DIRECTORATE OF GOVERNEMENT EXAMINATIONs, CHENNAI-6

HIGHER SECONDARY EXAMINATIONS (SECONDYEAR) MARCH-2024

BUSINESS MATHEMATICS AND STATISTICS - ANSWER KEY

Maximum Marks - 90

GENERAL INSTRUCTIONS :-

1. Answers written only in **BLACK** or **BLUE** should be evaluated.
2. For objective type questions, award 1 mark for "writing the correct option's code and the corresponding option's answer".
3. Award "0 marks" for one who wrote both "option's code" and "option's answer" with one of them is not correct.
4. Marks should be awarded for suitable alternative method also.
5. Mark(s) should not be reduced for the correct answer / stage, if it is written without formula / properties also, 2* means award one mark for the formula.
6. Award full mark directly, if the solution is arrived with no mistakes without giving weightage for the stages.
7. The stage mark is essential, only if the part of the solution is incorrect.
8. Award marks, if the answer is in decimal value and also approximately equal to the key answer
9. **Important Note for Part II, Part III and Part IV**

   For a particular stage in which the stage mark is greater than 1 and one who begins with correct step but reaches with incorrect solution, for such suitable credits should be given by breaking the stage marks.

PART – I

	i. Answer all the questions **ii. Choose the most appropriate from the given Four alternatives and write the option code and the corresponding answer**		
Q.No	**Option**	**Answer**	**20×1=20**
1	(a)	2 sq. units	1
2	(c)	(e-1) sq. units	1
3	(a)	0.0613	1
4	(c)	0.0547	1
5	(c)	$2x + 3$	1
6	(d)	1	1
7	(b)	1 or 0	1
8	(b)	Equal to m+n-1	1
9	(a)	A has atleast one minor of order r which does not vanish	1
10	(b)	$\left(\frac{-\Delta_1}{\Delta_2}, -\frac{\Delta_1}{\Delta_3}\right)$	1
11	(a)	Harper	1
12	(d)	Sufficient	1
13	(d)	-cos$x$ +c	1
14	(c)	$\frac{\sqrt{\pi}}{2}$	1
15	(b)	7	1
16	(a)	One	1
17	(a)	2 and 1	1
18	(d)	Y=sin$x$ + c, c is an arbitrary constant	1
19	(a)	four	1
20	(a)	$\bar{x}$-chart	1

PART - II

Q. No.	Answer any <u>Seven</u> Questions. Question No. 30 is compulsory.		7×2=14
21	$(A,B) \sim \begin{pmatrix} 3 & -2 & 6 \\ 0 & 0 & -2 \end{pmatrix}$,	1	2
	$\boldsymbol{\rho(A) \neq \rho(A\ \ B)}$ The given system is inconsistent and has no solution.	1	
22	$\int \frac{1}{2}(1-\cos 2x)\,dx$	1	2
	$= \frac{1}{2}\left(x - \frac{\sin 2x}{2}\right) + C$	1	
23	$p = 122 - 5x - 2x^2$ $p_0 = 122 - 5(20) - 2(20)^2$		2
24	$\frac{dy}{dx} = e^{ax+by}$, $e^{-by}dy = e^{ax}dx$	1	2
	$\frac{e^{-by}}{-b} = \frac{e^{ax}}{a} + C \quad (or) \frac{e^{ax}}{a} = \frac{-e^{-by}}{b} + C$	1	
25	$\Delta^2 e^x$ $= \Delta(e^{x+h} - e^x)$ $= \Delta \boldsymbol{e^x(e^h - 1)}$	1	2
	$= \boldsymbol{(e^h - 1)^2 e^x}$	1	
26	$p = \frac{1}{5}, q = \frac{4}{5}, n = 25$	1	2
	$P(X = x) = 25C_x \left(\frac{1}{5}\right)^x \left(\frac{4}{5}\right)^{25-x}$	1	
27	$n = 50, \quad s = 6.3, \quad \sigma = 6$	1	2
	$S.E. = \sqrt{\frac{\sigma^2}{2n}} = 0.6$	1	
28	It is a general tendency of time series to increase or decrease or stagnates during a long period of time.		2

