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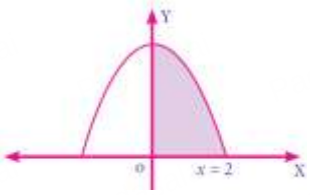
COMMON PUBLIC EXAMINATION –MARCH –2020

XII – BUSINESS MATHEMATICS AND STATISTICS **TENTATIVE ANSWER KEY**

Q.No	PART – I	MARKS
1.	(a) 3	1
2.	(c) $R_i \to 2R_i + 2C_j$	1
3.	(b) 0	1
4.	(a) 9	1
5.	(a) $2\sqrt{1+e^x}+C$	1
6.	(d) 2 sq.units	1
7.	(b) $\frac{200}{3}x^{1/2}$	1
8.	(b) 2 and 1	1
9.	(a) xe^{2x}	1
10.	(b) $y_2 - 2y_1 + y_0$	1
11.	(a) 3.045,3.8,3.85	1
12.	(b) $\frac{1}{15}$	1
13.	(c) $2.5e^{-1}$	1
14.	(b) –2.33	1
15.	(c) $\frac{1}{N}$	1
16.	(a) Accept H_0 when it is false	1
17.	(b) y = T×S×C×I	1
18.	(d) 2	1
19.	(d) unbalanced	1
20.	(b) Equal to m+n-1	1
	PART – II	
21.	The equation is 11x +3y = 64 ; 8x +3y = 49 $\Delta = \begin{vmatrix} 11 & 3 \\ 8 & 3 \end{vmatrix} = 9$; $\Delta_x = \begin{vmatrix} 64 & 3 \\ 49 & 3 \end{vmatrix} = 45$; $\Delta_y = \begin{vmatrix} 11 & 64 \\ 8 & 49 \end{vmatrix} = 27$ x = 5 ; y = 3	1 1
22.	$\int \frac{\cos 2x + 2\sin^2 x}{\cos^2 x}\,dx = \int \frac{\cos^2 x - \sin^2 x + 2\sin^2 x}{\cos^2 x}\,dx$ $= \int \sec^2 x\,dx$ $= \tan x + c$	1 1

23. $\text{Area} = \int_0^2 (4 - x^2)\, dx$

$= \left[4x - \frac{x^3}{3} \right]_0^2 = \frac{16}{3}$ sq.units



2

24. The equation is y = mx

Diff w.r.to x

$\frac{dy}{dx} = m$ — 1

The differential equation is $y = \frac{dy}{dx} x$ (or) ydx-xdy = 0 — 1

25. (i) $f(x) \geq 0, \forall x$ — 1

(ii) $\int_{-\infty}^{\infty} f(x)\, dx = 1$ — 1

26. Given np = 20 ; npq = 16

$\frac{npq}{np} = \frac{16}{20} \Rightarrow q = \frac{4}{5}$

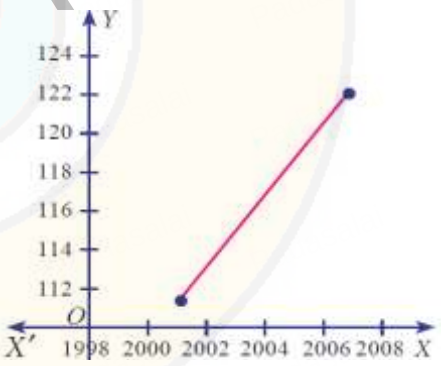
$\therefore p = \frac{1}{5}$ and n = 100 — 2

27. (i) Estimation — 1

(ii) Testing of Hypothesis — 1

28. Graph — 1

year	production	Average
2000	105	113.33
2001	115	
2002	120	
2003	100	Left out
2004	110	123.33
2005	125	
2006	135	



1

29. (i) Maximin = Max (40,-20,-40) = 40

The best strategy is S_1 — 1

(ii) Minimax = Mini (60,10,150) = 10

The best strategy is S_2 — 1

30. Given $x_0 = 0,\ x_1 = 1, x_2 = 2;\ y_0 = 0,\ y_1 = 1,\ y_2 = 20$

$y = \frac{(x - x_1)(x - x_2)}{(x_0 - x_1)(x_0 - x_2)} y_0 + \frac{(x - x_0)(x - x_2)}{(x_1 - x_0)(x_1 - x_2)} y_1 + \frac{(x - x_0)(x - x_1)}{(x_2 - x_0)(x_2 - x_1)} y_2$

