

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1965

Paper I (Practical) : Elementary Computation.

Time : 5 hours

Full marks : 100

(a) Figures in the margin indicate full marks for each question.

(b) Use of calculating machines is not permitted.

(a) Round off the following numbers to obtain the accuracy noted against each. Work out the absolute and relative errors in each of the rounded off numbers.

(i) 2.173 correct to two decimal places.

(ii) 17.1965 correct to three decimal places.

(iii) 0.0127 correct to two significant digits.

(iv) 0.00216 correct to three significant digits. (6)

(b) In respect of each of the following approximate numbers, mention :

(1) the number of significant digits.

(2) the limits within which the actual value lies.

(3) maximum possible relative error.

(Show the steps of your computation clearly)

(i) 2.3517; (ii) 0.5939; (iii) 357001 (9)

2. (a) Find the sum of the following approximate numbers correct to two decimal places, by contracted method.

$$0.51625 + 83.123 - 1.916351 + 0.00612 + 0.000012 \quad (3)$$

(b) EITHER

Find the product of 43.91 and 063.4 (both being approximate numbers). What is the number of significant digits in the product ? Mention the rule you have used. (5)

OR

0.38 is an approximate number. Work out $(0.38)^3$ and mention the number of significant figures in the result. (Show the steps of your computation clearly). (5)

(c) Find the continued product of 12.7053, 0.003275 and 5.432 correct to three decimal places by contracted method of multiplication. (4)

(d) Find the value of the following correct to three decimal places. (4)

$$1 - \frac{1}{1 \times 3} + \frac{1}{1 \times 3 \times 5} - \frac{1}{1 \times 3 \times 5 \times 7} + \dots + \frac{1}{1 \times 3 \times 5 \dots \times 61}$$

3. (a) Find the values of any six of the following by consulting appropriate tables and mention the number of significant digits in each case. Give reference to tables used.

(i) $\log_{10} (2.0814 \times 72.714)$ (vi) $(1.7)^2 + \sqrt{23550}$

(ii) $\log_{10} (\sqrt[3]{0.7159})$ (vii) $2^{17} + .3^{11}$

(iii) Antilog $(\log_{10} 10^{1.721})$ (viii) $\sin 16^\circ 10' 30''$

(iv) $e^{3.2}$ (ix) $\tan 24^\circ 19' 45''$

(v) $\frac{1}{\sqrt{151}} + \frac{1}{2304}$

(b) EITHER,

(1) Find the value of $\frac{e^{-m} m^x}{x!}$ correct to six decimal places,
for $m = 1.2$ and $x = 3$ and 6 . (6)

(11) Find the value of
 $1 + \sin x + \cos x + 0.2 \sin^2 x + 0.7 \tan x$ correct to six
decimal places for $x = 10^\circ$ and 30° . (4)

OR

Find the value of
$$\frac{\left[\sqrt[3]{20.17} \div (19.13)^2 \right]^{3/4}}{(5.7)^{4.6} \times 3^{1/8}} + 5^{1/2} \sin 25^\circ$$

for $x = 3$ and 5 . (10)

4. Determine by means of linear interpolation, the values of U_x
corresponding to $x = 522.4$, $x = 525.6$ and $x = 528.7$ from the data
furnished below :

x	U_x	x	U_x
522	0.71767	526	0.72099
523	0.71850	527	0.72181
524	0.71933	528	0.72263
525	0.72016	529	0.72346

(12)

5. (a) Solve graphically the equations $2x + 3y = 1$ and $3x - 2y = 8$. (6)

(b) EITHER,

Plot the graph of the curve,
$$y = .5x + .05x^2$$

using as many values of x within the range of -10 to $+10$, as
you think are necessary for a properly drawn graph.
From the graph so drawn, determine the area entirely enclosed by
the curve and the x axis. (12)

OR

Draw the graphic of the trigonometrical functions $y = \sin x$ and
 $y = \cos x$, between $x = 0$ and $x = 180^\circ$. Find the values of x within these
limits which satisfy the equation $\sin x = \cos x$. (12)

6. The following gives information with regard to progress made by
apprentices in their work :

<u>weeks of</u> <u>apprentice work</u>	<u>% efficiency</u> <u>achieved</u>	<u>weeks of</u> <u>apprentice work</u>	<u>% efficiency</u> <u>achieved</u>
1	18	7	50
2	31	8	48
3	38	9	54
4	40	10	57
5	?	11	62
6	46	12	74

(18)

Plot the data and draw a free hand curve to indicate the trend.

(1) Read from the graph the % efficiency value for the 5th week, and

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1963

Paper II (Practical) : Compilation and Presentation of Statistics

Time : 5 hours

Full marks : 100

(a) Figures in the margin indicate full marks for each question.

(b) Use of calculating machines is not permitted.

1. From an all India land utilisation survey, a summary table was prepared showing composition of gross area in thousand acres under the principal crops grown singly (C_1) and in mixture both apportioned to the principal crops (C_{m1}) and to other crops (C_{m2}) with their total (C_m).

Total allocated area (T_1) and total gross area (T_g) under the crops were also computed. Percentages of pure crop area i.e. singly grown (P_g), total mixed crop area (P_m) and total allocated area (P_A) to total gross area, were also calculated. The estimates were prepared for the six population zones - North India (N), East India (E), South India (S), West India (W), Central India (C), North-West India (N.W) and all India (A).

From the figures shown below, prepare a suitable table with proper title, headings, sub-totals and totals etc after filling up blank, and correcting obvious mistakes, if any :

$NC_B = 11724$	$SC_{m1} = 33$	$NT_A = 21897$	$NP_B = 39.71$
$EC_B = 3457$	$WC_{m1} = 2373$	$ET_A = 5404$	$EP_B = 45.82$
$SC_B = 848$	$CC_{m1} = 6841$	$ST_A = 881$	$SP_B = 91.68$
$WC_B = 5148$	$MC_{m1} = 10173$	$WT_A = 7521$	$WP_B = 51.26$
$CC_B = 13162$	$EC_{m1} = 1947$	$CT_A = 20003$	$CP_B = 47.18$
$N.WC_B = 18009$	$N.WC_{m1} = 5875$	$N.WT_A = 23884$	$N.WP_B = 63.29$
$AC_B = 52349$	$AC_{m1} = 27242$	$AT_A = 79530$	$AP_B = 94.78$
$NC_{m2} = 8393$	$SC_m = 77$	$NT_g = 30290$	$NP_m = 61.29$
$EC_{m2} = 2141$	$MC_m = 18566$	$ET_g = 7545$	$EP_m = 54.18$
$SC_{m2} = 44$	$WC_m = 3598$	$ST_g = 925$	$SP_m = 0.32$
$WC_{m2} = 1225$	$CC_m = 14733$	$WT_g = 10042$	$WP_m = 52.82$
$CC_{m2} = 7892$	$N.WC_m = 10445$	$CT_g = 27895$	$CP_m = 49.74$
$N.WC_{m2} = 4570$	$AC_m = 53902$	$N.WT_g = 28454$	$N.WP_m = 36.71$
$AC_{m2} = 25561$		$AT_g = 105151$	$AP_m = 50.22$

$NP_A = 72.29$
$EP_A = 71.62$
$SP_A = 95.24$
$WP_A = 47.90$
$CP_A = 71.71$
$N.WP_A = 38.94$
$AP_A = 75.69$

It may be noted that areas relating to (C_1), (C_{m1}), (T_1) and (T_g)

2. Prepare a blank tabular form with suitable headings and providing space for sub-totals and totals for presenting the distribution of population of a country by 6 age groups and 2 communities. Figures under each community are again to be shown under "male" and "female" and those again under "literate" and "illiterate" classification. Total population of the country is also required to be shown by each age group. (10)

3. Collect the following from the publications supplied to you and present them in a neat tabular form. Mention the sources together with page numbers from where you have compiled the data, along with proper notes where necessary.

