

INDIAN STATISTICAL INSTITUTE

QUESTION PAPERS

for

**The Computer's Certificate Examinations
March & September 1958**

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INDIAN STATISTICAL INSTITUTE
COMPUTER'S CERTIFICATE EXAMINATION, MARCH 1938.
PART 1A—SECTION I

Time : 3 Hours

Full marks : 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is not permitted.

GROUP A

1. Suggest a proper heading for the following table, scrutinize it and copy it out after correcting obvious mistakes. The figures refer to Aman sason. (25)

serial number	district	1932-1933			1933-1934		
		number of grids surveyed	number of grids checked	percent- age of grids checked	number of grids surveyed	number of grids checked	percent- age of grids checked
(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Burdwan	5193	517	10	5104	31	6
2	Birbhum	5250	556	17	3092	380	13
3	Bankura	4934	403	8	4920	378	8
4	Midnapore	6938	1002	4	6494	538	8
5	Howrah	1038	156	15	2279	77	7
6	Hooghly	2240	217	10	1040	151	7
7	24 Parganae	8090	810	13	6038	473	8
8	Nadia	2873	382	13	2741	163	8
9	Mursidabad	3721	380	102	3487	239	7
10	West Dinajpur	2592	478	18	2502	143	6
11	Mukta	3506	360	14	2504	245	10
12	Jalpaiguri	3313	570	17	3388	321	10
13	Darjeeling (Siliguri sub-division only)	432	107	25	2102	27	6
14	Cooch Bihar	2131	349	16	432	185	9
West Bengal		52251	6287	13	46123	3360	18

2. Represent the following data in a tabular form classified by age-group and employment condition. Also give a suitable heading for the table.

"Out of 1887 persons having some employment, 1333 are employed full-time. Age of one person having part-time employment has not been recorded. 471 persons are of age 16-25 years and 310 of them are employed full-time. 537 persons of age 26-40 years have got full-time employment and 224 persons of this age-group are employed part-time. Amongst other persons having full-time employment 425 are of age 41 to 61 years, 28 are above 60 years and 4 are below 16 years. 143 persons of age 41 to 60 years have part-time employment. 57 employed persons are above 60 years and 9 are below 16 years of age." (25)

Or,

Data given below show certain occupation and the number of persons engaged in them. Rearrange the data according to the following major groups of occupation by providing appropriate serial numbers for the major groups and the different occupations under them and entering subtotals as suitable.

- (1) Professional and technical workers,
 - (2) Handi-crafts men (mainly manual),
 - (3) Operatives (mainly mechanical),
 - (4) Sales workers and
 - (5) Others
- (25)

occupation	number of persons
1. Musician	4
2. Canvasser	2
3. Hand-loom weaver	6
4. Bus driver	3
5. Cook	1
6. Hollerith operator	2
7. Washerman	4
8. Fireman	1
9. Photographer	1
10. Librarian	2
11. Newspaper boy	3
12. Carpenter	10
13. Statistician	1
14. Stock-broker	2
15. Weaver	1
16. Boilerman	1
17. Barber	2
18. Mechanical engineer	1
19. Cobbler	4
20. Teacher	2
21. Hawker	5
22. Nurse	3
23. Tram conductor	7
24. Blacksmith	4
25. Fisherman	2

GROUP B

3. Complete the following table: (20)

x	y	$\frac{x}{y}$	xy	y ²	x+y	x-y
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10.65	1.5					
30.72	4.8					
41.81	3.7					
-1.32	-0.2					
5.64	0.6					
40.00	5.8					
-81.03	-7.3					
9.52	0.8					

and evaluate: Σx , Σy , $\Sigma(x/y)$, Σxy and Σy^2

Or, Evaluate (20)

$$\frac{2.02 \times (42.75 - 21.47) + 7.5 (8.7 + 13.8)}{(2.4 \times 3.1 + 1.0 \times 5.2)}$$

$$-\frac{17.0 \times 1.8}{3.4} + \frac{18.0 \div 5.8}{2.1 \times 1.0}$$

4. From the equation (10)

$$y = 5 - 3x + \frac{x^2}{2}$$

find the values of y for values of x = 1, 1.5, 2, 2.5 and 3.

5. The following are chest measurements (in inches) of 60 students belonging to six different sections of a class: (20)

serial number of student	sec. 1	sec. 2	sec. 3	sec. 4	sec. 5	sec. 6
1	34.0	31.9	32.5	32.0	33.5	35.0
2	30.1	35.6	34.1	36.0	34.6	32.1
3	33.5	33.8	34.8	35.4	32.1	34.3
4	33.6	34.6	33.7	32.8	33.1	33.6
5	33.0	34.2	33.3	32.7	32.4	34.7
6	32.8	35.3	34.3	34.0	33.3	33.8
7	33.6	32.6	32.0	33.4	34.9	35.7
8	32.7	33.4	35.7	34.2	35.0	34.6
9	31.8	35.7	34.7	35.1	33.1	35.2
10	33.9	34.4	35.1	33.7	35.2	34.2

(a) Arrange the measurements in ascending order of magnitude and find out the maximum and the minimum.

(b) Find out the measurement that occurs most often and state how often.

(c) Find out the average chest measurement for each section separately and for all sections combined.

PART IA—SECTION II

Time: 3 Hours

Full marks: 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is not permitted.

GROUP A

1. (a) Given $a^{10} = b^{17} = c^{18}$ and that $b = 8347$, calculate the values of a and c . (10)

- (b) Find the negative root of the quadratic equation

$$157x^2 - 656x - 314 = 0 \quad (10)$$

Or,

- (a) Using appropriate tables, write down the values of n^2 , \sqrt{n} , $\frac{1}{n}$ and $\log_{10} n$, for the following values of n : (10)

$$0.7251, 0.10235, 0.03914 \text{ and } 0.00481$$

- (b) Evaluate: (10)

$$\frac{27}{76} \text{ of } \left\{ \frac{(2.3145)^{3.76}}{0.8649 \times 10.863} \right\}$$

2. (a) In a professional examination, the qualifying mark is 80 out of 100 (full marks). The marks obtained by fifty qualified candidates are given below:

82, 86, 84, 93, 90, 84, 85, 90,
 92, 85, 86, 91, 82, 90, 84, 85,
 86, 90, 92, 90, 84, 86, 90, 91,
 81, 86, 85, 84, 90, 91, 90, 86,
 90, 92, 84, 86, 92, 94, 90, 82,
 83, 87, 88, 89, 84, 93, 90, 81,
 84, 87.

Calculate the mean as also the standard error of this mean. Present your calculations in a suitable tabular form. (16)

- (b) In the above problem, if the candidates who scored 90 and above are considered to have passed with credit, what is the mean mark obtained by such candidates? (4)

3.	angle (in degrees)	angle (in radians)
	57.26	0.9994919
	57.28	0.9997823
	57.30	1.0000737
	57.32	1.0003645

From the above data, using simple interpolation by proportional parts, calculate the value of 1 radian in degrees correct to three places of decimal.

Also, calculate in radians the value of 57.31 degrees.

(16)

Group B

4. Soil type in a tea plantation is such that it requires 70 lbs. of N, 30 lbs. of P and 40 lbs. of K per acre as nutrients.

