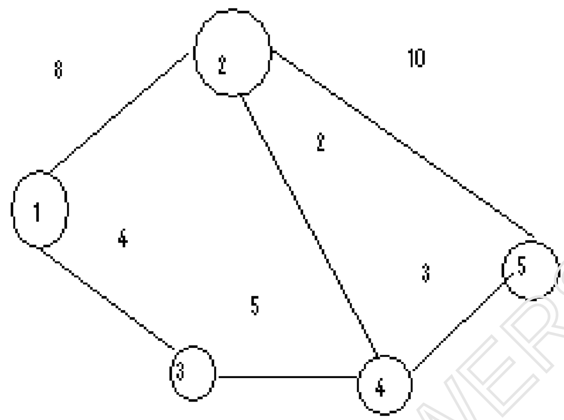
= $\frac{7x11621 - 408x198}{\sqrt{(7x23942 - 408^2)(7x5714 - 198^2)}}$ 0.5

= 0.5943 1.0

Positive (Direct) and Moderate relationship exits between marks obtained in Statistics And Economics by the students. 1.0

Marks

Q. 6 (a) 4.0



(b) Possible path Duration

(1, 2, 5)	8+10 =18 days	(Critical Path)	1.5
(1, 2, 4, 5)	8+2+3 = 13 days		0.75
(1, 3, 4, 5)	4+5+3 = 12 days	(Smallest Path)	0.75

(c) Slope = $\frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Days} - \text{Crash Days}}$ 1.0

Activity (i,j)	Slope (Rs.' 000 / Day)	
(1, 2)	50	1/3
(1, 3)	100	1/3
(2, 4)	40	1/3
(2, 5)	60	1/3
(3, 4)	25	1/3
(4, 5)	10	1/3

Marks

Q. 7

Maximise $6x + 8y + 7z$

$$\begin{aligned} 3x + y + z + S_1 &= 50 \\ 2x + y + 4z + S_2 &= 100 \\ x + 2y + 2z + S_3 &= 80 \end{aligned}$$

2.0

Tableau #1

x	y	z	S_1	S_2	S_3	p	
3	1	1	1	0	0	0	50
2	1	4	0	1	0	0	100
1	2	2	0	0	1	0	80
-6	-8	-7	0	0	0	1	0

2.0

Tableau #2

	x	y	z	S_1	S_2	S_3	p	
S_1	2.5	0	0	1	0	-0.5	0	10
S_2	1.5	0	3	0	1	-0.5	0	60
y	0.5	1	1	0	0	0.5	0	40
z	-2	0	1	0	0	4	1	320

3.0

Tableau #3

	x	y	z	S_1	S_2	S_3	p	
x	1	0	0	0.4	0	-0.2	0	4
S_2	0	0	3	-0.6	1	-0.2	0	54
y	0	1	1	-0.2	0	0.6	0	38
z	0	0	1	0.8	0	3.6	1	328

3.0

THE END