$y = 0 - x(x-2) + 10x(x-1)$

$y = x(9x-8)$ (or) $y = 9x^2 - 8x$ — 2

PART – III

31. $AB = \begin{pmatrix} -6 & 1 & -2 \\ 28 & -12 & 20 \\ 22 & -11 & 18 \end{pmatrix}$ — 1

$|AB| = 0 \quad \therefore$ The rank of AB is ≤ 2 — 1

Atlest one (2×2) minor of AB is $\neq 0$, Hence Rank of AB is 2 — 1

32.

$$\int \frac{1}{\sqrt{x^2+6x+13}}\,dx = \int \frac{1}{\sqrt{(x+3)^2+4}}\,dx$$

$$= \log\left|(x+3)+\sqrt{x^2+6x+13}\right| + c$$

1

2

33.

$\frac{dp}{dt} = 0.05p \Rightarrow p = ce^{0.05t}$

when t=0; p=2000 $\Rightarrow$ c = 2000 $\therefore$ $p = 2000e^{0.05t}$

when p=4000 $\Rightarrow$ $t = \frac{\log 2}{0.05} = \frac{0.6931}{0.05} \approx 14$ years

1

1

1

34.

$\Delta^4 y_0 = 0 \Rightarrow (E-1)^4 y_0 = 0$

$y_4 - 4y_3 + 6y_2 - 4y_1 + y_0 = 0$

$67.4 - 4y_3 + 6(54.1) - 4(4.2) + 45 = 0$

$y_3 = 60.05$

1

1

1

35.

$E(x) = \sum x_i p_i = 200$

$E(x^2) = \sum x_i^2 p_i = 2200000$

$Var(x) = E(x^2) - E[x]^2 = 2160000$

$S.D = \sqrt{2160000} = 1469.69$

x	-1000	2000
P(x)	0.6	0.4

1

1

1

36.

(i) The curve is bell-shaped and symmetrical about the line $x = \mu$

(ii) Mean, median and mode of the distribution coincide

(iii) The curve of a normal distribution has a single peak

(Any 3 point)

3

37.

$P = \frac{1}{3}; Q = \frac{2}{3}$

S.E for sample proportion = $\sqrt{\frac{PQ}{n}} = \sqrt{\frac{(1/2)(1/2)}{9000}} = 0.00496$

1

2

38.

Year	Sales	4 yearly centered moving total	4 yearly moving Average	4 yearly centered moving Average
2001	124			
2002	120	519	129.75	
2003	135	540	135.00	132.37
2004	140	578	144.50	139.75
2005	145	605	151.25	147.87
2006	158	635	158.75	155.00
2007	162	665	166.25	162.50
2008	170			
2009	175			

3

39.

The assignment model can be written in LPP as follows:

Minimize $z = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij}x_{ij}$

1

Subject to constraints:

$\sum_{i=1}^{m} x_{ij} = 1, j = 1,2,3,.....n$; $\sum_{j=1}^{n} x_{ij} = 1, i = 1,2,3,.....m$ and

x_{ij}=0 (or) 1 for all i,j.

2

40.

$e^{-4}=0.018 \Rightarrow e^{4}=55.55$

Total sale during first 4 days $= \int_0^4 (100+2x^2)\, e^x dx = 100\int_0^4 e^x\, dx + 2\int_0^4 x^2 e^x dx$ — 1

$= 100\left(e^4-1\right)+2\left(10e^4-2\right) \approx$ Rs. 6564 — 2

PART – IV

41.(a)

$C'(x) = 50+\frac{x}{50} \Rightarrow C(x) = 50x+\frac{x^2}{100}+k_1$

$R'(x) = 60 \Rightarrow R(x) = 60x+k_2$ — 1

when x=0, C=200 $\Rightarrow k_1 = 200$ and when x=0, R= 0 $\Rightarrow k_2 = 0$

$P(x) = R(x) - C(x) = 10x - \frac{x^2}{100} - 200$ — 1

$P'(x) = 10-\frac{x}{50}$; $P''(x) = -\frac{1}{50}$ — 1

$P'(x) = 0 \Rightarrow x=500$

when $x=500 \Rightarrow P''(x)<0$ $\therefore$ profit is maximum — 1

$\therefore$ maximum profit = P = Rs. 2300 — 1

41.(b)

