GOVERNMENT OF KARNATAKA

KARNATAKA STATE PRE-UNIVERSITY EDUCATION EXAMINATION BOARD

II YEAR PUC EXAMINATION 2012- MAR.

SCHEME OF VALUATION (corrected copy)

Subject Code : 31 Subject : STATISTICS

Qn. No.		Marks Allotted
	Section A	
I	Answer the following questions: $10 \times 1 = 10$	
1.	What is life table ?	
Ans	Life table is a table which gives the life history of a hypothetical group of new borns (or cohort), which gradually diminishes by death.	
	OR	
	Life table is a tabular presentation of numerical data describing the mortality conditions of a cohort.	1
2.	Write the formula for unweighted geometric mean index number.	
Ans	$P_{01} = \text{antilog}\left(\frac{\Sigma \log P}{n}\right)$ or $Q_{01} = \text{al}\frac{\Sigma \log Q}{n}$	
	where $P = \frac{p_1}{p_0} \times 100$ where $Q = \frac{q_1}{q_0} \times 100$	
	n = number of items.	1

Qn. No.		Marks Allotted
3.	Write the relationship between Laspeyre's, Paasche's and Dorbish-Bowley's index numbers.	
Ans	$P_{01}^{(D-B)} = \frac{P_{01}^{(L)} + P_{01}^{(P)}}{2}$	
	or	
	$Q_{01}^{(D-B)} = \frac{Q_{01}^{(L)} + Q_{01}^{(P)}}{2}$	1
	or $P_{01} = \frac{L+P}{2}$ or A.M. of L and P.	
4.	Name the graph used to represent time series data.	
Ans	Histogram.	1
5	For what values of P, Binomial Distribution is symmetrical?	
Ans	When $P = \frac{1}{2}$ or 0.5, B.D. is symmetrical or $P = Q$.	1
6.	What do you mean by standard normal variate?	
Ans	If X is a normal variate with mean μ and S.D σ then $Z = \frac{x-\mu}{\sigma}$ is a S.N.V.	1
	or	
	Z is a standard normal variate if its mean is 'zero' and sd. is 'one'.	
	or	
	p.d.f. $f(z) = \frac{1}{\sqrt{2\pi}} e^{-z^2/2}$, $-\infty < z < +\infty$	

Qn. No.		Marks Allotted
7.	What is meant by standard error?	
Ans	S.E. is the standard deviation of a sampling distribution.	1
8.	Define Power of a test.	
Ans	Power of a test $= (1-\beta)$ where $\beta = P$(type II error)	
	Or	
	Power of a test is the probability of rejecting H_0, when it is not true.	1
9.	Define solution in a L.P.P.	
Ans	The values of decision variables, x_1, x_2 etc which satisfy the constraints $AX (\leq, =, \geq) b$ OR $\sum a_{ij} x_j (\leq, =, \geq) b_j$ $i = 1$ to m, $j = 1$ to n is called the solution to a L.P.P.	1
10.	In $\bar{X}$ - chart, if one of the sample means lies outside the control lines what would you conclude?	
Ans	we conclude that the process is 'out of control' or 'lack of control'.	1

Qn. No.	Section - B.	Marks Allotted
	Answer any ten of the following. $10 \times 2 = 20$	
11.	Write the two sources of Vital Statistics.	
Ans	a) Registration Method 1.	2.
	b) Census enumeration Method 1.	
	c) Analytical Method	
Or	(a) Registers of Municipal, Panchayat offices	
	(b) Census Data	
12.	Write two norms for selecting the base year in the construction of index number.	
Ans	a) It should be a normal one / economically stable. 1.	2.
	b) It should not be too distant from the current period. 1.	
	c) 'fixed' or 'chainbase' can be considered.	
13	If Laspeyre's and Fisher's indices are 110 and 110.5 respectively, find Paasche's index number.	
Ans	Given: $P_{01}^{(L)} = 110$, $P_{01}^{(F)} = 110.5$.	
	$P_{01}^{(F)} = \sqrt{P_{01}^{(L)} \times P_{01}^{(P)}}$ 1	2
	$110.5 = \sqrt{110 \times P_{01}^{(P)}}$	
	$(110.5)^2 = 110 \times P_{01}^{(P)}$	
	$P_{01}^{(P)} = \frac{110.5 \times 110.5}{110} = 111.0023.$	
	$\therefore P_{01} = 111.0023.$ 1	

