(English Version)

Instructions : 1. Statistical table and Graph sheets will be supplied on request.

2. Scientific calculators are allowed.

3. All working steps should be clearly shown.

4. For Section-A, only the first written answers will be considered for evaluation.

5. For questions having diagram, graph and map, alternative questions are given at the end of the question paper in a separate section for visually challenged students.

SECTION – A

I. Choose the correct answer from the choices given : $(5 \times 1 = 5)$

1) Life expectancy of a newborn baby

   a) Mortality   b) Longevity

   c) Fertility   d) Fecundity

2) The weights used in the construction of Marshall-Edgeworth's price index number

   a) q_0 b) q_1

   c) $\left(\dfrac{q_0 + q_1}{2} \right)$ d) $(q_0 \div q_1)$

3) The variance of a χ^2 - distribution with 12 degrees of freedom is 24. Then its mean is

   a) 72   b) 2

   c) 0.5   d) 12

4) Type I error is

    a)   Rejecting H_0 when it is true

    b)   Accepting H_0 when it is true

    c)   Rejecting H_0 when it is not true

    d)   Accepting H_0 when it is not true

5) The game is said to be fair, if the value of the game is

    a) $V > 0$ b) $V = 0$

    c) $V < 0$ d) $V \neq 0$

II. Fill in the blanks by choosing the appropriate answer from those given in the brackets :

                                                             (5 × 1 = 5)

$$\left(\frac{1}{2}, \, d_2\sigma', \, \text{Geometric mean}, \, \sqrt{\frac{PQ}{n}}, \, \text{first}, \, \overline{R} \right)$$

6) The best average used in the construction of index number ⸺.

7) Binomial distribution is positively skewed when $p <$ ⸺

8) Standard error of the sample proportion is ⸺

9) For R-chart if σ' is known, then ⸺ is the central line.

10) The feasible solution to the L.P.P exists in ⸺ quadrant.

III. Match the following. (5 × 1 = 5)

A		B	
11)	Deaths of new born babies within 28 days	a)	Lepto Kurtic ($\beta_2 > 3$)
12)	Index number which doesn't satisfy unit test	b)	$1 - \beta$
13)	Student's t-distribution curve	c)	C_2
14)	Power of a test	d)	Neonatal deaths
15)	Shortage cost	e)	Simple aggregative price index number
		f)	P (Type I error)

IV. Answer the following questions : (5 × 1 = 5)

16) Write one use of vital statistics.

17) Define secular trend.

18) A normal variate has mean 150 and variance 25. Find the standard deviation.

19) Define rejection region.

20) When is the solution to the transportation problem said to be non-degenerate?

SECTION – B

V. Answer **any five** of the following questions : $(5 \times 2 = 10)$

21) Define irregular variation and give an example.

22) Write two conditions for applying binomial expansion method of interpolation and extrapolation.

23) Write down the Bernoulli distribution probability mass function with the parameter $p = \dfrac{2}{5}$.

24) If z_1 and z_2 are two independent S.N.Vs then name the distribution of $(z_1^2 + z_2^2)$ and write its mean.

25) Define parameter and statistic.

26) Given : $n_1 = 100$, $n_2 = 60$, $P_1 = 0.4$ and $P_2 = 0.8$. Find S.E. $(p_1 - p_2)$.

27) In statistical quality control, what are defect and defectives?

28) Given : $R = 5000$ items/year, $C_3 = ₹ 50$/cycle, $C_1 = ₹ 2$/item/year. Calculate minimum average inventory cost.

SECTION – C

VI. Answer **any four** of the following questions : $(4 \times 5 = 20)$

29) Construct a suitable index number for the following data and comment.

Item	Price (in ₹)		Quantity 2023
	2018	2023	
Rice	20	40	10
Wheat	25	32	3
Ragi	18	30	5
Oil	80	100	3

30) Interpolate the value of Y when $X = 25$, using Newton's forward difference method for the following data.

X	10	20	30	40
Y	13	15	19	25

31) In a class 60% of the students are boys. In a random sample of 5 students, find the probability that (a) 2 are boys (b) atleast one is a boy.

32) A box contains 5 blue and 7 pink marbles. 5 marbles are drawn at random. What is the probability that the sample contains 2 pink marbles? Also find the mean number of pink marbles.

33) A sample of 100 students is chosen from a large group of students. The average height of these students is 162 cm. and standard deviation is 8 cm. At $\alpha = 5\%$, can we reasonably assume that the average height of large group of students is 160 cm?

34) Five students were given an intensive coaching and 2 tests were conducted before and after coaching, the change in their marks are as follows :

2, 0, 5, –2, 3

Do the scores after coaching show an improvement? Use $\alpha = 5\%$.