$\sum p_0q_0 = 1560,\ \sum p_0q_1 = 1344,\ \sum p_1q_0 = 2140,\ \sum p_1q_1 = 1880$ — 2

Fisher's Ideal Index:

$$P_{01}^{\ F} = \sqrt{\frac{\sum p_1q_0 \times \sum p_1q_1}{\sum p_0q_0 \times \sum p_0q_1}} \times 100 = \sqrt{\frac{2140\times1880}{1560\times1344}} \times 100 = 138.5$$ — 1

Time reversal Test: $P_{01} \times P_{10} = \sqrt{\frac{\sum p_1q_0 \times \sum p_1q_1 \times \sum p_0q_1 \times \sum p_0q_0}{\sum p_0q_0 \times \sum p_0q_1 \times \sum p_1q_1 \times \sum p_1q_0}} = 1$ — 1

Factor reversal Test:

$$P_{01} \times Q_{01} = \sqrt{\frac{\sum p_1q_0 \times \sum p_1q_1 \times \sum p_0q_1 \times \sum p_1q_1}{\sum p_0q_0 \times \sum p_0q_1 \times \sum p_0q_0 \times \sum p_1q_0}} = \frac{1880}{1560} = \frac{\sum p_1q_1}{\sum p_0q_0}$$ — 1

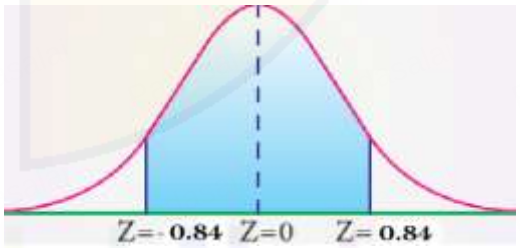
42.(a)

$\mu = 40,\ \sigma = 25$

From the normal table — 1

$z_1 = -0.84,\ z_2 = 0.84$

$z_1 = -0.84 \Rightarrow \frac{x-40}{25} = -0.84 \Rightarrow x = 19$ — 2



$z_2 = 0.84 \Rightarrow \frac{x-40}{25} = 0.84 \Rightarrow x = 61$ — 1

$\therefore$ 60 % of the candidate score between 19 and 61 — 1

42.(b)

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$
0	2			
		2		
1	4		2	
		4		6
2	8		8	
		12		
3	20			

— 2

$f(x) = y = y_0 + \frac{n}{1!}\Delta y_0 + \frac{n(n-1)}{2!}\Delta^2 y_0 + \frac{n(n-1)(n-2)}{3!}\Delta^3 y_0 + \ldots\ldots\ ;\ n = \frac{x-x_0}{h} = x$

$= 2+\frac{x}{1!}(2)+\frac{x(x-1)}{2!}(2)+\frac{x(x-1)(x-2)}{3!}(6)$

$f(x) = x^3-2x^2+3x+2$ — 2

$f'(x) = 3x^2-4x+3$ — 1

43.(a) Since f(x) is p.d.f

(i) $\int_{-\infty}^{\infty} f(x)dx=1 \Rightarrow \int_{0}^{10} Ax\,dx+\int_{10}^{20} A(20-x)\,dx=1 \Rightarrow A=\frac{1}{100}$ — 2

(ii) (a) $P(10 \le x \le 20) = \int_{10}^{20} \frac{1}{100}(20-x)dx = 0.5$ — 1

(b) $P(0 \le x < 10) = \int_{0}^{10} \frac{1}{100}\,x\,dx = 0.5$ — 1

(c) $P(5 \le x \le 15) = \int_{5}^{10} \frac{1}{100}\,x\,dx+\int_{10}^{15} \frac{1}{100}\,(20-x)\,dx = 0.75$ — 1

43.(b)

$$[A|B]=\begin{bmatrix}1&1&1&6\\1&2&3&10\\1&2&a&b\end{bmatrix} \sim \begin{bmatrix}1&1&1&6\\0&1&2&4\\0&0&a-3&b-10\end{bmatrix} \begin{matrix}\\R_2\to R_2-R_1\\R_3\to R_3-R_1\end{matrix}$$ — 2

(i) No solution $a=3, b\neq 0$ — 1

(ii) a unique solution $a\neq 3, b\in R$ — 1

(iii) a infinite number of solution $a=3, b=10$ — 1

44.(a)