Qn. No.		Marks Allotted
14.	Mention all the components of time series	
Ans	a) Secular trend (or movements) } 1 b) Seasonal variations c) Cyclical variations } 1 d) Irregular (or erratic) variations (1 or 2 → 1 mark ; 3 or 4 → 2 marks)	2.
15.	Under what conditions does the binomial distribution tend to P.D.	
Ans	When a) $n \to \infty$ } 1 b) $p \to 0$ c) $np = \lambda$, a constant → 1	2.
16.	If standard deviation of a normal distribution is 15, find Q.D and M.D	
Ans	Given: $\sigma = 15$. $Q.D. = \frac{2}{3}\sigma = \frac{2}{3} \times 15 = 10.$ 1 $M.D. = \frac{4}{5}\sigma = \frac{4}{5} \times 15 = 12.$ 1	2.
17.	A random sample of size 49 is drawn from a population whose variance is 25. Compute the standard error of the sample mean.	
Ans	Given: $n = 49$, VAR $\sigma^2 = 25$. $\therefore \sigma = \sqrt{25} = 5.$	

Qn. No.		Marks Allotted
	S.E (Sample mean) $= \frac{\sigma}{\sqrt{n}}$ 1 $= \frac{5}{\sqrt{49}} = \frac{5}{7} = 0.7143$ 1	2.
18.	Define one-tailed and two tailed tests	
Ans	A test of statistical hypothesis where Critical Region is considered at right tail or left tail of sampling distribution curve or where H_1 is of 'more than' or 'less than' type, is called one tailed test. 1	
	A test of statistical hypothesis where critical region is considered at both right and left tails of sampling distribution curve OR where H_1 is of 'not equal to' type, is called two-tailed test. 1	2
19.	If Z is an S.N.V, name the distribution of Z^2 and write its variance.	
Ans	Distribution of Z^2 is χ^2. 1 Its variance $= 2n$, where 1 n is the d.f. or $2 \times 1 = 2$.	2.

Qn. No.		Marks Allotted
20.	Why should a feasible region of a LPP lie in the first quadrant?	
Ans	a) A LPP can have a feasible solution, only when $x, y \geq 0$. (ie the non-negative restrictions are satisfied). 1.	2.
	b) When $x, y \geq 0$, the plotted values can lie only in the 1st quadrant of the graph. 1.	
	(ie x, y are ≥ 0, in the 1st quadrant)	
	Or $x \geq 0$, $y \geq 0$. (2)	
21.	Write two characteristics of a competitive game.	
	(Consider any two)	
Ans	a) Number of players are finite.	
	b) Each player has a finite number of courses of action. (strategies)	
	c) The game is said to be played, when each player adopts one of his courses of action (strategies).	2.
	d) Each time a game is played, corresponding combination of action results in a transaction (or pay-off).	

Qn. No.		Marks Allotted
22	Write LCL and UCL for c-chart when standards are given.	
	$UCL(c) = \lambda' + 3\sqrt{\lambda'}$ or $c' + 3\sqrt{c'}$ or $m' + 3\sqrt{m'}$ (1)	2.
	$LCL(c) = \lambda' - 3\sqrt{\lambda'}$ or $c' - 3\sqrt{c'}$ or $m' - 3\sqrt{m'}$ (1)	
	Section C	
III	Answer any eight of the following. 8×5 = 40.	
23.	For the following data find TFR and the number of children per woman.	

Age (years)	Women population	Number of Births	A.S.F.Rs
15-19	4700	235	50
20-24	5000	500	100
25-29	4600	920	200
30-34	4400	396	90
35-39	4000	240	60
40-44	3900	195	50
45-49	3000	90	30
			580

1.

1.

ASFR = $\frac{\text{No. of live births in a specified age group}}{\text{Total female population in that specified age group}} \times 1000$

TFR = 5Σ ASFR or 5Σ quinquennial ASFR 1.

$= 5 \times 580 = 2900.$ 1.

No. of children per woman is 2 or 3. 1.

0.5

OR Table — (2)
TFR formula (1)
answer (1)
conclusion (1)

Note: If ASFR are multiplied by 100 or not multiplied by any number, reduce 1 mark.

Qn. No.		Marks Allotted
24.	Write five steps in the construction of an index number. (consider any five) 5	
Ans	a) Stating the purpose of the index. b) Selecting the base period. c) Selecting the items. d) Obtaining price quotations. e) Choosing an average. f) Selecting the appropriate system of weights. g) Selecting an appropriate formula.	
25.	Compute the cost of living index number for the data given below.	

