ANSWER KEY

SECOND YEAR HIGHER SECONDARY EXAMINATION MARCH 2022

PART-~~I/II~~/III

SUBJECT: STATISTICS

CODE NO: ~~SY 532~~ SAY 732 VERSION: Q

60 SCORES 2 HOURS

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		Part I		
1		b) use of fertilizer and yield of crop	1	1
2.		b) −1	1	1
3		a) $b_{xy} < 1$	1	1
4		b) 9	1	1
5		a) symmetric	1	1
6		d) 6	1	1
7		b) fitness for use	1	1
8.		c) 1	1	1
9		d) All the above	1	1
10.		a) 4	1	1
11		c) 20	1	1
12.		b) 50	1	1
13.		b) Q	1	1
		Part II		
14.		$r = \pm\sqrt{b_{yx} \times b_{xy}}$ $= \pm\sqrt{0.64 \times 0.25} = 0.8 \times 0.5 = 0.4$	1 1	2
15.		Normality, Homogeneity, Independence, Additivity	½×4	2
16.		1. Quality is fitness for use 2. Quality is inversely proportional to variability	1 1	2

<table>
<tr><th>Qn. No</th><th>Sub Qns</th><th>Answer Key/Value Points</th><th>Score</th><th>Total Score</th></tr>
<tr><td>17</td><td></td><td>Trend, Seasonal variation, Cyclic variation, Irregular variation</td><td>$\frac{1}{2} \times 4$</td><td>2</td></tr>
<tr><td>18.</td><td></td><td>$3x - y = 10$ — ①
$2x + y = 15$ — ②
①+② ⇒ $5x = 25 \Rightarrow x = 5$
From ①; $3 \times 5 - y = 10$
$15 - y = 10 \Rightarrow y = 5$</td><td>1
1</td><td>2</td></tr>
<tr><td>19.</td><td></td><td>$z = \frac{x-\mu}{\sigma} = \frac{x-100}{6}$
$P(x > a) = 0.1093 \Rightarrow P(z > \frac{a-100}{6}) = 0.1093$
From table $\frac{a-100}{6} = 1.23$
$\Rightarrow a = 107.38$</td><td>½
½
½
½</td><td>2</td></tr>
<tr><td>20.</td><td></td><td>Moment estimate of $\mu = \bar{x}$
$= \frac{35+42+\dots+69}{6} = 51.5$</td><td>1
1</td><td>2</td></tr>
<tr><td></td><td></td><td><u>Part III</u></td><td></td><td></td></tr>
<tr><td>21.</td><td>a)
b)</td><td>$\frac{dy}{dx} = 8$
$\frac{dy}{dx} = 6x^2 - 24x + 10$
$\frac{d^2y}{dx^2} = 12x - 24$</td><td>1
1
1</td><td>3</td></tr>
<tr><td>22.</td><td></td><td>$z = \frac{x-\mu}{\sigma} = \frac{x-50}{5}$
a) $P(x > 50) = P(z > 0) = 0.5$
b) $P(40 < x < 60) = P(-2 < z < 2) = 2 \times 0.4772$
$= 0.9544$</td><td>½
1
1½</td><td>3</td></tr>
<tr><td>23.</td><td></td><td>

Sl no	Sample	Sample mean
1	18, 17	17.5
2	18, 16	17
3	18, 19	18.5
4	18, 15	16.5
5	17, 16	16.5

Sl no	Sample	Sample mean
6	17, 19	18
7	17, 15	16
8	16, 19	17.5
9	16, 15	15.5
10	19, 15	17

Mean of Sample means = $\frac{170}{10} = 17$</td><td>2
1</td><td>3</td></tr>
</table>

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
24.		(table below)	3	
25.		(table and working below)	1, 1, 1	3

24.

Year	Profit	3 Year Total	3 Yearly Moving average
2013	21		
2014	30	83	27.67
2015	32	80	26.67
2016	18	70	23.33
2017	20	78	26
2018	40	86	28.67
2019	26	76	25.33
2020	10		

Score: 3

25.

Sales (X)	Expenses (Y)	Rank in X (x)	Rank in Y (y)	d	d^2
55	16	4	1	3	9
60	15	2.5	2	0.5	0.25
50	11	5	6	−1	1
65	14	1	3	−2	4
60	13	2.5	4	−1.5	2.25
45	12	6	5	1	1
				0	17.5

Score: 1

$$\rho = 1 - \frac{6[\Sigma d^2 + CF]}{n^3 - n}$$

Score: 1

$$CF = \frac{\Sigma(m^3 - m)}{12} = \frac{2^3 - 2}{12} = \frac{6}{12} = 0.5.$$

$$\rho = 1 - \frac{6\times[17.5 + 0.5]}{6^3 - 6} = 1 - \frac{6\times 18}{210}$$

$$= 1 - 0.51 = 0.49$$

Score: 1

Total Score: 3

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
26.		$R(x) = 40 + 6x - x^2$		
		$R'(x) = 6 - 2x$	½	
		$R''(x) = -2.$	½	
		For Maximum $R'(x) = 0$	½	
		$\Rightarrow 6 - 2x = 0 \Rightarrow x = 3.$	½	3
		at $x = 3$, $R''(x) = -2 < 0$.		
		∴ $R(x)$ is maximum at $x = 3$.	½	
		Max Revenue $= R(3) = 40 + 6\times3 - 3^2 = 49$	½	
27		$f(x) = 2x, \quad 0 < x < 1$		
		Mean $= E(X)$	1	
		$= \int_0^1 x\, f(x)\, dx = \int_0^1 x \times 2x\, dx$	1	3
		$= 2/3$	1	
		Part IV		
28.		Given, $\bar{x} = 40, \bar{y} = 55, \sigma_x = 8, \sigma_y = 10$, $r = 0.6$.	1	
		$b_{yx} = \frac{r\sigma_y}{\sigma_x} = \frac{0.6 \times 10}{8} = 0.75.$	1	
		The reg. line of Y on X is $y - \bar{y} = b_{yx}(x - \bar{x})$	½	4.
		ie $y - 55 = 0.75(x - 40).$	½	
		When $x = 50$, $y = 62.5$. The score in Economics = 62.5.	1	
29.		a). $\Sigma P(x) = 1$	1	
		$\Rightarrow K = 1/10$.	1	
		b). $P(X \leq 2) = P(X = 0,1,2) = \frac{5}{10} = \frac{1}{2}$	1	4.
		$P(1 < X < 4) = P(X = 2,3) = \frac{5}{10} = \frac{1}{2}.$	1	

