SECOND YEAR HIGHER SECONDARY EXAMINATION MARCH 2018

SUBJECT: STATISTICS

CODE NO. 9020

Qn No	Scoring key	Split score	Total score
1 a 1 b	(iv) 0.5 (ii) 20	1 1	2
2	(ii) A B (i) No correlation (d) $r = 0$ (iii) $\frac{Cov(x,y)}{\sigma_x \times \sigma_y}$ (c) Correlation coefficient (iii) $1 - \frac{6\sum d^2}{n^3 - n}$ (a) Rank correlation coefficient (iv) Perfect correlation (b) $r = \pm 1$	½ × 4	2
3	$\sum X = 247, \sum Y = 263, \sum X^2 = 7345, \sum Y^2 = 7537, \sum XY = 7259, n = 10$ $r = \frac{n\sum XY - \sum X\sum Y}{\sqrt{n\sum X^2 - (\sum X)^2 \times \sqrt{n\sum Y^2 - (\sum Y)^2}}} $ $= \frac{10 \times 7259 - 247 \times 263}{\sqrt{10 \times 7345 - 247^2 \times \sqrt{10 \times 7537 - 263^2}}}$ $= \frac{7629}{\sqrt{12441 \times 6201}} = 0.87$ (or $r = \frac{Cov(x, y)}{\sigma_x \times \sigma_y}$) $r = \frac{76.29}{11.15 \times 7.87} = 0.87$	1 ½ ½	2
4	Since f(x) is a pdf, we have $\int_{-\infty}^{+\infty} f(x)dx = 1$ $ie, \int_{0}^{2} kx dx = 1$	½ ½	2
	$\Rightarrow k \left[\frac{x^2}{2} \right]_0^2 = 1 \qquad \Rightarrow k = \frac{1}{2}$	1	
5	Simple AM price index = $\frac{\sum x}{n}$, where x is the price relative. Here $\sum x = 111.11 + 122.86 + 110.42 = 344.39$, n = 3 \therefore Simple AM price index = $\frac{344.39}{3} = 114.797$	1 ½ ½	2
6	$b_{yx} = 0.23, \ \gamma = 0.45, \ \sigma_x = 10, \ \sigma_y = ?$ We have, $b_{yx} = \gamma \frac{\sigma_y}{\sigma_x}$ $\Rightarrow 0.23 = 0.45 \times \frac{\sigma_y}{10}$ $\Rightarrow \sigma_y = 5.11$	1 1/2	2
7	Let μ be the average mileage of that particular model automobile. Here, $H_0: \mu=23$ and $H_1: \mu\neq 23$ (or use $H_1: \mu<23$) Given that $\overline{x}=21.8, s^2=7.84$ and $n=50$	1/2	
	Since n is large, the test statistic to be used is: $Z = \frac{(\overline{x} - \mu)}{s / \sqrt{n}} \sim N(0, 1)$	<i>y</i> ₂	2

	$ie, Z = \frac{21.8 - 23}{\sqrt{7.84}/\sqrt{50}} = -3.03$	1/2	
	For $\alpha = 0.05$, the critical region is $ Z \ge Z_{\alpha/2}$, $ie, Z \ge 1.96$ (or $ Z > 2.58$)		
	Here $ Z = 3.03 > 1.96$ (or $ Z = 3.03 > 2.58$)		
	\therefore We reject H_0 . The given data does not agree with the claim of the	1/2	
	manufacturer.		