Items	Prices in Rupees		Weights	$P = \frac{P_1}{P_0} \times 100$	PW
	Base year	Current year			
A	100	125	50	125	6250
B	45	135	5	300	1500
C	50	200	10	400	4000
D	20	75	10	375	3750
E	40	40	15	100	1500
F	50	300	10	600	6000
			100		23000

3

$CPI = \frac{\Sigma PW}{\Sigma W}$ 1

$= \frac{23000}{100} = 230$ 1

Qn. No.		Marks Allotted

26. From the following data obtain the trend values by finding four yearly moving averages.

Years	Profits (in crores Rs)	4 yearly MOVing Sum	Ans 4 year moving Avg	2 period MOVing Sum	Trend Centered M. Avgs.
1996	12	–		–	–
1997	16	56	14	–	–
1998	8	68	17	124	15.5
1999	20	88	22	156	19.5
2000	24	112	28	200	25
2001	36	132	33	244	30.5
2002	32	150	37.5	282	35.25
2003	40	–		–	–
2004	42	–		–	–

5.

Or 1st two col.s (2) + last col. (2) + position (1) = 5

27. On an average the number of defective items in a box is 2. If there are 100 such boxes, in how many of them would you expect at least two defective items ?.

P.T.O.

Qn. No.		Marks Allotted
Ans	Given: $\lambda = 2$ defectives $N = 100$ items. p.m.f $P(X=x) = \frac{e^{-\lambda}\lambda^x}{x!}$	1.
	$E(X = \text{atleast 2 def.}) = N \cdot P(X \geq 2)$	1.
	$= N \cdot [1 - P(X < 2)]$	
	$= N \cdot [1 - P(X = 1 \text{ or } 0)]$	
	$= N \cdot [1 - \{P(X=1) + P(X=0)\}]$	1
	$= 100 \times \left[1 - \left\{\frac{e^{-\lambda}\lambda^1}{1!} + \frac{e^{-\lambda}\lambda^0}{0!}\right\}\right]$	5.
	$= 100 \times [1 - \{(0.1353 \times 2) + (0.1353 \times 1)\}]$	1.
	$= 100 \times [1 - (0.1353)\ 3] = 100 \cdot [1 - 0.4059]$	
	$= 100 \times 0.5941 = 59.41 \simeq 59.$	1.
28.	Weights of students of a college are normally distributed with mean 45 kgs and S.D 5 kgs. Find the probability that a randomly selected student has weight i) greater than 50 kgs. ii) less than 42 kgs.	
	P.T.O.	

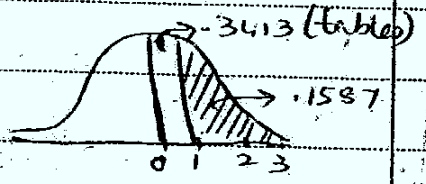
Qn. No.		Marks Allotted

Ans Given: In a N.D., $\mu = 45$ kgs, $\sigma = 5$ kgs

$$Z = \frac{x-\mu}{\sigma}$$ 1.

i) $P(x \geq 50)$:

$$Z = \frac{x-\mu}{\sigma} = \frac{50-45}{5} = \frac{5}{5} = +1$$ 1.



area to the right of 0 is = 0.5000

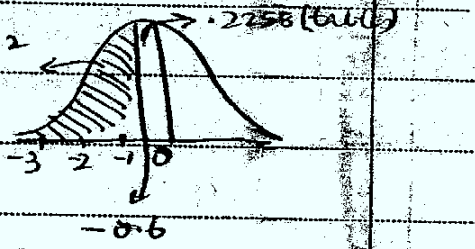
- area between 0 and $Z = 1$ is = 0.3413

∴ area to the right of $Z = 1$ is = 0.1587.

∴ $P(X \geq 50) = 0.1587$. 1. 5.

ii) $P(X < 42)$:

$$Z = \frac{x-\mu}{\sigma} = \frac{42-45}{5} = \frac{-3}{5} = -0.6$$ 1.

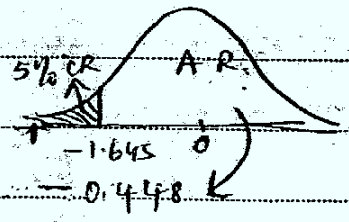


area to the left of 0 is = 0.5000

- area between 0 and $Z = -0.6$ is 0.2258

∴ area to the left of $Z = -0.6$ is 0.2742

∴ $P(X < 42) = 0.2742$. 1.

