

INDIAN STATISTICAL INSTITUTE
 Computer's Certificate Examination - May 1964
 Paper I (Practical) : Elementary Computation.

Time : 5 hours

Full marks : 100

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

1. (a) Round off the following approximate numbers correct to three places of decimals and indicate the number of significant figures in each of the rounded off numbers. (3)

(i) 400.311605 (ii) 4.00311605 (iii) .009500
 (iv) 0.68904 (v) .02325 (vi) 75.0319

- (b) Answer any two of the following : (10)

- (1) the following numbers are correct to the last significant digit only. Find their sum and determine its 'absolute' and 'percentage' errors.

23.684, 821.74 143,
 20.7, 361.415, 61.913.

- (ii) find the difference between $\sqrt{3.3}$ and $\sqrt{3.1}$ correct to three significant figures, and determine the relative error of the result.

- (iii) find the sum of the following numbers, each being correct only to the number of significant figures given. State the number of significant figures to which the result is correct.

7650, 0.0467 $\times 10^5$, 869.97 $\times 10^2$
 9.436 $\times 10^3$, 1.344 $\times 10$, 59.2 $\times 10^2$.

- (c) Find the product of the two following approximate numbers 48.6732 \times 701.32 and round off the result to the appropriate number of significant figures. (5)

2. Adopting short-cut methods, evaluate :

- (a) the products of :
 (i) 66357 \times 999 (ii) 3456 \times 546 (4)

- (b) quotient and remainder for
 (i) 78254 \div 25 (ii) 82361 \div 99 (4)

- (c)
$$\frac{2.53 \times 2.53 \times 2.53 - 2.38 \times 2.38 \times 2.38}{2.38 \times 2.53 + 2.38 \times 2.38 + 2.53 \times 2.53}$$
 (3)

Note : $\sqrt{\text{no credit will be given for working through routine process. All steps should be clearly indicated.}}$

Please turn over

3. (a) Using Chambers's Seven Figure Mathematical tables, write down the common logarithms of the numbers :

(i) 381.971 (ii) 0.0002539 (iii) 1.30608
 (iv) 0.1236921 (v) .00004 (vi) 301.6.17

- (b) Evaluate the following :

(i) $(x - 1.5)(x - 2.5)(x - 3.5)(x - 4.5)$
 when $x = 56.7$

(ii) $a^{p-1} a^{-p}$
 when $a = 2.5$ and $p = 1.5$ and 3.4

(iii) $\frac{(56.783)^4 - (37.685)^4}{(56.783)^3 + (37.685)^3}$

4. (a) From the following table of $f(x, p)$, find by simple linear interpolation, the value of $f(x, p)$ corresponding to :

$p = 40$ and $x = .62$

x	$p = 39$	$p = 41$	$p = 42$	$p = 44$
.61	.2534	.1947	.1652	.1758
.63	.3640	.2945	.2629	.2063
.64	.4254	.3526	.3107	.2565
.66	.5538	.4799	.4439	.3747

- (b)
- | year | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| workman compensation amount paid (000 Rs.) | 4,220 | 5,217 | 5,707 | 5,893 | 5,653 | 6,138 | 6,425 | 5,957 | 5,117 |

taking use of all the 9 yearly values given already, draw freehand smooth curve and estimate the value for the year 1957. (1)

5. Solve graphically, the equation $2 \sin^2 x = \cos 2x$ giving only these values which satisfy the equation and lie within the range $-\frac{\pi}{2}$ and $\frac{\pi}{2}$. (1)
6. Plot the graphs of $y = x$ and $y = x^3$ in appropriate scales and compute from the same, the approximate area enclosed by the line graph and the loops of the curve. (1)

Time : 5 hours

Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is not permitted.

1. From an analysis of statistical data collected on the basis of a sample survey on manufacturing industries in Bombay and West Bengal in 1959, the following estimates were available.
- (a) Total number of employees in Bombay was 9,167 while the combined estimate for this two States was found to be 6,761 more than that in Bombay.
- (b) Total salaries and wages in the two States taken together was Rs. 23,54,205 while it was Rs. 13,85,542 in Bombay.
- (c) Value of raw materials was not available separately for either of the States but their combined figure was Rs. 94,43,216.
- (d) Value of fuels and lubricants was available only for Bombay and it was Rs. 3,54,526.
- (e) Total value of work done by other concerns for the two states taken together was Rs. 1,49,336 while for West Bengal, it was Rs. 29,280.
- (f) Value of total input being the sum of items (c), (d) and (e) was available as Rs. 75,79,908 for Bombay only.
- (g) Value of products and bye-products for Bombay and West Bengal together were Rs. 1,50,99,490.
- (h) Value of work done for other concerns was available for West Bengal only and it was Rs. 47,791.
- (i) Total output being the sum of items (g) and (h) was found to be Rs. 62,46,272 for West Bengal only.
- (j) Value added for Bombay and West Bengal were found to be Rs. 20,40,315 and Rs. 22,97,772 respectively. It was calculated by subtracting the value of input from the value of output."