These nutrients can be applied in the form of different fertilisers.

N can be applied in the form of sulphate of Ammonia which contains 20.6 per cent of N or in the form of Groundnut cake which contains 7 per cent of N.

Sources of P are the fertilisers Mineral Phosphate and Superphosphate which contain respectively 32 per cent and 17 per cent of P.

Fertilisers which contain K_2O are Muriate of Potash and Sulphate of Potash, the percentage-contents of K being 55 per cent and 50 per cent respectively.

It is seen that eight possible fertiliser-mixtures can be prepared to get the needed nutrients. For example, one mixture will be composed of Sulphate of Ammonia, Mineral phosphate and Muriate of Potash.

Write down the composition of all the eight mixtures and find for each mixture, the quantity per acre that has to be applied so that the soil gets in each case the recommended quantities of N, P and K, namely 70 lbs., 30 lbs. and 40 lbs. respectively.

(25)

5. The following gives the pay distribution of Central Government employees in 1955 :

pay (in rupees)	number of employees
below 51	9140
51— 100	4618
101— 150	1261
151— 200	554
201— 250	231
251— 300	120
301— 350	73
351— 500	68
501— 750	52
751—1000	24
1001—1500	14
1501—2000	5
2001—2500	2
2501—3000	2
3001— above	1
total	16195

(i) Using the data given above, complete the following table :

pay (in rupees) [x]	number of employees [y]
51 and above	7055
101 -do-	..
151 -do-	..
201 -do-	
301 -do-	
351 -do-	
501 -do-	
751 -do-	
1001 -do-	
1501 -do-	
2001 -do-	
2501 -do-	
3001 -do-	

(ii) Draw a smooth graph to represent the distribution obtained in (i).

(iii) Use the graph to find out (a) the percentage of employees having a pay of Rs. 600 or more, (b) the amount in rupees which (or more than which) is given to 25 per cent of the employees. (25)

Or,

The following table gives the cumulative percentage of expenditure (y) on food items and cumulative percentage of total number of persons (x) by expenditure classes in Rs., for all India 1955-56.

per capita expenditure classes in Rs.	cumulative percentage of total number of persons (x)	cumulative percentage of expenditure on 'food' items. (y)
0-8	13.84	5.64
8-11	31.62	16.15
11-13	43.62	25.37
13-15	52.65	33.10
15-18	64.17	44.38
18-21	73.61	55.06
21-24	79.36	62.29
24-28	85.03	71.32
28-34	90.28	77.81
34-43	95.31	86.66
43-55	97.08	90.83
55 and above	100.00	100.00

- (i) Plot y against x on a graph paper.
 (ii) Draw a smooth curve through the plotted points.
 (iii) Draw the line $y = x$ on the same diagram.
 (iv) Estimate the area between the line $y = x$ and the smooth curve. (25)

PART IB—SECTION I

Time: 3 Hours

Full marks: 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is permitted.

GROUP A

1. The age distribution of 100 married women belonging to rural areas is given in the following table.

TABLE 1

age last birthday (years)	number of women
(1)	(2)
12—16	3
17—21	6
22—26	7
27—31	14
32—36	15
37—41	16
42—46	13
47—51	12
52—56	6
57—61	4
62—66	3
67—71	1
total	100

(a) Calculate the arithmetic mean, standard deviation, β_1 and β_2 of the above distribution. (You may assume the mid-points of the class intervals to be 14.5 years, 19.5 years, ..., 69.5 years). (25)

(b) What would be the values of the arithmetic mean and the standard deviation, if the ages in col. (1) of the above table had referred to:

(i) next birthday, (ii) nearest birthday? (5)

2. The age of the husband (h) and age of the wife (w) are given below for 25 couples.

(a) Plot the scatter diagram from the data and examine whether a straight line regression (for w on h) is appropriate or not. (10)

- (b) Calculate the coefficient of correlation between ages of husband and wife. (10)

TABLE 2

serial number of couple	age last birthday (years) of	
	husband (h)	wife (w)
(1)	(2)	(3)
1	29	18
2	35	25
3	35	20
4	21	17
5	32	24
6	60	55
7	25	16
8	39	29
9	30	25
10	26	16
11	40	35
12	53	40
13	55	52
14	42	40
15	50	45
16	51	46
17	50	40
18	40	28
19	52	42
20	60	55
21	80	72
22	45	40
23	60	50
24	41	27
25	40	30

Or,

Complete the blank cells in the following table. For the data in section B(1) of the table, draw graphs showing the values in cols. (5), (6) and (7) against those in col. (1) and obtain the median values of hours of work per week in rural, urban and all-India. (20)

TABLE (3) : STATUS OF ECONOMIC ACTIVITY AND GAINFUL EMPLOYMENT, DECEMBER 1953 : RURAL, URBAN, ALL-INDIA.

	estimated number of persons in millions			percentage of total		
	rural	urban	all-India	rural	urban	all-India
(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. distribution of population by status of economic activity.						
<i>Economic activity</i>						
1. total population	310.0	65.0		100.0	100.0	
2. outside labour force				54.5	64.7	
3. in labour force				45.5	35.3	
4. unemployed				0.21	1.31	
5. gainfully employed				45.3	34.0	
B. distribution of gainfully employed persons by period of work.						
<i>(1) hours of work per week</i>						
6. 7 hours and less				13.6	0.2	
7. 14 hours and less				17.5	12.1	
8. 28 hours and less				29.0	21.5	
9. 42 hours and less				40.3	39.5	
10. 56 hours and less				79.0	79.4	
11. 70 hours and less				96.1	93.9	
12. all				100.0	100.0	
<i>(2) extent of employment</i>						
13. quarter or less				12.8	6.4	
14. less than full				30.6	21.6	
15. all				100.0	100.0	
C. distribution of gainfully employed persons with less than full extent of employment, by causes of under-employment						
16. own illness and domestic reasons				22.8	15.8	
17. economic reasons				49.0	55.0	
18. others				28.2	29.2	
19. total				100.0	100.0	

GROUP B

3. The following table shows the index of physical production for all manufactures in a country. Fit a second degree curve, by the method of least squares, to show the trend of the Index over the different years and find out the residual sum of squares.

year	index	year	index
1900	100	1914	171
1901	112	1915	187
1902	121	1916	218
1903	123	1917	210
1904	123	1918	237
1905	142	1919	210
1906	151	1920	224
1907	150	1921	181
1908	133	1922	229
1909	160	1923	260
1910	157	1924	247
1911	156	1925	274
1912	175	1926	285
1913	180		

(25)

4. The following table shows the average weight of men of various heights and ages. Set up an analysis of variance table and test whether the variations among the different age groups and different height groups are significant. (25)

age group	height (foot and inches)							
	5'	5' 2"	5' 4"	5' 6"	5' 8"	5' 10"	6' 0"	6' 2"
15—19	113	118	124	132	140	148	158	168
20—24	119	124	131	139	146	154	163	173
25—29	124	128	134	142	150	158	169	181
30—34	127	131	137	145	154	163	174	186
35—39	129	133	140	148	157	167	178	191
40—44	132	136	142	150	159	169	181	194
45—49	134	138	144	152	161	171	183	197
50—54	135	139	145	153	162	172	184	198

PART 1B—SECTION II

Time: 3 Hours

Full marks: 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is permitted.

