Second Year Higher Secondary Examination, March 2021

Subject: STATISTICS **Code: SY 232**

Qn No.	Answer key/Value points	Split Score	Total Score
1(a) (b)	(i) positive $r = \frac{cov(x,y)}{\sigma_x \sigma_y}$ $= \frac{10}{\sqrt{16}\sqrt{9}} = \frac{10}{4 \times 3} = \frac{10}{12} = 0.83$	1 1 1	3
2(a) (b)	(ii) GM $r = \pm\sqrt{b_{yx} b_{xy}}$ $= \sqrt{0.225 \times 0.4} = 0.3$	1 1 1	3
3	n=10, ∑x=50, ∑y=200, b_{xy}=0.95 $\bar{x} = \frac{\sum x}{n} = \frac{150}{10} = 15$, $\bar{y} = \frac{\sum y}{n} = \frac{200}{10} = 20$ Regression equation of X on Y. $x - \bar{x} = b_{xy}(y - \bar{y})$ $x - 15 = 0.95(y - 20)$	½ + ½ 1 1	3
4(a) (b)	(i) 2 $\frac{dy}{dx} = 6x^2 \; 8 \; 6x$ $\frac{d^2y}{dx^2} = 12 \; 8x$	1 1 1	3
5(a) (b)	For any answer give 1 score. $\int_0^k \frac{x^2}{9}\,dx = 1$ $\left[\frac{x^3}{9 \times 3}\right]_0^k = 1$ $\frac{k^3 - 0}{9 \times 3} = 1$ $k = 3$	1 1 ½ ½	3
6(a) (b)	(iii) P(x)=P(X = x) Here P(x) ≥ 0 for all values of x ∑P(x)=0.3+0.2+0.3+0.2=1 ∴P(x) is a p m f **OR** Give 2 score if ∑P(x)=1 is verified	1 ½ 1 ½	3
7(a) (b)	(ii) mean=variance $\lambda = 2$ $P(x) = \frac{e^{-\lambda}\lambda^x}{x!}$ where $x = 0,1,2...$ $p(X = 4) = \frac{e^{-2}\, 2^4}{4!} = 0.09$	1 ½ 1 ½	3

8	np=6, npq=4 $q=\frac{2}{3}, p=\frac{1}{3}, n=18$ $f(x)=nC_x\, p^x q^{n-x}, x=0,1,\ldots n$ $=18C_x \left(\frac{1}{3}\right)^x \left(\frac{2}{3}\right)^{18-x}, x=0,1,\ldots 18$ *Note: Writing the pdf of binomial density function only ---give 1 score*	½ 1½ ½ ½	3
9(a) (b)	 μ Any 4 properties of normal distribution (½ x 4)	1 2	3
10(a) (b)	(i) hypothesis Definition of Type I error Definition of Type II error	1 1 1	3

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11(a) (b)	Unbiasedness, consistency, efficiency, sufficiency (½ x 4) (i) Sample mean	2 1	3
12(a) (b)	(iv) F- test Normality, homogeneity, independence, additivity (½ x 4)	1 2	3
13(a) (b)	(ii) Walter A Shewart Any two uses of SQC (1 × 2)	1 2	3
14(a)	$\bar{\bar{x}}=\frac{\sum \bar{x}}{m}=\frac{27}{10}=2.7$, $\bar{R}=\frac{\sum R}{m}=\frac{10}{10}=1$ CL= $\bar{\bar{x}}=2.7$ UCL= $\bar{\bar{x}}+A_2\bar{R}$=2.7+1.88×1=4.58 LCL= $\bar{\bar{x}}-A_2\bar{R}$=2.7-1.88×1=0.82 **OR** *For correct CL, UCL,LCL give one score each*	½ +½ 1 1	3
15(a)(b)(c)	1 score for each definition **OR** If any two definitions are correct then give 3scores	1+1+1	3
16(a) (b)	(ii) cost of living index $P_0=45$, $P_1=50$ Price relative= $\frac{P_1}{P_0}\times 100$ $=\frac{50}{45}\times 100 = 111.11$	1 ½ 1 ½	3
17	d: -1, 0, -1, -1, 2, 1, 1, -1 d^2: 1, 0, 1, 1, 4, 1, 1, 1 $\sum d^2=10$ $1-\frac{6\sum d^2}{n^3-n}$ $\frac{6\times 10}{\ldots}$	2 1 1	4

