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)	$\frac{-1}{\eta_d}$
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**

<table>
<tr><td rowspan="2">21</td><td>|A|=0</td><td>1</td><td rowspan="2">2</td></tr>
<tr><td>2X2 minor $\neq 0$
$\rho(A) = 2$ (o) Any other alternate methods</td><td>1</td></tr>
<tr><td rowspan="2">22</td><td>$f(x) = \int f'(x)dx + c$</td><td>1</td><td rowspan="2">2</td></tr>
<tr><td>$f(x) = 2x^4 - x^2 - 20$</td><td>1</td></tr>
<tr><td rowspan="2">23</td><td>y=mx
$\frac{dy}{dx} = m$</td><td>1</td><td rowspan="2">2</td></tr>
<tr><td>$y = x\frac{dy}{dx}$</td><td>1</td></tr>
<tr><td rowspan="2">24</td><td>$(E^{-1}\Delta)x^3 = \nabla(x^3)$
$\nabla(f(x) = f(x) - f(x-h)$</td><td>1</td><td rowspan="2"></td></tr>
<tr><td>$^2 - 3x + 1$</td><td>1</td></tr>
<tr><td rowspan="2">25</td><td>n(S) =36</td><td>1</td><td rowspan="2">2</td></tr>
<tr><td><table>
<tr><td>X</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr>
<tr><td>P(X</td><td>$\frac{1}{36}$</td><td>$\frac{2}{36}$</td><td>$\frac{3}{36}$</td><td>$\frac{4}{36}$</td><td>$\frac{5}{36}$</td><td>$\frac{6}{36}$</td><td>$\frac{5}{36}$</td><td>$\frac{4}{36}$</td><td>$\frac{3}{36}$</td><td>$\frac{2}{36}$</td><td>$\frac{1}{36}$</td></tr>
</table></td><td>1</td></tr>
<tr><td>26</td><td>$E(X) = \sum x_i P(x_i)$
E(X) = 1.8</td><td>2*</td><td>2</td></tr>
<tr><td rowspan="2">27</td><td>np=20, $\sqrt{npq} = 4$ (or) q = $\frac{4}{5}$, p =$\frac{1}{5}$</td><td>1</td><td rowspan="2">2</td></tr>
<tr><td>n =100</td><td>1</td></tr>
<tr><td>28</td><td>Given n=50, $\sigma = 6$
Standard Error = $\sqrt{\frac{\sigma^2}{2n}}$ =0.6</td><td>1
1</td><td>2</td></tr>
<tr><td>29</td><td colspan="2">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.
(Any 2 points)</td><td>2</td></tr>
</table>

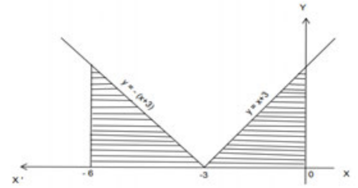
30 **Compulsory :**

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			

2

PART - III

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

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

<table>
<tr><td>35</td><td>$\Delta^4 y_0 = 0 \quad (or) \quad (E-1)^4 y_0 = 0$
$(y_4 - 4y_3 + 6y_2 - 4y_1 + y_0) = 0$
$y_3 = 31$</td><td>1
1
1</td><td>3</td></tr>
<tr><td>36</td><td colspan="2">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≥0 then E(x) ≥0
V. V(a)=0
VI. V(ax+b)=a^2 v(x) (Any three points)</td><td>3</td></tr>
<tr><td>37</td><td>n, the number of trials is indefinitely large (ie) n $\longrightarrow \infty$
p, the constant probability of success in each trial is very small p $\longrightarrow$ 0
np = λ is finite ,where λ is a positive real number</td><td>1
1
1</td><td>3</td></tr>
<tr><td>38</td><td><table>
<tr><th>$P = \frac{p_1}{p_0} X100$</th><th>PV</th></tr>
<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>
</table>
$\sum PV = 3284.77$
Cost of living index number = $\frac{\sum PV}{\sum V}$ =117.31</td><td>1
2*</td><td>3</td></tr>
<tr><td>39</td><td><table>
<tr><th>MINIMUM</th><th>MAXIMUM</th></tr>
<tr><td>40</td><td>60</td></tr>
<tr><td>-20</td><td>10</td></tr>
<tr><td>-40</td><td>150</td></tr>
</table>
Max (40,-20,-40) = 40 $\Longrightarrow$ S_1
Strategy S_1 is the best.
Min (60,10,150) = 10 $\Longrightarrow$ S_2
Strategy S_2 is the best.</td><td>1
1
1</td><td>3</td></tr>
<tr><td>40</td><td>Compulsory:<table>
<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>
</table>
$E(X) = \frac{3}{2}$
$Var(X) = \frac{81}{4}$</td><td>1
1
1</td><td>3</td></tr>
</table>