Present the data in a neat tabular form with sub-totals and totals whenever necessary, giving proper headings and supplying all the missing figures. (20)

2. Estimates were available with regard to the employment position in the rural and urban parts of ten districts of a State. Number of persons employed and number of persons unemployed were calculated separately for the rural and urban parts, and for each category of the age groups - below 14 years and above 14 years. Under each category of age groups, number of employed and unemployed persons were again available for males and females separately.

Prepare a neat proforma with suitable heading to accommodate the above information, keeping provision for sub-totals and totals whenever necessary (please note that information for rural and urban parts combined is not necessary for the proforma). (10)

Please turn over

3. Mention (for any five of the following,) publications in which the following information would be available. Give also (a) the name of the issuing authority and (b) their periodicity of the publications in each case.
- i) Quarterly price quotations (F.O.R.) of Asbestos (Grades A, B & C) for any important market in India.
 - ii) Monthly productions of Commercial Plywood in different States of India.
 - iii) Monthly rates of live-births and death rates per thousand population in India.
 - iv) Number of persons in custody pending investigation or on bail during the stage of investigation, for the charge of "Cattle theft" in different States in India for a particular year.
 - v) Number of Coal mines under the scope of the Mines Act in different States of India for a particular year.
 - vi) Monthly number and amount of inland money orders issued in India.
 - vii) Monthly receipt, expenditure and public debt of Central Govt.
 - viii) Industry-wise distribution of Coal and Coke, from various Coal fields by rail during a month.
 - ix) Monthly Index number of wholesale prices of cereals in Calcutta (with base 1950 = 100). (1)
4. Collect the following statistical information from the publications supplied to you and present them in a neat tabular form with suitable headings. Ment on the sources together with page numbers from where you have compiled the data along with proper notes wherever necessary.
- i) The number of school teachers by sex, trained or untrained and by type of institution (primary and secondary) for a particular year.
 - ii) Total cropped area, area under Rice, Jowar, Bajra, Maize, Barley and Wheat for the following States Andhra Pradesh, Madhya Pradesh, Punjab and Uttar Pradesh for any particular agricultural year. (1)
5. The following measurements were taken on 60 Brahmins of the Basti District during the 1941 Anthropometric Survey of U.P.
- a) Prepare the two-way distribution using suitable class-intervals for sitting height and stature.
 - b) Draw the frequency polygon for the marginal distribution of stature as obtained from (a).

Please turn over

c) Plot the scatter diagram showing the interrelationship between the two measurements. (Consider the first 20 individuals only).

Table : Stature and Sitting height of 60 Brahmins

sr. no. of individual	stature (cm)	sitting height (cm)	sr. no. of individual	stature (cm)	sitting height (cm)
(1)	(2)	(3)	(1)	(2)	(3)
1	1564	870	31	1620	856
2	1710	917	32	1622	838
3	1639	842	33	1674	881
4	1602	846	34	1652	849
5	1668	847	35	1620	843
6	1717	861	36	1639	845
7	1642	872	37	1689	869
8	1675	869	38	1610	878
9	1642	858	39	1675	842
10	1679	878	40	1604	853
11	1598	813	41	1717	895
12	1672	933	42	1584	845
13	1655	845	43	1713	873
14	1703	901	44	1670	899
15	1605	851	45	1542	804
16	1575	857	46	1589	805
17	1625	849	47	1597	849
18	1637	855	48	1650	815
19	1695	896	49	1667	879
20	1670	866	50	1645	841
21	1716	887	51	1699	870
22	1525	831	52	1578	841
23	1609	849	53	1599	822
24	1576	837	54	1667	878
25	1631	845	55	1690	913
26	1630	841	56	1622	848
27	1456	807	57	1694	905
28	1617	864	58	1700	899
29	1565	818	59	1666	871
30	1618	850	60	1605	833

(15+7+8)

6. The following table shows the value of exports from India to different regions of the world. Represent the data diagrammatically.

(lakhs of rupees)

year	r e g i o n							Total
	western hemisphere	western Europe	eastern Europe	middle east	other Africa	Asia exclu ding USSR	Oceania	
1958-59	12037	21935	3426	4484	2236	10120	2659	56897
1962-63	16021	23597	9323	5375	2575	9811	2667	69369

(10)

Please turn over

3. The table below shows spot prices of silver in Bombay during October 1962 - September 1963. Prepare a graph showing price changes over time as well as the variations within the same month.

month	spot prices (in Rs.) per kg. of silver		
	highest	lowest	Average of closing quotations on working days
(1)	(2)	(3)	(4)
October 1962	224.45	217.40	221.45
November 1962	224.55	187.80	208.03
December 1962	213.50	194.10	204.56
January 1963	232.00	210.85	220.09
February 1963	240.50	225.00	231.70
March 1963	242.00	235.00	239.31
April 1963	239.00	232.50	236.35
May 1963	236.00	224.00	231.42
June 1963	228.00	222.50	225.42
July 1963	235.50	224.00	229.41
August 1963	233.00	228.50	231.70
September 1963	237.50	232.25	235.14

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Time: 5 hrs.