8.	We have the trend equation $y = 18.04x + 126.55$ with origin 2010. We have		
	to shift the origin to 2015. The trend equation with shifted origin is:		
	y = 18.04(x+k) + 126.55, where k = 2015 – 2010 = 5	1	2
	ie, y = 18.04(x+5) + 126.55	1	
	or $y = 18.04x + 216.75$		
9.	Given n = 100, m = 10 and d = 170 $\overline{p} = \frac{d}{mn} = \frac{170}{10 \times 100} = 0.17 \text{ and } \overline{q} = 1 - 0.17 = 0.83$	1/2	
	The control limits of np chart are: $CL = n\overline{p} = 100 \times 0.17 = 17$	1/2	2
	$LCL = n\overline{p} - 3\sqrt{n\overline{p}q} = 17 - 3\sqrt{14.11} = 5.73$	1/2	
	$UCL = n\overline{p} + 3\sqrt{n\overline{p}q} = 17 + 3\sqrt{14.11} = 28.27$	1/2	
10	Mean = $E(X) = \sum xp(x) = 1 \times 0.5 + 2 \times 0.3 + 3 \times 0.2 = 1.7$	1	·
	$E(X^2) = \sum x^2 p(x) = 1^2 \times 0.5 + 2^2 \times 0.3 + 3^2 \times 0.2 = 3.5$	1	3
	$Variance = E(X^2) - [E(X)]^2$	1 1/2	3
	$ Variance = E(X_1) - [E(X_1)] $ $= 3.5 - 1.7^2 = 0.61$,-	
	$=3.5-1.7^{\circ}=0.61$	1/2	
11	The population values are 13, 11, 15, 17 and 18.		
	The population mean = $\frac{13+11+15+17+18}{5} = \frac{74}{5} = 14.8$	1	
		1	
	The possible number of SRSWORs of size 2 is $5C_2 = 10$.		
	Sample Sample Sample		
	No. mean 1 13, 11 12		
	2 13, 15 14	1	
	3 13, 17 15	1	3
	4 13, 18 15.5		_
	5 11, 15 13		
	6 11, 17 14		
	7 11, 18 14.5		
	8 15, 17 16 9 15, 18 16.5		
	9 15, 18 16.5 10 17, 18 17.5		
	Total 148		
	Mean of sample means = $\frac{148}{10}$ = 14.8	1/2	
	Mean of sample means = population mean. ∴ Sample mean is unbiased for	1/2	
	population mean.		
12	Let X denotes the weight of a particular kind of apple sold at a fruit market.		
	Then X is normally distributed with $\mu=100$ and $\sigma=20$.		

	17	V 100							
	$\therefore Z = \frac{X - \mu}{\sigma} = \frac{X - 100}{20} \text{ follows N(0, 1)}.$								
	a) $P(70 < X < 110) = P\left(\frac{70 - 100}{20} < \frac{X - \mu}{\sigma} < \frac{110 - 100}{20}\right)$								3
	= P(-1.5 < Z < 0.5) = 0.6247								
	- /		`	<i>'</i>	<i>j</i> - 0.0247			½ 1	
	b) $P(X > 1)$	10) = P(Z)	> 0.5) = 0	.3085				-	
	∴ No. of	apples weigh	n greater t	than 110	gm = 100	0×0.308	5 = 308	1/2	
							(or 309)		
13					Τ		\neg		
	Commodity	p_0 q_0	p_{l}	q_1	p_0q_0	p_1q_0	_		
		12 100	15	120	1200	1500		1 ½	
		6 210	7	240	1260	1470	\dashv		
	l	10 110	13	150	3560	1430 4400	\dashv		3
	Total				3300	14400			
		$\mathbf{\Sigma}$	n.a.					1	
	Laspyre's index n	umber = $\frac{4}{5}$	$\frac{2190}{1} \times 100$)				1	
		$=\frac{440}{100}$	$\frac{00}{60} \times 100 =$	123.6				1/2	
14.	(::) 1 1 - 5 - 1 1		50					1	1
14 a 14 b	(ii) Level of signit Let X be the thick		are pradu	cad by t	ha machin	a and lat	" he the	1	1
140							•	1/2	
	average thickness		•		JS against	$n_1: \mu \neq$	0.05 .	, -	
	Given $n = 10, \overline{x} =$								
	The test statistic	is $t = \frac{\overline{x} - \mu}{t}$! — , follov	ws $t_{c_{n-1}}$				1/2	
	The test statistic is $t = \frac{\overline{x} - \mu}{\sqrt[s]{n-1}}$, follows $t_{(n-1)}$.								
