

INDIAN STATISTICAL INSTITUTE

QUESTION PAPERS

for

Computer's Certificate Examinations

May & November 1962

Price Rupee 2.00

INDIAN STATISTICAL INSTITUTE

COMPUTER 3 CERTIFICATE EXAMINATION—MAY 1962

PAPER I: 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 *any four* of the following numbers to the indicated accuracy. (2)

- (i) 3256 to the nearest hundred.
- (ii) 5.781 to the nearest tenth.
- (iii) 3,502,378 to the nearest million
- (iv) 143.475 correct to one decimal place.
- (v) 0.0045 to the nearest thousandth.
- (vi) 46.7385 to the nearest hundredth
- (vii) .000098501 correct to two significant digits.

(b) What is the maximum error in each of the following approximate measurements? Give the number of significant digits in each case. (2)

- (i) 3.867×10^8 miles.
- (ii) 186,000 miles per second.

(c) Find the quotient of the approximate numbers 72.48 and 5.16, with four and three significant figures respectively, and find the number of significant digits in the results. Explain how you arrived at the number of significant digits. (5)

Or,

The ratio of the circumference to the diameter of a circle is 3.14159 : 1. If the circumference of a circle is 5.87 feet, find the diameter correct to the thousandth of a foot. If the given ratio is correct to the figures given, find up to what figure the value obtained will be reliable. Give reasons. (5)

(d) The numbers 48.39 and 685.2 are both approximate and correct to the figures given. Find their product and state how many figures of the result are trustworthy. Explain how you arrived at the number of trustworthy figures. (5)

2. *Either,*

Simplify correct to four places of decimal by contracted method of division.

$$\frac{5.84275}{3.27845} \quad (9)$$

Or,

Find the product of the two numbers given below, by contracted method of multiplication, correct to the nearest thousand.

$$4983.642 \text{ by } 712.6142 \quad (9)$$

3. (a) Find the values of *any two* of the following by consulting mathematical tables and mention the number of significant digits in the results. Give reference to the tables and page number used. (4)

$$(i) \sqrt[4]{980234.24}$$

$$(ii) \sqrt[3]{68912.45}$$

$$(iii) \frac{1}{\sqrt{27.29}}$$

(b) Evaluate the following by using logarithms and find the maximum possible errors in the result. Give reference to the tables used. (10)

$$\frac{2.781}{.01873} \sqrt{\frac{(43.25) (.08743)}{(.002356) (6.824)}}$$

(c) Evaluate by consulting appropriate tables the value of

$$\frac{\sqrt[3]{3.8142 \times (6.12)^{4.12}}}{\sqrt[4]{16.1921}} \quad (6)$$

Give reference to tables used.

(d) Find the values of

$$(i) 4^2 + 8^2 + 12^2 + 16^2 + \dots + 40^2 \quad (4)$$

$$(ii) \sin + 4\sqrt{1 - \cos^2 \theta}, \quad \text{for } \theta = 25^\circ \quad (4)$$

(e) Find the value of

$$\log_{10} 3.6912 + \log_{2-13} 7.1932 + \log_e 6.68 \quad (8)$$

4. *Eüther*,

The following table gives the value of $F(x, y)$ for different values of x and y . Find by linear interpolation the values of $F(x, y)$ for (15)

$$(i) x = 0.8 \quad \text{and} \quad y = 4$$

$$(ii) x = 1.15 \quad \text{and} \quad y = 8.5$$

x	y				
	1	3	5	7	9
0.5	0.35029	0.34667	0.34294	0.33912	0.33521
0.7	0.31006	0.30563	0.30114	0.29659	0.29200
0.9	0.26369	0.25888	0.25406	0.24923	0.24439
1.1	0.21546	0.21069	0.20594	0.20121	0.19652
1.3	0.16915	0.16474	0.16038	0.15608	0.15183

Or,

The following table gives the hour angles of the sun corresponding to certain altitudes (a) and declinations (d) at a place in a certain latitude. Find by linear interpolation the hour angle corresponding to $d = 12^\circ$ and $a = 10^\circ$. (15)