Full marks 100

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

1. Calculate the value of R correct to three decimal places, where

$$R = 1 + t + t^2 + t^3 + t^4 + t^5 + t^6$$

for $t = 1.1, 1.2$ and 1.3 .

[9]

2. Find by interpolation the value of y corresponding to $x = 3.2$ and 4.7 from the values given below.

[13]

x	:	2	3	4	5	6
y	:	8.1	8.8	9.6	9.9	10.4

3. By using a suitable interpolation formula find out as accurately as possible the value of y for $x = 21.3$, based on the following table of values.

x	y
20	15.64
22	14.89
25	14.14
29	12.63

[14]

4. Find by Simpson's $1/3$ rule the value of

$$\int_{2.0}^{2.4} \left(x^3 + \frac{1}{x} + 8\right) dx$$

[14]

- 5.(a) By tabulating the function $f(x) = 315x^3 - 525x^2 + 231x - 17$ against suitable values of x ascertain that the equation $f(x) = 0$ has three real and distinct roots in the interval $(0, 1)$ and obtain the first approximations (to one place of decimal in each case) of the three roots.

[8]

- (b) By the method of finer and finer tabulation, using linear interpolation at each stage to locate the root, obtain the largest roots correct to four significant digits.

[12]

6. Solve for x, y, u and v the simultaneous linear equations.

$$3x + 4y + u - v = 6$$

$$5x - 7y + 17u + 3v = 35$$

$$8x - 3y + 16u + 4v = 41$$

$$2x - 11y + 18u + 2v = 29$$

[15]

7. Evaluate the cofactor and minor of the element in the 2nd row and 3rd column of the following determinant:-

53085	305199	4013	111237
305199	1058341	1821	675055
111237	675055	11065	248171
1821	11065	66	4013

[15]

INDIAN STATISTICAL INSTITUTE (8)
 Computer's Certificate Examination, May 1964
 Paper IV (Practical) : Descriptive Statistics

Time 5 hrs.

Full Marks: 100

- (a) Those who have already passed according to old rules in Part IB, Section I only will not be required to answer Group A; but will answer the questions in Group B only, in time not exceeding 3 hours.
- (b) Figures in the margin indicate full marks.
- (c) Use of calculating machines is permitted.

Group A

- 1.(a) From the frequency distribution given below calculate the mean deviations as measured:
- (i) from the median (ii) from the mean [6+]
- (b) Calculate also the standard deviation of the distribution. [3]
- (c) Arrange the 3 calculated deviation measures, in ascending order of magnitude and obtain the appropriate measures of relative dispersion. [3]

age-groups (mid pts. of classes)	frequency	age-groups (cont'd.) (mid pts. of classes)	frequency
27.5	1	57.5	126
32.5	2	62.5	163
37.5	4	67.5	35
42.5	10	72.5	6
47.5	21	77.5	1
52.5	53	<u>Total</u>	<u>422</u>

2. You are furnished with the following details about price relatives and values of Textile fibres.

Textile groups →	Cotton	Wool	Rayon	Silk
$\frac{p_{54}}{p_{53}} \times 100$	103.55	98.67	96.87	92.92
$\frac{p_{55}}{p_{53}} \times 100$	103.26	82.19	97.15	86.76
$\frac{p_{56}}{p_{53}} \times 100$	102.96	79.29	91.17	84.72
Values-dollars	1,520.1	871.1	429.3	26.6

($p_{53} \times q_{53}$) (where p and q with their subscripts have their usual meanings)

Construct an index number of general textile prices for the years 1954 onwards, with the year 1953 as base, preferably after making such adjustments in the weights, as would enable one to judge the contribution of the various components to the over all index, each year. [5]

Please Turn Over

i) Marks awarded to 10 pupils on the basis of two tests A and B are given below:

Test marks (A): 10, 9 8 8 7 6 6 6 5 5

Test marks (B): 8 10 8 9 6 7 6 4 5 7

Obtain the ranks of the students after arranging the results suitably and evaluate the coefficient of correlation between the ranks. [10]

ii) For the calculation of correlation coefficient from 25 pairs of observations of x and y the following values were obtained

$$n = 25, \sum x = 125, \sum x^2 = 650, \sum y = 100, \sum y^2 = 460, \sum xy = 555$$

Subsequent scrutiny of the calculations however showed that two pairs of values had been incorrectly entered.