GROUP A

1. The following table gives the frequency distribution of chest measurements in inches of 10,000 men. Fit a normal curve to the data and calculate the expected frequencies for all the classes. Represent graphically the observed as well as the expected distribution. (35)

chest measurement in inches	frequency	chest measurement in inches	frequency
33	6	41	1640
34	35	42	1120
35	125	43	600
36	338	44	222
37	740	45	84
38	1303	46	30
39	1810	47	5
40	1940	48	2

2. (a) The following table gives the temperature θ of a vessel of cooling water recorded at the end of t minutes for different values of t .

t	0	1	2	3	5	7	10	15	20
θ	92.0	85.3	79.5	74.5	67.0	60.5	53.5	45.0	39.5

If the data can be graduated by $\theta = 31.5 + 60(0.0033)^t$, calculate the theoretical values of θ for each value of t . Represent the observed and fitted values of θ on a graph paper.

(b) The distribution of the scores in a logical memory test on 300 boys and 250 girls are given below :

boys		girls	
score	frequency	score	frequency
11.5—15.5	10	11.5—15.5	13
15.5—19.5	79	15.5—19.5	41
19.5—23.5	128	19.5—23.5	68
23.5—27.5	68	23.5—27.5	73
27.5—31.5	15	27.5—31.5	35
		31.5—35.5	20

Assuming the distribution of the scores of the boys to be normal, estimate the number of boys reaching or exceeding the median score of girls. (8)

Or,

The table below shows the classification of 894 coal mines in Great Britain in 1945 according to size and output per manshift. Test whether there is any significant relationship between the size of mine and output per manshift. (15)

size of mine (no. of wage earners)	Number of mines			
	output per manshift			
	under 15 cwt.	15 cwt and under 20 cwt	20 cwt and under 25 cwt	25 cwt and over
100—499	103	140	76	42
500—999	58	131	76	39
1000 and above	25	73	83	48

GROUP B

3. Evaluate Y for integral values of x from 1 to 7, from the relation :

$$Y = \frac{7093}{1.108\sqrt{2\pi}} e^{\frac{-(x-4)^2}{2(1.108)^2}}$$

and draw the graph of Y against x .

(15)

4. The following table gives the post office savings bank transactions in India from the year 1938 to 1950.

(a) Calculate the balance at the end of the year, from 1940 onwards.

(b) Represent graphically the following time series, (i) number of depositors at the end of the year, (ii) deposits during the year and (iii) average balance per depositor. Also comment on these graphs. (20)

TABLE : POST OFFICE SAVINGS BANK TRANSACTION

year ending 31 March	number of depositors at the end of year (thousands)	deposits during the year (lakhs of rupees)	withdrawals during the year (lakhs of rupees)	balance at the end of the year (lakhs of rupees)
(1)	(2)	(3)	(4)	(5)
1938	3786	4820	4839	7740
1939	4241	5185	4748	8186
1940	4583	4740	5094	..
1941	2844	3151	5032	..
1942	2756	2723	3467	..
1943	2504	2698	2683	..
1944	2774	3070	2783	..
1945	3093	4913	3309	..
1946	3507	8264	4781	..
1947	3973	10433	7703	..
1948	3153	9967	8083	..
1949	3426	9815	7777	..
1950	3808	10166	8296	..

5. For each of the following, write the name of at least one publication from which you can get the required information. For each of the publications indicate also the name of the publishing authority and the periodicity (weekly, monthly, etc.) of its publication. (15)

- (i) Production of sulphuric acid in India in January 1957.
- (ii) Number of registered trade unions in Bombay State in 1954-55.
- (iii) All India estimates of area and production of rice in 1954-55.
- (iv) Per capita availability of mill-made cloth in India in 1956.
- (v) Production, despatches and stocks of coal in Bihar in January 1957.
- (vi) Number of persons arrested during 1953 for house-breaking in Punjab.
- (vii) Number of co-operative societies in West Bengal at the end of 1954-55.
- (viii) Mean dry bulb temperature at Simla during May 1955.
- (ix) Index number of wholesale prices in India during the week ending 1st April 1950.
- (x) Number of males, having production of raw materials as the principal means of livelihood in Delhi, in 1941.

PART IC—SECTION I

Time : 4 Hours

Full marks : 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is permitted.

GROUP A

1. Draw the graph of the function $y = x^3 - 2x - 5$ in the interval $x = 2$ to $x = 3$. From the graph, obtain a root of the equation $x^3 - 2x - 5 = 0$ correct to two places of decimal. (10)

Or,

Evaluate each term in the expansion :

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \dots$$

so as to obtain the value of e correct to six places of decimal. (10)

2. The value of
$$\sum_{r=0}^x \frac{n!}{r!(n-r)!} p^r (1-p)^{n-r}$$

is approximately equal to that of

$$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^t e^{-t^2/2} dt, \text{ where } t = \frac{((x + \frac{1}{2}) - np)}{\sqrt{np(1-p)}}.$$

Verify the approximation for $n = 15$, $p = 0.4$ and $x = 4$. (15)

Or,

The moment coefficients calculated from a frequency distribution based on a sample of 100 observations were :

$$\begin{aligned} \text{mean} &= 0.31658 \\ \text{variance} &= 19.35496 \\ \beta_1 &= 0.73475 \\ \beta_2 &= 4.06432 \end{aligned} \quad (\mu_3 \text{ positive})$$

It was discovered later on that an observation 2.7 was misread as 7.2. Obtain the corrected values of the above. (15)

3. The following table shows the death rate per thousand living persons, for a certain community :

year (t)	death rate per thousand
1851	24.7
1861	24.8
1871	25.2
1881	28.7
1891	29.0
1901	26.7
1911	22.7
1921	21.2
1931	23.8
1941	26.8
1951	27.2

After making the most suitable change in origin, fit a cubic (3rd degree) curve of the form $y = a + bx + cx^2 + dx^3$ where y is the death rate and x the new independent variable. By calculating appropriate residual sums of squares, examine whether the third degree curve gives a better fit to the data than a second degree curve. (25)

GROUP B

4. The values of specific gravity, fat content, and total solids obtained from each of 15 samples of milk are given below:

sample number	specific gravity	fat content	total solids
1	28.8	5.5	14.22
2	28.0	4.8	13.22
3	29.0	4.9	13.56
4	29.6	5.0	13.89
5	29.9	4.8	13.20
6	30.0	5.5	13.32
7	29.0	4.7	13.48
8	29.5	4.8	13.57
9	29.1	4.9	13.76
10	28.0	5.1	13.93
11	29.5	4.5	13.18
12	29.4	4.6	13.27
13	28.8	4.3	12.92
14	29.2	5.0	13.96
15	29.6	4.5	13.36

Obtain the equation for regression of specific gravity on fat content and total solids and test the significance of the regression coefficients. Calculate the partial correlation between specific gravity and total solids and test its significance. Also calculate and test the significance of the Multiple correlation coefficient (30)

5. Three treatments viz 9 inches, 12 inches and 15 inches of irrigation were employed in a simple randomised block design with six replications and a plot size of $\frac{1}{10}$ th acre and the yields in lbs, were recorded. In order to increase the precision of the estimates of the treatment comparisons, it was suggested that plot yields of a crop of the same variety of wheat, taken over all the plots under uniform conditions in the previous year could also be used. (these are given in the table below in brackets).