Qn. No.		Marks Allotted
29.	Among 500 randomly selected persons of a city, 260 were coffee drinkers. Test at 5% level of significance that less than 53% of the population in the city drinks coffee.	
Ans	Given: $n = 500$, $x = 260$, $P = 53\%$. $\therefore Q = 47\%$	
	$\alpha = 5\%$.	
	$p = \frac{x}{n} = \frac{260}{500} = 0.52$.	1
	H_0: $P = 53\%$, H_1: $P < 53\%$.	1
	or H_0: $P = 0.53$ H_1: $P < 0.53$	
	$Z = \frac{p - P}{\sqrt{\frac{PQ}{n}}}$	1
	$= \frac{0.52 - 0.53}{\sqrt{\frac{0.53 \times 0.47}{500}}} = \frac{-0.01}{\sqrt{\frac{0.2491}{500}}} = \frac{-0.01}{\sqrt{.0004982}}$	5
	$\therefore Z_{cal} = \frac{-0.01}{0.02232} = -0.44803$.	1
	$Z_{5\%} = -1.645$ 	1
	Since Z_{cal} lies in A.R. Accept H_0	1
	i.e. $P \geq 53\%$	
	or $p = 0.53$	

Qn. No.		Marks Allotted

30. Following are the points scored by five students in a competition:

1, 13, 9, 5, 7

Test at 5% level of significance that the population variance is more than 15.

Ans Given: $n = 5$, $\sigma^2 = 15$, $\alpha = 5\%$.

$H_0: \sigma^2 = 15$, $H_1: \sigma^2 > 15$ 1.

$\chi^2 = \frac{ns^2}{\sigma^2}$ 1

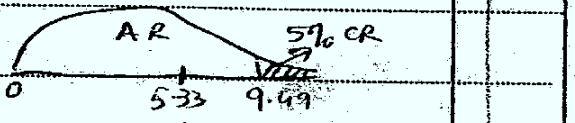
where $s^2 = \frac{\Sigma x_i^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2$

						Totals
X	1	13	9	5	7	35
X^2	1	169	81	25	49	325

$s^2 = \frac{325}{5} - \left(\frac{35}{5}\right)^2 = 65 - 49 = 16.$ 1.

$\chi^2_{cal} = \frac{ns^2}{\sigma^2} = \frac{5 \times 16}{15} = 5.33$ 1.

$\chi^2_{5\%}(4) = 9.49.$



Since χ^2_{cal} lies in A.R, accept H_0 1

ie $\sigma^2 = 15$.

Marks Allotted: 5

Qn. No.		Marks Allotted
31.	Mean and Standard Deviation of heights of two localities regarding persons gave the following results:	

Sample	Locality A	Locality B
Size	12	8
mean(cms)	175.3	177.7
S.D. (cms)	4.2	3.7

Can we conclude at 5% level of significance that the population of locality A on an average are shorter than locality B?

Ans Given: $n_1 = 12$, $n_2 = 8$

$\bar{X}_1 = 175.3$ cms, $\bar{X}_2 = 177.7$ cms

$S_1 = 4.2$ cms, $S_2 = 3.7$ cms

$\alpha = 5\%$

P.T.O.

Qn. No.		Marks Allotted

$H_0: \mu_A = \mu_B$; $H_1: \mu_A < \mu_B$ 1.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s_p^2\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \text{ or } \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{n_1 s_1^2 + n_2 s_2^2}{n_1+n_2-2}\left(\frac{n_1+n_2}{n_1 n_2}\right)}}$$ 1.

with d.f. $(n_1 + n_2 - 2)$

$$s_p^2 = \frac{n_1 s_1^2 + n_2 s_2^2}{n_1+n_2-2} = \frac{12(4.2)^2 + 8(3.7)^2}{12+8-2}$$ 1.

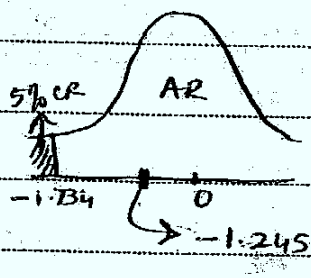
$$= \frac{12(17.64) + 8(13.69)}{18} = \frac{211.68 + 109.52}{18} = 17.844$$ 5.

$$t = \frac{175.3 - 177.7}{\sqrt{17.84\left(\frac{1}{12}+\frac{1}{8}\right)}} = \frac{-2.4}{\sqrt{17.84(.0833+0.125)}}$$

$$= \frac{-2.4}{\sqrt{17.84(.2083)}} = \frac{-2.4}{\sqrt{3.71607}} = \frac{-2.4}{1.9277} = -1.245$$

$t_{cal} = -1.245$. 1.

$t_{5\%}^{(18)} = -1.734$.



Since t_{cal} lies in A.R., we accept H_0 i.e. $\mu_A = \mu_B$. 1.

∴ We cannot conclude that the population of locality A on an average is shorter than locality B.

II

GOVERNMENT OF KARNATAKA

KARNATAKA STATE PRE-UNIVERSITY EDUCATION EXAMINATION BOARD

II YEAR PUC EXAMINATION

SCHEME OF VALUATION

Subject Code : 31 Subject : Statistics

Qn. No.		Marks Allotted
32.	Solve the following game using minimax-maximin principle. Is the game fair?	