		, , ,	- 1						2
	Here, $t = \frac{0.053 - 0.05}{0.003 / \sqrt{9}} = 3$								2
	0.00.	1/2							
	For $\alpha = 0.01$ and								
		1/2							
15	Here t = 3 < 3.2			ne maci	ille is work	Cing in pro	——————————————————————————————————————		
15	$\overline{R} = \frac{5+6++6}{10}$	$\frac{6}{1} = 5.8$, n = 5	i					1	
	The control limits							•	
	$CL = \overline{R} = 5.8$	s ioi n – char	נ מו כ.					1/2	3
	$LCL = R = 5.8$ $LCL = D_3 \overline{R} = 0$	ν 5 Ω – Ω							
	1		0.065					1/2	
	$UCL = D_4 \overline{R} = 2$						_	½ ½	
-	All observed values are within the control limits. So the process is in control.							1	
16 a	(iii) Seasonal variations								1
16 b									
	Month No. of 3 yearly 3 yearly								1
		homes		g total	moving				
					averag	e			
	June	6			_				
	July	7	22		7.33			2	,
	August	9	24		8			2	2
	September	8	26		8.67				
	October November	9	31		10.33				
	November 10 31 10.33								
L	December 12								ـ ــــــــــــــــــــــــــــــــــــ

17 a	$y = x^3 + 7x^2 + 10x + 6$		
	$\frac{dy}{dx} = 3x^2 + 14x + 10$		
		1	2
	$\frac{d^2y}{dx^2} = 6x + 14$	1	
	ax	-	
17 b	$\begin{bmatrix} x \\ 1 \end{bmatrix}^k$		
	$\int_{0}^{k} x^{2} dx = 9 \qquad \Rightarrow \left[\frac{x^{3}}{3} \right]_{0}^{k} = 9$	1	2
	-		_
	ie, $\frac{k^3}{3} - 0 = 9 \implies k = 3$	1	
18 a	Let X be the number of candidates selected out of n = 1000 candidates		
	appeared. The probability of selection , $p=0.2\%=0.002$ is very small, we	:	
	can use the Poisson distribution with $\lambda = np = 1000 \times 0.002 = 2$		
	We have the pmf, $e^{-\lambda} \lambda^{x}$		
	$f(x) = \frac{e^{-\lambda} \lambda^x}{x!}, \ x = 0, 1, 2,$	1/2	
		1/2	
	$ie, f(x) = \frac{e^{-2}2^x}{x!}, x = 0, 1, 2,$.,	2
	P(3 persons selected) = $P(X = 3)$	1/2	
	$=\frac{e^{-2}2^3}{3!}=\frac{0.1353\times 8}{6}=0.1804$	1/2	
	3: 0		
	(Attempt with Binomial Distribution also consider)		
18 b	Let X be the number of workers suffering from the occupational decease. Then		
	X follows Binomial distribution with $n = 6$, $p = 0.2$ and $q = 0.8$. The pmf is:	14	
	$f(x) = {}^{n}C_{x}p^{x}q^{n-x}, x = 0, 1,, n$	1/2	2
	$ie, f(x) = {}^{6}C_{x}(0.2)^{x}(0.8)^{6-x}, x = 0,1,,6$	1/2	_
	P(4 will suffer from the decease) = P(X=4)	1/2	
	$= {}^{6}C_{4} \times (0.2)^{4} \times (0.8)^{2} = 15 \times 0.0016 \times 0.64 = 0.01536$	1/2	
19 a	(iv) 12	1	1
19 b	Any 3 of the relations given below. Each carries 1 score.		
1	 The square of a Standard Normal variable is a Chi – square variable with 1 degrees of freedom. 		
	The sum of squares of n independent Standard Normal variables is Chi		
	- square variable with n degrees of freedom.		