	□ □1 3□ □1 0.1172 □ 0.8828 8 □8		
18	2x-y+1=0....................(1), 3x-2y+7=0................(2) Let (1) be the regression eq Yon X and (2) be the regression eq X on Y From (1) ⟶ byx=2 From (2) ⟶ bxy=2/3 Here b_{yx} x b_{xy} >1 so our assumption is wrong Regression eq Yon X is 3x-2y+7=0, regression eq X on Y is 2x-y+1=0 *Note: Also consider the reverse assumption. Scores divide accordingly.*	½ 1 1 ½ + ½ ½	4
19	$c(x)=2x^2-24x+107$ $c^I(x)=4x-24$ $c^{II}(x)=4$ for maxima and minima $c^I(x)=o$ ⟹ x=6 $c^{II}(6)$is positive c(x) has minimum at x=6 *Note: For correct procedure give 2 score*	1 1 1 ½ ½	4
20(a) (b)	(iii) P(X □ x) ∑P(x)=1 0.4+k+0.2+0.1=1 K=0.3 *Note: for correct value of K give 3 score(irrespective of steps)*	1 1 1 1	4

21(a) (b)	(i)E(4x-3)=4×4 - 3=13 (ii)V(4x-3)=16×2=32 1 □ $kx\ dx^2$□1 0 3 1 k□ □□ □^{x}3 0 □1 $\frac{1}{3}$ 3 k(□0) 1□ k □3	1+1 ½ ½ ½ ½	4
22(a) (b)	(iii) n or (iv) x (table below) Mean of sample mean $\frac{128}{10}$ □□ 12.8 ***Note:*** *For calculation of Population mean=12.8 give 1 score* *SRSWR with correct procedure and answer give 3 score*	1 2 1	4
23	Any attempt to solve the problem give 4 score	4	4

Samples	**(8,12)**	**(8,13)**	**(8,15)**	**(8,16)**	**(12,13)**	**(12,15)**	**(12,16)**	**(13,15,)**	**(13,16)**	**(15,16)**
x	10	10.5	11.5	12	12.5	13.5	14	14	14.5	15.5

Qn	Answer	Score	Total
24	$H_0:\mu=55$, $H_1:\mu \neq 55$	½	
	Given $\bar{x}=56.2$, $\sigma^2 = 32$,n=81	½	
	$z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$	1	
	$= \frac{56.2-55}{\sqrt{32/81}}$	1	
		½	
	$= 1.91$	½	
	Table value of z=1.96		4
	Here IzI< table value of z, so we accept H_0. Hence mean is 55		
	Note: For correct procedure give 3 score		

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Source	df	SS	MSS	F	$F_{0.05}$
Between	3	139.81	46.6	20.8	3.13
within	19	42.62	2.24		
Total	22	182.43			

Here $F>F_\alpha$ — 2 ½

Reject H_0 .ie; we reject the hypothesis that the effects of fertilisers are equal — ½

Note: If correct table only then give 3 scores — 1 — 4

Qn	Answer	Score	Total
26(a)	Definition/explanation of time series	2	
(b)	Trend, periodic movements, irregular variations	2	4
	OR		
	Trend, seasonal variation, cyclical variation, irregular variations (½ x 4)		

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Year	2010	2011	2012	2013	2014	2015	2016	2017
Sales	55	56	55	58	54	52	54	58
3yr total	--	166	169	167	164	160	164	--
3yr moving average	--	55.33	56.33	55.67	54.67	53.33	54.67	--