35) For the following transportation problem, find the initial basic feasible solution by North-West corner rule. Compute the total transportation cost.

		Dealers			
		D_1	D_2	D_3	Availability
	O_1	8	4	12	50
Factory	O_2	10	5	6	20
	O_3	7	15,	3	10
Demand		40	20	20	

36) The price of a machine is ₹ 3,000. Its maintenance cost and resale value at different ages are given below :-

Year	1	2	3	4	5	6
Maintenance cost (₹)	1000	1100	1150	1300	1500	1900
Resale value (₹)	1750	1250	850	600	500	450

What is the annual average cost? When the machine be replaced?

VII. Answer **any two** of the following questions.   **(2 × 5 = 10)**

37) The daily wages of workers of a factory are normally distributed with mean ₹ 500 and standard deviation ₹ 40. Find the probability of worker whose daily wage will be (a) more than ₹ 530 (b) between ₹ 380 and ₹ 460.

38) Following expected frequencies are obtained after fitting binomial distribution by estimating the parameter.

O_i	29	37	45	62	50	27
E_i	7	35	75	81	43	9

Test whether binomial distribution is a good fit at $\alpha = 1\%$.

39) In a fish net manufacturing process, the average number of defects per square meter is known to be 3. Determine the control limits for the number of defects.
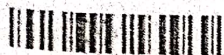
40) Solve the following linear programming problem graphically.

Maximise $Z = 5x + 10y$

Subject to constraints : $5x + 4y \le 40$
$3x + 4y \ge 24$
and $x \ge 0, y \ge 0$.

SECTION – D

VIII. Answer **any two** of the following questions :

(2 × 10 = 20)

41) Calculate gross reproduction rate and net reproduction rate for the following data and comment on the result.

Age group (in years)	Female population	Female births	Survival ratio
15-19	50,000	1,000	0.91
20-24	60,000	7,000	0.90
25-29	45,000	8,000	0.89
30-34	40,000	5,000	0.88
35-39	30,000	3,000	0.87
40-44	25,000	1,000	0.86
45-49	20,000	100	0.85

42) a) Compute the cost of living index number for the following data. (5)

Group	Weight	Price (in ₹)	
		Base Year	Current Year
Food	5	1600	2400
House rent	10	4000	5000
Clothing	3	800	1000
Fuel and lighting	4	100	400
Others	5	1600	2000
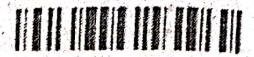
b) Compute value index number from the following data. Comment on the result. (5)

Item	2018		2020	
	Price (₹)	Quantity (kg)	Price (₹)	Quantity (kg)
A	50	8	60	10
B	80	4	100	5
C	70	6	60	6
D	30	5	50	7

43) Fit a second degree parabola of the type $y = a + bx + cx^2$ by the method of least squares to the following time series. Estimate the value for 2020.

Year	2010	2012	2014	2016	2018
Value	14	12	11	10	13

SECTION – E

(For Visually Challenged Students only)

40) Write the procedure of solving linear programming problem graphically.

CANARA VIKAAS PRE UNIVERSITY COLLEGE
Statistics answer key – 2024

Section – A

I. Choose the correct answer 5x1=5

1. b) longevity
2. c) $\frac{q_0+q_1}{2}$
3. d) 12
4. a) Rejecting H_0 when it is true
5. b) V=0

II. Fill in the blanks by choosing appropriate answer from those given in brackets 5x1=5

6. Geometric mean
7. 1/2
8. $\sqrt{\frac{PQ}{n}}$
9. $d_2\sigma'$
10. First

III. Match the following 5x1=5

11. d) neonatal deaths
12. e) simple aggregative price index number
13. a) leptokurtic ($\beta_2>3$)
14. b) 1-β
15. c) C_2

IV. Answer the following questions 5x1=5

16. Vital statistics are used in medical research

17. The general tendency of the time series data to increase or to decrease or to remain constant during a long period of time is called secular trend.

18. SD=$\sqrt{Variace}$=5

19. Rejection region is the set of those values of the test statistic, which leads to the rejection of the null hypothesis.

20. Number of positive allocations= m+n-1

Section – B

V. Answer any FIVE questions 5x2=10

21. It is the irregular movement of the data over a period of time.
For example, sudden increase in death rate of Nepal due to earth quake

22.
   a. The values of the independent variable should have a common difference.
   b. The value of X for which the value of Y is to be estimated should be one of values of X.