Taken as		should be	
\bar{x}	\bar{y}	\bar{x}	\bar{y}
6	14	8	12
8	6	6	8

Obtain the correct value of the correlation coefficient. [10]

Group B

The sum of squares and products of three characters x_1 , x_2 and x_3 taken on 60 units, are summarised as:

$$N = 60; \sum x_1 = 207; \sum x_2 = 470; \sum x_3 = 4705,$$

$$\sum x_1^2 = 1127; \sum x_2^2 = 5120; \sum x_3^2 = 412039$$

$$\sum x_1 x_2 = 2618; \sum x_1 x_3 = 18325; \sum x_2 x_3 = 39811$$

i) Obtain linear regression equation of x_1 on x_2 and x_3 . Find out from the equation the value of x_1 when $x_2 = 6.5$ and $x_3 = 50.8$. [14]

ii) Calculate multiple correlation coefficient $R_{1.23}$ [6]

Fit a curve of the form $y = a + bt^b$ to the data given below by the method of least squares. [15]

t	1	2	3	4	5	6
y	70	180	270	350	1380	1648

Using the data given below calculate indices of seasonal variation of revenue receipts by the method of moving averages or link relatives. [15]

Revenue receipts in million dollars

Year	Jan.-March	April-June	July-Sept.	Oct.-Deco.
1955	810	759	1030	935
1956	1226	1087	1391	1200
1957	1363	966	1101	1146
1958	1010	922	1113	970
1959	1079	860	1174	1097

Time: 5 hrs.

Full marks: 100

- a) Those who have already passed according to the old rules in Part IB Section II or in Part IC Section I will be exempted from answering Group A or B respectively. They should however answer questions from the other two groups (i.e. from B and C or from A and C as the case may be) in time not exceeding 3 hours.
- b) Figures in the margin indicate full marks.
- c) Use of calculating machines is permitted.

Group A

1. The following table presents a distribution of weights (measured to the nearest pound) for a sample of 300 Army recruits of a county. Average weight and standard deviation of the distribution are known to be 184.3 and 14.54 lbs., respectively.

Fit a normal curve to the data and test the goodness of fit.

<u>weights (in pounds)</u>	<u>frequency</u>
150 - 158	9
159 - 167	24
168 - 176	51
177 - 185	66
186 - 194	72
195 - 203	48
204 - 212	21
213 - 221	6
222 - 230	3

2. An educationist claims that the average weight of school-students in Calcutta is at the most 110 lbs., and that in a study made to test this claim, 150 school students selected at random, had an average weight of 111.2 lbs., with a standard deviation of 7.2 lbs.

State, giving reasons whether the result of the study supports the claim of the educationist?

3. A marketing study conducted in Bombay showed that in a random sample of 200 housewives, 138 preferred beverage A to beverage B. In a similar study in Calcutta, 162 out of 200 housewives preferred beverage A to beverage B. Test this significance of difference between the two proportions of preferences.
4. Data on rice yield (x_1), temperature (x_2) and rainfall (x_3) were collected over a period of 20 years of a country. If x_1 is the dependent variable and x_2 and x_3 are the independent variables, test the significance of partial regression co-efficients involved when the following statistics are given

$$b_{12.3} = 19.60 \quad \sum x_1^2 = 33850.20$$

$$b_{13.2} = 0.18 \quad \sum x_1^2 x_2^2 = 464.71$$

$$\sum x_1^2 x_3^2 = 23396.10$$

where x_1^2 , x_2^2 , x_3^2 stand for the deviation of the variates x_1 , x_2 , x_3 from their respective means.

5. Using random number tables:
- draw a simple systematic sample of size 7 from a population containing 40 units. [4]
 - draw a random sample size 2 from a Normal population with mean = 5, and standard deviation = 10. [5]
- [give details of the method used and reference to pages of the tables consulted].
- arrange 5 treatments A, B, C, D and E in 3 blocks so as to form the lay-out of a randomized block experiment. [6]
6. The following table shows the results of a completely randomized nutrition experiment conducted on twelve mice with three rations A, B and C. Analyse the data and find out the best treatment, if any. [10]

gains in weight (oz)

A	3.7	5.1	4.4	6.8
B	14.0	15.5	15.0	17.5
C	8.3	9.4	10.6	7.7

7. A Latin-square experiment was carried out with 4 varieties A, B, C and D of wheat. The following table shows the lay-out and the yields in suitable units per plot.

Prepare the analysis of variance table, based on the data:

B	D	A	C
15	3	22	7
C	A	B	D
8	13	26	4
D	B	C	A
4	20	10	11
A	C	D	B
12	7	5	17

[15]

Group C

Samples of size 5 each were taken from ten shipments of a product to check the existence of assignable causes of variation in a certain quality characteristic. The inspection results are being given below. Examine the results for control.

shipment	average	range
1	56.0	4.4
2	54.6	4.0
3	52.6	3.4
4	55.0	3.6
5	53.4	3.1
6	55.2	4.3
7	53.3	4.2
8	52.3	4.3
9	53.7	2.8
10	53.9	3.9
11	50.1	4.0
12	53.3	3.8
13	55.7	4.2
14	54.2	4.3
15	51.9	3.9

[value of λ_2 to be supplied. Also D_3 and D_4].