$\frac{a}{d}$	10°	14°	18°	22°
(1)	(2)	(3)	(4)	(5)
20°	6h 10m 26s	5h 49m 17s	5h 28m 27s	5h 7m 48s
25°	5 54 41	5 34 5	5 13 39	4 53 17
10°	5 39 16	5 18 50	4 58 37	4 38 17
5°	5 23 50	5 3 30	4 43 4	4 22 29

h = hour, m = minute, s = second

5. Either,

Solve graphically the following equation

$$x \log_{10} x = 1.2 \quad (10)$$

Find the area bounded by the curve, the x -axis and the ordinates at $x=1$ and $x=3$. (6)

Or,

Draw the Graph of the equation $y = x - 2x - 8$ between $x = -2$ and $x = +4$. (10)

Find the area bounded by the curve, the x -axis and the ordinates at $x=2$ and $x=+4$. (6)

6. The following table gives the nine-year moving averages computed for New York Bank clearings centred against the years indicated in the table.

New York City Bank clearings : 9 year moving averages

year	nine-year moving average (in thousands of million dollars)
(1)	(2)
1904	78.4
1905	84.3
1906	80.3
1907	88.1
1908	92.0
1909	94.8
1910	93.6
1911	94.3
1912	102.3
1913	113.2

Plot the above data and draw a freehand smooth curve. Estimate from the graph the values of the Bank clearings during the years 1902 and 1915 (10)

**PAPER II : COMPILATION AND PRESENTATION OF
STATISTICS**

Time : 5 hours

Full marks : 100

- (a) Attempt any five questions.
- (b) Figures in the margin indicate full marks.
- (c) Use of Calculating machines is not permitted.

1. Collect the following from the publications supplied to you and present them in neat tabular forms. Mention the source and page number from which you have compiled the data..

(a) The transactions of Post Office Savings Banks in India for any four years. (4)

(b) The five latest population figures for any 12 of the following countries :—

Algeria, Brazil, Burma, Canada, China (mainland), France, Honduras, Iran, Kenya, Libya, Morocco, Mozambique, Nigeria, Papua, Sarawak, Sikkim, Spain, Tonga, USSR and Venezuela. (6)

(c) The total acreage and the average wholesale prices of the following commodities for any one year : Bajra, Gram, Jowar, Jute, Moongdal, Potato and Tobacco, for any 5 of the following states :

Uttar Pradesh, Orissa, Andhra, West Bengal, Punjab, Bihar, Mysore, Bombay. (Write N.A. if any figure is not available) (10)

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

(i) Production of sugar in Andhra, Bihar and Uttar Pradesh.

(ii) Quantity of electricity generated in Madras, West Bengal and Maharashtra.

(iii) Balance of profit or loss before taxes of the Indian Scheduled Banks for the year 1959-60.

(iv) Value of Central Government contracts placed in India and abroad for the year 1958-59.

(v) Total number of mandays lost due to industrial disputes for the following industries : Coal mining, Jute Mills, Commerce and Services in December 1959 and August 1960.

(vi) Quantity and value of imports into India for the six months ending on 30th September 1961 from the countries indicated against each : cheese (Switzerland and U.K.), Aniseed (China and Hongkong), Yeast (Italy and Netherlan), Diesel Oil (Bahrein and Lebanon), Vitamin C (Germany and Japan) and Manometers (France and Australia).

(vii) All-India figures for the direct expenditure on Basic Schools by sources for the year 1959-60.

(viii) Quantity and value of exports from India for the six months ending 31st March 1961 of the following commodities to the countries indicated against each :—

Hair oil (Burma and Muscat), Nylon fabrics (Trinidad & Haiti), Crown corks (Kuwait and Singapore), Coiling fans (Egypt and Zanzibar), Football covers (Kenya and Tunis) and Bicycles (Aden and Tanganyika). (20)

3. *Either,*

The following 100 measurements of length and breadth of a variety of seed in millimetres is given below. Prepare a two-way frequency distribution of the data.

Give reasons for the choice of class intervals adopted by you. (20)

Length	Breadth	Length	Breadth	Length	Breadth	Length	Breadth	Length	Breadth
185	162	195	154	192	151	180	146	176	126
205	169	180	142	167	128	122	101	203	105
216	154	148	91	196	179	183	167	162	146
165	167	144	125	184	150	131	119	152	128
153	180	186	127	191	170	164	123	143	123
189	108	168	139	163	118	194	128	171	126
178	147	169	155	161	137	160	109	160	122
170	140	192	155	184	68	116	87	191	134
148	115	160	107	181	146	186	171	231	203
163	122	136	83	113	79	174	158	201	122
131	103	160	123	186	153	167	131	255	107
154	121	143	115	204	164	179	131	138	101
157	136	191	175	177	134	187	169	168	115
203	184	93	74	171	118	156	124	194	138
180	165	176	129	146	130	136	98	164	119
209	136	215	100	125	174	139	139	191	133
149	118	170	133	143	127	158	103	169	134
189	141	162	125	152	139	160	138	182	164
199	156	166	145	200	154	176	154	165	115
192	171	179	142	162	112	96	80	214	169

Or,

The following data represent the lengths in millimetres of a sample of 157 beans.