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	
	$\sim\begin{bmatrix}1 & 1 & 1 & 5000\\ 0 & 1 & 2 & 5800\\ 0 & 0 & -16 & -28800\end{bmatrix}$ $R_3 \to R_3 - R_2$	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…..n	1	
	n =4 , p = $\frac{18}{100}$ (or) 0.18 , q = $\frac{82}{100}$ (or) 0.82	1	
	(i) P(x=1) ≈ 0.3969	1	
	(ii) P(x=0) ≈ 0.4521	1	
	(iii) P(x≤2) ≈ 0.9797	1	
43 (a)	$\eta_d = \frac{p+2p^2}{100-p-p^2}$ $\frac{-p}{x}\left(\frac{dx}{dp}\right) = \frac{p+2p^2}{100-p-p^2}$	1	5
	$\int \frac{dx}{x} = \int \frac{2p+1}{p^2+p-100}\,dp$	1	
	$x = k\,(p^2 + p - 100)$	1	
	k = -1	1	
	Demand function $x = 100 - p - p^2$ **(OR)**	1	

<table>
<tr><td rowspan="4">43
(b)</td><td>$\sigma = 1.6$, n = 64, $\bar{X}$ = 90</td><td>1</td><td rowspan="4"></td></tr>
<tr><td>$\bar{X} - Z_{\frac{\propto}{2}}\frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{X} + Z_{\frac{\propto}{2}}\frac{\sigma}{\sqrt{n}}$
$SE = \frac{\sigma}{\sqrt{n}} = 0.2$</td><td>1
1</td></tr>
<tr><td>89.61 ≤ μ ≤ 90.39 (or) (89.61,90.39)</td><td>1</td></tr>
<tr><td>Conclusion : Customer will accept the component.</td><td>1</td></tr>
<tr><td rowspan="2">44
(a)</td><td>$\frac{dy}{dx} = \frac{-(y - 2yx^2)}{2xy^2 - x^3}$
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$\int\frac{dx}{x}$
y$x\sqrt{y^2 - x^2} = c$</td><td>1
1
1
1</td><td rowspan="7">5</td></tr>
<tr><td>Curve passes through (1,2) $\therefore c = 2\sqrt{3}$
solution :y$x\sqrt{y^2 - x^2} = 2\sqrt{3}$ (or) $\boldsymbol{x^2y^2(y^2 - x^2) = 12}$
(OR)</td><td>1</td></tr>
<tr><td rowspan="5">44
(b)</td><td><table><tr><td>Quarter</td><td>I</td><td>II</td><td>III</td><td>IV</td></tr><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></table>Grand Average = 326 0825</td><td>1</td></tr>
<tr><td>S.I. for I Quarter =$\frac{243\ 83}{326\ 0825}$ x 100 = 74.77</td><td>1</td></tr>
<tr><td>S.I. for I Quarter = $\frac{312}{326.0825}$ x 100 = 95.68</td><td>1</td></tr>
<tr><td>S.I. for III Quarter = $\frac{361.67}{326.0825}$ x 100 = 110.91</td><td>1</td></tr>
<tr><td>S.I. for IV Quarter = $\frac{386.83}{326.0825}$ x 100 = 118.63</td><td>1</td></tr>
<tr><td>45
(a)</td><td>Transition Matrix T = $\begin{array}{c c} & \begin{array}{cc} A & B \end{array} \\ \begin{array}{c} A \\ B \end{array} & \begin{pmatrix} 0.65 & 0.35 \\ 0.45 & 0.55 \end{pmatrix} \end{array}$
Market shares after one year = $\begin{array}{c} \begin{array}{cc} A & B \end{array} \\ (0.48 \quad 0.52) \end{array}$
A Soap = 48% , B Soap = 52%
At equilibrium, $(A \quad B)\begin{pmatrix} 0.65 & 0.35 \\ 0.45 & 0.55 \end{pmatrix}$= $(A \quad B)$
A’s share = 56.25 %
B’s share = 43.75 % (OR)</td><td>1
1
1
1
1</td><td>5</td></tr>
<tr><td>45
(b)</td><td><table><tr><td>x</td><td>y</td><td>Δy</td><td>$\Delta^2 y$</td><td>$\Delta^3 y$</td></tr><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></table></td><td>2</td><td></td></tr>
</table>