23. $p(x)=p^x q^{1-x}$, x=0, 1
$=(2/5)^x(3/5)^{1-x}$, x=0, 1

24. Chi square distribution with 2 degrees of freedom

    Mean =2

25. A statistical constant of the population is called parameter

       A function of sample values is called statistic

26. $SE(p_1-p_2)= \sqrt{\frac{P_1Q_1}{n_1} + \frac{P_2Q_2}{n_2}} = 0.0711$

27. A defect is a quality characteristic which does not conform to specifications. An item having one or more defects is a defective item

28. $C(Q^0) = \sqrt{2C_1C_3R} = 1000$

Section C

VI. Answer any four questions   **4x5=20**

29.

Item	p_0	p_1	q_1	p_0q_1	p_1q_1
Rice	20	40	10	200	400
Wheat	25	32	3	75	96
Ragi	18	30	5	90	150
Oil	80	100	3	240	300
				605	**946**

$P_{01}^P = \frac{\sum p_1q_1}{\sum p_0q_1} \times 100 = 156.3636$

Current year price is increased b6y 56.3636%

30.

x	y	Δ^1	Δ^2	Δ^3
10	13			
20	15	2		
30	19	4	2	
40	25	6	2	0

$X = \frac{25-10}{10} = 1.5$

$y = y_0 + x\Delta_0^1 + \frac{x(x-1)}{2!}\Delta_0^2 + \frac{x(x-1)(x-2)}{3!}\Delta_0^3 = 16.75$

31. X: No of boys

 p=0.6, q=0.4, n=5

Pmf is given by $p(x) = {}^nC_x p^x q^{n-x} = {}^5C_x(0.6)^x(0.4)^{5-x}$, x = 0, 1, … … 5

      p(2)=0.2304

P(at least 1 boy) =1- p(0) = 1- 0.0102 =0.9898

32. X: Number of pink marbles

a=7, b=5, n=5

$$p(x)=\frac{^aC_x \, ^bC_{n-x}}{^{a+b}C_n}, x=0, 1, \ldots \ldots \min(a, n)$$

$p(2)= 0.2651$

$\text{Mean}=\frac{na}{a+b}=2.9167$

33. H_0: $\mu=160$ $\quad\quad$ H_1: $\mu\neq160$

Test statistic $\frac{\bar{x}-\mu_0}{s/\sqrt{n}}\sim N(0, 1)$

$\quad\quad = 2.5$

Critical value at 5% k=1.65

We reject H_0 and accept H_1. Average height large group of students is not 160cm

34. H_0: $\mu_1=\mu_2$ $\quad\quad$ H_1: $\mu_1<\mu_2$

$\bar{d} = 1.6$, $S_d=2.4166$

Test statistic $t_{cal} = \frac{\bar{d}}{s_d/\sqrt{n-1}} \sim t_{n-1}$

$\quad\quad = 1.3241$

Critical value at 5% = -2.13

We accept H_0

The scores after coaching do not show improvement.

35. $x_{11}=40$, $x_{12}=10$, $x_{21}=10$, $x_{22}=10$, $x_{33}=10$

Total cost $\Sigma\Sigma C_{ij}x_{ij}$=Rs.500

36. P=Rs.3000

year	Ci	Sn	P-Sn	sum Ci	$A(n)=\frac{(P-S_n)+\sum_{i=1}^{n} C_i}{n}$
1	1000	1750	1250	1000	2250
2	1100	1250	1750	2100	1925
3	1150	850	2150	3250	1800
4	1300	600	2400	4550	1737.5
5	1500	500	2500	6050	1710
6	1900	450	2550	7950	1750

Machine should be replaced at the end of 5th year and annual average cost is Rs.1710

VII. Answer any TWO of the following $\quad\quad\quad\quad\quad\quad\quad\quad$ 2x5=10

37. X: Daily wages of workers of a factory

$\quad\quad$ $\mu=500$, $\sigma=40$, $Z=\frac{x-\mu}{\sigma} = \frac{x-500}{40} \sim N(0, 1)$

P(X>530)=P(Z>0.75)=0.2266

P(380<X<460)=P(-3<Z<-1) = 0.9987 - 0.8413=0.1574

38. H_0: Binomial distribution is a good fit

$\quad$ H_1: Binomial distribution is not a good fit

Oi	Ei	$\frac{(O_i - E_i)^2}{E_i}$
29	7	69.14286
37	35	0.114286
45	75	12
62	81	4.45679
50	43	1.139535
27	9	36
		122.8535

Test Statistic $\chi^2{}_{cal} = \frac{(O_i - E_i)^2}{E_i} \sim \chi^2{}_{n-c}$

$\qquad$ =122.8535

n=6, c=2 n-c=4

Critical value at 1% k_2=9.49

We reject H_o and accept H_1

Binomial distribution is not a good fit

39.