$I=\int \frac{x}{2x^4-3x^2-2}\,dx=\int \frac{x}{(x^2-2)(2x^2+1)}\,dx$

Put $t=x^2$; $dt = 2x\,dx$

$I=\frac{1}{2}\int \frac{dt}{(t-2)(2t+1)} =\frac{1}{2}\int\left(\frac{A}{t-2}+\frac{B}{2t+1}\right)dt$ — 2

By partial fraction $A=\frac{1}{5}$; $B=\frac{-2}{5}$ — 1

$\therefore I=\frac{1}{2}\int\left(\frac{1/5}{t-2}-\frac{2/5}{2t+1}\right)dt$

$I=\frac{1}{2}\left[\frac{1}{5}\log|t-2|-\frac{1}{5}\log|2t+1|\right]+c$ — 1

$I=\frac{1}{10}\left[\log\left|\frac{t-2}{2t+1}\right|\right]+c=\frac{1}{10}\left[\log\left|\frac{x^2-2}{2x^2+1}\right|\right]+c$ — 1

44.(b)

$\frac{dy}{dx}=\frac{-(3xy+y^2)}{x^2+xy}$ ------- (1)

Put $y = vx$; $\frac{dy}{dx}=v+x\frac{dv}{dx}$

$(1) \Rightarrow \frac{1+v}{4v+2v^2}dv=\frac{-dx}{x}$ — 1

Integrating

$\log(4v+2v^2) = -4\log x+\log c$ — 1

$c = x^4(4v+2v^2)$

$\Rightarrow c = 2x^2(2xy+y^2)$ — 1

when $x=2, y=12 \Rightarrow c = 1536$ — 1

$\therefore$ The cost function is $x^2(2xy+y^2) = 768$ — 1

45.(a)

(i) North west corner rule :

	I	II	III	IV
A	(21) 5	(13) 1	3	3
B	3	(12) 3	(3) 5	4
C	6	4	(12) 4	3
D	4	1	(2) 4	(17) 5

1

Transportation schedule :

$A \to I, A \to II, B \to II, B \to III, C \to III, D \to III, D \to IV$

Transportation cost = Rs. 310

(ii) Least cost method:

	I	II	III	IV
A	5	(25) 1	(9) 3	3
B	(15) 3	3	5	4
C	6	4	4	(12) 3
D	(6) 4	1	(8) 4	(5) 5

2

Transportation schedule :

$A \to II, A \to III, B \to I, C \to IV, D \to I, D \to III, D \to IV$

Transportation cost = Rs. 214

(iii) vogel's approximation method:

	I	II	III	IV
A	(6) 5	(6) 1	(17) 3	(5) 3
B	(15) 3	3	5	4
C	6	4	4	(12) 3
D	4	(19) 1	4	5

2

Transportation schedule :

$A \to I, A \to II, A \to III, A \to IV, B \to I, C \to IV, D \to II$

Transportation cost = Rs. 202

45.(b)

$n = 50$, $\bar{x} = \frac{\sum x}{n} = 51$; $\mu = 52$; $\sigma^2 = 25$; $\sigma = 5$

Null hypothesis $H_0 : \mu = 52$

Alternative hypothesis $H_1 : \mu \neq 52$ — 2

$Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{51 - 52}{\frac{5}{\sqrt{50}}} = -1.4142 \Rightarrow |z| = 1.4142$

$\alpha = 0.01 \Rightarrow z_{\frac{\alpha}{2}} = 2.58$ — 2

Inference : since $|z| < z_{\frac{\alpha}{2}}$ at 1% level of significance, H_0 is accepted. — 1

$\therefore$ There is no significant difference between sample mean and population mean

46.(a)

$a=1;\ b=2;\ h=\frac{1}{n};\ f(x) = 2x^3 - 4$

$f(a+rh) = \frac{6r}{n} + \frac{6r^2}{n^2} + \frac{2r^3}{n^3} - 2$ — 1

$\int_a^b f(x)\,dx = \lim_{n \to \infty} \sum_{r=1}^{n} h\, f(a+rh)$

$\int_1^2 (2x^3 - 4)\,dx = \lim_{n \to \infty} \left[\frac{6}{n^2} \sum_{r=1}^{n} r + \frac{6}{n^3} \sum_{r=1}^{n} r^2 + \frac{2}{n^4} \sum_{r=1}^{n} r^3 - \frac{2}{n} \sum_{r=1}^{n} 1 \right]$ — 2