(a) Using a tally sheet, arrange the data in a frequency distribution with suitable class intervals. Give reasons for the choice of class interval. (12)

(b) Draw a histogram of the frequency distribution on a graph paper. (8)

20.6	21.7	23.3	19.4	18.1	22.2	22.5	18.0	20.1	19.8
20.6	22.0	22.0	22.5	20.9	18.6	21.7	21.1	17.1	19.3
22.5	20.6	19.0	20.6	20.1	20.8	23.1	22.0	21.3	21.6
20.1	22.8	21.1	22.4	18.9	20.5	21.4	20.3	17.0	21.6
19.5	21.5	20.1	22.1	23.7	23.2	22.2	20.1	20.5	20.0
18.7	22.3	18.2	20.1	19.0	20.7	20.7	21.0	17.5	18.1
20.7	20.3	21.4	19.3	22.7	20.9	22.0	20.5	22.0	20.8
16.7	21.2	19.4	20.0	18.7	19.8	21.0	18.2	20.6	18.4
19.0	18.5	20.7	18.4	20.7	19.4	20.4	18.1	19.7	19.1
22.1	21.1	19.1	17.8	21.8	20.6	17.5	21.0	19.9	16.8
19.4	21.3	20.6	18.6	23.1	18.7	20.7	18.7	18.7	20.0
21.5	19.6	22.0	20.8	20.7	22.3	19.8	20.2	20.4	18.0
21.2	21.5	16.6	20.6	20.5	21.6	21.1	19.7	20.5	16.7
17.0	18.7	20.8	20.0	23.1	20.5	25.1	21.0	21.5	21.6
22.3	19.8	15.8	22.5	20.7	19.0	21.2	22.1	22.6	23.7
21.8	21.8	20.7	19.7	19.4	21.1	19.2			

4. A survey was undertaken to find out the civil condition of the rural and urban population of an area for persons aged 15 and upwards. A consolidated table was prepared, but unfortunately the working sheets were mislaid, some of the data in the final table obliterated and it was also known that a few typing mistakes had crept in. The following are also definitely known :

Total population—1116800. Total urban population—6848.

Total married males—443922. Total unmarried females—23716

Total widowed persons (male and female)—136510

Total male in age group (15-34)—200313

Total female in age group (35-54)—100150 and

Total widowed (males and females) in age group (55 and upwards)—71335.

The table, as available, is given below. Present the table in a neat form after filling up the missing values and correcting the typing mistakes as far as possible. (20)

	Age group : 15—34			
	Rural		Urban	
	Male	Female	Male	Female
Unmarried		16506	6635	
Married		228624	12605	13713
Widowed	5518	10342	133	244
Total			19373	18714

	Age group : 35—54			
	Rural		Urban	
	Male	Female	Male	Female
Unmarried	6037		341	90029
Married		14494	9588	8247
Widowed	13267		508	614
Total	177037	181209		8809

	Age group : 55 and upwards			
	Rural		Urban	
	Male	Female	Male	Female
Unmarried	1544	666	48	66602
Married	69.240	53153		4327
Widowed	22123		893	1611
Total	92907		5294	6940

5. Draw up a neat skeleton table with proper heading and spacing for presenting the results of a sample survey of un-employment conducted in an Indian State in 1960. The table will give the estimated number of un-employed persons in rural and urban areas of the state according to age-group, sex and educational standard.

Assume that there are nine age-groups (in years), viz, 0-15, 16-17, 18-21, 22-26, 27-36, 37-46, 47-56, 57-61, 62 and above and five broad categories of educational standards, viz, (i) illiterate, (ii) literate below matric, (iii) matriculate, (iv) intermediate and (v) graduate and above.