	3. If X is a Standard Normal variable and Y is a Chi – square variable with X		
	degrees of freedom, n. Then $t = \frac{X}{\sqrt{Y/n}}$ is a t variable with degrees of		
	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	3 X 1	3
	freedom n. A. If X is a Chi – square variable with degrees of freedom n , and X is		
	4. If X_1 is a Chi – square variable with degrees of freedom n_1 and X_2 is another independent Chi – square variable with degrees of freedom		
	l		
	n_2 . Then $F = \frac{X_1}{N_2}$ is a F variable with degrees of freedom (n_1, n_2) .		
	X_2/n		
	5. The square of a t variable with degrees of freedom n is a F variable		
	with degrees of freedom (1, n).		
L		1	<u> </u>

$t_1 = \frac{(x_1 - x_2 - x_3 - x_4)}{4} \text{ is unbiased.}$ $V(t_1) = V\left(\frac{x_1 + x_2 + x_3 + x_4}{4}\right) = \frac{\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{16} = \frac{\sigma^2}{4} = 0.25\sigma^2$ $t_2 = \frac{2x_1 + x_2 + x_3 + x_4}{5} \text{ is unbiased.}$ $V(t_2) = V\left(\frac{2x_1 + x_2 + x_3 + x_4}{5}\right) = \frac{4\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{25} = \frac{7\sigma^2}{25} = 0.28\sigma^2$ $\text{Here, } V(t_1) < V(t_2). \text{ So } t_1 \text{ is efficient than } t_2 . \qquad 1$ $\text{Let } x \text{ denotes the rank of number of years of smoking and } y \text{ denotes the rank of lung damage grade.}$ $\frac{x}{10} \frac{y}{10} \frac{d}{10} = \frac{x - y}{10} \frac{d^2}{10}$ $\frac{10}{10} \frac{10}{10} \frac{0}{10} \frac{0}{10}$ $\frac{9}{10} \frac{7}{10} \frac{1}{20} \frac{4}{4}$ $\frac{1}{6} \frac{5}{5} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10$	$t_1 = \frac{(x_1 - x_2) - x_3}{4} \text{ is unbiased.}$ $V(t_1) = V\left(\frac{x_1 + x_2 + x_3 + x_4}{4}\right) = \frac{\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{16} = \frac{\sigma^2}{4} = 0.25\sigma^2$ $t_2 = \frac{2x_1 + x_2 + x_3 + x_4}{5} \text{ is unbiased.}$ $V(t_2) = V\left(\frac{2x_2 + x_3 + x_4}{5}\right) = \frac{4\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{25} = \frac{7\sigma^2}{25} = 0.28\sigma^2$ $\text{Here, } V(t_1) < V(t_2). \text{ So } t_1 \text{ is efficient than } t_2 \qquad 1$ 1 21 Let x denotes the rank of number of years of smoking and y denotes the rank of lung damage grade. $\frac{x}{10} \frac{y}{10} \frac{d = x - y}{10} \frac{d^2}{10} = \frac{1}{99} \frac{d^2}{10} = \frac{1}{990} = \frac{1}{990} = \frac{1}{990} \frac{d^2}{10} = \frac{1}{990} = $	20 a	(iii) θ	1	1
$V(t_1) = V\left(\frac{x_1 + x_2 + x_3 + x_4}{4}\right) = \frac{\sigma^2 + \sigma^3 + \sigma^2 + \sigma^2}{16} = \frac{\sigma^3}{4} = 0.25\sigma^2$ $t_1 = \frac{2x_1 + x_2 + x_3 + x_4}{5} \text{ is unbiased.}$ $V(t_2) = V\left(\frac{2x_1 + x_2 + x_3 + x_4}{5}\right) = \frac{4\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{25} = \frac{7\sigma^2}{25} = 0.28\sigma^2$ $\text{Here, } V(t_1) < V(t_2). \text{ So } t_1 \text{ is efficient than } t_2.