(Attempt any two)

(a) Number of Registered factories and employment therein for first half of any year, by States in India.

(b) Revenue and expenditure of different States (on Revenue account) for three consecutive years. Revenue should be classified as Tax and non-tax Revenue, and expenditure should be classified as Developmental and Non-developmental expenditure.

(c) Number of hospitals, dispensaries, beds and patients treated, for any year, by States in India. (10)

4. Mention in which publication the following information would be available. Give also the name of the issuing authority and the periodicity of the publication in each case.

(Answer any five)

(a) Monthly total number of man-shifts worked in coal mines in India.

(b) Total number of live-stock imported to West Bengal from different States of India for a particular year.

(c) Monthly Post Office savings bank deposit in India, classified as "receipt" and "outstanding".

(d) Number of vacancies notified during a month in Employment Exchanges of the different States in India.

(e) Total number of motor-vehicles in Indian Union including motor-cycles and auto-rickshaws.

(f) Statistics of mental hospitals by States in India.

(g) Monthly estimated employment in public sector, (classified under "Central Government", "State Government", "Quasi Government" and "Local Bodies").

(h) Monthly electricity generated, state-wise in India.

(i) Monthly approximate gross-earning of Government Railways in India.

(j) Annual all India statistics of educational institutions, scholars and expenditures on education. (10)

5. The following table gives the length (recorded to the nearest tenth of a centimetre) and also the number of grains per earhead of 160 earheads of a particular variety of wheat. Rearrange the data in the form of a bivariate frequency distribution (correlation table) using suitable class intervals for each variable. (25)

(Please see next page for table)

Table . Data on length of earhead (x, in cm.) and number of grains per earhead (y) of a particular variety of wheat.

x	y	x	y	x	y	x	y
10.2	38	8.9	20	9.8	26	8.4	24
8.8	23	9.0	28	9.5	29	13.4	48
10.5	33	7.7	17	10.1	30	8.2	29
11.4	38	7.5	20	9.6	34	6.6	17
9.9	29	12.7	42	10.2	39	9.6	27
10.0	28	11.7	38	8.7	34	8.4	30
10.0	32	8.3	21	7.9	20	10.0	32
10.9	26	9.7	32	12.5	34	10.5	40
11.3	40	10.8	28	10.7	30	10.5	32
9.5	31	9.1	37	9.1	27	12.1	42
12.5	43	9.0	32	11.2	39	9.7	30
11.0	32	11.1	32	9.7	26	8.9	25
10.1	29	11.4	42	10.4	31	9.7	40
9.7	28	10.4	27	11.0	40	11.2	31
11.5	33	10.9	31	13.6	41	11.0	40
11.7	32	9.4	28	9.6	32	13.1	45
10.2	40	9.5	23	11.1	36	10.5	33
9.8	31	12.2	36	8.5	28	8.4	33
9.3	29	9.1	29	10.6	29	11.5	30
10.5	33	10.4	24	10.4	34	9.4	23
9.0	22	9.4	22	11.3	35	11.8	34
9.6	29	8.4	23	8.7	26	8.5	25
11.4	40	10.8	34	10.6	30	10.5	35
9.9	23	6.7	17	9.5	26	7.0	17
10.6	28	11.2	39	11.5	45	8.3	21
8.4	25	7.0	15	9.6	25	11.7	33
8.9	28	10.9	32	7.0	18	10.0	29
11.9	37	8.7	27	10.4	37	9.5	23
12.0	40	10.6	30	8.7	25	10.9	31
12.2	39	8.0	14	12.8	50	9.7	25
6.5	17	11.5	35	9.8	31	10.0	27
9.8	32	9.1	21	6.3	17	10.9	29
7.6	21	7.6	23	10.1	33	8.9	24
10.9	35	8.9	31	7.4	31	5.5	13
6.5	16	10.1	29	8.6	33	10.6	38
8.8	26	9.3	29	13.3	38	11.5	37
11.3	37	10.0	30	10.7	30	9.8	26
6.7	15	8.5	24	9.7	31	11.7	44
8.9	23	11.6	30	11.7	36	9.2	31
10.2	31	10.6	32	10.4	29	11.8	41

6. Represent the following data suitably in a pie chart.

(11)

Area under principal crops in India, 1956-57

Crop	Area 000 hectares	Crop	Area 000 hectares
Rice	32,278	Cotton	8,019
Jowar	16,238	Jute & mesta	1,069
Bajra	11,251	Tea, Coffee etc.	482
Maize	3,759	Sugar cane	2,047
Ragi	2,279	Tobacco	419
Semi millets	4,976	Potatoes	286
Wheat	13,525	Others	1,361
Barley	3,510		
Other foodgrains	23,317	Total	1,37,319
Oilseeds	12,195		

(Source : Directorate of Economics & Statistics, Ministry of Agriculture, Government of India.)

7. The following table gives expenditure on recognised educational institutions classified according to sources from which finances are drawn. Give a suitable graphic representation.

(14)

Year	Govt. Funds		District Board Funds	Municipal Funds	Fees	Endowments	Other Sources	Total
	Central	States						
1953-54	578	7962	866	585	3291	464	1029	14775
1954-55	857	9027	905	604	3534	496	1077	16500
1955-56	1215	10506	110	655	3790	569	1251	18976
1956-57	1417	11539	1016	694	4010	644	1258	20627
1957-58	1766	13988	970	748	4359	698	1511	24040

(Source : Ministry of Education)

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INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1963

Paper III (Practical) : Selected Techniques of Computation

Time : 5 hours

Full marks : 100

- (a) Figures in the margin indicate full marks for each question.
 (b) Use of calculating machines is permitted.