29	The transportation problem is to determine the amount to be transported from each origin to each destinations such that the total transportation cost is minimized		2
30	$V(\mathrm{X}) = \mathrm{E}(\mathrm{X}^2) - [\mathrm{E}(\mathrm{X})]^2$	1	2
	$\mathrm{V}(\mathrm{X}) = \mathrm{E}(\mathrm{X}^2)$	1	

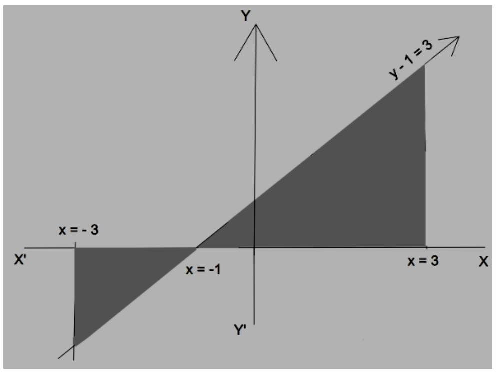
PART – III

Q. No.	**Answer any seven questions. Question number 40 is compulsory.**	**7×3=21**	
31	$(A \quad B)\begin{pmatrix}0.9 & 0.1\\ 0.3 & 0.7\end{pmatrix} = (A \quad B)$	1	3
	0.9A + 0.3B = A	1	
	A = 75 % B = 25 %	1	
32	$\int \frac{1}{\sqrt{x+1}+\sqrt{x-1}} X \frac{\sqrt{x+1}-\sqrt{x-1}}{\sqrt{x+1}-\sqrt{x-1}} dx$	1	3
	$\int \frac{\sqrt{x+1}-\sqrt{x-1}}{(x+1)-(x-1)} dx$ $\int \frac{\sqrt{\boldsymbol{x}+\mathbf{1}}-\sqrt{\boldsymbol{x}-\mathbf{1}}}{\mathbf{2}} \boldsymbol{dx}$	1	
	$\frac{1}{3}[(x+1)^{3/2}-(x-1)^{3/2}]$ + c	1	
33	$P = tanx \quad Q = cos^3x$ I.F = $e^{\int pdx} = e^{\log secx}$ **=** $\mathbf{sec}\ \boldsymbol{x}$	1	3
	$y(I.F) = \int Q(I.F)\,dx + c$ $= \int cos^2 xdx + c$ $= \int \frac{1+cos2x}{2}dx + c$ $= \frac{1}{2}\left(x + \frac{sin2x}{2}\right) + c$	2*	

<table>
<tr><td>34</td><td>$\Delta^4 U_0=(E-1)^4 U_0$
$=(E^4-4E^3+6E^2-4E+1)U_0$ (or)
$=U_4-4U_3+6U_2-4U_1+U_0$</td><td>1

1</td><td rowspan="2">3</td></tr>
<tr><td></td><td>$\boldsymbol{\Delta^4 U_0=0}$
(Any other Alternate method award full marks)</td><td>1</td></tr>
<tr><td>35</td><td>
<table>
<tr><th rowspan="2">Stra tegy</th><th colspan="2">States of Nature</th><th rowspan="2">Minimum</th><th rowspan="2">Maximum</th></tr>
<tr><th>E_1</th><th>E_2</th></tr>
<tr><td>S_1</td><td>40</td><td>60</td><td>40</td><td>60</td></tr>
<tr><td>S_2</td><td>10</td><td>-20</td><td>-20</td><td>10</td></tr>
<tr><td>S_3</td><td>-40</td><td>150</td><td>-40</td><td>150</td></tr>
</table>
Maximin (40, -20, -40) = 40 S_1 is the best Strategy
Minimax (60, 10, 150) = 10 S_2 is the best Strategy</td><td>1