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
30	a)	Variance = 3	1	
	b)	Mean = np = 10		
		Variance = npq = 8		
		$\frac{npq}{np} = q = 8/10 = 0.8$	½	
		$p = 1 - q = 0.2$	½	4
		$np = 10 \Rightarrow n = 10/0.2 = 50$		
		$f(x) = nC_x\, p^x q^{n-x}, \quad x = 0, 1, \ldots, n.$	1	
		$= 50C_x (0.2)^x (0.8)^{50-x}, \quad x = 0, 1, .., 50$	½	
		$P(X=2) = 50C_2 (0.2)^2 (0.8)^{48}$	½	
31		(ANOVA table below)	2½	

Source	d.f	S.S	MSS	F	$F_{0.05}$
Between	5	60	12	3	4.17
Within	19	76	4		
Total	24	136			

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		The critical region is $F > F_\alpha$	½	4
		Here $F = 3 < F_\alpha$	½	
		So we accept the hypothesis that all the effects are equal.	½	
32		Let us assume that $x - 2y + 50 = 0$ —① be the reg line of Y on X and $2x - 3y + 10 = 0$ —② be the reg line of X on Y.	½	
		For ① $b_{yx} = 1/2$.	1	
		For ② $b_{xy} = 3/2$	1	
		$b_{yx} \times b_{xy} = \frac{1}{2} \times \frac{3}{2} = \frac{3}{4} < 1$	½	4
		∴ our assumption is right.	½	
		The reg line of Y on X is $x - 2y + 50 = 0$	½	
		The reg line of X on Y is $2x - 3y + 10 = 0$.		

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
33		Let μ be the mean of the population.		
		We have to test $H_0: \mu = 66$ against $H_1: \mu \neq 66$	½	
		From the given Sample		
		$n=10$, $\Sigma x = 678$	½	
		$\bar{x} = \frac{\Sigma x}{n} = 67.8$	½	
		Given $\sigma = 2.86$		
		Test statistic is		
		$t = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \sim N(0,1)$	1	
		$= \frac{67.8 - 66}{2.86/\sqrt{10}} = 1.99$	½	4
		The critical region is $\lvert Z\rvert \geq Z_{\alpha/2}$		
		For $\alpha = 0.05$, $Z_{\alpha/2} = 1.96$	½	
		Here $\lvert Z\rvert = 1.99 < Z_{\alpha/2}$		
		∴ We accept Ho		
		Hence the mean of the population can be assumed as 66 inches.	½	
		Part V		
34.		(table below)	3	

X	Y	X^2	Y^2	XY
12	22	144	484	264
15	25	225	625	375
16	23	256	529	368
20	30	400	900	600
25	32	625	1024	800
30	35	900	1225	1050
118	167	2550	4787	3457

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
		$r = \dfrac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{n\Sigma x^2 - (\Sigma x)^2} \times \sqrt{n\Sigma y^2 - (\Sigma y)^2}}$	1	
		$= \dfrac{6 \times 3457 - 118 \times 167}{\sqrt{6 \times 2550 - 118^2} \times \sqrt{6 \times 4787 - 167^2}}$	1	6.
		$= \dfrac{1036}{\sqrt{1376} \times \sqrt{833}}$	½	
			½	
		$= \underline{\underline{0.97}}$		
35.		(table below)	3	
		a). Laspeyre's Index no. $= \dfrac{\Sigma P_1 q_0}{\Sigma P_0 q_0} \times 100$	½	6.
		$= \dfrac{1950}{1530} \times 100 = 127.45.$	½	
		b) Paasche's Index no. $= \dfrac{\Sigma P_1 q_1}{\Sigma P_0 q_1} \times 100$	½	
		$= \dfrac{2310}{1820} \times 100 = 126.92$	½	
		c) Fisher's Index no. $= \sqrt{L \times P}$	½	
		$= \sqrt{127.45} \times \sqrt{126.92} = 127.18$	½	

P_0	q_0	P_1	q_1	$P_0 q_0$	$P_0 q_1$	$P_1 q_0$	$P_1 q_1$
60	4	80	6	240	360	320	480
70	6	90	8	420	560	540	720
55	10	65	12	550	660	650	780
40	8	55	6	320	240	440	330
				1530	1820	1950	2310

Qn. No	Sub Qns	Answer Key/Value Points	Score	Total Score
36.	a)	i) proper definition.	1	
		ii) proper definition	1	
		iii) proper definition	1	
	b).	$V(t_1) = \frac{\sigma^2+4\sigma^2+\sigma^2}{4} = \frac{6\sigma^2}{4} = \frac{3\sigma^2}{2}$	1	6.
		$V(t_2) = \frac{\sigma^2+4\sigma^2+9\sigma^2}{36} = \frac{14\sigma^2}{36} = \frac{7\sigma^2}{18}$	1	
		Here $V(t_2) < V(t_1)$	½	
		∴ t_2 is efficient than t_1	½	