		Company Y			
		A	B	C	Row minima
Company X	P	1	−1	3	−1
	Q	2	−1	2	−1
	R	−1	0	0	−1
	S	2	0	4	0 (maximin value)
	Column maxima	2	0 (minimax value)	4	

5.

Value of the game is '0' 1.

Best strategy for X is 'S' 1

for Y is 'B'

Since the value is '0', the game is fair. 1

Note: If solution is given using 'Dominance' method NO mark is given.

33. A firm is considering replacement of a machine whose purchase cost is Rs 5000. Its resale value and running costs for successive years are given below.

P.T.O.

Qn. No.		Marks Allotted

Year	1	2	3	4	5	6	7	8
Running Costs (Rs)	1500	1600	1800	2100	2500	2900	3400	4000
Resale value (Rs)	3500	2500	1700	1200	800	500	500	500

Suggest the optimal replacement period.

Given: $P = 5000$. (or $C = 5000$)

Ans $A(n) = \dfrac{P - S_n + \sum C_i}{n}$

or $T_{avg} = \dfrac{C - S(t) + \sum f(t)}{n} = \dfrac{T}{n}$ 1.

Years	$P - S_n$ $[C - S(t)]$	C_i $[f(t)]$	$\sum C_i$ $[\sum f(t)]$	$(P - S_n) + \sum C_i$ T	$A(n)$ T_{avg}
1	1500	1500	1500	3000	3000
2	2500	1600	3100	5600	2800
3	3300	1800	4900	8200	2733.33
4	3800	2100	7000	10800	2700
5	4200	2500	9500	13700	2740
6	4500	2900	12400	16900	2816.6
7	4500	3400	15800	20300	2900
8	4500	4000	19800	24300	3037.5

5. 3.

Note: Calculation for 6, 7 and 8th years are ~~Not~~ mandatory.

The machine can be replaced at the end of 4th year. 1

OR Table 4 marks
· Conclusion 1 mark } (5)

Qn. No.		Marks Allotted

34. Ten samples of 100 each of P.V.C. pipes manufactured by a firm are inspected for the number of defectives. The number of pipes having defects are noted as below: 2, 1, 3, 0, 2, 2, 4, 4, 5, 6

Calculate control limits for np-chart.

Ans Given: $n = 100$, $k = 10$.

Sample No.	1	2	3	4	5	6	7	8	9	10	Total
defectives(d)	2	1	3	0	2	2	4	4	5	6	29

$UCL_d = n\bar{p} + 3\sqrt{n\bar{p}\bar{q}}$

$CL_d = n\bar{p}$

$LCL_d = n\bar{p} - 3\sqrt{n\bar{p}\bar{q}}$ } 1

$\bar{p} = \frac{\Sigma d}{nk} = \frac{29}{100 \times 10} = 0.029$

$\therefore \bar{q} = 1 - \bar{p} = 1 - 0.029 = 0.971$ } 1

5

$UCL_d = (100 \times 0.029) + 3\sqrt{100(0.029)(0.971)}$

$= 2.9 + 3\sqrt{2.8159} = 2.9 + 3(1.67806)$

$= 2.9 + 5.0342 = 7.9342$ 1

$CL_d = 2.9$ 1

$LCL_d = 2.9 - 5.0342 = -2.1342$ 1

4 0.

Qn. No.	Section D.	Marks Allotted

IV. Answer any two of the following. $2 \times 10 = 20$

35. For the following data, compute Standardized Death Rates and hence comment:

Age (years)	Village A Population	Village A Deaths	Village B Population	Village B Deaths	Standard Population
0-10	600	18	400	16	500
10-20	1000	10	1500	6	1200
20-60	3000	24	2400	24	2500
60-100	400	20	700	21	500

$St\ DR_{(A)} = \frac{\Sigma PA}{\Sigma P}$ 1.

Ans

ASDR(A)	PA	ASDR(B)	PB	P
30	15000	40	20000	500
10	12000	4	4800	1200
8	20000	10	25000	2500
50	25000	30	15000	500
	72000		64800	4700

5.

$ASDR = \frac{\text{No. of deaths in a specified age group}}{\text{Total no of Population in that sp. age gp}} \times 1000$ 1.

$St\ DR_A = \frac{\Sigma PA}{\Sigma P} = \frac{72000}{4700} = 15.319$ 1.

$St\ DR_B = \frac{\Sigma PB}{\Sigma P} = \frac{64800}{4700} = 13.787$ 1.