$= \frac{7}{2}$ — 2

46.(b)

$\bar{\bar{x}} = \frac{\sum \bar{x}}{n} = \frac{681 + 586 + 651 + 641 + 630 + 639}{6} = 638$

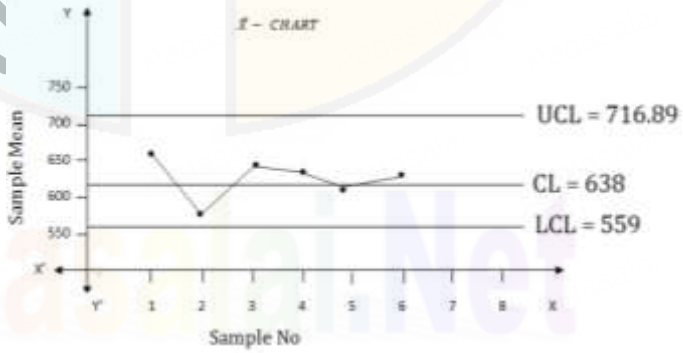
$\bar{R} = \frac{\sum R}{6} = \frac{118 + 167 + 134 + 171 + 190 + 200}{6} = 163.33$ — 1

control limit for $\bar{x}$ chart:

$UCL = \bar{\bar{X}} + A_2 \bar{R} = 716.89$

$CL = \bar{\bar{X}} = 638$

$LCL = \bar{\bar{X}} - A_2 \bar{R} = 559.11$



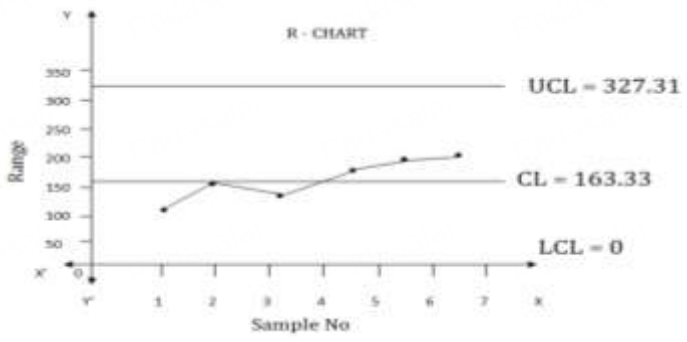
2

control limit for R chart:

$UCL = D_4 \bar{R} = 327.31$

$CL = \bar{R} = 163.33$

$LCL = D_3 \bar{R} = 0$



2

47.(a)	At Equlibrium, $Q_d = Q_s$ $\frac{d^2p}{dt^2} - 5\frac{dp}{dt} - 6p + 24 = 0$ The A.E is $m^2 - 5m - 6 = 0 \Rightarrow m = -1, 6$ C.F $= Ae^{-t} + Be^{6t}$ $P.I = \frac{-24e^{0t}}{D^2 - 5D - 6} = 4$ $\therefore y = Ae^{-t} + Be^{6t} + 4$	1 1 1 1 1
47.(b)	$\lambda = 2.5$ (i) $p(x = 0) = e^{-2.5} = 0.08208$ (ii) $p(x = 3) = \frac{e^{-2.5}(2.5)^3}{3!} = 0.2138$ (ii) $p(x \geq 5) = 1 - p(x<5) = 0.10882$	1 2 2

MARK ANALYSIS

(WITHOUT CHOICE)

PART	Questions	Total Questions	Book Back Questions	Interior/Creative Questions	Total Marks
I	1 Mark	20	16	4	20
II	2 Marks	10	9	1	20
III	3 Marks	10	8	2	30
IV	5 Marks	14	10	4	70
Total Marks			108	32	140
Percentage			77%	23%	100%

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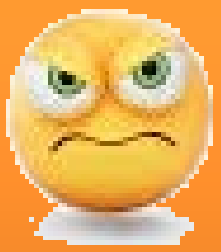

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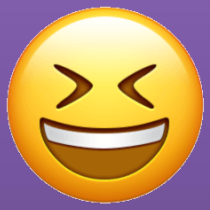
12th – Toppers Answers Sheet

12th – Exam Time Tables



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