

DIRECTORATE OF GOVERNEMENT EXAMINATION, CHENNAI-6
HIGHER SECONDARY EXAMINATIONS (SECOND YEAR) MAY 2022
BUSINESS MATHEMATICS AND STATISTICS - ANSWER KEY

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.

20×1=20

Q.No	Option	Answer
1	(a)	2
2	(d)	Consistent and has a unique solution
3	(c)	$\frac{1}{2}$
4	(b)	MC-MR=0
5	(a)	$\frac{-1}{n_a}$
6	(d)	$\frac{9}{2}$
7	(b)	2 and 6
8	(b)	$x=vy$
9	(a)	$f(x+h) - f(x)$
10	(a)	$f(a) - f(a-h)$
11	(b)	zero
12	(a)	$\frac{1}{15}$
13	(c)	$2.5 e^{-1}$
14	(c)	$\frac{1}{81}$
15	(d)	finite subset
16	(d)	random sample
17	(a)	$\frac{\sigma}{\sqrt{n}}$
18	(a)	Either positive or negative
19	(b)	Fisher Index number
20	(d)	all of the above

PART – II

Answer any **Seven** questions. **Question No. 30** is compulsory.

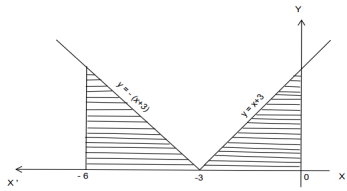
7×2=14

21	$ A =0$	1	2																						
	2×2 minor $\neq 0$ $\rho(A) = 2$ (or) Any other alternate methods	1																							
22	$f(x) = \int f'(x)dx + c$	1	2																						
	$f(x) = 2x^4 - x^2 - 20$	1																							
23	$y=mx$	1	2																						
	$\frac{dy}{dx} = m$																								
24	$(E^{-1}\Delta)x^3 = \nabla(x^3)$	1	2																						
	$\nabla(f(x) = f(x) - f(x - h))$	1																							
25	$n(S) = 36$	1	2																						
	<table border="1" style="margin: auto; border-collapse: collapse; text-align: center;"> <tbody> <tr> <td style="padding: 2px 5px;">X</td> <td style="padding: 2px 5px;">2</td> <td style="padding: 2px 5px;">3</td> <td style="padding: 2px 5px;">4</td> <td style="padding: 2px 5px;">5</td> <td style="padding: 2px 5px;">6</td> <td style="padding: 2px 5px;">7</td> <td style="padding: 2px 5px;">8</td> <td style="padding: 2px 5px;">9</td> <td style="padding: 2px 5px;">10</td> <td style="padding: 2px 5px;">11</td> <td style="padding: 2px 5px;">12</td> </tr> <tr> <td style="padding: 2px 5px;">$P(x)$</td> <td style="padding: 2px 5px;">$\frac{1}{36}$</td> <td style="padding: 2px 5px;">$\frac{2}{36}$</td> <td style="padding: 2px 5px;">$\frac{3}{36}$</td> <td style="padding: 2px 5px;">$\frac{4}{36}$</td> <td style="padding: 2px 5px;">$\frac{5}{36}$</td> <td style="padding: 2px 5px;">$\frac{6}{36}$</td> <td style="padding: 2px 5px;">$\frac{5}{36}$</td> <td style="padding: 2px 5px;">$\frac{4}{36}$</td> <td style="padding: 2px 5px;">$\frac{3}{36}$</td> <td style="padding: 2px 5px;">$\frac{2}{36}$</td> <td style="padding: 2px 5px;">$\frac{1}{36}$</td> </tr> </tbody> </table>	X		2	3	4	5	6	7	8	9	10	11	12	$P(x)$	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$
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$P(x)$	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$														
26	$E(X) = \sum x_i P(x_i)$ $E(X) = 1.8$	2*	2																						
27	$np=20, \sqrt{npq} = 4$ (or) $q = \frac{4}{5}, p = \frac{1}{5}$	1	2																						
	$n = 100$	1																							
28	Given $n=50, \sigma = 6$	1	2																						
	Standard Error = $\sqrt{\frac{\sigma^2}{2n}} = 0.6$	1																							
29	<ol style="list-style-type: none"> 1. It is an important tool for the formulating decision and management policies. 2. It helps in studying the trends and tendencies. 3. It determines the inflation and deflation in an economy. <p style="text-align: right;">(Any 2 points)</p>		2																						

30	Compulsory :					2	
	x	y	Δy	$\Delta^2 y$	$\Delta^3 y$		$\Delta^4 y$
	1	4					
			10				
	2	14		12			
			22		6		
	3	36		18			0
			40		6		
	4	76		24			
			64				
5	140						
	1 Mark	1 Mark					