Perform the analysis of variance and covariance for the above.

Test also whether the use of the pre-experimental yields in the analysis of covariance brings about a significant improvement in the efficiency of the experiment. (20)

Yield in lbs, per plot ($\frac{1}{10}$ th acre).

(figures in brackets show yields in the previous year obtained under uniform conditions).

replication	irrigation		
	9"	12"	15"
1	9.1(8.9)	22.2(21.0)	27.0(29.0)
2	10.1(14.2)	16.4(14.8)	9.2(13.0)
3	17.0(16.1)	23.6(24.8)	13.1(18.1)
4	19.3(18.2)	19.1(16.1)	21.1(23.9)
5	14.1(16.8)	16.2(13.8)	22.0(21.1)
6	19.2(16.6)	23.0(20.0)	20.0(17.3)

Time : 4 Hours

PART IC : SECTION II

Full marks : 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is permitted.

GROUP A.

1. (a) Evaluate the following determinant (15)

$$\begin{vmatrix} a & b & c \\ a & a+b & a+b+c \\ a & 2a+b & 3a+2b+c \end{vmatrix}$$

Where $a = 2434$, $b = 1782$ and $c = 4570$.

- (b) The following table gives the values of $F(a,b)$ for different values of a and b :

a \ b	60	61	62	63
63	1.34893	1.35595	1.36302	1.37013
66	1.37728	1.38477	1.39233	1.39995
67	1.40600	1.41400	1.42208	1.43022
68	1.34510	1.44302	1.45225	1.46096

- (i) Interpolating by proportional parts, obtain the value of $F(61.25, 66.32)$. (5)
 (ii) With the help of a suitable interpolation formula and using higher differences find out the values of $F(61.42, 65.00)$. (5)

Or,

Distribution of heights of 900 persons is given below. Calculate β_1 and β_2 and hence determine the pearsonian curve that may be fitted to the data and obtain the values of the constants in the equation to the curve.

Test the goodness of fit of the curve. (25)

height (in inches)	number of persons
53—55	1
55—57	9
57—59	29
59—61	114
61—63	230
63—65	261
65—67	180
67—69	63
69—71	11
71—73	2

2. An agricultural experiment was conducted to determine the best combination of 3 varieties (v_1, v_2, v_3) of wheat with two different manures (M_1 and M_2). The layout of the experiment together with the yields of the different combinations in each plot

is given below. Is there any difference among the yields due to the different combinations? If so which combination gives the best yield?

v_2M_1 :—18.7 v_1M_1 :—16.1 v_2M_2 :—30.8 v_1M_2 :—26.2 v_2M_2 :—22.3 v_1M_2 :—22.5
 v_2M_1 :—18.5 v_2M_2 :—23.7 v_2M_1 :—14.3 v_2M_1 :—18.1 v_1M_1 :—12.9 v_1M_2 :—16.6
 v_1M_1 :—18.8 v_2M_1 :—26.1 v_1M_2 :—21.7 v_2M_1 :—20.2 v_2M_2 :—30.6 v_2M_2 :—27.4
 v_2M_2 :—36.4 v_2M_2 :—30.3 v_1M_1 :—20.7 v_1M_2 :—25.2 v_2M_1 :—31.7 v_2M_1 :—24.8

Can you test from this experiment whether the overall effect of manure M_2 is better than that of M_1 . (25)

GROUP B

3. The following tables shows the quantitative production of certain crops for the years 1949-50; 1950-51 and 1951-52. The weights attached to each of the crops are proportional to the value of the crop in 1949-50.

Calculate (i) the link relatives of each of the crops for the years 1950-51 and 1951-52 (with the preceding year as base) and (ii) the index of crop production correct to one decimal place by chain base method using the weights given. (30)

crop	weights	unit of quantity	production		
			1949-50	1950-51	1951-52
rice	15.8	100's of tons	9789	10334	7695
wheat	5.0	—do—	2630	2907	1889
jowar	14.0	—do—	11353	10002	9765
bajra	7.5	—do—	5700	4007	4396
maize	1.7	—do—	946	421	671
ragi	1.8	—do—	1915	1672	1279
other milleta	3.0	—do—	3512	2722	2431
pulses	11.1	—do—	3855	3279	2636
sugarcane	7.6	—do—	5878	8341	9316
cotton	9.7	1000's of bales	6416	8528	5936
chillies	0.4	100's of tons	371	409	513
potatoes	0.5	—do—	293	298	189
groundnut	12.8	—do—	3067	5418	2844
tobacco	7.7	—do—	699	897	498
linseed	0.1	—do—	14	15	11
other oil seeds	1.3	—do—	426	379	477

4. Referring to necessary official publications supplied to you, prepare a table bringing out the trend in the Consumer Price Index—working class for India, and in the Index Number of Cost of Living for the U.K., the U.S.A. and Japan, over a period of any twelve consecutive months between 1934 and 1957. (Necessary adjustments for bringing the series to a common base year, should be made. Also with regard to India, revised figures should be used whenever available).

Comment on the trends in the four countries. (20)

INDIAN STATISTICAL INSTITUTE

COMPUTER'S CERTIFICATE EXAMINATION, SEPTEMBER 1958.

PART IA, SECTION I

Time: 3 Hours

Full marks: 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is not permitted.

GROUP A

1. The following schedule gives information about 15 persons.

serial number of person	age in years (last birth day)	sex M/F	civil condition (U/M/W/D)	type of present employment (FT/P/N)	type of employment sought (FT/P/N)	average monthly income (Rs.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	32	M	M	P	FT	15
2	24	F	M	N	N	—
3	0	F	U	N	N	—
4	36	M	M	P	FT	18
5	21	F	M	N	N	—
6	46	M	W	P	FT	17
7	23	M	U	FT	FT	63
8	64	F	W	N	N	—
9	34	M	M	FT	FT	53
10	25	F	M	P	N	25
11	7	F	U	N	N	—
12	1	F	U	N	N	—
13	41	M	M	FT	FT	73
14	34	F	M	P	N	20
15	17	M	U	N	N	—

- [List of abbreviations: (a) sex: M = Male, F = Female.
 (b) civil condition: U = Unmarried, M = Married, W = Widowed, D = Divorced.
 (c) type of present employment/ employment sought: FT— Full time, P = Part time, N = Nil.]

Prepare the following tables, giving proper attention to title, column headings and other details of tabulation.

(a) Distribution of persons by sex, civil condition and age group (0-10, 11-20, 21-30 and above 30).

(b) Distribution of persons by sex and type of present employment allowing average per capita income in each case.

(c) Distribution of persons by type of present employment and type of employment sought.

(d) Distribution of persons of ages 18 to 60 years, having or seeking full-time employment, by civil condition, sex and type of employment sought. (25)

2. *Either,*

Copy out the following schedule after correcting obvious mistakes and removing unnecessary entries, if any.