Provide, in your table, space (with appropriate heading) for meaningful sub-totals and percentages. The arrangement in the table should be such that it facilitates meaningful comparisons. (20)

6. *Either,*

Present the data on 'National Income of India' given in the table below by an absolute component bar chart. (20)

NATIONAL INCOME : BY INDUSTRIAL ORIGIN, INDIA
(1952-53 — 1959-60)

(In 100 crores of rupees)

	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60
Agriculture	48.1	53.1	43.5	45.2	55.2	62.8	62.4	61.4
Mining Manufacturing and Small enterprises	17.0	17.7	18.0	18.5	20.0	21.2	21.7	23.0
Commerce, Transport and Communications	17.8	18.0	18.1	18.8	19.6	20.7	21.5	21.8
Other services	15.4	16.0	16.5	17.3	18.2	19.3	20.6	22.0
Net domestic product at factor cost	98.3	104.8	96.1	99.8	113.0	114.0	126.2	129.2

Or,

Present graphically the data given in the table below : (20)

Consumer Price Index Numbers
Base : 1949 = 100

Year	India	Pakistan	Burma	Ceylon	U.K.	U.S.A.
1951	105	100	83	110	112	109
1952	103	102	79	100	123	111
1953	106	113	77	111	127	112
1954	101	111	74	110	129	113
1955	96	106	76	110	135	112
1956	105	110	85	109	141	114
1957	111	120	92	112	147	118
1958	116	128	89	114	151	121
1959	121	120	76	115	152	121
1960	124	128	83	113	153	124

7. From the following narrative presentation of statistical data draw up a table arranged in the way you think most appropriate with appropriate headings. (20)

The report on the second Agricultural Labour Enquiry, 1956-57 reveals that 11.0 lakhs households or 24.4% of the total rural households in West Bengal depended mainly on agricultural wage-employment as their mainstay. Of the total number of agricultural labour households 78.7% were those of casual labourers, the remainder 21.3% being those of attached labourers.

The report further reveals that in 1950-51 the number of agricultural labour households in West Bengal was 10.8 lakhs or 25.2% of the households in rural areas. The percentages of casual and attached labour households were 91.3 and 8.7 respectively.

It is stated in the report that the overall size of households of agricultural labourers in West Bengal had increased to 4.3 in 1950-57 as against 4.0 in 1950-51. Of the total family size 4.3, 1.5 were wage earners comprising 1.2 men, 0.2 women and 0.1 children. The corresponding figures for 1950-51 are 1.5 wage earners made up of 1.1 men, 0.3 women and 0.1 children.

Wage-paid employment constituted an integral part of gainful employment of agricultural labourers. Taking all agricultural labourers (casual and attached) together, the total quantum of wage-paid employment of male labourers during 1955-57 was about 242 days—187 days in the agricultural sector and 55 days in the non-agricultural sector. The corresponding figures for 1950-51 were 239, 194 and 45 days.

The average wage-paid employment of women workers was about 168 days in 1956-57 as against 179 days in 1950-51.

It had been observed that there was greater dependence on child labour during 1956-57. The relative wage-employment available to child labour showed an increase from 209 days in 1950-51 to 282 days in 1956-57.

As regards employment of casual and attached labourers, the report shows that in 1956-57, the male casual workers were employed for about 252 days whereas the male attached labourers were employed for more than 318 days. As compared to 1950-51, both showed a definite fall—casual worker 20 days and attached workers 30 days.

PAPER III : SELECTED TECHNIQUES OF COMPUTATION

Time : 5 hours

Full marks : 100

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

1. (a) *Either,*

Find the value of e^x for $x=0.141$; 0.143 and 0.158 from the following table using 6 ordinato (quintic) interpolation coefficients. (15)

x	e
0.12	1.12750
0.13	1.13883
0.14	1.15027
0.15	1.16183
0.16	1.17351
0.17	1.18531
0.18	1.19722

Or,

Find the values of $f(x)$ when $x=1.11$ from the following table by using suitable interpolation formula. Give reasons for the choice of your formula (15)

x	$f(x)$
1.0	0.8413
1.1	0.8043
1.2	0.8849
1.3	0.9032
1.4	0.9192
1.5	0.9332

(b) Determine the value of x for which $\log x = 3.7430$ using Lagrange's formula of interpolation or divided difference formula of interpolation, given the following values: (15)

x	$\log x$
5531	3.742804
5532	3.742882
5533	3.742961
5534	3.743039
5535	3.743118

2. Either,

(a) Draw the curve of $y = y_0 \left(1 + \frac{x}{a}\right)^{pa}$

$$\text{where } \log y_0 = 1.5315$$

$$p = 0.5$$

$$a = 8.0$$

between $x=0.0$ to $x=2.0$ (take five ordinates at equal intervals); give your estimate of area bounded by this curve, the x -axis and the ordinates at $x=0.0$ and $x=2.0$ by graphic method. Show the steps of your calculation. (16)