1. (a) Tabulate

$$t = r \sqrt{\frac{(n-2)}{1-r^2}}$$

for integer values of n from 2 to 10 and for $r = 0.90; 0.95$ and 0.99 . (6)

(b) EITHER,

The following table gives for some values of x the values of $f(x)$ which is a third degree polynomial in x . Prepare a difference table to locate errors, if any, correct any error detected, and find out by using a suitable interpolation formula, the value of $f(x)$ for $x = 0.052$.

x	$f(x)$
.02	- 0.57325
.03	- 0.84169
.04	- 0.09587
.05	- 0.16296
.06	0.43355
.07	0.71465
.08	1.00501
.09	1.30338

(16)

OR

By using Lagrange's interpolation formula find out as accurately as possible the value of $\sin \theta$ for $\theta = 2$ radians, based on the following values of $\frac{\sin \theta}{\theta}$ where the values of θ are in radians.

$\frac{\theta \times 18}{\pi}$	$\frac{\sin \theta}{\theta}$
10	0.5642
11	0.4894
12	0.4135
14	0.2630

(16)

2. EITHER,

(a) Find by quadrature the value of :

$$\int_0^1 (1-x^2)^{\frac{1}{2}} dx \text{ correct to five decimal places, by}$$

calculating 13 ordinates and then using Simpson's one-third rule. (10)

(b) Evaluate the integral by using Trapezoidal rule and compare the result with that obtained in (a). (7)

OR

(a) Find correct to four decimal places the value of :

$$\sum_{x=6}^{x=15} \frac{1}{2(x+1)^2} \quad (15)$$

(b) By a graphical method find the value of :

$$\int_6^{15} (x+1)^{-2} dx \quad (10)$$

3. (a) Solve graphically the equations (correct to one place of decimal)

$$(i) y = \frac{4}{3} \sqrt{9-x^2}$$

$$(ii) 3y = 7 - x \quad (12)$$

(b) Find correct to three decimal places, by numerical method, the smallest positive root of

$$x^x + 2x = 6 \quad (13)$$

4. (a) Solve the following equations

$$3.1x - 2.0y + 3.8z = 14.9$$

$$2.1x + 5.1y - 2.9z = -8.6$$

$$5.9x + 3.1y + 2.1z = 8.9 \quad (8)$$

(b) Find the product of the two determinants

$$\begin{vmatrix} 1 & 3 & 4 \\ 2 & 7 & 3 \\ 1 & 3 & 5 \end{vmatrix} \quad \text{and} \quad \begin{vmatrix} 1 & 2 & 0 \\ 2 & 3 & 6 \\ 3 & 4 & 6 \end{vmatrix} \quad (4)$$

(c) (i) Evaluate the following determinant

$$\begin{vmatrix} 2 & 4 & -2 & 3 \\ 1 & -2 & 1 & 0 \\ -2 & 0 & -1 & 3 \\ 2 & 3 & -2 & 3 \end{vmatrix} \quad (9)$$

(ii) Find the co-factor of the element in the second row and third column of the above determinant. (2)

(iii) Find the minor of the element in the fourth row and second column in the determinant. (2)

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INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1963

Paper IV (Practical) : Descriptive Statistics

Time : 5 hours

Full marks :100

- (a) Those who have passed (according to the old rules) in Part 1B, Section I only (and not in Section II of part 1B or in Section I of Part 1C) should answer questions in Group B only in 3 hours. In this case mention the time of handing over the answer-script, on cover page. All other should answer the full paper.
- (b) Figures in the margin indicate full marks for each question.
- (c) Use of calculating machines is permitted.

Group A.

1. A frequency distribution of age at death from Diphtheria, is given below:

age at death (years)	frequency	age at death (years)	frequency
under 1	602	20 and under 24	89
1 and under 2	1,133	25 and under 29	56
2 and under 3	1,183	30 and under 34	67
3 and under 4	1,112	35 and under 44	110
4 and under 5	913	45 and under 54	60
5 and under 9	2,290	55 and under 64	52
10 and under 14	435	65 and under 74	22
15 and under 19	118	75 and under 84	12

- a) Evaluate from the above data, the mean and median age at death from Diphtheria. Which do you think is the more appropriate average in the present case and why? [8 + 4 + 2 = 14]
- b) What information can the above results furnish you regarding the skewness of the distribution? What further measure would be necessary to enable you to get at a measure of skewness? [4]

2. EXPORTS

The figures below give details of exports of Indian Tea to various countries in the world on the basis of calendar years.

Exports of Indian Tea: 1956 and 1959.

Destination	Price of exported tea (in Rs. per lb.)		Quantities (in 000 lbs.)	Value (in 000 Rs.)
	1956	1959		
1. Europe (incl. U.S.S.R.)	2.72	2.75	406934	1108617
2. Asia	2.80	2.75	24124	67543
3. Africa	2.52	2.18	29027	75257
4. America	2.82	2.65	51084	143992
5. Oceania	2.50	2.34	10849	27162
6. Other countries	3.27	2.54	1739	5678
			524557	1428249

Compute from the data an index of export price of tea for the year 1959 with 1956 as base year by the weighted price relative method. [8]

OR

After an index number A, for textile fibres, has been in operation up to 1955 with 1953 as base year it was decided to start a new series of Index number B and this time with 1955 as base. The figures are given below.

	Index numbers	
	A	B
1953	100	
1954	100.95	
1955	95.74	100
1956		97.88
1957		100.28

It is required to find out how the index number of textile fibres have behaved during the entire period. Construct a continuous series with (i) 1953 as base and (ii) 1955 as base. [8]

3. The figures of average weekly earnings in dollars and average weekly expenditure on entertainments in dollars (movies, sports etc.) are given below on the basis of a sample study of 85 families:

y: average weekly expenditure	x: average weekly wages (in dollars)						
	30-39	40-49	50-59	60-69	70-79	80-89	90-99
0.00 - 0.99	1						
1.00 - 1.99	2	3	1				
2.00 - 2.99	1	2	10	2			
3.00 - 3.99		5	6	5	1	1	1
4.00 - 4.99			2	4	3	2	1
5.00 - 5.99				1	10	6	2
6.00 - 6.99				2	5	2	2
7.00 - 7.99						1	1

- i) Calculate the coefficient of correlation.
- ii) Obtain the linear regression equation for regression of y on x.
- iii) Estimate the average weekly expenditure corresponding to an average weekly wage of 60 dollars. [24]

Group B

4. An instructor of Mathematics wished to determine the relationship of grades in a final examination to grades on two periodical tests given during the year. Calling X_1 , X_2 and X_3 the grades of a student in the first test, second test and final examination respectively, he obtained the following results in respect of a total of 120 students.

$$\bar{X}_1 = 6.8 \quad S_1^2 = 1.00 \quad r_{12} = 0.60$$

$$\bar{X}_2 = 7.0 \quad S_2^2 = 0.64 \quad r_{13} = 0.70$$

$$\bar{X}_3 = 74.0 \quad S_3^2 = 81.0 \quad r_{23} = 0.65$$

where \bar{X} , S and r stand for the mean, standard deviation (divisor 120) and correlation coefficient respectively.