(12)

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - November 1964

Paper I (Practical) : Elementary Computation

Time : 5 hours

Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is not permitted.

1. (a) Round off the following approximate numbers to five significant figures and find their sum. Determine the absolute and percentage errors of the sum. (4)

95.00136,	0.00708761,	2.171312
0.191973,	312.015,	0.0237173

- (b) i) A beam and a pin were found to measure 10.6 feet and 0.63 inches respectively, the measurements being correct to the last significant digit. Determine the maximum possible percentage errors of the readings and state which of them is more accurate.

ii) Evaluate

$$\frac{61.276 \times 3.159}{11.4032}$$

where all the factors are approximate and correct only to the last significant figure. Mention, to how many significant figures the result is correct.

- iii) Below are given some approximate numbers and their relative errors. Determine to how many significant figures the given numbers are reliable.

	<u>number</u>	<u>relative error</u>	
1)	0.4405	.0009279	
2)	1.4131	.0000227	(3+4+4)

2. (a) Find the products in three steps of multiplication. (4)

i) 3749×216636

ii) 7354×42428

The steps should indicate the process.

- (b) Adopting short-cut methods determine quotient and remainder for the following: (4)

i) $425579 \div 144$

ii) $163577 \div 25$

No credit will be given for adopting routine processes.

- (c) Evaluate by easy methods: (4)

i) $8^4 \times 7^4$

ii) $13^5 + 7^3$

No credit will be given for routine processes.

Please turn over

(a) Write down the numbers for which the logarithms, are given below.

- i) 3.7300552 ii) 2.8100335 iii) 0.827046
 iv) 1.2011512 v) 1.471213 vi) 0.0569049 (6)

(b) Find the sum correct to five significant figures :

$$(1.2345)^0 + (1.2345)^1 + (1.2345)^2 + (1.2345)^3 + \dots + \dots + (1.2345)^9 \quad (9)$$

(c) i) Find the logarithm of 26 to base 2.

ii) Find the cube root of 735.668

iii) Find the square root of 11486 (3+3+2)

(a) A particular function $\beta(x, y)$ has been tabulated for the various values of x and y given below.

Calculate the values of the function for

		x = 0.25 and y = 9			
x		.75	.50	.10	.01
y	8	5.0706	7.3441	13.3616	20.0902
	10	6.7372	9.3418	15.9871	23.2093
	11	7.5841	10.3410	17.2750	24.7250
	13	9.2991	12.3398	19.8119	27.6883

(6)

(b) The temperature records of a place 'P' for any particular day between 0 to 24 hours are shown below :

Hour of the day	2	4	6	8	10	12	14	16	18	20	22	24
					(midday)							(midnight)
Temperature (degrees fahrenheit)	49	47	49	53	58	65	74	78	72	68	60	57

Plot the values on a square paper and find out graphically the temperatures you could expect at 13 and 15 hours. (8)

Draw the graph of $\cos x - \sin 2x$ for values of x lying between 0° and 90° ; hence obtain its minimum value within this range. (16)

Plot the graph of the function $y = x^2 + 3x - 2$ and compute the approximate area bounded by the curve and the x axis. (14+6)

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - November 1964

Paper II (Practical) : Compilation and Presentation of Statistics

Time : 5 hours

Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is not permitted.

1. A sample survey was conducted for collection of data on consumer expenditure from 500 households, in the rural part of a country. The average monthly per-capita expenditure of some selected items were calculated for groups denoted by A, B, C and D where the monthly per capita total expenditures are respectively Rs. 0 - 10, Rs. 10 - 25, Rs. 25 - 50 and Rs. 50 & above. The combined estimate pooled over all classes was denoted by E.

The selected items were food, clothing, fuel and light, rent and miscellaneous, being denoted by f, g, h, i, and j respectively. Total non-food and the total of food and non-food were denoted by n and t respectively.

Estimates of average monthly per-capita values were recorded as follows.

$$A_h = 0.63 \quad B_f = 14.82 \quad C_f = 24.11 \quad D_g = 18.62 \quad E_g = 1.42$$

$$A_i = 0.00 \quad B_h = 1.28 \quad C_g = 4.83 \quad D_i = 1.80 \quad E_h = 1.13$$

$$A_j = 0.41 \quad B_i = 0.06 \quad C_h = 2.02 \quad D_j = 46.11 \quad E_i = 0.04$$

$$A_n = 1.26 \quad B_j = 2.03 \quad C_i = 0.08 \quad D_n = 69.98 \quad E_j = 2.28$$

$$A_t = 6.74 \quad B_t = 19.53 \quad C_n = 13.95 \quad D_t = 111.99 \quad E_t = 16.97$$

- Present the above data in a neat tabular form with proper heading after supplying the missing figures. Also calculate for the expenditure class E only, the percentages of per-capita expenditure on the selected items to the per-capita total expenditure. (20)

2. Data for six monthly income groups were needed for tabulation separately for agricultural and non-agricultural classes of the rural population of a country. Estimates for number of literates and illiterates for males and females separately were available, for each of the income groups.