[Abbreviations as in Question 1] (25)

schedule number	serial number of person	name (beginning with 'head')	relation with 'head'	present age (years)	age at marriage (years)	sex (M/F)	civil condition (U/M/W/D)	type of present employment (FT/P/N)	type of employment sought (FT/P/N)	reason for seeking change, if already employed FT (codes)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	1	Mr. Paresh Sur	self	42	25	M	U	FT	FT	3
1	2	Mrs. Kanika Sur	wife	35	28	M	W	N	PT	2
1	3	Miss Dipti Sur	daughter	13	X	M	U	N	N	X
2	1	Mr. Biraj Roy	self	40	28	F	W	FT	N	1
2	2	Mrs. Kamala Roy	wife	34	22	F	W	FT	FT	2
2	3	Mr. Ranjan Roy	son	11	X	M	U	N	N	X
2	4	Miss Bakul Roy	daughter	9	X	M	U	N	N	X
2	5	Miss Parul Roy	daughter	3	X	F	U	N	FT	2
3	1	Mr. Naresh Das	self	26	27	M	U	FT	N	X
3	2	Mrs. Bina Das	wife	48	18	F	M	N	N	X

Or,

(a) A list of surveys, recently conducted, is given below. Prepare a revised list giving the names of the surveys, sorted out by districts, under the three types: (i) surveys in connection with agriculture, horticulture and animal husbandry, (ii) refugee-surveys and (iii) family-budget enquiries.

(1) Crop-survey in the district of Burdwan.

(2) Aptitude survey amongst displaced persons residing in the camps of district Midnapore.

- (3) Enquiry into the number of fruit-bearing tree in the district of Hoogly.
- (4) Enquiry into the employment condition of displaced persons residing in the district of Burdwan.
- (5) Survey for estimation of acreage and yield-rates of principal crops of the district of Hoogly.
- (6) Enquiry into utilisation of agricultural loan received under refugee-rehabilitation scheme in Nadia district.
- (7) Enquiry into percentage expenditure on purchase of coconut for household consumption in the district of Midnapore.
- (8) Enquiry into cost of oil-seed-cake consumed per milch-cow in district Burdwan.
- (9) Enquiry into cost of oil-seed-cake used per family for washing utensils in district Midnapore. (13)

(b) Prepare a list of the following maps classified according to administrative units arranged in alphabetical order, and show the number of maps in each case:

- (1) 34 mouza-maps of P.S. Pursura of Hoogly district—15 purchased in 1953 and the rest in 1954.
- (2) 23 mouza-maps of P.S. Kharibari of Darjeeling district—12 purchased in 1956 and the rest purchased in 1957.
- (3) 7 mouza-maps of P.S. Dobra of Midnapore district.
- (4) 5 mouza-maps of P.S. Dhaniakhali of Hoogly.
- (5) 18 mouza-maps of P.S. Jhargram of Midnapore district.
- (6) 3 mouza-maps of P.S. Phul-Bazar of Darjeeling.
- (7) 12 mouza-maps of P.S. Midnapore.
- (8) 4 mouza-maps of P.S. Mogra of Hoogly district.
- (9) 2 mouza-maps of P.S. Jore-Bungalow of Darjeeling.

(P.S. means Police Station) (12)

GROUP B

3. *Either*, (20)

Evaluate

$$\frac{(3.5 \times 2.3 - 2.1 \times 3.3) (7.0 - 6.6)}{19.3 - 9.7 + 7.3 \times 1.3} \times \frac{.1032}{.01932} - \frac{28.00 - 10.24}{5.3 + 3.2} \div \frac{12.25 - 4.41}{3.5 + 2.1}$$

$$\frac{.1032}{5.9}$$

Or,

Complete the following table :

(20)

a	b	$a+b$	$a-b$	a^2	(a^2-b^2)	ab	a/b
5.2	2.1						
2.1	1.7						
-3.9	-2.4						
7.3	5.6						
5.2	6.3						
9.7	7.5						
8.4	6.8						
-2.8	3.2						
total							

4. From the equation

$$x^2 - 4xy + 4y^2 = z$$

find out the values of z for the following pairs of x and y values. (10)

Pair number	(1)	(2)	(3)	(4)	(5)	(6)	(7)
x	1	1	2	2	3	3	3
y	0	1	1	2	1	2	3

5. The following data relate to head-lengths (HL) and head-breadths (HB) measured in millimetres on 50 individuals who were either Kshatriyas (K) or Brahmins (B). Sex (M or F) and age in years of each individual were also recorded.

serial number	caste	HL	HB	sex	age	serial number	caste	HL	HB	sex	age
1	B	174	139	M	23	26	K	183	132	M	33
2	K	193	146	M	46	27	K	186	137	F	42
3	B	182	141	M	28	28	K	178	128	F	61
4	B	172	138	F	23	29	B	168	133	F	28
5	K	176	140	M	30	30	B	172	140	M	42
6	K	181	138	M	32	31	K	182	138	M	43
7	B	183	133	F	37	32	B	181	141	M	46
8	K	194	139	M	36	33	K	187	132	M	37
9	B	167	139	M	29	34	B	173	137	M	35
10	K	181	134	F	32	35	K	178	139	M	34
11	K	163	138	M	28	36	K	173	142	F	29
12	B	159	140	F	26	37	B	184	133	F	32
13	B	175	135	M	45	38	B	181	127	F	33
14	K	185	152	M	29	39	K	168	142	F	37
15	B	191	148	F	35	40	K	173	131	M	46
16	K	181	138	M	42	41	K	182	133	M	23
17	K	172	137	F	36	42	B	171	128	M	37
18	B	170	136	M	28	43	B	185	131	F	28
19	B	178	132	F	25	44	K	173	137	F	41
20	K	185	141	M	24	45	B	192	140	M	39
21	K	188	150	M	43	46	K	186	129	M	41
22	B	193	143	M	37	47	K	180	132	F	42
23	K	185	146	M	42	48	B	183	133	F	43
24	K	178	138	F	50	49	K	175	122	M	40
25	B	181	137	F	32	50	B	182	116	M	41

(i) Obtain the average head-length and average head-breadth for Kshatriya males.

(ii) Find out the number of individuals aged 30 or above, who have head-length between 160 and 180 mm. (both values inclusive) and at the same time head-breadth between 135 and 140 mm. (both values inclusive).

(iii) Obtain the average head-breadth (a) of females who are below 30 years in age and (b) of females who are 30 years or more in age. (20)

Time : 3 Hours

PART 1A, SECTION II

Full marks : 100

- (a) Answers to the different groups are to be given in separate books.
(b) Figures in the margin indicate full marks.
(c) Use of calculating machines is not permitted.

GROUP A

1. Either,

(a) Calculate $14.0018752 \times 126.428908$ by contracted multiplication correct to 3 decimal places. (8)

(b) Evaluate

$\frac{80}{|170 \times |10} \times 10^{-10}$, where the sign $|$ is the factorial sign implying that $|a = a(a-1)(a-2) \dots 3.2.1$ (8)

Or,

(a) Solve $\frac{20x}{70} \left(\frac{1}{3} - x \right) = -\frac{70}{41}$.