(b) Obtain the same area using Trapezoidal rule and Simpson's one-third rule of numerical integration. (9)

Or,

(a) Find the integral of $\cos x$ from $x=0$ to $x=0.8$ using the following table by

(i) Graphic method (12)

(ii) Trapezoidal rule (4)

(iii) Simpson's rule (5)

(b) For 20 Army personnel the regression of weight of kidneys (y) on weight of heart (x) both measured in oz, is $y = 0.390x + 0.934$ and regression of weight of heart on weight of kidneys is $x = 1.212y - 2.401$.

Find the correlation between the two variables. (5)

(c) From the data given below compute the correlation ratio of y on x . (5)

Analysis of variance of y

source	d.f.	sum of square
Between arrays of x	11	592
Within arrays of x	91	278
Total	102	870

Or,

(a) Write out the Laspeyres's and Paasche's formula of index number of prices and Fishers ideal index number. Explain the symbols used by you. (9)

(b) Average monthly per capita expenditure in 1950 on food items and the average prices of these items in 1950 and 1957 are given below. Calculate a suitable index of food prices for 1957 with the year 1950 as base. (16)

item	per capita monthly expenditure (Rs.)	prices per seer (Rs.)	
		1950	1957
(1)	(2)	(3)	(4)
1. food grains	18.02	0.52	0.62
2. pulses	4.22	0.62	0.70
3. oils	6.02	2.47	3.11
4. vegetables	8.01	0.50	0.63
5. milk	14.25	0.75	0.85
6. meat and fish	8.32	2.08	2.68
7. fruits	3.11	2.15	2.60
8. salt	0.31	0.08	0.11
9. apices	3.25	2.55	3.72
10. sugar	3.85	0.80	1.00

GROUP B

3. Either,

(a) The following table gives the weight in lbs. (x_0), age in years (x_1) and height in inches (x_2) of 10 males. Obtain the multiple regression equation of x_0 on x_1 and x_2 . Calculate the multiple correlation coefficient $R_{0.12}$ of x_0 on x_1 and x_2 ; and the partial correlation coefficients $r_{01.2}$ and $r_{02.1}$ and interpret the correlation coefficients. (10+5+5)

x_0	x_1	x_2
130	25	72
111	25	68
135	33	67
165	22	68
167	22	70
128	30	68
147	24	70
126	30	65
125	23	66
140	40	70

(b) (i) If $R_{1-23}=1$, what will be the value of R_{2-13} and R_{3-12} and why? (3)

(ii) If $R_{1-23}=0$, will R_{2-31} also be zero? What does R_{1-23} and R_{2-13} measure? (2)

Or,

The following table shows the monthly revenue receipts of State Governments in India. Obtain measures of seasonal variation by the method of moving averages or link relatives. (25)

Month Year	Total receipts of State Governments in India (Rs. crores) in											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1952	23	39	62	17	18	16	20	17	12	22	20	18
1953	25	26	105	20	22	20	26	18	23	29	15	16
1954	32	36	93	21	21	22	29	21	15	27	27	21
1955	32	42	99	24	24	23	29	24	21	32	28	21

4. Fit a third degree polynomial to the data given below by the method of orthogonal polynomial taking x as the independent variable.

x	1	2	3	4	5	6	7	8	9
y	35	61	91	195	319	516	616	718	792

By calculating the appropriate residual sum of squares, examine whether the third degree polynomial gives better fit than the second degree curve. (25)

PAPER V: ELEMENTARY STATISTICAL METHODS

Time: 5 hours

Full marks: 100

- Those who have passed (according to old rules) Part 1B Section II should answer questions of Groups B and C only in 3 hours.
- Those who have passed (according to old rules) Part 1C Section I should answer questions of Groups A and C only in 2 hours.
- Figures in the margin indicate full marks.
- Use of Calculating machines is permitted.