Prepare a proforma with proper heading, keeping space for sub-totals and totals wherever necessary for presenting the data. (10)

3. Mention for any five of the following items the publications where the information would be available; give also the name of the issuing authority and the periodicity of the publications in each case.
- i) monthly savings deposits with Scheduled Banks in India.
 - ii) daily agricultural wages in different states of India.
 - iii) monthly gross earnings of Govt. Railways under different categories and different railways.

Please turn over

- iv) number of factories (a) on register at the beginning of the year (b) newly registered (c) removed from the register (d) on register at the end of the year (e) working on any day during the year and factories submitting returns in different states of India.
- v) monthly production and installed capacity of asbestos sheets, rods and tubes in India.
- vi) yearly gross receipt of Import duty and Excise duty by Govt. of India from Motor Spirit.
- vii) employment in Public Sector undertakings in India for a particular year. (10)

Collect the following from the publications supplied to you and present them in a neat tabular form. Mention the sources together with page number from where you have compiled the data along with proper notes where necessary. Answer any two of the following :

- i) prepare a statement showing the monthly value of India's Foreign Trade (Import, Export and Balance of Trade) for a particular year.
- ii) prepare a statement showing the estimated number of persons employed on Road Construction in different states and union territories of India for a particular year.
- iii) prepare a statement showing the number of Agricultural Labourers in different states in India according to Census 1961.
- iv) prepare a statement showing the quantity and value of Asbestos production in the different states of India for any two years. (10)

The following table shows the distribution of the national income over different sectors of the India's economy. Give a suitable graphical representation of the data.

sector	national income at factor cost at current prices in Rs. <u>crores</u> (= 10 ⁹)		
	1948-49	1951-52	1954-55
1. agriculture	42.5	50.2	43.5
2. mining, manufacturing and small enterprises	14.8	16.8	18.0
3. commerce, transport and communication	16.0	17.9	18.1
4. other services	13.4	15.0	16.5
5. total	86.7	99.9	96.1

(10)

Please turn over

6. Prepare a suitable graph for the following data relating to India's trade with the U.K.

month	value in lakhs of rupees		
	imports (-)	exports (+)	balance
August 1962	1509	1650	+ 140
September "	1295	1638	+ 343
October "	1258	1615	+ 357
November "	1619	1291	- 328
December "	1419	1646	+ 228
January 1963	1452	1789	+ 337
February "	1293	1232	- 61
March "	1453	1344	- 109
April "	1339	999	- 340
May "	1450	1011	- 439
June "	1299	1028	- 272
July "	1411	1331	- 79
August "	1351	1504	+ 234

(10)

7. The following data for 60 households were collected in the Chittaranjan Survey, January-March 1955.

Table : Total monthly expenditure and percentage expenditure on food for 60 households

sl.no. of household	total monthly expenditure (Rs.)	percentage expenditure on food	sl.no. of household	total monthly expenditure (Rs.)	percentage expenditure on food
(1)	(2)	(3)	(1)	(2)	(3)
1	41.80	84.62	31	135.34	66.14
2	34.10	90.65	32	105.35	80.38
3	27.06	57.06	33	126.34	59.20
4	50.22	75.95	34	148.46	72.46
5	38.94	68.03	35	143.95	77.99
6	41.69	70.66	36	111.51	65.70
7	67.36	68.54	37	110.55	76.97
8	73.21	69.93	38	147.70	60.94
9	53.12	69.49	39	128.11	63.27
10	75.45	54.79	40	139.38	60.17
11	56.13	79.37	41	119.22	70.81
12	63.57	67.55	42	105.07	68.80
13	53.61	77.58	43	148.37	71.64
14	74.75	62.29	44	142.70	74.81
15	72.07	67.71	45	137.08	63.74
16	73.88	57.91	46	106.72	54.01
17	79.56	72.56	47	120.13	56.56
18	99.35	70.79	48	103.10	57.51
19	98.86	60.09	49	178.98	49.98
20	83.68	68.32	50	165.99	60.30
21	92.92	62.30	51	176.45	50.06
22	84.47	60.31	52	162.86	59.18
23	86.58	71.90	53	158.19	63.10
24	78.92	87.18	54	200.42	52.50
25	136.94	64.48	55	191.54	60.46
26	103.38	54.22	56	167.79	62.72
27	109.18	75.75	57	162.69	63.50
28	150.00	74.67	58	163.47	55.39
29	121.22	56.35	59	183.42	44.80
30	137.25	60.60	60	173.47	46.05

(a) Prepare the two-way distribution of total monthly expenditure and percentage expenditure on food, using suitable class intervals.