Also write down the equation whose roots are equal in magnitude to the roots of the above equation but have opposite signs. (10)

(b) Evaluate $e^{-1.5} (1.5)^{2.5}$, where e is the base of Napierian logarithm. (6)

2. The frequency distribution of the blood-pressure readings of 200 persons is given in the following table :

range of blood-pressure (in millimetres of mercury)	f
90—94	1
95—99	3
100—104	12
105—109	15
110—114	28
115—119	42
120—124	37
125—129	26
130—134	14
135—139	8
140—144	4
145—149	5
150—154	3
155—159	1
160—164	—
165—169	1
total	200

Calculate the mean of the distribution and also the standard error of the mean. (10)

3. The prices of six varieties of rice, ranging from very coarse to extra fine, for the years 1953-57 are given below :

varieties	price per seer (in Rs. as)				
	1953	1954	1955	1956	1957
1. extra fine	1 — 2	1 — 0	1 — 0	1 — 1	1 — 4
2. fine	0 — 15	0 — 13	0 — 14	0 — 15	1 — 1
3. medium (superior)	0 — 12	0 — 11	0 — 11	0 — 12	0 — 13
4. medium (inferior)	0 — 10	0 — 9	0 — 9	0 — 10	0 — 11
5. coarse	0 — 7	0 — 6	0 — 6	0 — 7	0 — 8
6. very coarse	0 — 5	0 — 5	0 — 5	0 — 6	0 — 6

Knowing that for every 2 seers of the extra fine variety, 5 seers of the fine variety, 10 seers of the medium (superior) variety, 16 seers of the medium (inferior) variety, 32 seers of the coarse variety and 15 seers of the very coarse variety had been sold throughout the period, calculate the index number for the average price of rice in each of the years 1954-57, taking the year 1953 as base. (18)

GROUP B

4. Either,

The square roots of integers 0-15 are given below in Table 1. Construct a graph paper by drawing vertical and horizontal lines such that on each of the x and y axes, the numbers 1, 2, 3 etc. will be shown at distances $\sqrt{1}, \sqrt{2}, \sqrt{3}$ etc., from the origin.

On this graph paper plot the eleven points whose abscissas (x) and ordinates (y) are given in Table 2. Draw a smooth curve through these points. (25)

TABLE 1 : SQUARE ROOTS

integer	square root
0	0.00
1	1.00
2	1.41
3	1.73
4	2.00
5	2.23
6	2.44
7	2.64
8	2.82
9	3.00
10	3.16
11	3.31
12	3.46
13	3.60
14	3.74
15	3.87

TABLE 2

point	abscissa (x)	ordinate (y)
1	0	10
2	1	9
3	2	8
4	3	7
5	4	6
6	5	5
7	6	4
8	7	3
9	8	2
10	9	1
11	10	0

Or,

Table 1 below gives the response rate (x) and the corresponding probit values (y). Plot y against x and draw a smooth curve through these points. Use this smooth curve to complete column 3 of Table 2.

TABLE 1

response (x)	probit (y)
(1)	(2)
0	—
.1	3.72
.2	4.16
.3	4.48
.4	4.75
.5	5.00
.6	5.25
.7	5.52
.8	5.84
.9	6.28

TABLE 2

concentration of drug (c)	response (x)	probit (y)
(1)	(2)	(3)
.01	.00	
.02	.00	
.03	.17	
.04	.00	
.05	.33	
.06	.67	
.07	.67	
.08	1.00	
.09	.83	

Having completed column (3) of Table 2, plot the points (y, c) of this table on a graph paper and draw a smooth free-hand curve through these points. (25)

5. The following table gives the female population and the total children born to females for each individual age from 15 to 34 in a country, in 1930.

age in years	female population	number of children born
15	395050	89
16	374924	489
17	382781	5163
18	363145	29632
19	352614	46232
20	340862	61416
21	338623	73526
22	324266	73957
23	300341	74625
24	292068	71432
25	285321	70521
26	274334	68860
27	265628	67349
28	254823	61521
29	245316	59637
30	232310	55934
31	225608	51857
32	214197	46268
33	205328	42435
34	194851	38228

Using the data given above, complete the following table :

age group	female population	number of children born	average number of children born per female
15—10			
20—24			
15—24			
25—29			
15—29			
30—34			
15—34			

(25)

PART 1B, SECTION I

Time : 3 Hours

Full marks : 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is permitted.

GROUP A

1. *Either,*

The following table gives the percentage distribution of displaced households in (a) government colonies, (b) other areas, by percentage levels of proper utilisation of loans. Calculate the arithmetic mean and standard deviation of the percentage levels of proper utilisation of loans separately for displaced households in (a) government colonies, and (b) other areas.

Also calculate the arithmetic mean and standard deviation of the characteristic for all displaced households. (30)

percentage level of proper utilisation	percentage distribution of displaced households in	
	government colonies	other areas
(1)	(2)	(3)
upto 10.0	21.5	13.7
10.1—20.0	1.9	—
20.1—30.0	2.5	1.4
30.1—40.0	1.2	2.7
40.1—50.0	1.0	—
50.1—60.0	5.0	1.4
60.1—70.0	9.3	4.1
70.1—80.0	3.4	6.8
80.1—90.0	2.5	2.7
90.1—100.0	51.1	67.2
total	100.0	100.0
(number of households)	(321)	(73)

Or,

The following table gives the percentage distribution of 1010 small scale manufacturing establishments by size (number of persons engaged). Calculate the arithmetic mean, median, standard deviation and β_1 of the distribution. (30)

size of establishment	percentage	
(1)	(2)	
1-5	12	
6-10	12	
11-15	13	
16-20	12	
21-30	18	
31-40	12	
41-50	7	
51-75	9	
76-100	3	
101-150	2	
total	100	(30)

2. The following table gives the land possessed (col. 1), economic status code (col. 2), wife's age at marriage (col. 3), wife's age at present (col. 4) and number of children born (col. 5) for 30 couples.

land possessed (acres)	economic status code	wife's age (years)		number of children born
		at marriage	at present	
(1)	(2)	(3)	(4)	(5)
10	3	15	20	0
5	4	15	45	7
7	4	16	17	0
1	4	14	27	5
6	4	11	28	5
5	3	16	42	7
6	4	16	55	5
2	3	18	40	5
0	3	15	50	10
6	2	18	40	8
3	3	12	35	6
3	2	13	30	6
0	4	14	33	8
18	3	14	50	10
4	3	8	52	0
2	3	21	25	0
0	4	10	60	11
1	3	8	40	7
7	1	11	60	7
2	2	14	61	5
0	2	10	36	5
5	1	18	33	5
46	2	15	26	6
0	3	17	34	5
5	1	12	40	10
70	3	13	25	6
16	1	21	40	9
14	1	16	37	5
5	2	17	46	8
0	2	7	45	6

[The economic status codes are : 1-upper; 2-upper middle; 3-lower middle; 4-lower].

Either, From the above data, prepare a table showing the number of couples, total children born and number of children born per couple, for (i) each economic status in each of the following 'land possessed' groups: 0-2, 3-6, 7 and above and (ii) each economic status as a whole. Represent the results in a diagrammatic form. (20)

Or, From the above data, plot the scatter diagram connecting children born and marriage duration; (marriage duration is defined as wife's age at present minus age at marriage).