<table>
<tr><td></td><td>$X_0 = 1951$, $h = 10$, $n= 0.4$
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</td><td>1

1
1</td><td></td></tr>
<tr><td rowspan="8">46
(a)</td><td>$\frac{3x^2+6x+1}{(x+3)(x^2+1)} = \frac{A}{x+3} + \frac{Bx+C}{x^2+1}$
$\int \frac{3x^2+6x+1}{(x+3)(x^2+1)}dx = \int \left(\frac{1}{x+3} + \frac{2x}{x^2+1}\right)dx$</td><td>1
2</td><td rowspan="12">5
Marks</td></tr>
<tr><td>$= \log|x+3| + \log|x^2+1| + C$</td><td>1</td></tr>
<tr><td>$= \log|(x+3)(x^2+1)|+C$ (or) $\log|x^3+3x^2+x+3| + C$</td><td>1</td></tr>
<tr><td colspan="2">(ALTERNATE METHOD)</td></tr>
<tr><td>$f(x) = (x+3)(x^2+1) = x^3+3x^2+x+3$</td><td>1</td></tr>
<tr><td>$f'(x) = 3x^2+6x+1$</td><td>1</td></tr>
<tr><td>$\int \frac{f'(x)}{f(x)}dx = \log|f(x)| + c$</td><td>1</td></tr>
<tr><td>$\int \frac{3x^2+6x+1}{(x^3+3x^2+x+3)}dx = \log|x^3+3x^2+x+3| + C$ (OR)</td><td>2</td></tr>
<tr><td rowspan="4">46
(b)</td><td>Demand = Supply = 90</td><td>1</td></tr>
<tr><td>Final Allocation :<table>
<tr><td></td><td>D_1</td><td>D_2</td><td>D_3</td><td>D_4</td><td></td></tr>
<tr><td>O_1</td><td>(16)
5</td><td>(3)
3</td><td>6</td><td>2</td><td>19/3/0</td></tr>
<tr><td>O_2</td><td>4</td><td>(15)
7</td><td>(22)
9</td><td>1</td><td>37/22</td></tr>
<tr><td>O_3</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>
</table></td><td>2</td></tr>
<tr><td>Total transportation cost = 80+9+105+198+63+125</td><td>1</td></tr>
<tr><td>= ₹ 580</td><td>1</td></tr>
<tr><td>47
(a)</td><td>$p_d = p_s$ (or) $x_0 = 4, p_0 = 13$
$cs = \int_0^{x_0} f(x)dx - p_0x_0 = \int_0^4 (25-3x)dx - 52 = 24$ units
$ps = p_0x_0 - \int_0^{x_0} g(x)dx = 52 - \int_0^4 (5+2x)dx = 16$ units</td><td>1
2*
2*</td><td rowspan="2">5</td></tr>
<tr><td>47
(b)</td><td>$\sum p_0 q_0 = 1200$ $\sum p_0 q_1 = 973$ $\sum p_1 q_0 = 1280$ $\sum p_1 q_1 = 1040$
(i)Laspeyre's price index number $P_{01}^{L} = \frac{\sum p_1q_0}{\sum p_0q_0} X100$
$P_{01}^{L} = 106.67$
(ii)Paasche's price index number $P_{01}^{P} = \frac{\sum p_1q_1}{\sum p_0q_1} X100$
$P_{01}^{P} = 106.89$
(ii)Fisher's price index number $P_{01}^{F} = \sqrt{P_{01}^{L} x P_{01}^{P}}$
$P_{01}^{F} = 106.78$</td><td>2

1

1

1</td></tr>
</table>