1
1</td><td>3</td></tr>
<tr><td>36</td><td>$p=0.4\ q=1-0.4=0.6, n=5$
i. $P(X=1)=0.2592$
ii. $P(X\geq 1)=1-P(X=0)\quad =0.9222$</td><td>1
1
1</td><td>3</td></tr>
<tr><td>37</td><td>n=100, $\bar{x}=7.4$, s=1.2
S.E = $\frac{\sigma}{\sqrt{n}}=\frac{1.2}{\sqrt{100}}=0.12$</td><td>1</td><td rowspan="3">3</td></tr>
<tr><td></td><td>$\bar{x}-z_{\alpha/2}\frac{\sigma}{\sqrt{n}}\leq\ \mu\leq\bar{x}+z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$</td><td>1</td></tr>
<tr><td></td><td>(7.165 $\boldsymbol{\leq\mu\leq 7.635}$)</td><td>1</td></tr>
<tr><td>38</td><td>$UCL=\bar{\bar{x}}+3\frac{\sigma}{\sqrt{n}}$
UCL = 0.534</td><td>1</td><td rowspan="3">3</td></tr>
<tr><td></td><td>CL=$\bar{\bar{x}}=0.532$</td><td>1</td></tr>
<tr><td></td><td>$LCL=\bar{\bar{x}}-3\frac{\sigma}{\sqrt{n}}$
=0.5293</td><td>1</td></tr>
</table>

39	$f(X) = F'(x) = \begin{cases} 4k(x-1)^3 & 1 \le x \le 3 \\ 0 & otherwise \end{cases}$	1	3
	$\boldsymbol{k = \frac{1}{16}}$	1	
	$f(x) = \frac{1}{4}(x-1)^3, 1 \le x \le 3$	1	
40		1	3
	$A = -\int_{-3}^{-1}(x+1)dx + \int_{-1}^{3}(x+1)dx$	1	
	= 10 sq. units	1	

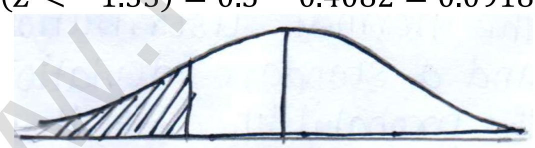
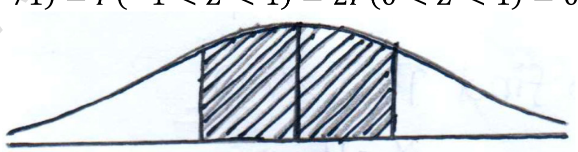
PART – IV

<table>
<tr><td>Q. No.</td><td>Answer all the questions.</td><td colspan="2">7×5=35</td></tr>
<tr><td>41 (a)</td><td>$x + y + z = 8500, \; 2x + 3y + 6z = 38000, \quad x + y - z = 0$</td><td>1</td><td rowspan="6">5</td></tr>
<tr><td></td><td>$\Delta = -2 \neq 0,$

$\Delta_x = -500, \; \Delta_y = -8000, \; \Delta_z = -8000$</td><td>1</td></tr>
<tr><td></td><td>$x = ₹\,250, \quad y = ₹\,4000, \; z = ₹\,4250$
(OR)</td><td>3</td></tr>
<tr><td>(b)</td><td>

x	Y	$X = x - 1998$	X^2	XY
1995	155	-3	9	-465
1996	162	-2	4	-324
1997	171	-1	1	-171
1998	182	0	0	0
1999	158	1	1	158
2000	180	2	4	360
2001	178	3	9	534
N=7	**1186**	**0**	**28**	**92**

</td><td>2</td></tr>
<tr><td></td><td>$a = \frac{\sum Y}{n} = \frac{1186}{7} = 169.428$
$b = \frac{\sum XY}{\sum X^2} = \frac{92}{28} = 3.2857$</td><td>1
1</td></tr>
<tr><td></td><td>$\mathbf{y = a + bX}, \quad \mathbf{y = 169.428 + 3.2857\,X}$</td><td>1</td></tr>
</table>

