VIKAAS PU COLLEGE
Answer key- II PUC Statistics - 2019
Section A

1. Survival ratio is the probability that a person aged x years will survive up to age x+1
2. Current year prices
3. $P_{01} \times Q_{01} = \frac{\sum p_1 q_1}{\sum p_0 q_0}$=$V_{01}$
4. The causes for irregular variation are Earthquake, tsunami, strike, lockouts
5. Variance = pq
6. 0.5
7. The standard deviation of sampling distribution of a statistic is called its standard error.
8. If a single value is proposed as an estimate of the unknown parameter then it is point estimation
9. The error that occurs by accepting null hypothesis when it is actually not true is called type II error or Second kind error
10. X bar chart
11. When the number of positive allocations in any BFS is less than m+n-1, then the solution is said to be degenerate
12. $t^0 = \frac{Q^0}{R}$

Section B

13. $CBR = \frac{No.\ of\ live\ births\ in\ a\ year}{Average\ population\ in\ the\ year} \times 1000$

$$20 = \frac{No.\ of\ live\ births\ in\ a\ year}{200000} \times 1000$$
$$No.\ of\ live\ births\ in\ a\ year = 4000$$

14.
   a. Base period should be economically stable.
   b. The base period should not be too distant from the given period.
   c. Depending on the situation the base period is fixed base period or chain base.
   d.

15. $P_{01}^{K} = \frac{\sum p_1 q}{\sum p_0 q} \times 100 = \frac{500}{400} \times 100 = 125$

16. i. The sum of deviations obtained from the actual and trend values is zero.
    ii. The sum of squares of deviations obtained from the actual and trend values is least.

17.
   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 must be one of the values of x.

18. i. Standard normal distribution (ii) Chi-square distribution with one degree of freedom

19. Median = 0, Variance = $\frac{n}{n-2} = 2$

20. A statistical hypothesis is a statement regarding the parameters of the population. It is denoted by H. Example, H: μ=50 and σ=3

21. $t_{cal} = \frac{\bar{d}}{\frac{s_d}{\sqrt{n-1}}} \sim t_{n-1}$ t_{cal} = 4

22.

a. There is a risk of accepting a bad lot and rejecting a good lot, since verification is done only on the basis of samples.
b. Timely identification of the production of defective cannot be achieved.

23. North West Corner rule and Matrix Minima Method

24. $S^0 = Q^0 \frac{C_2}{C_1+C_2} = 198\ units$

Section C

25. .

Age	Population	Deaths	Std. population	A	PA
below 5	4000	144	4500	36	162000
5-14	10500	63	10000	6	60000
15-64	13500	81	12500	6	75000
65 and above	2000	102	3000	51	153000
			30000		450000

ASDR=$\frac{Number\ of\ deaths\ in\ a\ specified\ age\ group\ in\ a\ year}{Total\ number\ of\ population\ in\ that\ particular\ age\ group\ in\ a\ year} \times 1000$

STDR =$\frac{\sum PA}{\sum P} = \frac{450000}{30000}$=15

26.

ITEMS	p_0	p1	P	log P
A	4	7	175	2.243038
B	5	10	200	2.30103
C	15	21	140	2.146128
D	10	25	250	2.39794
				9.088136

Simple average of price relative (GM) = antilog ($\frac{\sum \log P}{n}$) $= antilog(2.2720)$=187.0682

27. Consumer price index number is the index number of the cost met by a specified class of consumers in buying a 'basket of goods and services'

a. Defining purpose and scope.
b. Conducting family budget enquiry and selecting the weights.
c. Obtaining price quotations.
d. Computing the index number.

28.

Year	Sales ('000)	3 yearly moving sum	trend values
2012	30		
2013	36	105	35
2014	39	108	36
2015	33	111	37
2016	39	117	39
2017	45	126	42
2018	42		

Given time series has upward trend.

29.

x	y	Δ1	Δ2	Δ3
30	73			
40	198	125		
50	573	375	250	
60	1198	625	250	0

$$x = \frac{34-30}{10} = 0.4$$

y= $y_0 + x\Delta_0^1 + \frac{x(x-1)}{2!}\Delta_0^2 + \frac{x(x-1)(x-2)}{3!}\Delta_0^3$ = 93

30.

Given average defective items λ=2

Let X denotes number of defective items. Hence X~P(λ=2)

Pmf is given by, $p(x) = \frac{e^{-\lambda}(\lambda)^x}{x!} = \frac{e^{-2}(2)^x}{x!}, x = 0, 1, 2, ...$

P[at least 2 defective items] = 1-P[X<2]= 1-p(0)- p(1)= $1 - \frac{e^{-2}(2)^0}{0!} - \frac{e^{-2}(2)^1}{1!}$ =0.5941

Number of boxes = 100×0.5941 = 59 boxes.

31.