- a) Obtain the linear equation for regression of X_3 on X_1 and X_2 . [9]
- b) Estimate the final grades of two students who scored respectively 9 and 7 in the first test and 4 and 8 in the second test. [3]
5. Correlation coefficients between weight (X_1) and height (X_2), weight (X_1) and age (X_3), and height (X_2) and age (X_3), in respect of 50 boys were obtained as:

$$r_{12} = 0.82$$

$$r_{13} = 0.77$$

$$r_{23} = 0.90 \quad \text{respectively.}$$

- a) Compute the multiple correlation coefficient of X_1 on X_2 and X_3 . [4]
- b) Compute the partial correlation coefficient of weight and height eliminating the effect of age. [4]
6. The following table shows the United States freight car loadings in millions of rail road cars during the years 1951-1957. Obtain a seasonal index by using any of the following methods:

- (1) Ratio to trend method
- (2) Ratio to moving average method
- (3) Link relative method.

[15]

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1951	37	28	30	31	40	38	33	33	43	31	27	
1952	36	29	28	29	36	26	29	31	33	41	31	26
1953	33	27	28	29	30	32	37	32	31	40	27	24
1954	30	24	24	24	33	27	32	27	27	36	26	25
1955	25	25	32	27	37	30	30	38	31	32	37	26
1956	27	27	35	29	38	31	23	37	32	32	37	26
1957	26	26	31	25	35	29	27	37	28	29	32	22

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7. FITTING

Fit a curve $\log y = a + bx$ to the following data and graduate the values of petroleum for the different years.

Year (x)	Production of petroleum (y) (millions of barrels)
1941	1402.2
1942	1386.6
1943	1505.6
1944	1677.0
1945	1711.1
1946	1733.4
1947	1857.0
1948	2020.2
1949	1841.9
1950	1973.6
1951	2247.7
1952	2290.0
1953	2360.0

[15]

GR

Fit the cubic $y = a_0 + a_1x + a_2x^2 + a_3x^3$ to the following data. Calculate the expected values and draw the fitted curve on a graph along with the observed values

x :	1	2	3	4	5	6	7
y :	10.16	13.90	17.93	16.25	18.50	25.67	28.00

[15]

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INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1963

Paper V (Practical) : Elementary Statistical Methods

Time : 5 hours

Full marks : 100

- (a) Those who have passed (according to old rules) Part 1B, Section II only (and not in Section I of Part 1B or in Section I of Part 1C) should answer questions of Group B and C only in 2½ hours.
- (b) Those who have passed (according to old rules) Part 1C, Section I only (but not in section I of Part 1B or in Section II of Part 1B) should answer questions of Group A and C only in 3½ hours.
- (c) All other should answer the full paper.
- (d) Figures in the margin indicate full marks for each question.
- (e) Use of calculating machines is permitted.

GROUP A

1. The following table gives the distribution of the number of alpha particles falling on a counting device, during periods of fixed duration, in 2608 repeated trials. Fit a Poisson distribution and test the goodness of fit.

<u>Number of particles</u>	<u>Frequency</u>	<u>Number of particles</u>	<u>Frequency</u>
0	57	7	139
1	203	8	45
2	383	9	27
3	525	10	10
4	532	11	4
5	408	12	1
6	273	13	1
		<u>Total</u>	<u>2608</u>

(20)

2. Two analysts each determined the iron content of a material on ten specimens each, and the results, in the same unit, are shown below

<u>Analyst A</u>	<u>Analyst B</u>
4.40	4.62
4.62	4.57
4.43	4.85
4.60	4.94
4.55	4.67
4.43	4.50
4.46	4.55
4.39	4.35
4.75	4.90
4.71	4.84

Compute the variance for each analyst and test if B is more variable than A.

(10)

3. The following coded data were derived from laboratory tests on a certain steel product. X_0 represents tensile strength of the product. X_1 and X_2 represent concentrations of two elements thought to be related to tensile strength.

(Table see next page)

Please turn over

Test No.	X_0	X_1	X_2	Test No.	X_0	X_1	X_2
1	184	21	26	11	104	19	14
2	70	8	16	12	140	20	23
3	91	22	16	13	160	22	26
4	120	18	29	14	17	9	18
5	116	20	21	15	110	20	11
6	174	20	27	16	89	16	15
7	104	13	19	17	170	24	18
8	117	15	28	18	74	16	8
9	26	10	17	19	107	16	18
10	110	19	13	20	112	16	23

(a) Compute the multiple correlation coefficient $R_{0.12}$ and test for its significance.

(b) Also compute the partial correlation coefficient $r_{01.2}$ and test for its significance. (20)

GROUP B

4. (a) The following data relate to lives in hours of sample lamps taken from batches of electric lamps. Test whether the batches differ amongst themselves in average length of life.

Batch	Sample size	Life of individual lamps
A	7	1600, 1610, 1650, 1680, 1700, 1720, 1800
B	5	1580, 1640, 1640, 1700, 1750
C	6	1510, 1520, 1530, 1570, 1600, 1680

(9)

(b) The data given below are in respect of yield of wheat, in suitable units per acre, under five different treatments, based on a 5×5 Latin Square fertilizer experiment.

Prepare the Analysis of Variance Table based on the data.

Row	C o l u m n				
	1	2	3	4	5
1	B:57.8	C:40.5	A:33.4	D:53.5	E:41.9
2	D:50.5	E:45.5	C:51.8	B:52.6	A:31.9
3	A:46.1	D:47.9	E:55.6	B:52.6	C:53.3
4	C:58.2	B:55.1	E:43.2	A:38.8	D:53.4
5	E:53.0	A:41.0	D:48.7	C:54.6	E:55.7

(16)

5. EITHER,

(In each case mention the page numbers and names of Tables used)

(a) Select a random sample of 10 units out of 90 units serially numbered (without replacement).

(b) Arrange 12 treatments numbered 1 - 12, in random order.

Please turn over

(c) Fifteen villages with their respective areas in square miles, are listed below. Select 3 villages with probability proportional to area (with replacement).

<u>village no.</u>	<u>area</u>	<u>village no.</u>	<u>area</u>
1	2.12	9	6.93
2	3.75	10	5.10
3	1.62	11	2.75
4	4.83	12	1.07
5	3.25	13	8.93
6	6.22	14	1.76
7	1.17	15	3.52
8	1.82		

(10)

CR

(a) Prepare a layout of randomized block experiment to test the difference in yield of 6 varieties of sugar cane, in 6 blocks.

(b) Prepare a layout of a Latin Square experiment to test the difference in yield of 6 varieties of wheat.

(for both (a) and (b) above, you may assume that a piece of land sloping west to east is available).

(c) Arrange the letters ABCDE, in random order. (10)

GROUP C

6. Investigate by plotting suitable control charts any evidence of lack of control, in the following data :

Averages and Ranges of resistance

(a) <u>Sample No.</u>	<u>n</u>	<u>\bar{x}</u>	<u>R</u>
1	5	151.6	36.6
2	5	145.4	28.2
3	4	160.8	33.6
4	4	152.7	21.3
5	5	136.0	12.9
6	5	147.3	26.1
7	5	161.7	27.6
8	5	151.0	21.5

(10)

(b) Number of holes observed in bitumen coated hessian sheets.