(b) Draw the ogive and also the frequency polygon of the (marginal) distribution of total monthly expenditure obtained from (a) (15.0.27)

5 hours

Full marks : 100

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

Calculate the value of R correct to three places of decimals :

(8)

$$R = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \frac{x^5}{120}$$

for $x = 0.1, 0.2, 0.3$ and 0.4 .Find by interpolation, the value of y corresponding to $x = 82.9$ from the values given below :

(9)

x	y
81	19.2
82	20.1
83	24.2
84	26.8
85	27.9

Find by interpolation, the value of x corresponding to $y = 89.0$ from the values given below :

(12)

x	y
11	87.6
12	88.7
13	90.1
14	92.4

(a) Find by Trapezoidal rule with $h = 0.1$, the value of

(9)

$$\int_{1.7}^{1.9} (x^2 + \sqrt{2x}) dx$$

(b) Find by Simpson's $1/3$ rule with $h = 0.1$, the value of

(12)

$$\int_{8.0}^{8.4} \left(x + \frac{1}{x^2} \right) dx$$

5. (a) Obtain by graphical method, the first approximations to the three roots of the equation $10x^3 - 11x^2 + 12x - 7 = 0$. (8)

(b) By the method of repeated interpolation and finer tabulation, obtain one of the roots correct to 4 places of decimals. (12)

6. Solve for x, y, u and v the set of simultaneous linear equations : (15)

$$2x + y + 10u + 6v = 72$$

$$x - 2y + 4u + 20v = 30$$

$$3x - y + 3u - 7v = 32$$

$$x + 3y + 7u + 13v = 47$$

7. Evaluate the determinant :

$$\begin{vmatrix} 15.129 & 23.860 & 1.793 & 0.990 \\ 23.860 & 54.756 & 3.633 & 3.511 \\ 1.793 & 3.633 & 18.225 & 21.122 \\ 0.998 & 3.511 & 21.122 & 60.516 \end{vmatrix}$$

(15)

Time : 5 hours

Full marks : 100

- a) Those who have already passed according to old rules in Part IB, Section I only will not be required to answer Group A; but will answer the questions in Group B only, in the time not exceeding 3 hours.
- b) Figures in the margin indicate full marks.
- c) Use of calculating machines is permitted.

GROUP A

1. (a) The following distribution is given :

<u>no. of persons per family</u>	<u>no. of families</u>	<u>no. of persons per family</u>	<u>no. of families</u>
1	26	6	42
2	113	7	21
3	120	8	14
4	95	9	5
5	60	10	4

Obtain the geometric and harmonic means of the above distribution. (12)

- (b) Find the missing frequencies
- f_3
- and
- f_4
- in the following distribution, when it is known that the mean value
- $\bar{x} = 11.00$
- , and
- $N = 60$
- . (8)

Classes: 9.3-9.7 9.8-10.2 10.3-10.7 10.8-11.2 11.3-11.7 11.8-12.2 12.3-12.7 12.8-13.2

frequencies: 2 5 f_3 f_4 14 6 3 1

2. From the following bivariate table, calculate (a) the correlation coefficient and (b) the correlation ratio
- η_{yx}

X: chronological age (years)

Y: performance test (time taken to score)	5	6	7	8	9	10	11	12	13	14
60 - 64	1									
55 - 59	3									
50 - 54	2	1								
45 - 49	0	2	1							
40 - 44	1	4	2	0	0	1				
35 - 39	1	5	0	1	1	0				
30 - 34	1	0	5	3	2	1	0	0	1	
25 - 29		1	6	7	1	2	3	1	0	
20 - 24			0	4	6	0	1	0	2	1
15 - 19			1	1	10	8	7	5	2	0
10 - 14				2	0	4	5	4	6	5

(8+10)

(20)

3. The following details about prices and quantities of Textile Fibres are given :

Textile variety	prices per lb.(in dollars)				quantity (in millions of lbs)			
	1953	1954	1955	1956	1953	1954	1955	1956
Cotton	0.338	0.350	0.349	0.340	4,521.0	4,125.2	4,384.2	4,339.1
Wool	1.729	1.706	1.421	1.371	503.8	389.9	428.2	454.9
Rayon	0.351	0.346	0.341	0.320	1,223.0	1,154.8	1,419.2	1,201.2
Silk	5.295	4.920	4.594	4.466	5.4	6.4	7.2	7.7

- i) Construct link relative index numbers of Textile Fibre Prices, using the average of 1953 and 1954 quantities as weights.
 ii) Chain these relatives, to give index numbers with 1953 as fixed base.