PART - III

Answer any **Seven** questions. **Question No. 40** is compulsory. **7×3=21**

31	$(A \ B)T = (A \ B)$		3
	Where $A+B=1$	1	
	$A = 75\%$ (or) $\frac{3}{4}$ $B=25\%$ (or) $\frac{1}{4}$	1 1	
32	$I = \int_{-1}^1 \frac{(2x+3) dx}{x^2+3x+7}$	1	3
	$= [\log(x^2+3x+7)]_{-1}^1$	1	
	$= \log(11) - \log(5) = \log\left(\frac{11}{5}\right)$	1	
33		1	3
	$A = \int_a^b y dx$ (or)		
	$\int_{-6}^{-3} -(x+3) dx + \int_{-3}^0 (x+3) dx$ = 9 sq.units	1 1	
34	$(1-x)dy = (1+y)dx$	1	3
	$\int \frac{dy}{1+y} = \int \frac{dx}{1-x}$	1	
	$(1+y)(1-x) = c$ (Or) $(1+y)(x-1) = c$	1	

35	$\Delta^4 y_0 = 0$ (or) $(E - 1)^4 y_0 = 0$ $(y_4 - 4y_3 + 6y_2 - 4y_1 + y_0) = 0$ $y_3 = 31$	1 1 1	3												
36	I. $E(a) = a$ where a is a constant II. $E(ax) = aE(x)$ III. $E(ax+b) = aE(x)+b$ where a & b are constants IV. If $x \geq 0$ then $E(x) \geq 0$ V. $V(a)=0$ VI. $V(ax+b)=a^2 v(x)$ (Any three points)		3												
37	n , the number of trials is indefinitely large (ie) $n \rightarrow \infty$ p , the constant probability of success in each trial is very small $p \rightarrow 0$ $np = \lambda$ is finite ,where λ is a positive real number	1 1 1	3												
38	<table border="1" data-bbox="328 751 1052 1024"> <thead> <tr> <th>$P = \frac{p_1}{p_0} \times 100$</th> <th>PV</th> </tr> </thead> <tbody> <tr> <td>112</td> <td>1120</td> </tr> <tr> <td>121.43</td> <td>607.15</td> </tr> <tr> <td>113.33</td> <td>679.98</td> </tr> <tr> <td>140</td> <td>560</td> </tr> <tr> <td>105.88</td> <td>317.64</td> </tr> </tbody> </table> $\sum PV = 3284.77$ Cost of living index number = $\frac{\sum PV}{\sum V} = 117.31$	$P = \frac{p_1}{p_0} \times 100$	PV	112	1120	121.43	607.15	113.33	679.98	140	560	105.88	317.64	1 2*	3
$P = \frac{p_1}{p_0} \times 100$	PV														
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39	<table border="1" data-bbox="495 1150 885 1312"> <thead> <tr> <th>MINIMUM</th> <th>MAXIMUM</th> </tr> </thead> <tbody> <tr> <td>40</td> <td>60</td> </tr> <tr> <td>-20</td> <td>10</td> </tr> <tr> <td>-40</td> <td>150</td> </tr> </tbody> </table> Max (40,-20,-40) = 40 $\Rightarrow S_1$ Strategy S_1 is the best. Min (60,10,150) = 10 $\Rightarrow S_2$ Strategy S_2 is the best.	MINIMUM	MAXIMUM	40	60	-20	10	-40	150	1 1 1	3				
MINIMUM	MAXIMUM														
40	60														
-20	10														
-40	150														
40	Compulsory: <table border="1" data-bbox="495 1533 885 1711"> <tbody> <tr> <td>$X=x$</td> <td>6</td> <td>-3</td> </tr> <tr> <td>$P(X=x)$</td> <td>$\frac{1}{2}$</td> <td>$\frac{1}{2}$</td> </tr> </tbody> </table> $E(X) = \frac{3}{2}$ $Var(X) = \frac{81}{4}$	$X=x$	6	-3	$P(X=x)$	$\frac{1}{2}$	$\frac{1}{2}$	1 1 1	3						
$X=x$	6	-3													
$P(X=x)$	$\frac{1}{2}$	$\frac{1}{2}$													

PART – IV Answer all the questions.