Given a+b = 12, a = 5, b = 7, n = 4

Let X denotes that caught fish is a marked one

Pmf is given by, $p(x)=\frac{{}^aC_x \, {}^bC_{n-x}}{{}^{a+b}C_n}, x = 0, 1, ... \min(a, n)$

P[3 marked fishes] = p(3) =$\frac{10\times7}{495}$ = 0.1414

Mean = Mean= $\frac{na}{(a+b)}$=1.6667

32. H_0: $\mu_1 = \mu_2$

H_1: $\mu_1 \neq \mu_2$

Test statistic is given by, $Z_{cal} = \frac{\bar{x}_1-\bar{x}_2}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}} \sim N(0, 1)$ under H_0

Z_{cal} = -2

At 1% level of significance, the critical value (k) is ±2.58

Accept H_0. There is no significant difference in the mean weight of boys and girls.

33. H_0: μ = 120

H_1: μ <120

$\bar{x}$=108, n=17, s=8.

Test statistic is given by, $t_{cal} = \frac{\bar{x}-\mu_0}{s/\sqrt{n-1}} \sim t_{n-1}$

t_{cal}= -6

At 5% level of significance with 16 d.f. k = - 1.75

We reject Ho. Those who practice yoga have average blood sugar less than 120.

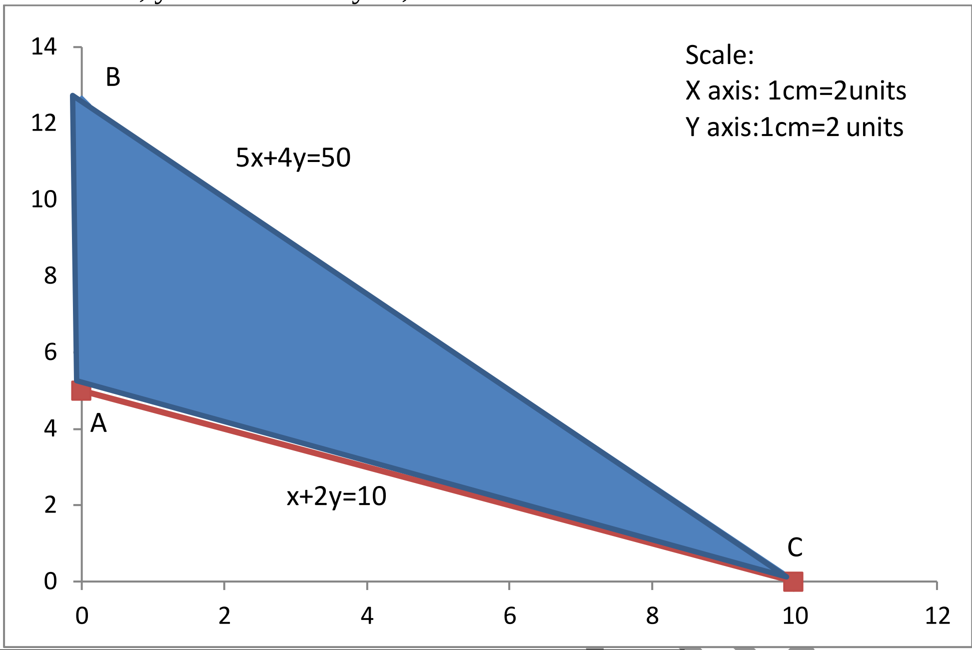
34. $\bar{c} = \frac{\sum defect}{k}$ = 4

CL = $\bar{c} = 4$

LCL =$\bar{c} - 3\sqrt{\bar{c}}$ = - 2 taken as 0

UCL = $\bar{c} + 3\sqrt{\bar{c}}$ = 10

35. $5x+4y=50$
When $x=0, y=12.5$ and when $y = 0, x= 10$
$X+2y=10$
When $x=0, y= 5$ and when $y=0, x=10$



Corner points	Z=3X+2Y
A(0, 5)	**10 (Minimum)**
B(0, 12.5)	25
C(10, 0)	30

Given LPP has unique solution.
$x = 0, y = 5$ and $Z = 10$

36. A_2 dominates A_1, A_3, A_4 and hence A_1, A_3, A_4 are deleted.
B_1 dominates B_2, B_3, B_4 and hence B_2, B_3, B_4 are deleted.
Saddle point exists at (2, 1)
Strategy of Player A is A_2
Strategy of Player B is B_1
Value of the game is 9.

Section D

37.

Year	Female population	Female births	Survival rate	WSFR	WSFR×S
15-19	16000	480	0.91	30	27.3
20-24	14500	812	0.9	56	50.4
25-29	13000	650	0.9	50	45
30-34	11500	460	0.88	40	35.2
35-39	10000	300	0.87	30	26.1
40-44	8700	87	0.86	10	8.6
45-49	7500	30	0.85	4	3.4
				220	196

WSFR = $({}^{f}B_x / {}^{f}P_x) \times 1000$
GRR = $i \times \Sigma$ WSFR $= 5\times 220 = 1100$
NRR = $i \times \Sigma$ WSFR $\times S = 5\times 196 = 980$
NRR per thousand = $0.980 < 1$
Population is Decreasing

38.