42 (a)	$\frac{4x^2+2x+6}{(x+1)^2(x-3)} = \frac{A}{x+1} + \frac{B}{(x+1)^2} + \frac{C}{x-3}$	**1**	5
	$\frac{4x^2+2x+6}{(x+1)^2(x-3)} = \frac{1}{x+1} - \frac{2}{(x+1)^2} + \frac{3}{x-3}$	**2**	
	$\int \frac{4x^2+2x+6}{(x+1)^2(x-3)} dx = \int \frac{dx}{x+1} - 2\int \frac{dx}{(x+1)^2} + \int \frac{3dx}{x-3}$	**1**	
	$\int \frac{4x^2+2x+6}{(x+1)^2(x-3)} dx = \log\lvert x+1 \rvert + 3\log\lvert x-3\rvert + \frac{2}{x+1} + c$	**1**	
	(OR)		
(b)	$\mu = 68, \quad \sigma = 3$ $z = \frac{x-\mu}{\sigma}$	1 1	
	$P(x > 72) = \frac{72-68}{3} = 1.33$ $P(Z > 1.33) = 0.5 - 0.4082 = 0.0918$  **Out of 500 students=0.0918×500 = 45.9 ≅ 46**	1	
	$P(X < 64) = P(Z < -1.33) = 0.5 - 0.4082 = 0.0918$  **Out of 500 students = 0.0918 × 500=45.9≅ 46**	1	
	$P(65 < X < 71) = P(-1 < Z < 1) = 2P(0 < Z < 1) = 0.6826$  **Out of 500 students= 0.6826 × 500 = 341.37≅342**	1	

<table>
<tr><td rowspan="5">43
(a)</td><td>$C(X) = 50x + \frac{x^2}{100} + 200$</td><td>1</td><td rowspan="7">5</td></tr>
<tr><td>$R(X) = 60x$</td><td>1</td></tr>
<tr><td>$P = R - C$
$P = 10x - \frac{x^2}{100} - 200$</td><td>1</td></tr>
<tr><td>$\frac{dP}{dx} = 0$ then $x = 500$ and $\frac{d^2P}{dx^2} = \frac{-1}{50} < 0$</td><td>1</td></tr>
<tr><td>Max. profit $P = 10(500) - \frac{(500)^2}{100} - 200$
$= ₹\,2300$
(OR)</td><td>1</td></tr>
<tr><td rowspan="2">(b)</td><td>**Total Demand = Total supply = 17**
Final Distribution:
<table>
<tr><td></td><td>D_1</td><td>D_2</td><td>D_2</td><td>D_4</td><td>Su.</td></tr>
<tr><td>O_1</td><td>(1) 2</td><td>(5) 3</td><td>11</td><td>7</td><td>6</td></tr>
<tr><td>O_2</td><td>1</td><td>0</td><td>6</td><td>(1) 1</td><td>1</td></tr>
<tr><td>O_3</td><td>(6) 5</td><td>8</td><td>(3) 15</td><td>(1) 9</td><td>10</td></tr>
<tr><td>De.</td><td>7</td><td>5</td><td>3</td><td>2</td><td></td></tr>
</table>
</td><td>1
3</td></tr>
<tr><td>Total transportation cost is
$= 2 + 15 + 1 + 30 + 45 + 9 = ₹\,102$</td><td>1</td></tr>
<tr><td>44
(a)</td><td>
$\frac{dy}{dx} = \frac{y^2 - 2xy}{x^2 - 2xy}$

$\left.\begin{array}{l} y = vx \\ \frac{dy}{dx} = v + x\frac{dv}{dx} \end{array}\right\}$

$x\frac{dv}{dx} = \frac{3v^2 - 3v}{1 - 2v}$

$\int \frac{(2v-1)dv}{v^2 - v} = -3\int \frac{dx}{x}$

$(y^2 - xy)x = c$

(OR)</td><td>1
1
1
1
1</td><td>5</td></tr>
</table>

44 (b)

p_0	q_0	p_1	q_1	p_0q_0	p_0q_1	p_1q_0	p_1q_1
40	5	48	4	200	160	240	192
45	2	42	3	90	135	84	126
90	4	95	6	360	540	380	570
85	3	80	2	255	170	240	160
50	5	65	8	250	400	325	520
65	1	72	3	65	195	72	216
Total				**1220**	**1600**	**1341**	**1784**