$ 1 1 1 1 1 1 1 1 1 1	$V(t_1) = V\left(\frac{x_1 + x_2 + x_3 + x_4}{4}\right) = \frac{\sigma^2 + \sigma^3 + \sigma^2 + \sigma^2}{16} = \frac{\sigma^2}{4} = 0.25\sigma^2$ $t_1 = \frac{2x_1 + x_2 + x_3 + x_4}{5} \text{ is unbiased.}$ $V(t_2) = V\left(\frac{2x_1 + x_2 + x_3 + x_4}{5}\right) = \frac{4\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{25} = \frac{7\sigma^2}{25} = 0.28\sigma^2$ $\text{Here, } V(t_1) < V(t_2). \text{ So } t_1 \text{ is efficient than } t_2.$ 1 $\text{21} \text{Let } x \text{ denotes the rank of number of years of smoking and } y \text{ denotes the rank of lung damage grade.}$ $\frac{x}{10} \frac{y}{10} \frac{d = x - y}{20} \frac{d^2}{4}$ $\frac{1}{10} \frac{1}{10} 0 0 0 0$ $\frac{9}{10} 7 2 4 4$ $\frac{1}{10} \frac{1}{10} 0 0 0$ $\frac{9}{10} 7 2 4 4$ $\frac{1}{10} \frac{1}{10} 0 0 0$ $\frac{9}{10} 7 2 4 4$ $\frac{1}{10} \frac{1}{10} 0 0 0$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} 0 0$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} 0 0$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} 0 0$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} 0 0$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} 0 0$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10} \frac{1}{10}$ $\frac{1}{10} \frac{1}{10} \frac{1}{10}$	20 b	$t_1 = \frac{x_1 + x_2 + x_3 + x_4}{4}$ is unbiased.		
$I_2 = \frac{2x_1 + x_2 + x_3 + x_4}{5} \text{ is unbiased.}$ $V(t_2) = V\left(\frac{2x_1 + x_2 + x_3 + x_4}{5}\right) = \frac{4\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{25} = \frac{7\sigma^2}{25} = 0.28\sigma^2 \qquad 1$ Here, $V(t_1) < V(t_2)$. So t_1 is efficient than t_2 . 1 21 Let x denotes the rank of number of years of smoking and y denotes the rank of lung damage grade. $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$I_2 = \frac{2x_1 + x_2 + x_3 + x_4}{5} \text{ is unbiased.}$ $V(t_2) = V\left(\frac{2x_1 + x_2 + x_3 + x_4}{5}\right) = \frac{4\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{25} = \frac{7\sigma^3}{25} = 0.28\sigma^2$ $\text{Here, } V(t_3) < V(t_2). \text{ So } t_1 \text{ is efficient than } t_2 \text{ .} \qquad 1$ $21 \text{ Let } x \text{ denotes the rank of number of years of smoking and } y \text{ denotes the rank of lung damage grade.}$ $\frac{x}{10} \frac{y}{10} \frac{d = x - y}{10} \frac{d^2}{10} \frac{d^2}{10$		$V(t_1) = V\left(\frac{x_1 + x_2 + x_3 + x_4}{4}\right) = \frac{\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{16} = \frac{\sigma^2}{4} = 0.25\sigma^2$	1	
Here, $V(t_1) < V(t_2)$. So t_1 is efficient than t_2 .	Here, $V(t_1) < V(t_2)$. So t_1 is efficient than t_2 .				3
Here, $V(t_1) < V(t_2)$. So t_1 is efficient than t_2 .	Here, $V(t_1) < V(t_2)$. So t_1 is efficient than t_2 .		$V(t_2) = V\left(\frac{2x_1 + x_2 + x_3 + x_4}{5}\right) = \frac{4\sigma^2 + \sigma^2 + \sigma^2 + \sigma^2}{25} = \frac{7\sigma^2}{25} = 0.28\sigma^2$	1	
of lung damage grade.	of lung damage grade.			1	