<u>serial number</u>	<u>length of piece (yds)</u>	<u>number of holes</u>
1	25	71
2	30	82
3	20	41
4	25	30
5	25	48
6	25	73
7	30	45
8	25	37
9	30	40
10	25	37

(7)

INDIAN STATISTICAL INSTITUTE
 Computer's Certificate Examination, November 1963
 Paper I (Practical) : Elementary Computation.

Time : 5 hours

Full marks : 100

- (a) Figures in the margin indicate full marks for each question.
 (b) Use of calculating machines is not permitted.

1. (a) Round off the following, retaining accuracy indicated and work out the absolute and relative errors in each case.

- i) 3.0013 correct to three significant digits
 ii) 5.32517 correct to the nearest hundredth. (3)

- (b) Copy out the reciprocals of the following numbers from appropriate tables and find the average of the reciprocals.

60, 61, 62, 63, 64.

To how many decimal places is this average correct and why ? (3)

- (c) How many significant digits are there in the following approximate numbers ?

(i) 0.00207015 ; (ii) 890×10^3

work out the upper limits of the absolute and relative errors in these approximate numbers. Your computational steps should be clearly shown. (6)

- (d) The product of two approximate numbers has been obtained as 301413. The relative error in this product is less than 0.0005. How many significant digits are there in the product ? (3)

2. (a) EITHER

Find the value of $349.1 \div 6.634$ where both are numbers rounded off to the last digit. How many digits in the result are significant and why ? (5)

OR

The logarithm of a number is 3.49852 find the antilog of this number from suitable tables. How many digits in the antilog are trustworthy and why ? (5)

- (b) Find, correct to four decimal places, the value of

$$1 + \frac{(0.5)}{1 \text{ I}} + \frac{(0.5)^2}{2 \text{ I}} + \frac{(0.5)^3}{3 \text{ I}} + \frac{(0.5)^4}{4 \text{ I}} + \dots \quad (4)$$

- (c) Find, correct to three places of decimals, the value of

$$\frac{0.349662}{0.28501 \times 0.608175} \quad (4)$$

Please turn over

- (d) Add the following approximate numbers and mention the number of significant digits in the total.

$$5.1625, 86.43, 191.6 \times 10^{-3}, 4.3 \times 10^2, 0.93402 \times 10^3 \quad (3)$$

3. (a) Find the value of any six of the following by consulting appropriate tables and mention the number of significant digits in them. Give reference to tables used. ✓ (9)

i) $\log_{10} (17.61 \div 4.4612 \times 2.1)$

ii) $\log_{10} (5.49)^{3.1}$

iii) $\log_e 7.1$

iv) $\frac{1}{2}$ correct to five places of decimals

v) coefficient of the fifth term in the expansion of $(x + y)^{11}$

vi) $\sqrt[3]{5.522531} + \sqrt[3]{49.633}$

vii) $(\cos 51^\circ 10')^{\frac{1}{2}}$

viii) $\log \tan 41^\circ 15' 30''$

ix) $\sum_{n=150}^{154} n^3$

- (b) Find the value of any two of the following.

i) $y = 100 \left(1 + \frac{x}{4}\right)^{40} \left(1 - \frac{x}{5}\right)^{50}$ for $x = 2, 3$ (5)

ii) $\frac{[(3.1)^2 + \sqrt{1.41}]^{2.1}}{(2.1)^{2.1}} + 5.7^{7.0} 4.0$ (5)

iii) $\sin^2 \theta - \cos^2 \theta + 0.2 \log \tan \theta$
for $\theta = 11^\circ$ and 15° . (5)

4. TABLE

In the following two-way probability table, find out by linear interpolation, the probability values corresponding to

$$v = 8, \quad m = 2.63$$

$$v = 10, \quad m = 2.88$$

v \ m	2.6	2.7	2.8	2.9
7	.63557	.61127	.58715	.56329
9	.81654	.79814	.77919	.75976
11	.92103	.91026	.89268	.88637
13	.97052	.96530	.95951	.95313

(14)

Please turn over

OR

- (a) Furnished below are the figures of monthly average coal production (raisings) in India, in thousand metric tons.

years	coal raisings (000 metric tons)	years	coal raisings (000 metric tons)
1955	3236	1959	?
1956	?	1960	4384
1957	3683	1961	4675
1958	3838	1962	5004

Obtain by linear interpolation, estimates of the production (raising) figures during the years 1956 and 1959. (8)

- (b) Using the estimates obtained in (a) above, plot the values of coal raisings for all the eight years. Draw a freehand curve. By extending it obtain an estimate for the year 1963. (6)

5. Draw the graph of the trigonometric function $y = \sin x + \cos x$ between the range $x = 0$ and $x = 2\pi$. Read out from the graph the values of x for which y is

(i) minimum (ii) zero (iii) maximum.

(you may choose the 9 intervals -

$$0, \frac{\pi}{4}, \frac{2\pi}{4}, \frac{3\pi}{4}, \frac{4\pi}{4}, \dots, \frac{7\pi}{4}, \frac{8\pi}{4} -$$

as usual remembering that π represents 180° .) (18)

6. EITHER

- (a) Solve graphically the equations

$$6.2x - 3.7y = 11.3$$

$$5.2x + 1.8y = 9.7$$

(9)

- (b) Find the area of the triangle bounded by the y -axis and the two straight lines given by the two equations in (a) above. (9)

OR

- (a) Solve the equation $x^2 - 0.50x - 8.64 = 0$ by plotting the function $y = x^2 - 0.50x - 8.64$. (10)

- (b) From the graph, determine the area of the portion enclosed by the curve and the x -axis. (8)

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INDIAN STATISTICAL INSTITUTES

Computer's Certificate Examination, November 1963

Paper II (Practical) : Compilation and Presentation of Statistics

Time : 5 hours

Full marks : 100

- (a) Figures in the margin indicate full marks for each question.
- (b) Use of calculating machines is not permitted.

1. The official wholesale price index (with the year ended March 1953 as 100) in India rose by 1.2 percent to 129.1 during the week ended June 30, 1962 as against 127.6 for the earlier week. The index was also higher by 1.7 percent and 1.6 percent respectively when compared with that of a month ago and the corresponding week of previous year.

The index for "Food articles" pushed up further by 2 units compared to 125.6 for previous week, 1.8 percent compared with 125.4 for the corresponding week of last month and 4.4 percent more compared to last year. The index for Liquor and Tobacco declined by 0.4 percent to 99.1 compared to previous week and 2.9 percent compared to corresponding week of the previous month. The index for the corresponding last year was 98.6.