Since $St\ DR_B < St\ DR_A$, Village B is more healthy. 1.

Qn. No.		Marks Allotted

36. Construct Fisher's Price Index Number for the following data. Test whether it satisfies 'Time Reversal Test' and 'Factor Reversal Test'.

Commodity	Base Year		Current Year	
	Price	Quantity	Price	Quantity
A	7	70	9	99
B	9	81	11	110
C	15	225	20	110
D	20	300	25	350

Ans

Com.	p_0	q_0	p_1	q_1	p_1q_0	p_0q_0	p_1q_1	p_0q_1
A	7	70	9	99	630	490	891	693
B	9	81	11	110	891	729	1210	990
C	15	225	20	110	4500	3375	2200	1650
D	20	300	25	350	7500	6000	8750	7000
					13521	10594	13051	10333

4

$$P_{01}^{(F)} = \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}} \times 100 \quad \text{1.}$$

$$= \sqrt{\frac{13521}{10594} \times \frac{13051}{10333}} \times 100$$

$$= \sqrt{1.2763 \times 1.26304} \times 100 = \sqrt{1.612} \times 100$$

$$P_{01}^{(F)} = 1.2696 \times 100 = 126.96. \quad \text{1.}$$

Note: If 1000 ℓ is considered in the formula, REDUCE 2 marks. of no number

P.T.O.

Qn. No.		Marks Allotted
	TRT: $P_{01} \times P_{10} = 1$	1.
	$= \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1} \times \frac{\Sigma p_0 q_1}{\Sigma p_1 q_1} \times \frac{\Sigma p_0 q_0}{\Sigma p_1 q_0}}$	
	$= \sqrt{\frac{13521}{10594} \times \frac{13051}{10333} \times \frac{10333}{13051} \times \frac{10594}{13521}} = 1.$	1.
	FRT: $P_{01} \times Q_{01} = V_{01} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_0}$	1.
	$= \sqrt{\frac{\Sigma p_1 q_0}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1} \times \frac{\Sigma q_1 p_0}{\Sigma q_0 p_0} \times \frac{\Sigma q_1 p_1}{\Sigma q_0 p_1}}$	
	$= \sqrt{\frac{13521}{10594} \times \frac{13051}{10333} \times \frac{10333}{10594} \times \frac{13051}{13521}}$	
	$= \sqrt{\frac{(13051)^2}{(10594)^2}} = \frac{13051}{10594} = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_0}$	1.
	Note: If the table value is wrong, reduce 2 marks.	
37.	Fit a second degree equation of the form $y = a + bx + cx^2$ to the following data regarding profits and estimate the profit for 1990.	

Years	1985	1986	1987	1988	1989
Profits (in Rs'000s)	10	12	13	10	8

P.T.O.

Qn. No.									Marks Allotted
Ans	Years	y	x = deviation from 1987	x^2	xy	x^2y	x^3	x^4	
	1985	10	−2	4	−20	40	−8	16	3
	86	12	−1	1	−12	12	−1	1	
	87	13	0	0	0	0	0	0	
	88	10	1	1	10	10	1	1	
	89	8	2	4	16	32	8	16	
	$n=5$	53	0	10	−6	94	0	34	

$y = a + bx + cx^2$.

Normal equations are

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

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

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

1 When $\Sigma x = 0$,

$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{-6}{10} = -0.6$ 1

When $\Sigma x = 0$ & $\Sigma x^3 = 0$,

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

& $\Sigma x^2y = a\Sigma x^2 + c\Sigma x^4$.

$\therefore 53 = 5a + 10c$

$94 = 10a + 34c$

Multiply 1st equation by 2.

$\therefore 106 = 10a + 20c$

$\ominus 94 = \ominus 10a \ominus 34c$

$12 = -14c$. $\therefore c = \frac{-12}{14} = -0.8571$ 1

P.T.O.

Qn. No.		Marks Allotted

$53 = 5a + 10(-.8571)$

$= 5a - 8.571.$

$\therefore 5a = 53 + 8.571 = 61.571$

$a = \frac{61.571}{5} = 12.3142$ 1.

10

$Y_c = 12.3142 + (-0.6)X + (-0.8571)X^2$ 1.

$Y_{1990} = 12.3142 - 0.6(3) - 0.8571(9)$

$= 12.3142 - 1.8 - 7.7139$

$= 12.3142 - 9.5139 = 2.8003.$ 1.

$\therefore$ Estimated profit for 1990 is 2.8 in '000 yrs.

Note: If straight line is fitted, Give 2 marks.

38. The following data were obtained for number of defectives items for a sample of size 5 for 500 samples during a week.