$ \begin{array}{ c c c c }\hline 10 & 10 & 0 & 0 & 0 \\\hline 9 & 7 & 2 & 4 & 4 \\\hline 8 & 6 & 2 & 4 & 4 \\\hline 7 & 9 & -2 & 4 & 4 \\\hline 6 & 5 & 1 & 1 & 1 \\\hline 5 & 8 & -3 & 9 & 4 \\\hline 4 & 4 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline & & & & & & & & & & & & & & & & & & $	$ \begin{array}{ c c c c c }\hline 10 & 10 & 0 & 0 & 0 \\\hline 9 & 7 & 2 & 4 & 4 \\\hline 8 & 6 & 2 & 4 & 4 \\\hline 7 & 9 & -2 & 4 & 4 \\\hline 6 & 5 & 1 & 1 & 1 \\\hline 5 & 8 & -3 & 9 & 9 \\\hline 4 & 4 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline & & & & & & & & & & & & & & & & & & $	21	· · · · · · · · · · · · · · · · · · ·		
$ \begin{array}{ c c c c }\hline 10 & 10 & 0 & 0 & 0 \\\hline 9 & 7 & 2 & 4 & 4 \\\hline 8 & 6 & 2 & 4 & 4 \\\hline 7 & 9 & -2 & 4 & 4 \\\hline 6 & 5 & 1 & 1 & 1 \\\hline 5 & 8 & -3 & 9 & 4 \\\hline 4 & 4 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline & & & & & & & & & & & & & & & & & & $	$ \begin{array}{ c c c c c }\hline 10 & 10 & 0 & 0 & 0 \\\hline 9 & 7 & 2 & 4 & 4 \\\hline 8 & 6 & 2 & 4 & 4 \\\hline 7 & 9 & -2 & 4 & 4 \\\hline 6 & 5 & 1 & 1 & 1 \\\hline 5 & 8 & -3 & 9 & 9 \\\hline 4 & 4 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline 3 & 2 & 1 & 1 & 1 \\\hline 1 & 1 & 0 & 0 & 0 \\\hline & & & & & & & & & & & & & & & & & & $		r v $d-r-v$ J^2		
$ \begin{array}{ c c c c c }\hline 9 & 7 & 2 & 4 & \\ \hline 8 & 6 & 2 & 4 & \\ \hline 7 & 9 & -2 & 4 & \\ \hline 6 & 5 & 1 & 1 & \\ \hline 5 & 8 & -3 & 9 & \\ \hline 4 & 4 & 0 & 0 & 0 & \\ \hline 3 & 2 & 1 & 1 & \\ \hline 1 & 1 & 0 & 0 & \\ \hline \hline & & & & & & \\ \hline & & & & & & \\ \hline & & & &$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				
	$ \begin{array}{ c c c c }\hline 8&6&2&4&\\\hline 7&9&-2&4&\\\hline 6&5&1&1&1\\\hline 5&8&3&-3&9&\\\hline 4&4&0&0&0&\\\hline 3&2&1&1&1&\\\hline 2&3&-1&1&1&\\\hline 1&1&0&0&0&\\\hline &&&&&&&&\\\hline &&&&&&&\\\hline &&&&&&\\\hline &&&&&\\\hline &&&&&&\\\hline &&&&&&\\\hline &&&&&\\\hline &&&&&&\\\hline &&&&&\\\hline &&&&&\\\hline &&&&&&\\\hline &&&&&&\\\hline &&&&&\\\hline &&&&&&\\\hline &&&&&&&\\\hline &&&&&&&&$				
$ \begin{array}{ c c c c }\hline 6&5&1&1&1\\\hline 5&8&-3&9&\\\hline 4&4&0&0&0\\\hline 3&2&1&1&\\\hline 1&1&0&0&\\\hline &&&&&&\\\hline \end{array} $ Rank correlation coefficient, $\rho=1-\frac{6\sum d^2}{n^2-n}$ $=1-\frac{6\times 24}{10^3-10}=1-\frac{144}{990}=0.8545 \qquad 1 $ (or attempt using Karl Pearsons formula, give 2 scores) $ \begin{array}{ c c c c }\hline 22 \text{ a} & & & & & & & & & & & & & & & & & & $	$ \begin{array}{ c c c c c }\hline 6&5&1&1&1\\\hline 5&8&-3&9&\\\hline 4&4&0&0&0\\\hline 3&2&1&1&\\\hline 1&1&0&0&\\\hline &&&&&&\\\hline \end{array} $				