The index for "Fuel and Power, Light and Lubricants" group stood at 124.1 as against 124.3 for the earlier week. The corresponding index in last year was 121.5 and the index for the corresponding week of last month was 122.3.

The index for "Industrial raw materials" advanced by 0.4 percent as compared with 136.5 for the previous week. The index for corresponding week of last month was 134.9 and that for last year was 150.7.

The index for "Manufacturing articles" moved up by 1.0 percent to 130.0 against 128.7 for the earlier week.

The index numbers were 127.9 and 125.8 during corresponding weeks of last month and last year respectively.

Present the above data in a neat tabular form with proper headings. (20)

2. A survey was conducted for getting an estimate of the personnel of a country under 2 categories of academic qualifications.
(i) undergraduate (ii) graduate and 2 categories of technical qualifications (i) diploma holders and (ii) graduate engineers by age and community with their employment status.

Draw up a blank tabular form with proper headings and space for sub-totals and totals taking that there were 6 age groups and 3 communities. (10)

3. Mention in which publications the following information would be available. Give also the name of the issuing authority and the periodicity of the publications in each case.

(Answer any five)

- (i) Monthly stock held by mills of salt in India.
(ii) Monthly General Quantum Index number (by sea, air and land) of export (1958 = 100) of India.

Please turn over

- (iii) Trend showing both yearly and monthly in the daily average loading of coal (in wagon) from West Bengal and Bihar coal fields for certain years.
 - (iv) Monthly state wise production of power transformers in India.
 - (v) Monthly fuel consumption such as coal, diesel fuel, other fuel oil, petrol and total in terms of coal in Govt. Railways for any particular month.
 - (vi) Yearly expenditure incurred on bridge constructions on National Highways (Bridges including all bridges major or minor of all dimension).
 - (vii) Different types of Motor Vehicles on roads in India during a particular year.
 - (viii) Number of valid votes polled during any election by state.
 - (ix) Number of Auxiliary-nurse-midwives in different states for particular year.
 - (x) Total number of spinning mills and composite mills in existence in Cotton Mill Industry by states in India for a particular month. (10)
4. Collect the following from this publications supplied to you and present them in a neat tabular form. Mention the sources together with page numbers from where you have compiled the data along with proper notes where necessary. (Answer any two). (10)
- a) Details of Revenue from various excise duties under the following heads :-
 - Total gross revenues on basic items,
 - total net revenues on basic items,
 - total duties on additional items,
 - grand total of union excise duties,
 - state share of excise duties,
 - net receipts,for any 3 consecutive years.
 - b) Index number of Industrial production (1953 = 100) and wholesale price index (1958 = 100) of the following countries for the five consecutive years.
 - (i) India, (ii) United Kingdom and (iii) United States.
 - c) Mileage of entire municipal roads maintained by Public Works Departments in India by states and by types of roads for any particular year.
5. The following table gives the life (in completed hours) of internally frosted incandescent lamps as obtained in life tests.
- (a) Reorganise the data in a frequency distribution using suitable class intervals. (15)
 - (b) Draw the histogram and the ogive based on the frequency distribution. (10)

(for table see next page)

Please turn over

Table 1. Life of 200 incandescent lamps

Ser No.	Life	Ser No.	Life	Ser No.	Life	Ser No.	Life	Ser No.	Life
1	1067	41	923	81	901	121	841	161	1023
2	919	42	1333	82	1324	122	814	162	984
3	1196	43	811	83	818	123	1103	163	856
4	785	44	1217	84	1250	124	1000	164	924
5	1126	45	1085	85	1203	125	708	165	801
6	936	46	896	86	1078	126	1143	166	1122
7	918	47	958	87	890	127	935	167	1292
8	1156	48	1311	88	1303	128	1069	168	1116
9	920	49	1037	89	1011	129	1170	169	880
10	948	50	702	90	1102	130	1067	170	1173
11	855	51	521	91	996	131	1037	171	1134
12	1092	52	933	92	780	132	1151	172	932
13	1162	53	920	93	900	133	863	173	938
14	1170	54	1153	94	1106	134	990	174	1078
15	929	55	946	95	704	135	1035	175	1180
16	950	56	858	96	621	136	1112	176	1106
17	905	57	1071	97	854	137	931	177	1184
18	972	58	1069	98	1178	138	970	178	954
19	1035	59	830	99	1138	139	932	179	824
20	1045	60	1063	100	951	140	904	180	529
21	1157	61	930	101	1187	141	1026	181	998
22	1195	62	807	102	1067	142	1147	182	996
23	1195	63	954	103	1118	143	883	183	1133
24	1340	64	1063	104	1037	144	867	184	765
25	1122	65	1002	105	958	145	990	185	775
26	938	66	909	106	760	146	1258	186	1105
27	970	67	1077	107	1101	147	1192	187	1081
28	1237	68	1021	108	949	148	922	188	1171
29	956	69	1062	109	932	149	1150	189	705
30	1102	70	1157	110	956	150	1091	190	1425
31	1022	71	999	111	824	151	1039	191	610
32	978	72	932	112	653	152	1083	192	916
33	832	73	1035	113	930	153	1040	193	1001
34	1009	74	944	114	935	154	1289	194	895
35	1157	75	1049	115	878	155	699	195	709
36	1151	76	940	116	934	156	1083	196	860
37	1009	77	1122	117	910	157	880	197	1110
38	765	78	1115	118	1058	158	1029	198	1149
39	958	79	833	119	730	159	658	199	972
40	902	80	1320	120	980	160	912	200	1002

6. The following data give the age-distribution for male and female populations in India, in 1951. Represent the data graphically by drawing a suitable pyramid bar chart.

(13)

Please turn over

Age Table, India
(1951 Census)

Age group	Population (in lakhs)	
	Male	Female
0 - 4	239	237
5 - 9	231	223
10 - 14	209	196
15 - 19	185	174
20 - 24	163	158
25 - 29	148	142
30 - 34	134	124
35 - 39	118	106
40 - 44	101	89
45 - 49	85	75
50 - 54	68	61
55 - 59	52	48
60 - 64	37	37
65 - 69	24	25
70 & above	38	40

7. The following table gives the paid-up Capital of joint stock companies at work, in four consecutive years, classified according to the nature of industries.

(Figures in Rs. lakhs)

Year	Agriculture and Allied industries	Mining & quarrying	Processing and manufacture	Construction and utilities	Commerce (Trade & Finance)	Transport & Communication & Storage
1954-55	3950	3728	53292	1416	24722	4471
1955-56	4152	3800	54762	5348	25934	3880
1956-57	4233	3902	60437	5500	26695	4921
1957-58	4411	5710	91915	5682	26471	4242

Year	Community and business service	Personal and other service	Grand total
1954-55	127	1252	9,29,58
1955-56	682	1399	9,99,57
1956-57	627	1442	10,77,57
1957-58	741	1457	13,06,29

Give a suitable graphic presentation of the data.

(12)

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INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - November 1963

Paper III (Practical): Selected Techniques of Computation

Time: 5 hours.