ITEM	p_0	p_0q_0	p_1	p_1q_1	q_0	q_1	p_0q_1	p_1q_0
A	10	50	12	48	5	4	40	60
B	15	120	18	126	8	7	105	144
C	6	18	4	20	3	5	30	12
D	3	12	3	15	4	5	15	12
		200		**209**			**190**	**228**

$P_{01}^{L} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100 = 114$

$P_{01}^{P} = \frac{\sum p_1 q_1}{\sum p_0 q_1} \times 100 = 110$

$P_{01}^{DB} = \frac{1}{2}\left[\frac{\sum p_1 q_0}{\sum p_0 q_0} + \frac{\sum p_1 q_1}{\sum p_0 q_1}\right] \times 100 = 112$

39.

Year	y	x	x^2	x^3	x^4	xy	x^2y
2010	460	-2	4	-8	16	-920	1840
2012	550	-1	1	-1	1	-550	550
2014	680	0	0	0	0	0	0
2016	840	1	1	1	1	840	840
2018	1020	2	4	8	16	2040	4080
	3550		**10**	**0**	**34**	**1410**	**7310**

Second degree equation is $y = a + bx + cx^2$

Normalequations,

$\Sigma y = na + b\,\Sigma x + c\Sigma x^2$

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

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

By substituting and solving the above equations, a= 680, b=141, c=15

Hence the Second degree trend is $y = 680 + 141x + 15x^2$

40. a. X : No. of heads obtained

n=4, p = 0.5, q = 0.5, N=128

X~B(n,p)

$p(x) = {}^{n}C_x\, p^x q^{n-x}$, x= 0, 1, 2, 3, 4

$T_x = N.p(x)$

x	T_x
0	8
1	32
2	48
3	32
4	8
	128

b. H_0: die is unbiased H_1: die is not unbiased

Under the assumption that H_0 is true the expected frequencies are 120/6=20 each

x	1	2	3	4	5	6	**Total**
O_i	30	25	18	10	22	15	**120**
E_i	20	20	20	20	20	20	**120**
$\frac{(O_i - E_i)^2}{E_i}$	5	1.25	0.2	5	0.2	1.25	**12.9**

Test statistic is given by, $\chi^2{}_{cal} = \sum \frac{(O_i - E_i)^2}{E_i} \sim \chi^2_{n-1} under\ H_0$

$\chi^2{}_{cal}$ =12.9

Hence at 5% level of significance critical value (right tail) for (6-1)=5 degrees of freedom is k_2 = 11.07. We reject H_0 if $\chi^2{}_{cal} > k_2$ otherwise we accept H_0.

On comparison we Reject H_0.Hence die is not unbiased

Section E

41. Given μ=50 and σ = 5

Let X denotes the weights of students. Hence X~N(μ, σ^2)

$$Z = \frac{X - \mu}{\sigma} = \frac{X - 50}{5} \sim N(0,1)$$

i. $P[X > 45] = P\left[\frac{X-50}{5} > \frac{45-50}{5}\right]$= P[Z>-1) =0.8413

ii. $P[42 < X < 58] = P\left[\frac{42-50}{5} < \frac{X-50}{5} < \frac{58-50}{5}\right]$

= P[-1.6<Z<1.6]= P[Z>-1.6] – P[Z>1.6]

= 0.9452 – 0.0548= 0.8904

42. Given n = 400, x = 250. P_0 = 0.5

p=x/n = 250/400 = 0.625

H_0: P = 0.5

H_1 :P> 0.5

Test statistic is given by,$Z_{cal} = \frac{p - P_0}{\sqrt{\frac{P_0 Q_0}{n}}} \sim N(0,1)$ under H_0

= 5

At 5% level of significance, the critical value is k = 1.65

We reject H_0. Majority of men in the village are smokers.

43. H_0: inoculation and attack of cholera are independent.

H_1: inoculation and attack of cholera are not independent

	Attacked	Not attacked	Total
Inoculated	10	15	25
Not Inoculated	15	10	25
Total	25	25	50

Test statistic is given by, $\chi^2{}_{cal} = \frac{N(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)} \sim \chi^2_1\ under\ H_0$

= 2

Hence at 1% level of significance critical value (right tail) for 1 degree of freedom is k_2 = 6.63.

We accept H_0. Inoculation and attack of cholera are independent

44. $A(n) = \frac{(P - S_n) + \sum_{i=1}^{n} C_i}{n}$

year	C_i	S_n	P-S_n	ΣC_i	A(n)
1	100	3000	2000	100	2100
2	200	2500	2500	300	1400
3	330	2000	3000	630	1210
4	510	1500	3500	1140	1160
5	860	1000	4000	2000	1200

The machine should be replaced by the end of 4^{th} year.