Also calculate the coefficient of correlation between marriage duration and children born. (20)

GROUP B

3. The following table shows the food intake, x , and gain in weight, y , of 32 rats receiving 4 rations. Set up an analysis of covariance table and test the significance of difference between the rations in respect of the weights after correcting for the effect of food intake. (30)

Food intake, x (10 caloric units) and gains in weight y (grams)

ration 1			ration 2			ration 3			ration 4		
rat number	x	y	rat number	x	y	rat number	x	y	rat number	x	y
1	108	73	9	99	98	17	194	94	25	165	90
2	136	102	10	117	74	18	198	79	20	164	76
3	138	118	11	90	56	19	196	96	27	161	90
4	159	104	12	141	111	20	198	98	28	150	64
5	146	81	13	106	95	21	210	102	29	175	86
6	141	107	14	112	88	22	196	102	30	135	51
7	175	100	15	110	82	23	230	108	31	132	72
8	149	87	16	117	77	24	222	91	32	190	90

4. Assuming a straight line relationship of the form $y = -a + bx$, find out the regression equation, by the method of Least Squares, from the following data. (20)

Family Budget Enquiry, 1955-56

family serial number	annual expenditure on total food in rupees (y)	total annual expenditure in rupees (x)
1	1779.0	3038.0
2	1669.0	2781.0
3	1488.5	2790.0
4	1660.0	4160.0
5	2111.0	3571.0
6	1391.0	3173.0
7	941.8	2664.9
8	1916.8	3966.0
9	1384.1	4012.0
10	1355.0	3161.0
11	1318.5	3284.3
12	1083.6	2464.6

PART 1B, SECTION II

Time : 3 Hours

Full marks : 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is permitted.

GROUP A

1. Calculate the frequencies of the normal distribution which has the same mean, standard deviation and total frequency as the distribution given below and corresponding to the same class-intervals as in this distribution. Test the goodness of fit.

x	f
80—81	1
81—82	8
82—83	35
83—84	82
84—85	122
85—86	124
86—87	83
87—88	34
88—89	10
89—90	1

(32)

2. Either,

(a) The heights of a large number of students were measured and the mean was found to be equal to 67.5 inches. It was also found that 40 per cent of the students were between 66.2 inches and 68.8 inches in height. What is the standard deviation of the heights? (Assume the distribution of heights to be normal). (9)

(b) The sample sizes (N), the mean values (M) and standard deviation (σ), with respect to weights recorded for two sets of male students are as follows :

$$N_1 = 200, M_1 = 140.4 \text{ lbs.}, \sigma_1 = 17.7 \text{ lbs.};$$

$$N_2 = 200, M_2 = 138.8 \text{ lbs.}, \sigma_2 = 16.2 \text{ lbs.};$$

Is the difference in the two mean values significant? (9)

Or,

(a) During a given month one machine produced 900 units, but spoiled 3.2 per cent of them. During the same month another machine with a more experienced operator produced 1000 units, but spoiled 2.8 per cent of them. Is the difference between the percentages of spoilage significant? (9)

(b) Given the following values of $f(x, y)$, estimate the value of $f(23, 17)$

$$f(20, 15) = 6.004, f(20, 20) = 4.304$$

$$f(25, 15) = 6.029, f(25, 20) = 4.346 \quad (9)$$

GROUP B

3. Find the values of

(a) $0.3x^{0.12} + x^{\frac{1}{2}} + \log_8 (x^2)$, when $x = 2.17$

(b) $\frac{x^{0.15} + (1.75)^{\frac{1}{2}}}{1.47 + \log_{10} \left(\frac{x}{6.7} \right)}$, when $x = 5.4$ (15)

4. The following table gives in million KWH units the electricity generated (y_1), total electricity sold (y_2) and electricity sold for domestic consumption (y_3), in India during the years 1948 to 1956. Present the data in suitable graphical form.

Calculate the percentage of amount of electricity sold for domestic consumption to total amount sold and plot a curve to show the changes in the percentage over the years.

Comment on the graphs (20)

TABLE : Electricity, Production and Distribution
(Unit—Million KWH)

Year →	1948	1949	1950	1951	1952	1953	1954	1955	1956
Electricity generated	381	409	426	488	516	559	625	708	803
Total electricity sold	310	334	346	399	420	454	508	577	658
Electricity sold for domestic consumption	34.1	39.5	43.7	49.6	50.3	56.6	61.7	67.5	78.5

5. For each of the following items write the name of at least one publication from which you can get the required information. For each of the publication, also indicate the name of the publishing authority and its periodicity of publication viz., weekly, monthly, etc. (15)

(i) Gross amount of import duty collected at all ports of India in the month of June 1953.

(ii) Number of trade disputes in India resulting in stoppage of work, number of workers involved and number of mandays lost during May 1956.

(iii) Earnings from carrying rice (in husk) by class I railways in Indian Union during the year 1949-50.

(iv) Area irrigated from Government canals in different districts of Bihar during the 5 years 1938-39 to 1942-43.

(v) Working class cost of living index number of Bombay City in the month of June 1958.

- (vi) Number of boy students on rolls in recognised engineering institutes in West Bengal during 1951-52.
- (vii) Total mileage of extra-municipal roads in U.P. as on 31st March 1950.
- (viii) All India second estimate of cotton crop for 1955-56.
- (ix) Number of cheques cleared in Bombay city in January 1958.
- (x) Total productive capital employed in factories in the State of Madras during 1953-54.

PART 1C, SECTION I

Time : 4 Hours

Full marks : 100

- (a) Answers to the different groups are to be given in separate books.
- (b) Figures in the margin indicate full marks.
- (c) Use of calculating machines is permitted.

GROUP A

1. *Eiher*,

The average heights in cms. of a certain type of plants observed during different weeks are as follows :

Week	1	2	3	4	5	6	7	8	9	10	11	12
Height	18	36	68	98	131	170	206	228	247	250	254	254

Fit a polynomial of the third degree and plot the observed and the expected values on a graph. (25)

Or,

(a) Using tables of the normal, probability integral, prepare a nomogram to read off the values of x for given values of p , where

$$\frac{1}{\sqrt{2\pi}} \int_0^{\infty} e^{-\frac{1}{2}t^2} dt = p. \quad (13)$$

[Note: 1. Graduation of x on one side of a line and of p on the other side of the same line would suffice.]

2. Graduation for values of p greater than 0.6 is not required.]

(b) The following data show the population (expressed in million) of the United States at each Census from 1790 to 1880.

year	population
1790	3.929
1800	5.308
1810	7.240
1820	9.638
1830	12.866
1840	17.009
1850	23.192
1860	31.443
1870	39.558
1880	50.156

Letting x denote years and assuming the growth of population is governed by the law,

$$y = \frac{197.27}{1+07.32e} - .0313x,$$

calculate the estimated population for the different years (12)

2. Represent the following information in a tabular form after converting the percentages to actual numbers where necessary and giving a suitable heading for the table. (25)

In one of the recent Employment Survey, it has been observed that about 22.5 per cent of the total population belong to the labour force and of them 32 per cent are unemployed at present, while 4.75 per cent have full-time and 63.25 per cent only part-time employment.