Full marks: 100

- (a) Figures in the margin indicate full marks for each question.
 (b) Use of calculating machines is permitted.

- 1.(a) Tabulate the values of

$$R(t) = \frac{1}{t + \frac{1}{t + \frac{1}{t + 3}}}$$

for values of t from 0.0 to 0.5 at intervals of 0.1.

[1]

- (b) BITNER

Evaluate using four-point interpolation coefficients the values of $\alpha(x)$ corresponding to (i) $x = 0.81$ and (ii) $x = 0.85$, on the basis of the following values.

x	$\alpha(x)$
0.76	1.01390
0.78	1.01542
0.80	1.01767
0.82	1.01884
0.84	1.02075
0.86	1.02279
0.88	1.02499
0.90	1.02734

[20]

OR

By using Newton's formulae, find out the values of $f(x)$ corresponding to (i) $x = 4.03$ (ii) $x = 4.44$, from the following values.

x	$f(x)$
4.0	0.031671
4.1	0.020650
4.2	0.013346
4.3	0.005399
4.4	0.054125
4.5	0.033977

[20]

- 2.

BITNER

Find by quadrature,

$$F(\alpha) = \int_0^2 x^5 (1-x)^7 dx$$

and hence tabulate, correct to four decimal places,

$$T = \sqrt{\frac{(n-1)F(\alpha)}{(1-k)+(k-1)F(\alpha)}}$$

for all the six combinations of n and k values corresponding to $n = 15, 20$ and $k = 2, 3, 4$.

Please Turn Over

OR

On the basis of the data given below, plot the values of $f(x)$ against corresponding values of x , using the same scale for both the axes. Draw a free-hand curve to represent the graph of $f(x)$.

Find out from the chart the area enclosed between the curve and the straight line $y = x$

Expenditure group	Cumulative percentage of persons (x)	Cumulative percentage of monthly expenditure f(x)	Expenditure group	Cumulative percentage of persons (x)	Cumulative percentage of monthly expenditure f(x)
1	15.5	2.2	7	79.6	46.0
2	32.7	6.4	8	84.3	62.1
3	44.1	10.2	9	89.6	73.5
4	54.3	16.3	10	94.2	82.7
5	65.1	22.1	11	97.3	91.3
6	74.7	33.7	12	100.0	100.0

[20]

3. Solve the following equation graphically correct to one place of decimal

$$x^2 + \sin x = 0.$$

[10]

4. Find by numerical method one of the roots of

$$0.6x^3 + x - 8 = 0$$

[10]

5. Solve for x, y, z and u in the equations

$$\begin{aligned} x - y - z + u &= -6 \\ 2x + y + z &= 0 \\ 3x - 5y + 0z &= 13 \\ x + y - z + u &= 15 \end{aligned}$$

[12]

- 6.(a) Find the minor and cofactor of the element in the third row and third column of the determinant

$$\begin{vmatrix} 1.0 & 0.1 & 0.6 \\ 0.1 & 1.0 & 0.8 \\ 0.6 & 0.8 & 1.0 \end{vmatrix}$$

[3]

- (b) Evaluate the following determinant

$$\begin{vmatrix} 1.0000 & 0.6032 & 0.3240 & 0.4060 \\ 0.6032 & 1.0000 & -0.3532 & 0.3640 \\ 0.3240 & -0.3532 & 1.0000 & 0.1136 \\ 0.4060 & 0.3640 & 0.1136 & 1.0000 \end{vmatrix}$$

[15]

0-0000

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INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination, November 1963

Paper IV (Practical) : Descriptive Statistics

Time : 5 hours

Full marks : 100

- (a) Those who have passed (according to the old rules) in Part 1B, Section I only (and not in Section II of Part 1B or in Section I of Part 1C) should answer questions in Group B only in 5 hours. In this case mention the time of handing over the answer-script, on cover page. All other should answer the full paper.
- (b) Figures in the margin indicate full marks for each question.
- (c) Use of calculating machines is permitted.

GROUP A1. EITHER

Distribution of salaries of 2334 senior employees are given below :

Monthly salary classes (Rs.)	frequency	Monthly salary classes (Rs.)	frequency
720 - 840	2	1320 - 1440	437
840 - 900	5	1440 - 1560	63
900 - 1000	18	1560 - 1800	74
1000 - 1100	123	1800 - 2000	30
1100 - 1200	369	2000 - 2500	5
1200 - 1320	1208		

- (a) Calculate the median salary and also the first and third quartiles. Hence calculate a measure of skewness. (5+8+2)
- (b) Evaluate also the modal salary for the distribution. (5)

OR

Calculate the mean and standard deviation of the following distribution applying Sheppard's Correction for the second moment. (8+12)

wt. in lbs (class marks)	frequency	wt. in lbs (class marks)	frequency
95.5	15	165.5	76
105.5	34	175.5	28
115.5	139	185.5	16
125.5	300	195.5	3
135.5	357	205.5	4
145.5	319	215.5	3
155.5	205	225.5	1

Please turn over

2. Construct for the year 1959, a general index number of prices of Tea (Auction sale prices modified to the nearest pence) with the year 1954 as base, based on the data given below. (10)

Tea variety	Auction prices of tea				Quantities sold	
	1954		1959		(00000 lbs)	
	Sh.	d.	Sh.	d.	1954	1959
A	5	4	4	10	1646	1839
B	5	2	3	8	245	338
C	5	4	3	3	99	66
D	5	4	5	1	702	853
E	4	11	3	0	10	4
F	4	8	3	2	153	429
G	5	2	4	7	6	13

3. The following table gives data obtained from a study of 60 wheat farms, in 1923.

x = cost per bushel (Mid points of the class intervals)	y = yield per acre in bushels (Mid points of the class intervals)												
	8	10	12	14	16	18	20	22	24	26	28	30	
1.60		1	2										
1.40		1	3	1									
1.20			4	1									
1.00		1	1	4	2	1	-	1					
0.80			1	1	3	3	2	-	1	-	1		
0.60				1	1	2	2	1	3	2	1	2	
0.40							1	1	1	2	1	1	2

- i) Calculate the correlation coefficient r_{yx} . (10)
- ii) Calculate the correlation ratio η_{yx} . (5)
- iii) Write down the equation for linear regression of y on x. (5)

GROUP B

4. Average monthly earnings (in Rupees) of rickshaw pullers of a town are recorded in the following table over a period of 6 years. Calculate the indices of seasonal variations by the methods of moving average or link relatives. (15)

Please turn over

Month	Year					
	1951	1952	1953	1954	1955	1956
January	75	60	70	72	80	78
February	80	70	75	70	65	70
March	80	86	84	88	90	92
April	90	85	96	90	90	85
May	88	86	90	78	87	80
June	90	100	98	90	88	85
July	110	108	120	112	110	105
August	108	105	118	110	112	110
September	95	98	102	100	98	95
October	100	96	100	102	96	94
November	90	92	96	100	102	98
December	85	75	70	86	85	80

5. Mean & standard deviation of (i) Wheat production (x_1) in million of bushels; (ii) area cultivated (x_2) in million acres and (iii) yield (x_3) in bushel per acre of a country with zero order correlation coefficient between (x_1) and (x_2); (x_1) and (x_3) and (x_2) and (x_3); are given below.