(12)

GROUP B

4. In a study conducted on 50 experimental units correlation between three variates, x_1 , x_2 and x_3 were estimated as :

$$r_{12} = 0.79; \quad r_{13} = 0.38; \quad r_{23} = 0.49$$

- i) Calculate $r_{12,3}$, $r_{32,1}$ and $R_{2,13}$
 ii) If the mean values and standard deviations of x_1 , x_2 and x_3 be given as

(6)

	mean	standard deviation
x_1	30.8	15.6
x_2	46.8	32.6
x_3	43.1	14.8

Calculate regression co-efficient $b_{12,3}$

1d

- iii) Set up the regression equation of x_1 on x_2 and x_3 , and find the value of x_1 when $x_2 = 40.3$ and $x_3 = 60.5$

(8)

5. Fit a third degree polynomial to the data given below.

t	y
1	40
2	49
3	54
4	52
5	40
6	49
7	59

(11)

Please turn over

(21)

Estimate the trend in the series given below, using 5-year moving averages. Plot the original series and the trend on a graph paper. (15)

<u>year</u>	<u>cost of living index number</u>	<u>year</u>	<u>cost of living index number</u>
1922	180	1934	141
1923	174	1935	143
1924	176	1936	147
1925	176	1937	154
1926	172	1938	156
1927	168	1939	158
1928	166	1940	184
1929	164	1941	199
1930	157	1942	200
1931	148	1943	199
1932	144	1944	201
1933	140	1945	203

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INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - November 1964

Paper V (Practical) : Elementary Statistical Methods

Time - 5 hours

Full marks 100

- a) Those who have already passed according to the old rules in Part IB Section II or in Part IC Section I will be exempted from answering Group A or B respectively. They should however answer questions from the other two groups (i.e. from B and C or from A and C as the case may be) in time not exceeding 3 hours.
- b) Figures in the margin indicate full marks.
- c) Use of calculating machines is permitted.

GROUP A

1. The following table contains a distribution obtained in 320 tosses of 6 coins. Calculate the expected frequencies of number of heads, when the chance of getting a head in a toss is 0.5 for each coin using the formula for the binomial distribution and test at 5 percent level of significance whether the 6 coins are unbiased.

Number of heads	Observed frequencies
0	9
1	31
2	66
3	108
4	83
5	19
6	4
	320

[14]

2. A study to determine whether salesmanship (as measured by volume of sales) is independent of a salesman's sense of humour (as measured by a certain objective test) produced the results shown in the following table.

Volume of sales	Sense of humour		
	Low	Average	High
Low	75	61	52
Average	123	100	103
High	48	67	77

Apply a suitable test to examine whether the hypothesis of independence is to be accepted or rejected.

[12]

3. On the basis of a test given to random samples of 10 students of each of 2 different schools, the following results were obtained.

Please turn over

Marks obtained	
School - 1 (x_1)	School - 2 (x_2)
74	75
60	83
94	72
76	98
57	85
82	78
74	66
91	94
53	93
69	82

- a) Test for the difference between the average performance of the students in the 2 schools, assuming equality of variances.
- b) Also test for the equality of variances of the 2 groups of students. [9 + 9]

The partial correlation coefficient of wheat yield (x_1) with rainfall (x_2) eliminating the effect of temperature (x_3) with the data collected over a period of 20 years of a country is $r_{12.3} = 0.36$. Test its significance. [6]

GROUP B

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

- a) select a simple random sample of size 5 without replacement from a population containing 197 units. [2]
- b) select two dates at random without replacement from the year 1964. [4]
- c) select 2 units with probability proportional to size (x) with replacement, from the following population [5]

unit no.	size (x)
1	35
2	30
3	15
4	20
5	17
6	8
7	13
8	2
9	16
10	24

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6. Volume measurements of 10 pots, taken by 4 investigators, are given below. Each investigator measured every pot twice. Make an analysis of variance of the data to examine whether there are significant differences between investigators, between pots and whether there is any investigator \times pot differential effect.

measurements (volume in cc)

investigator pot	A	B	C	D
1	38 40	27 34	39 30	44 46
2	42 40	42 40	35 40	38 47
3	38 40	23 43	34 42	46 50
4	12 12	20 16	15 26	17 22
5	26 18	28 22	19 30	11 26
6	6 8	15 20	8 14	10 16
7	50 52	52 50	44 52	51 50
8	34 26	40 41	30 42	34 24
9	22 24	31 28	26 30	30 17
10	48 42	56 53	52 42	50 47

Total corrected Sum of Squares = 14136.1875

[25]

GROUP C

- 7.A) In twenty samples of size 100 each, the number of defective items are found to be 3, 3, 2, 2, 4, 3, 3, 6, 5, 4, 6, 6, 5, 5, 1, 4, 3, 3, 3 and 2 respectively. Examine whether the process is under control or not.

[8]

- b) From 25 samples of size 5 each, it is found that

$$\sum_{k=1}^{25} \bar{X} = 375 \quad \text{and} \quad \sum_{k=1}^{25} R = 10$$

Compute the control limits of \bar{X} and R charts.

[1]