CL	λ'	3
LCL	$\lambda' - 3\sqrt{\lambda'}$	-2.19615=0
UCL	$\lambda' + 3\sqrt{\lambda'}$	8.196152

40. 5x+4y=40 $\qquad$ 3x+4y=24

$\quad$ x=0, y=10 $\qquad$ x=0, y=6

$\quad$ y=0, x=8 $\qquad$ y=0, x=8

X axis: 1cm=2 units
Y axis: 1cm=2 units
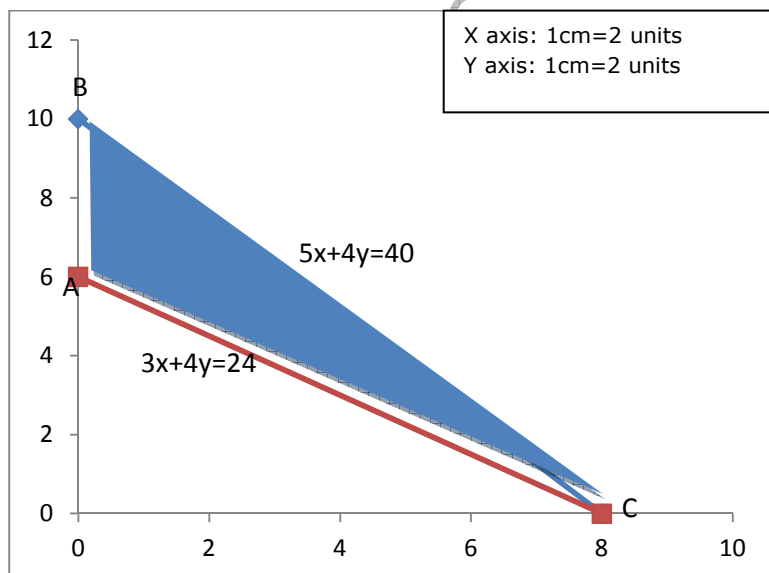
Corner Points	Z=5x+10y
A(0, 6)	60
B(0, 10)	100 - Maximum
C(8, 0)	40

Given LPP has unique solution
x=0, y=10 and Z=100

Section D

VIII. Answer any TWO of the following 2x10=20

41.

year	female population	female births	survival rate	WSFR	WSFR×S
15-19	50000	1000	0.91	20	18.2
20-24	60000	7000	0.9	116.667	105
25-29	45000	8000	0.89	177.778	158.2222
30-34	40000	5000	0.88	125	110
35-39	30000	3000	0.87	100	87
40-44	25000	1000	0.86	40	34.4
45-49	20000	100	0.85	5	4.25
				584.444	517.0722

GRR = i × Σ WSFR=2922.2222 $\qquad$ WSFR = $(^tB_x/^tP_x) \times 1000$

NRR = i × Σ WSFR × S=2585.361

NRR/1000 = 2.5853 > 1

Population is increasing

42. a.

ITEMS	p_0	p_1	Weights	P	WP
Food	1600	2400	5	150	750
House Rent	4000	5000	10	125	1250
Clothing	800	1000	3	125	375
Fuel and Lighting	100	400	4	400	1600
Others	1600	2000	5	125	625
			27		**4600**

CLI=$\frac{\Sigma WP}{\Sigma W}$=170.3704

b.

ITEM	p0	q0	p_1	q_1	p_0q_0	p_1q_1
A	50	8	60	10	400	600
B	80	4	100	5	320	500
C	70	6	60	6	420	360
D	30	5	50	7	150	350
					1290	**1810**

$V_{01} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_0} \times 100$=140.3101

Current year value is increased by 40.3101%

43.

year	y	x	x^2	x^3	x^4	xy	x^2y
2010	14	-2	4	-8	16	-28	56
2012	12	-1	1	-1	1	-12	12
2014	11	0	0	0	0	0	0
2016	10	1	1	1	1	10	10
2018	13	2	4	8	16	26	52
	60		**10**	**0**	**34**	**-4**	**130**

$y = a + bx + cx^2$, where a, b and c are constants, found using the normal equations,

$n\,a + b\,\Sigma x + c\Sigma x^2 = \Sigma y$ --- (1)

$a\Sigma x + b\,\Sigma x^2 + c\Sigma x^3 = \Sigma xy$ --- (2)

$a\Sigma x^2 + b\Sigma x^3 + c\Sigma x^4 = \Sigma x^2 y$ --- (3)

From (2), b = -0.4

From (1) 5a+10c=60

From (3) 10a+34c=130

On solving a=10.5714 and c=0.7142

$y = a + bx + cx^2 = 10.5714 - 0.4\,x + 0.7142x^2$

Estimate for the year 2020 (x=3), y=15.7992