Scores: 2, 2 — Total 4

Note: for computation of moving average without moving total give 4 score

Qn	Answer	Score	Total
28	$\sum P_0=101$, $\sum P_1=116$	2	
	Simple aggregate index number = $\frac{\sum P_1}{\sum P_0} \times 100$	1	
	$= \frac{116}{101} \times 100 = 114.85$	1	4
29	n=6, $\sum x=340$, $\sum x^2=19450$, $\sum xy=4685$, $\sum y=82$, $\sum y^2=1140$	2 ½	
	r = $\frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2}\sqrt{n\sum y^2 - (\sum y)^2}}$	1	
	$= \frac{6 \times 4685 - 340 \times 82}{\sqrt{6 \times 19450 - (340)^2}\sqrt{6 \times 1140 - (82)^2}}$	1½	
	$= 0.64$	1	6
	OR		
	Also consider alternative method :cov(x,y)=6.39, SD(x)=5.53,SD(y)=1.8 (½each), Table calculation 2½ , r=0.64 (formula 1score+answer 1 score)		

Qn	Answer key	Score	Total
30(a)	(iii) Less than 1	1	
(b)	x- age or cars, y- annual maintenance cost n=4, $\sum x=20, \sum x^2=120, \sum xy=490, \sum y=85$	1	
	$\bar{x} = \frac{20}{4} = 5,\ \bar{y} = \frac{85}{4} = 21.25$	½ + ½	
	byx = $\frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$ *OR* byx $= \frac{\text{cov}(x,y)}{\text{var}(x)}$	1	
		½	
	$= \frac{4\times 490 - 20\times 85}{4\times 120 - (20)^2} = 3.25$ $\quad \frac{16.25}{5} = 3.25$	1	
		½	
	Regression equation Y on X is $y - \bar{y} = b_{yx}(x - \bar{x})$		6
	$y - 21.25 = 3.25(x-5)$		
	When x=5 , y=21.25 *Note: predicting the value of y is not compulsory* **OR** Identifying the problem as an application of regression equation give 1 score **OR** Computation of regression equation X on Y give 4 scores		
31(a)	(iii) $z = \frac{x-5}{3}$	1	
(b)	(i) $\mu=700$, $\sigma=50$	½	
	$P(690 < X < 720) = P\left(\frac{690-700}{50} < \frac{X-700}{50} < \frac{720-700}{50}\right)$	½	
	$= P(-0.2 < Z < 0.4)$	½	
	$= P(-0.2 < Z < 0) + P(0 < Z < 0.4)$ $= 0.0793 + 0.1554$ $= 0.2347$	½	
		1	
	Number of workers=1000×0.2347 = 235		
	(ii) $P(X > 750) = P\left(Z > \frac{750-700}{50}\right)$	½	
	$= P(Z > 1)$	½	6
	$= 0.5 - 0.3413 = 0.1587$	1	
	Number of workers=1000×0.1587 = 159 *Note: Give full score if probabilities are calculated correctly*		

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p_1	p_0	q_1	q_0	p_1q_1	p_1q_0	p_0q_1	p_0q_0
40	20	6	8	240	320	120	160
60	50	5	10	300	600	250	500
50	40	15	15	750	750	600	600

$= 124.7$

121.77

20	20	25	20	500	400	500	400
Total				**1790**	**2070**	**1470**	**1660**

	Score	Total
	2	
(a)Laspeyre's Index Number, $L = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100 = \frac{2070}{1660} \times 1($	1+ ½	
	1+ ½	
(b)Paasche's Index Number, $P = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100 = \frac{1790}{1470} \times 100 =$	½ + ½	
(c)Fishers Index Number= $\sqrt{L \times P} = \sqrt{124.7 \times 121.77} = 123.23$		6
Note: for correct procedure give 3 score		

SCHEME FINALISATION TEAM