Considering the employment position of the persons of all ages, it is noticed that out of a total of 554 persons having some sort of employment, 6.86 per cent have full-time employment, out of which 30 persons like to change their jobs. Amongst the persons having part-time employment very few persons numbering 10, do not like to seek full time employment.

The survey further shows the distribution according to community. Amongst the labour force population, 80 per cent belong to 'scheduled castes'. For 6 persons community was not recorded and among them there is none having full-time employment and the number of part-time holders is 4. As the 'scheduled castes' comprise the bulk of the labour force under the 'caste hindu' there are only 106 persons with some sort of employment, including 6 having full-time employment.

Reviewing the overall employment position of the persons of all ages by community, it is noticed that amongst the persons having full-time employment, only 8 persons of the 'scheduled castes' community do not seek change of occupation. The corresponding numbers amongst part-time holders are 2 and 8 for 'caste hindus' and 'scheduled castes' respectively.

The survey further provides the number of families, population, and persons of ages 16-60 by community. 'Scheduled castes' represent 70 per cent of the families with 2,806 persons, out of which 1536 belong to age group (16-60) years. For 6 families, accounting for 22 persons, community was not recorded. Of them 63.6 per cent belong to age group (16-60) years. No family was returned under 'scheduled tribes' and 'other communities'.

The survey covers a population of 3556 comprising 864 families. Of the total population, 1920 belong to age group (16-60) years.

[Note: The definition of labour force covers 'any persons within the age group (16-60) years, having full-time employment or seeking full-time employment].

GROUP B

3. The following data relate to the initial weights and the growth rates of 15 pigs classified according to pen and type of food given.

pen	food	initial weight	growth rate in lbs. per week
I	A	48	9.04
	C	48	9.11
	B	39	8.51
II	B	32	9.24
	C	37	8.50
	A	35	8.21
III	A	35	9.32
	B	41	9.34
	C	42	8.00
IV	C	50	10.37
	A	48	10.56
	B	46	9.68
V	B	37	9.67
	A	43	10.42
	C	40	8.76

Use the techniques of analysis of variance and covariance to study the effect of food on growth rate after eliminating the effect of initial weight. (30)

4. The table below gives the results of 20 measurements on each of the three variables X_1 , X_2 and X_3 .

Calculate the multiple correlation coefficient ($R_{1,23}$) and the partial correlation coefficient $r_{1,23}$.

Test the significance of the partial correlation coefficient.

X_1	X_2	X_3
22	29	2
26	1	4
23	5	3
8	31	1
25	25	3
12	16	1
13	26	1
30	15	4
12	6	2
26	10	3
24	21	2
7	12	1
23	24	3
28	16	3
25	6	4
22	20	2
25	35	1
32	9	4
37	19	4
20	14	2

(2)

PART 1C, SECTION II

Time: 4 Hours

Full marks: 100

- (a) Answers to the different groups are to be given in separate books.
 (b) Figures in the margin indicate full marks.
 (c) Use of calculating machines is permitted.

GROUP A

1. *Either,*

- (a) Calculate the value of u_3 of the series $u_0 = 580$, $u_1 = 550$, $u_2 = 520$ and $u_4 = 385$. (7)
 (b) Evaluate (7)

$$\begin{vmatrix} 16 & 12 & 14 \\ 20 & 15 & 16 \\ 28 & 21 & 32 \end{vmatrix} \times \begin{vmatrix} 5 & 9 & 3 \\ 12 & 7 & 14 \\ 14 & 16 & 17 \end{vmatrix}$$

Or,

- (a) Apply a central difference formula to obtain the u_{28} , given $u_{20} = 14$, $u_{24} = 32$, $u_{28} = 35$, $u_{32} = 40$. (7)
 (b) Solve (7)

$$\begin{vmatrix} 12 & 4 & 6 \\ 8 & 5 & 3 \\ 16 & 13 & x \end{vmatrix} = 0$$

2. (a) The number of persons living in a locality falling under different age groups is given below. Calculate β_1 and β_2 of the distribution and determine the appropriate Pearsonian type that would fit the distribution.

central age	number living
17	11
22	48
27	124
32	213
37	281
42	295
47	185
52	104
57	40
62	15
67	3
total	1310

(b) Assuming that a normal distribution would fit the data, obtain the expected frequency and test the goodness of fit. (18)

3. In an experimental station the effect of two manures M_1 and M_2 , each applied at two different times T_1 and T_2 , were tested on a variety of wheat. The Latin square layout of the experiment together with the yields of each plot is given below.

(a) Test which of the four combinations give the best result.

M_1T_1 125	M_1T_2 81	M_2T_2 102	M_2T_1 65
M_2T_1 72	M_2T_2 135	M_1T_2 142	M_1T_1 165
M_1T_2 115	M_1T_1 161	M_2T_1 85	M_2T_2 142
M_2T_2 132	M_2T_1 75	M_1T_1 145	M_1T_2 118

(b) From the above data test if the overall effect of the application of manure at time T_2 is better than that applied at time T_1 (i.e. main effect of time). (18)

GROUP B

4. The following table shows the retail prices of commodities generally consumed by the working class in a certain city. The weights attached to each commodity and the price per unit are also given.

(a) Calculate the consumer price index numbers for February 1956 and March 1956.

(b) Calculate the weighted index number for Food (consisting of cereals and pulses). (25)

TABLE

item	weight	unit	price per unit in base period (1953-54)			price in February 1956			price in March 1956		
			Rs.	As.	Pya.	Rs.	As.	Pya.	Rs.	As.	Pya.
Rice	3	seer	0	0	0	0	8	0	0	8	3
Wheat	2	seer	0	4	0	0	3	0	0	4	0
Jowar	30	seer	0	3	0	0	4	0	0	4	0
Maize	5	seer	0	3	0	0	3	0	0	3	0
Bajra	15	seer	0	4	0	0	5	0	0	5	0
Pulses	5	seer	0	5	0	0	0	0	0	5	0
Groundnut oil	8	seer	0	10	8	0	12	5	0	12	2
Coconut oil	5	seer	0	8	0	0	10	0	0	9	6
Chillies	4	seer	0	6	0	0	8	5	0	8	0
Salt	1	seer	0	2	3	0	2	0	0	3	0
Vegetables	2	seer	0	3	3	0	3	0	0	3	6
Matches	1	per box	0	0	0	0	0	0	0	0	10
Firewood	4	seer	0	3	0	0	3	0	0	3	0
Charcoal	2	seer	0	4	0	0	4	0	0	4	8
Shirting	2	yard	0	12	0	1	4	0	1	8	3
Blouse piece	2	yard	0	14	6	1	2	6	1	3	6
Saree	8	per saree	8	0	0	10	2	0	10	8	0
Dhotee	3	per dhotee	6	4	0	7	8	0	7	12	0

5. From the publications supplied to you, find out the value of Imports and Exports from the countries of U.K., Japan, France, U.S.A. Iran and India, for the ten years preceeding 1954. Comment on the balance of trade of these countries during this period, specially with reference to India during this period. (25)