7×5=35

41 (a)	$x+y+z=5000, 6x+7y+8z=35800, 6x+7y-8z=7000$	1	5
	$(A, B) \sim \begin{bmatrix} 1 & 1 & 1 & 5000 \\ 6 & 7 & 8 & 35800 \\ 6 & 7 & -8 & 7000 \end{bmatrix}$	1	
	$\sim \begin{bmatrix} 1 & 1 & 1 & 5000 \\ 0 & 1 & 2 & 5800 \\ 0 & 0 & -16 & -28800 \end{bmatrix} R_3 \rightarrow R_3 - R_2$	1	
	$x = ₹1000, y = ₹2200, z = ₹1800$ (OR)	2	
41 (b)	(i) $k = \frac{1}{10}$	1	
	(ii) $P(x < 6) = \frac{81}{100}$	1	
	$P(x \geq 6) = \frac{19}{100}$	1	
	$P(0 < x < 5) = \frac{8}{10}$	1	
	(iii) The minimum value of $x = 4$	1	
42 (a)	$u' = 3x^2 ; v_1 = \frac{e^{3x}}{9}$	1	5
	$u'' = 6x ; v_2 = \frac{e^{3x}}{27}$	1	
	$u''' = 6 ; v_3 = \frac{e^{3x}}{81}$	1	
	$\int x^3 e^{3x} dx = x^3 \left(\frac{e^{3x}}{3}\right) - 3x^2 \left(\frac{e^{3x}}{9}\right) + 6x \left(\frac{e^{3x}}{27}\right) + c$ (or) $= e^{3x} \left(\frac{x^3}{3} - \frac{x^2}{3} + \frac{2x}{9} - \frac{2}{27}\right) + c$ (OR)	2*	
42 (b)	$P(X=x) = nC_x p^x q^{n-x}, x = 0, 1, 2, 3, \dots, n$	1	
	$n = 4, p = \frac{18}{100}$ (or) 0.18, $q = \frac{82}{100}$ (or) 0.82	1	
	(i) $P(x=1) \approx 0.3969$	1	
	(ii) $P(x=0) \approx 0.4521$	1	
	(iii) $P(x \leq 2) \approx 0.9797$	1	
43 (a)	$\eta_d = \frac{p+2p^2}{100-p-p^2}$	1	5
	$\frac{-p}{x} \left(\frac{dx}{dp}\right) = \frac{p+2p^2}{100-p-p^2}$		
	$\int \frac{dx}{x} = \int \frac{2p+1}{p^2+p-100} dp$		
	$x = k(p^2 + p - 100)$		
	$k = -1$		
	Demand function $x = 100 - p - p^2$ (OR)	1	