$ \begin{vmatrix} \frac{6}{5} & \frac{5}{8} & \frac{1}{-3} & \frac{9}{9} \\ \frac{4}{4} & \frac{4}{4} & 0 & 0 \\ \frac{3}{3} & \frac{2}{2} & \frac{1}{1} & \frac{1}{1} \\ \frac{1}{2} & \frac{3}{3} & \frac{-1}{-1} & \frac{1}{1} \\ \frac{1}{2} & \frac{1}{3} & \frac{-1}{-1} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{3} & \frac{-1}{-1} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{-1}{2} & \frac{-1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{-1}{2} & \frac{-1}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{-1}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{-1}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{-1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{-1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac$	$ \begin{vmatrix} \frac{6}{5} & \frac{5}{8} & \frac{1}{-3} & \frac{1}{9} \\ \frac{4}{4} & \frac{4}{4} & 0 & 0 \\ \frac{3}{3} & \frac{2}{2} & \frac{1}{1} & \frac{1}{1} \\ \frac{1}{2} & \frac{3}{3} & \frac{-1}{1} & \frac{1}{1} \\ \frac{1}{2} & \frac{1}{3} & \frac{-1}{1} & \frac{1}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{2} & \frac{-1}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{3} $		7 9 -2 4		
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$ \begin{vmatrix} 4 & 4 & 0 & 0 & 0 \\ 3 & 2 & 1 & 1 & 1 \\ 2 & 3 & -1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 0 \\ \hline & Total & \sum d^2 = 24 \\ \hline \\ Rank correlation coefficient, $\rho = 1 - \frac{6\sum d^2}{n^3 - n}$ & 1 & \\ & = 1 - \frac{6\times 24}{10^3 - 10} = 1 - \frac{144}{990} = 0.8545 & 1 & \\ \hline \\ (or attempt using Karl Pearsons formula, give 2 scores) & 1 & \\ \hline \\ 22 a & Correlation coefficient. & 1 & 1 & 1 \\ \hline \\ 22 b & The two regression lines are: \\ 3x + 2y = 26 (1) \text{ and } 6x + y = 31 (2) \\ \hline \\ (i) \text{ Let } (1) \text{ denotes the regression line of Y on X and } (2) \text{ denotes the regression line of X on Y.} \\ \hline \\ Equation (1) \text{ becomes, } 2y = -3x + 26 \text{ or } y = \frac{-3}{2}x + 13 \Rightarrow b_{yx} = \frac{-3}{2} & y_x \\ \hline \\ Equation (2) \text{ becomes, } 6x = -y + 31 \text{ or } x = \frac{-1}{6}y + \frac{31}{6} \Rightarrow b_{xy} = \frac{-1}{6} & y_x \\ \hline \\ \text{Now, } b_{yx} \times b_{xy} = \frac{-3}{2} \times \frac{-1}{6} = \frac{1}{4} < 1 \text{ . Hence our assumption is correct} \\ \hline \\ \therefore r = \pm \sqrt{b_{yx}} \times b_{xy} = \pm \sqrt{\frac{1}{4}} = \frac{-1}{2} = -0.5 \\ \hline \\ \text{(ii) Let \overline{x} and \overline{y} be the averages. The equations (1) and (2) become: } \\ \hline \\ 3\overline{x} + 2\overline{y} = 26 (4) \\ \hline \\ (3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4 & \frac{y_x}{4} \\ \hline $	$ \begin{vmatrix} 4 & 4 & 0 & 0 & 0 \\ \hline 3 & 2 & 1 & 1 & 1 \\ \hline 2 & 3 & -1 & 1 & 1 \\ \hline 1 & 1 & 0 & 0 & 0 \\ \hline & Total & \sum d^2 = 24 \\ \hline \\ Rank correlation coefficient, $\rho = 1 - \frac{6\sum d^2}{n^3 - n}$ & 1 & \\ & = 1 - \frac{6\times 24}{10^3 - 10} = 1 - \frac{144}{990} = 0.8545 & 1 & \\ \hline (or attempt using Karl Pearsons formula, give 2 scores) & 1 & \\ \hline 22 a & Correlation coefficient. & 1 & 1 & 1 \\ \hline 22 b & The two regression lines are: & 3x + 2y = 26 (1) and 6x + y = 31 (2) (i) Let (1) denotes the regression line of Y on X and (2) denotes the regression line of X on Y. & Equation (1) becomes, 2y = -3x + 26 or y = \frac{-3}{2}x + 13 \Rightarrow b_{yx} = \frac{-3}{2} & \frac{1}{2}x + $		5 8 -3 9		4