No of defective items	0	1	2	3	4	5
No of Samples.	170	180	120	20	8	2

Test at 5% level of significance that the B.D. is a good fit.

Ans

x	0	1	2	3	4	5	Total
f	170	180	120	20	8	2	500
fx	0	180	240	60	32	10	522

$\bar{x} = \frac{\Sigma fx}{N} = \frac{522}{500} = 1.044.$

Qn. No.		Marks Allotted
	Mean = np.	
	$5p = 1.044$. $\therefore p = \frac{1.044}{5} = 0.208 \simeq 0.2 = \frac{1}{5}$	1.
	$\therefore q = 1 - 0.2 = 0.8$.	
	pmf = $P(X=x) = \binom{n}{x} p^x q^{n-x}$	1.
	Theoretical frequency = $N \times P(X=x)$	
	For $x=0$, $E(X=0) = 500 \times \binom{5}{0} \left(\frac{1}{5}\right)^0 \left(\frac{4}{5}\right)^{5-0}$	
	$= 500 \times \frac{1024}{3125} = 163.84 \simeq 164$.	1.
	Recurrence Relation:	
	$E(X=x) = \frac{n-x+1}{x} \times \frac{p}{q} \times E(X=x-1)$	
	For $x=1$, $E(X=1) = \frac{5-1+1}{1} \times \frac{0.2}{0.8} \times 163.84$	
	$= \frac{163.84}{0.8} = 204.8 \simeq 205$.	2 3.
	For $x=2$, $E(X=2) = \frac{5-2+1}{2} \times \frac{0.2}{0.8} \times 204.8$	
	$= \frac{0.4}{0.8} \times 204.8 = 102.4 \simeq 102$.	
	For $x=3$, $E(X=3) = \frac{5-3+1}{3} \times \frac{0.2}{0.8} \times 102.4$	
	$= \frac{0.2 \times 102.4}{0.8} = 25.6 \simeq 26$	
	For $x=4$ $E(X=4) = \frac{5-4+1}{4} \times \frac{0.2}{0.8} \times 25.6$	
	$= \frac{0.1}{0.8} \times 25.6 = 3.2 \simeq 3$	
	For $x=5$, $E(X=5) = \frac{5-5+1}{5} \times \frac{0.2}{0.8} \times 3.2$	
	$= \frac{0.2 \times 0.2}{0.8} \times 3.2 = 0.16 \simeq 0$	1.

P.T.O.

Qn. No.		Marks Allotted

H_0: B.D. is a good fit 1

H_1: B.D. is not a good fit.

X	O_i	E_i	$O_i - E_i$	$(O_i - E_i)^2$	$\frac{(O_i - E_i)^2}{E_i}$
0	170	164	6	36	0.2195
1	180	205	-25	625	3.0488
2	120	102	18	324	3.1764
3	20	26			
4	8 (30)	3 (29)	1	1	0.0345
5	2	0			
	500	500			6.4784

1

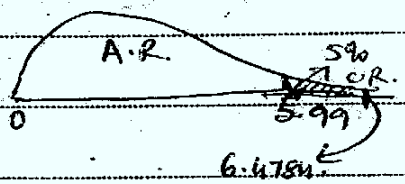
10

$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$ with $n = 1 - 1 - 2 = 2$ d.f. 1

or $n - c = 4 - 2 = 2$ d.f.

$\chi^2_{cal} = 6.4784$. 1

$\chi^2_{5\%}(2) = 5.99$.



Since χ^2_{cal} lies in Critical Region,

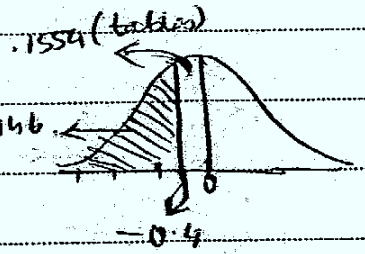
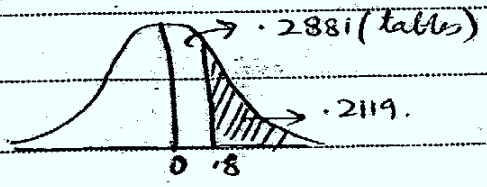
Reject H_0.