	Mean	Standard deviation
i) x_1	742.71	124.68
ii) x_2	52.49	7.36
iii) x_3	14.13	1.40

$$r_{12} = 0.782; \quad r_{13} = 0.587 \quad \text{and} \quad r_{23} = 0.016.$$

- (a) (i) Calculate the partial correlation coefficient $r_{12.3}$ and $r_{23.1}$ (1)
 (ii) and Multiple Correlation Coefficient $R_{3.12}$ (2)
- (b) Obtain linear regression equation of yield on production and area cultivated. Hence find out the yield for a year in which wheat production is 850 million bushels, and area cultivated was 60 million acres. (1)
- (c) The multiple correlation coefficient $R_{2.13}$ between 3 characters is calculated as 0.4231 and $r_{12} = 0.3485$; find $r_{23.1}$. (1)

Please turn over

6. EITHER

Fit a third degree polynomial to the following data.

x	y
0	13.96
1	16.40
2	18.25
3	21.60
4	23.50
5	27.40
6	28.30
7	30.26
8	24.25
9	25.30
10	29.68

(15)

ORTwo measurements on human body p and q are known to be related in the form

$$q = a + bp + c \log_{10} p$$

Fit the curve by the method of least squares by making use of the summary data supplied below.

$$N = 20, \quad \sum p = 210; \quad \sum p^2 = 2870;$$

$$\sum q = 268; \quad \sum q^2 = 3788; \quad \sum pq = 3148$$

$$\sum q \log_{10} p = 267.7713$$

$$\sum \log_{10} p = 18.3861; \quad \sum p \log_{10} p = 230.0033$$

$$\sum (\log_{10} p)^2 = 19.2695$$

Find the value of q when $p = 15$.

(15)

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INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - November 1963

Paper V (Practical): Elementary Statistical Methods.

Time: 5 hours

Full marks: 100

- (a) Those who have passed (according to old rules) in Part 1B, Section II only (and not in Section I of Part 1B or in Section I of Part 1C) should answer questions of Group B and C only in 3 hours.
- (b) Those who have passed (according to old rules) in Part 1B, Section I only (but not in Section I of Part 1B or in Section II of Part 1B) should answer questions of Group A and C only in 3 hours.
- (c) All other should answer the full paper.
- (d) Figures in the margin indicate full marks for each question.
- (e) Use of calculating machines is permitted.

GROUP A

1. Compute, correct to five places of decimal, the individual terms of the Binomial Distribution for $n=0$ and $p = 0.273$. [15]

2. The mean and the central moments of stature were computed as follows from measurements on 100 individuals

$$\begin{aligned} \text{Mean} &= 67.693 \text{ (in.)} \\ \mu_2 &= 7.316 \text{ (in.)}^2 \\ \mu_3 &= -2.300 \text{ (in.)}^3 \\ \mu_4 &= 155.663 \end{aligned}$$

It has been subsequently discovered that during these computations, a measurement of 67 ins., was wrongly read as 76 ins.

Compute corrected values of all these four statistics. [10]

3. A group of ten animals are weighed after regular treatment over a period with a preparation which is reputed to promote growth. These weights, together with those of a control group who have had the same diet except that they have not been given the preparation are shown below

Treated group	73 67 75 69 88 72 74 63 81 79
Untreated group	65 69 74 71 77 60 72 56 79 70

Test for the difference in average weight. Do these results indicate that the preparation has any significant effect on the mean weight of animals? [12]

4. At intervals over a certain period, inspectors examine the characteristics of a 'Zipper' slide. If the result of examination is unsatisfactory, the press producing the slide is shut down. The following data give the number of 'inspections' and 'shut-downs' of the ten presses of an establishment.

Apply a suitable test to find out if the different presses can be considered as homogeneous in respect of the relative frequency of 'shut-downs'?

Press No.	Number of		Press No.	number of	
	inspections	shut-downs		inspections	shut-downs
1	100	7	5	102	5
2	105	11	7	99	7
3	97	6	8	90	10
4	105	8	9	100	8
5	102	6	10	100	12

[13]

GROUP B

5. (a) An experiment (completely randomized) was conducted with 9 plots and 3 manurial treatments M_1 , M_2 and M_3 . The results are given below.

Analyse the data and find out the best treatment if any.

Treatment	Yield (in suitable units)		
M_1	19.1	15.1	16.7
M_2	34.5	31.1	35.4
M_3	31.2	22.3	34.5

[10]

- b) A randomized block experiment was carried out with 4 blocks and 5 varieties of rice. The following table shows the layout and the yields of rice in suitable units per acre.

Prepare the Analysis of Variance Table based on the data. [15]

Block I	(5)	(3)	(4)	(1)	(2)
	31	23	30	15	28
Block II	(4)	(5)	(3)	(1)	(2)
	26	30	22	10	25
Block III	(5)	(1)	(3)	(4)	(2)
	26	16	24	21	25
Block IV	(3)	(2)	(1)	(4)	(5)
	19	22	20	25	31

6. Problem

Using random number tables, and giving details of the method adopted and reference to pages of the tables used:

- i) Draw a random sample of size 15 without replacement from a population, the units of which are serially numbered from 1 to 311. [3]
- ii) Draw a random sample of size 15 with replacement from a population, the units of which are serially numbered from 1 to 195. [3]
- iii) Arrange the numbers 1 to 15 in random order. [2]
- iv) Give a random permutation of the letters P, Q, R, S, T, U. [2]

OR

- i) Using a randomising procedure, construct two separate Latin Squares of size 6×6 , from Fisher and Yates' Tables. [6]
 - ii) Arrange in 5 blocks 5 treatments M_1, M_2, M_3, M_4, M_5 , so as to form the lay-out of a randomized block experiment. [4]
- (Explain clearly the procedure adopted.)

GROUP C

7. i) Set up a suitable control chart and examine for statistical control the following data relating to the number of defective settings per day in a factory.

Date	No. of items produced	No. of defectives	Date	No. of items produced	No. of defectives
13	395	12	19	402	13
14	412	20	20	401	12
16	306	11	21	309	17
17	330	15	23	397	19
18	415	25			

[7]

- ii) 11 samples of size 5, taken from a production process give rise to the following mean values. It is known that the Range is already in control and that the value of mean Range(\bar{R}), for sample size 5 is 2.7 cms. Examine the data for statistical control.

Sample No.	Mean value (cms.)
1	23.2
2	19.6
3	19.3
4	19.7
5	21.6
6	26.0
7	16.5
8	23.1
9	22.2
10	19.9
11	19.6