2

$$P_{01}^F = \left(\sqrt{\frac{\sum p_1q_0}{\sum p_0q_0} \times \frac{\sum p_1q_1}{\sum p_0q_1}}\right) \times 100 = \mathbf{110.706}$$

1

Time Reversal Test:

$$P_{01} \times P_{10} = \mathbf{1}$$

1

Factor Reversal Test:

$$P_{01} \times Q_{10} = \frac{\mathbf{1784}}{\mathbf{1220}} = \frac{\sum \mathbf{p_1q_1}}{\sum \mathbf{p_0q_0}}$$

1

∴It's satisfies both tests.

45 (a)

I = $\int_0^{\frac{\pi}{2}} \frac{sinx}{sinx+\cos x}$dx — 1

I = $\int_0^{\frac{\pi}{2}} \frac{cosx}{sinx+\cos x}$dx — 1

2I = $\int_0^{\frac{\pi}{2}} dx$ — 1

2I = $\frac{\pi}{2}$ — 1

I = $\frac{\pi}{4}$ — 1

5

(OR)

45 (b)

x	y	∇y	∇^2y	∇^3y
0	1			
		1		
1	2		1	
		2		0
2	4		1	
		3		0
3	7		1	
		4		0
4	11		1	
		5		0
5	16		1	
		6		**0**
6	22		**1**	
		7		
7	**29**			

(table above)	2	
$y = y_n + \frac{n}{1!}\nabla y_n + \frac{n(n+1)}{2!}\nabla^2 y_n + \frac{n(n+1)(n+2)}{3!}\nabla^3 y_n + \cdots$	1	
$x_n = 7, h = 1$ & $n = x - 7$	1	
$y = \frac{1}{2}(x^2 + x + 2)$	1	

46 (a)

$k = \frac{1}{10}$	**1**	5
$P(X < 6) = \frac{81}{100}$	**1**	
$P(X \geq 6) = \frac{19}{100}$	**1**	
$P(0 < X < 5) = \frac{4}{5}$	**1**	
The minimum value of x for which $P(X \leq x) > \frac{1}{2}$ is 4	**1**	

(OR)

46 (b)	$n = 400, \quad \overline{x} = 67.47$ $\mu = 67.39 \quad \sigma = 1.30$ $Null\ Hypothesis \quad : H_0 : \mu = 67.39$ $Alternate\ Hypothesis : H_1 : \mu \neq 67.39$ $\lvert z \rvert = 1.2308$ $\lvert z \rvert = 1.2308 < 1.96$ $H_0\ is\ accepted$	1 1 1 1 1	
47 (a)	$\mathbf{3m^2 + m - 14 = 0}$	1	5
	$\mathbf{C.F = Ae^{\frac{-7}{3}x} + Be^{2x}}$	1	
	$P.I_1 = \frac{-4}{14} = \frac{-2}{7}$ $P.I_2 = xe^{\frac{-7}{3}x}$	1 1	
	General solution $y = C.F. + P.I_1 + P.I_2$ $\mathbf{y = Ae^{\frac{-7}{3}x} + Be^{2x} + \frac{-2}{7} + xe^{\frac{-7}{3}x}}$ **(OR)**	1	
47 (b)	$\boldsymbol{n = 4, \quad p = 0.18, \quad q = 0.82}$	1	
	$P(X = x) = nC_x p^x q^{n-x}$ $(i)\ P(X = 1) = \mathbf{0.3969}$	2*	
	$(ii)\ P(X = 0) = \mathbf{0.45212}$	1	
	$(iii)\ P(X \leq 2) = 0.45212 + 0.3969 + 0.1307 = \mathbf{0.9797}$	1	