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(ii) Let \overline{x} and \overline{y} be the averages. The equations (1) and (2) become: $3\overline{x} + 2\overline{y} = 26 (3)$ $6\overline{x} + \overline{y} = 31 (4)$ $(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4$	(ii) Let \overline{x} and \overline{y} be the averages. The equations (1) and (2) become: $3\overline{x} + 2\overline{y} = 26 (3)$ $6\overline{x} + \overline{y} = 31 (4)$ $(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4$		$r = \pm \sqrt{b_{xx} \times b_{yy}} = \pm \sqrt{\frac{1}{1}} = -0.5$	1	
$3\overline{x} + 2\overline{y} = 26 (3)$ $6\overline{x} + \overline{y} = 31 (4)$ $(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4$	$3\overline{x} + 2\overline{y} = 26 (3)$ $6\overline{x} + \overline{y} = 31 (4)$ $(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4$		V 7 2		
$6\overline{x} + \overline{y} = 31 (4)$ $(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4$	$6\overline{x} + \overline{y} = 31 (4)$ $(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4$			1	
$(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price} = 4$	$(3) - 2 \times (4) \Rightarrow -9\overline{x} = -36 \Rightarrow \overline{x} = 4 \text{ , average price = 4}$		• • • • • • • • • • • • • • • • • • • •		
			· ,	1/2	
			, , , , , , , , , , , , , , , , , , , ,	1/2	

23 a	(iv) Equality of more than two means						1	1
23 b	$H_{\scriptscriptstyle 0}$: The yiel							
		A 20 21 23	B 18 20 17	C 25 28 22			<i>y</i> ₂	
	Grand Total, G	= 64 + 55 +		_ 				
	Correction facto	or, $CF = \frac{G}{L}$	$\frac{194^2}{1} = \frac{194^2}{9} = \frac{194^2}{9}$	4181.78			1/2	
	Total Sum of Sq Between Sum of	uares, TSS	= Sum of squ = $20^2 + 21^2$	uares of all 0 $++22^{2}$			1/2	
	Between Sum of			$\frac{55^2}{3} + \frac{75^2}{3}$	-4181.78	= 66.89	<i>y</i> ₂	4
	Source Between	df 2	SS 66.89	<i>MSS</i> 33.445	<i>F</i> 7.34	5.14	1 1/2	
	Within	6	27.33	4.555	7.54	3.14		
	Here $F > F_{0.5}$. varieties of seed	2 1/2						
24	The hypotheses are: H_0 : Drinking habit and the favour in local sale of liquor are independent. H_1 : Drinking habit and the favour in local sale of liquor are not independent. We are given a 2X2 contingency table. The contingency table along with the expected frequencies is:							
	Question	Question	To	tal				
			No (29) 8	7			1 1/2	
	No 18	(16) 6	(8) 2	4				5
	Total	74	37 1:	11				
	The test statistic	1						
	The value of tes $\chi^2 = \frac{(56 - 58)}{58}$ The critical region	1						
	Here $\chi^2 = 0.90$ favour in local s	1/2						