43 (b)	$\sigma = 1.6, n = 64, \bar{X} = 90$	1																																									
	$\bar{X} - Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{X} + Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$	1																																									
	$SE = \frac{\sigma}{\sqrt{n}} = 0.2$	1																																									
	$89.61 \leq \mu \leq 90.39$ (or) $(89.61, 90.39)$	1																																									
	Conclusion : Customer will accept the component.	1																																									
44 (a)	$\frac{dy}{dx} = \frac{-(y^3 - 2yx^2)}{2xy^2 - x^3}$	1																																									
	$y = vx, \frac{dy}{dx} = v + x \frac{dv}{dx}$ $\int (\frac{1}{v} + \frac{1/2}{v+1} + \frac{1/2}{v-1}) dv = -3 \int \frac{dx}{x}$ $yx\sqrt{y^2 - x^2} = c$	1 1 1																																									
	Curve passes through (1,2) $\therefore c = 2\sqrt{3}$ solution : $yx\sqrt{y^2 - x^2} = 2\sqrt{3}$ (or) $x^2y^2(y^2 - x^2) = 12$ (OR)	1																																									
44 (b)	<table border="1"> <thead> <tr> <th>Quarter</th> <th>I</th> <th>II</th> <th>III</th> <th>IV</th> </tr> </thead> <tbody> <tr> <td>Total</td> <td>1463</td> <td>1872</td> <td>2170</td> <td>2321</td> </tr> <tr> <td>Averages</td> <td>243.83</td> <td>312</td> <td>31.67</td> <td>386.83</td> </tr> </tbody> </table>	Quarter	I	II	III	IV	Total	1463	1872	2170	2321	Averages	243.83	312	31.67	386.83	1	5																									
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	Grand Average = 326.0825																																										
	S.I. for I Quarter = $\frac{243.83}{326.0825} \times 100 = 74.77$	1																																									
S.I. for II Quarter = $\frac{312}{326.0825} \times 100 = 95.68$	1																																										
S.I. for III Quarter = $\frac{361.67}{326.0825} \times 100 = 110.91$	1																																										
S.I. for IV Quarter = $\frac{386.83}{326.0825} \times 100 = 118.63$	1																																										
45 (a)	Transition Matrix $T = \begin{matrix} & A & B \\ A & (0.65 & 0.35) \\ B & (0.45 & 0.55) \end{matrix}$	1	5																																								
	Market shares after one year = $\begin{pmatrix} 0.48 & 0.52 \end{pmatrix}$ A Soap = 48% , B Soap = 52%	1																																									
	At equilibrium, $\begin{pmatrix} A & B \end{pmatrix} \begin{pmatrix} 0.65 & 0.35 \\ 0.45 & 0.55 \end{pmatrix} = \begin{pmatrix} A & B \end{pmatrix}$	1																																									
	A's share = 56.25 %	1																																									
	B's share = 43.75 % (OR)	1																																									
45 (b)	<table border="1"> <thead> <tr> <th>x</th> <th>y</th> <th>Δy</th> <th>$\Delta^2 y$</th> <th>$\Delta^3 y$</th> </tr> </thead> <tbody> <tr> <td>1951</td> <td>35</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>7</td> <td></td> <td></td> </tr> <tr> <td>1961</td> <td>42</td> <td></td> <td>9</td> <td></td> </tr> <tr> <td></td> <td></td> <td>16</td> <td></td> <td>1</td> </tr> <tr> <td>1971</td> <td>58</td> <td></td> <td>10</td> <td></td> </tr> <tr> <td></td> <td></td> <td>26</td> <td></td> <td></td> </tr> <tr> <td>1981</td> <td>84</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	1951	35						7			1961	42		9				16		1	1971	58		10				26			1981	84				2	
	x	y	Δy	$\Delta^2 y$	$\Delta^3 y$																																						
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	$X_0 = 1951, h = 10, n = 0.4$ Newton's Formula (or) $y = 35 + \frac{0.4}{1}(7) + \frac{(0.4)(-0.6)}{2}(9) + \frac{(0.4)(-0.6)(-1.6)}{6}(1)$ $y = 36.784$ Lakhs	1 1 1																															
46 (a)	$\frac{3x^2+6x+1}{(x+3)(x^2+1)} = \frac{A}{x+3} + \frac{Bx+C}{x^2+1}$	1	5 Marks																														
	$\int \frac{3x^2+6x+1}{(x+3)(x^2+1)} dx = \int \left(\frac{1}{x+3} + \frac{2x}{x^2+1} \right) dx$	2																															
	$= \log x+3 + \log x^2+1 + C$	1																															
	$= \log (x+3)(x^2+1) + C$ (or) $\log x^3+3x^2+x+3 + C$	1																															
	(ALTERNATE METHOD)																																
	$f(x) = (x+3)(x^2+1) = x^3+3x^2+x+3$	1																															
	$f'(x) = 3x^2+6x+1$	1																															
	$\int \frac{f'(x)}{f(x)} dx = \log f(x) + c$	1																															
$\int \frac{3x^2+6x+1}{(x^3+3x^2+x+3)} dx = \log x^3+3x^2+x+3 + C$ (OR)	2																																
46 (b)	Demand = Supply = 90	1	5 Marks																														
	Final Allocation :																																
	<table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>D₁</th> <th>D₂</th> <th>D₃</th> <th>D₄</th> <th></th> </tr> </thead> <tbody> <tr> <td>O₁</td> <td>(16) 5</td> <td>(3) 3</td> <td>6</td> <td>2</td> <td>19/3/0</td> </tr> <tr> <td>O₂</td> <td>4</td> <td>(15) 7</td> <td>(22) 9</td> <td>1</td> <td>37/22</td> </tr> <tr> <td>O₃</td> <td>3</td> <td>4</td> <td>(9) 7</td> <td>(25) 5</td> <td>34/25/0</td> </tr> <tr> <td></td> <td>16/0</td> <td>18/15/0</td> <td>31/9</td> <td>25/0</td> <td></td> </tr> </tbody> </table>			D ₁	D ₂	D ₃	D ₄		O ₁	(16) 5	(3) 3	6	2	19/3/0	O ₂	4	(15) 7	(22) 9	1	37/22	O ₃	3	4	(9) 7	(25) 5	34/25/0		16/0	18/15/0	31/9	25/0		2
		D ₁		D ₂	D ₃	D ₄																											
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	16/0	18/15/0	31/9	25/0																													
Total transportation cost = 80+9+105+198+63+125 = ₹ 580	1 1																																
47 (a)	$p_d = p_s$ (or) $x_0 = 4, p_0 = 13$ $cs = \int_0^{x_0} f(x) dx - p_0 x_0 = \int_0^4 (25 - 3x) dx - 52 = 24$ units $ps = p_0 x_0 - \int_0^{x_0} g(x) dx = 52 - \int_0^4 (5 + 2x) dx = 16$ units	1 2* 2*																															
	47 (b) $\sum p_0 q_0 = 1200 \quad \sum p_0 q_1 = 973 \quad \sum p_1 q_0 = 1280$ $\sum p_1 q_1 = 1040$	2	5																														
(i) Laspeyre's price index number $P_{01}^L = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$ $P_{01}^L = 106.67$	1																																
(ii) Paasche's price index number $P_{01}^P = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$ $P_{01}^P = 106.89$	1																																
(ii) Fisher's price index number $P_{01}^F = \sqrt{P_{01}^L \times P_{01}^P}$ $P_{01}^F = 106.78$	1																																