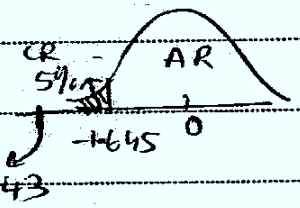
ie B.D. is not a good fit. 1

Note: If $p = 0.81$ and $q = 0.79$, the expected frequencies are 154, 804, 109, 29, 04, 0 and

$\chi^2 = 5.8694$ $\chi^2_{cal} < \chi^2_{tab}$

Accept H_0

Qn. No.	Section E:	Marks Allotted
V	Answer any two of the following. $2 \times 5 = 10$	
39.	If X is normally distributed with mean 50 and variance 25, then find i) $P(X \leq 48)$, ii) $P(X \geq 54)$.	
Ans	Given: $\mu = 50$, $var = \sigma^2 = 25$. $\therefore \sigma = 5$ $Z = \frac{x - \mu}{\sigma}$.	1.
	i) $P(X \leq 48)$: $Z = \frac{48-50}{5} = \frac{-2}{5} = -0.4$.	1.
		5
	$\therefore P(X \leq 48) = 0.5 - 0.1554 = 0.3446$.	1.
	ii) $P(X \geq 54)$: $Z = \frac{54-50}{5} = \frac{4}{5} = +0.8$.	1.
		
	$\therefore P(X \geq 54) = 0.5 - 0.2881 = 0.2119$.	1.

Qn. No.		Marks Allotted
40.	It is required to test whether those who practise Yoga have average blood sugar less than 120. A sample consisting of 35 persons who practise Yoga is observed. If their mean sugar is 114 and S.D. is 8. what would you conclude? (Use 5% level of significance)	
Ans	Given: $n = 35$, $\bar{x} = 114$, $s = 8$.	1.
	$H_0: \mu = 120$, $H_1: \mu < 120$.	1.
	$Z = \dfrac{\bar{x} - \mu}{s/\sqrt{n}}$	1.
	$= \dfrac{114-120}{8/\sqrt{35}} = \dfrac{-6}{8/5.9} = \dfrac{-6\times 5.9}{8} = -4.43$	1.
	$Z_{5\%} = -1.645$ 	
	Since Z_{cal} lies in Critical Region, Reject H_0. i.e. $\mu < 120$.	1.
	Note: In the Z formula, if σ is taken instead of 's' do not cut marks. P.T.O.	

5

Qn. No.		Marks Allotted

41. Following is the data regarding five students administered for an I.Q. test before and after treatment of Yoga.

IQ before	118	120	116	115	125
IQ after	125	118	125	120	130

Is treatment effective? (Use 5% level of significance).

Ans $H_0: \mu_1 = \mu_2$, $H_1: \mu_1 < \mu_2$ 1.

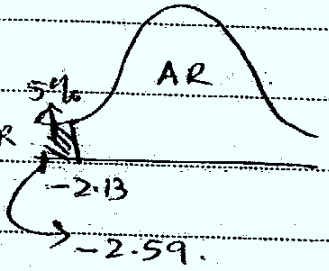
X	Y	$d = (x-y)$	d^2
118	125	−7	49
120	118	2	4
116	125	−9	81
115	120	−5	25
125	130	−5	25
$n = 5$		−24	184

$$t = \frac{\bar{d}}{s_d/\sqrt{n-1}}$$ 1.

$$\bar{d} = \frac{\Sigma d}{n} = \frac{-24}{5} = -4.8$$

$$s_d = \sqrt{\frac{\Sigma d^2}{n} - \left(\frac{\Sigma d}{n}\right)^2} = \sqrt{\frac{184}{5} - (4.8)^2}$$ 1.

$$= \sqrt{36.8 - 23.04} = \sqrt{13.76} = 3.7.$$

Qn. No.		Marks Allotted
	$t = \frac{\bar{d}}{s_d/\sqrt{n-1}} = \frac{-4.8}{3.7/\sqrt{5-1}}$	
	$= \frac{-4.8}{3.7} \times 2 = -2.59$.	1
	$t_{5\%}^{(4)} = -2.13$ 	5.
	Since t_{cal} lies in C.R, reject H_0	1
	ie $\mu_1 < \mu_2$. or treatment is effective.	
42.	There is a demand for 8000 items per year. The ordering cost is Rs200 and carrying cost is Rs 10. per item per year. Then find i) EOQ. ii) minimum average inventory cost.	
Ans	Given: $D = 8000$ or $R = 8000$	1
	$C_3 = 200$, $C_1 = 10$.	
	i) E.O.Q. or $Q^0 = \sqrt{\frac{2DC_3}{C_1}}$ or $\sqrt{\frac{2C_3R}{C_1}}$	1
	$= \sqrt{\frac{2 \times 200 \times 8000}{10}} = 565.6 \simeq 566.$	1 5.
	ii) $C(Q^0)$ or $TQ = \sqrt{2C_1C_3D}$ or $\sqrt{2C_1C_3R}$	1
	$= \sqrt{2 \times 10 \times 200 \times 8000}$	
	$= 5656.80$ or Rs 565.7.	1