GROUP A

1. Either,

(a) Answer either (i) or (ii)

(i) Calculate the theoretical frequencies in the class ranges given below assuming the distribution to be normal with mean = 7.8 inches and standard deviation = 2.0 inches and test the goodness of fit.

class ranges in inches	frequency
up to 2.5	3
2.5—4.5	47
4.5—6.5	202
6.5—8.5	370
8.5—10.5	280
10.5—12.5	76
12.5—14.5	8
14.5 and above	1
Total	600

(15)

(ii) The following table shows the number of days in a 50 day period during which x automobile accidents occurred in a city. Fit a Poisson distribution to the data. Also, test whether the fit is good.

Number of accidents (x)	Number of days (f)
0	21
1	18
2	7
3	3
4	1

(15)

(b) The following table shows the distribution of some beans according to length.

Length in m.m. (central values)	Frequency	Length in m.m. (central values)	Frequency
(1)	(2)	(1)	(2)
9.5	1	13.5	920
10.0	7	14.0	1787
10.5	18	14.5	2294
11.0	38	15.0	2082
11.5	70	15.5	1129
12.0	115	16.0	275
12.5	109	16.5	55
13.0	437	17.0	6

Find out the suitable Pearsonian type of curve that may be fitted to the data (20)

Or,

a) From three normal populations having variances 10, 12 and 14 respectively, random samples of n_i ($i=1, 2, 3$) units were selected without replacement. Sample sizes and numerical values of sample means based on the sampled units are given below :

Population	Total number of units in population	Sample size	Sample Mean
I	$N_1=1000$	$n_1=404$	$\bar{x}_1=3.8$
II	$N_2=1200$	$n_2=480$	$\bar{x}_2=4.9$
III	$N_3=1500$	$n_3=900$	$\bar{x}_3=7.7$

(i) Calculate the standard errors of \bar{x}_1 , \bar{x}_2 and \bar{x}_3 . (6)

(ii) Calculate the standard error of the linear function

$$0.8\bar{x}_1 + 0.9\bar{x}_2 - 1.3\bar{x}_3$$

and express the standard error as percentage of the value of the linear function. (4)

(b) The following summary data were obtained from measurements of three characters x_1 , x_2 and x_3 on 20 units.

$$\bar{x}_1 = 15.8$$

$$\bar{x}_2 = 20.5$$

$$\bar{x}_3 = 50.6$$

$$s_1^2 = 21.3$$

$$s_2^2 = 3.4$$

$$s_3^2 = 0.9$$

$$r_{12} = 0.7702; \quad r_{13} = 0.5935; \quad r_{23} = 0.2193$$

$$x_1 = -100 + 1.79x_2 + 2.28x_3$$

(i) Test whether r_{23} is significantly different from zero. (5)

(ii) Test whether the partial correlation coefficient of x_1 on x_2 eliminating effect of x_3 , differs significantly from 0.7. (6)

(iii) Test whether the multiple correlation coefficient of x_1 on x_2 and x_3 is significantly different from zero. (6)

(iv) Test whether $b_{12.3}$ is significantly different from zero. (8)

2. (a) 1000 persons, randomly selected, were inoculated with B.C.G. Incidence of T.B. among these 1000 persons as well as among another 600 persons, also randomly selected but not inoculated with B.C.G., were observed as under :

	Affected with T.B.	Not affected with T.B.	Total
Inoculated with B.C.G.	157	843	1000
Not inoculated with B.C.G.	362	238	600

Test whether there is association between inoculation with B.C.G. and incidence of T.B. (5)

(b) From two normal populations having the same standard deviation two random samples of sizes 5 and 4 respectively were drawn. The table below gives the mean and standard deviation computed from the sample. The square of the sample standard deviation is obtained as sum of squares of deviation from mean divided by $(n-1)$

Population	n	Mean	Standard deviation
I	5	6.34	0.6
II	4	5.82	0.5

Test the significance of the difference of the two population means. (5)

(c) Random samples of sizes 4 and 6 were drawn from two normal populations having variances σ_1^2 , σ_2^2 respectively. The standard deviation,

$$s = \sqrt{\frac{n_1 \sum (x_i - \bar{x})^2}{n_1 - 1}}$$

Computed from the two samples are given below.

$$s_1 = 0.72 \quad s_2 = 0.65$$

Test whether the variances in the two populations are significantly different from one another. (5)

GROUP B

3. (a) An experiment was performed with five varieties of wheat, A, B, C, D and E, in the form of a Latin Square Layout to determine differences, if any, in yield rates of the varieties. The table below gives observed yield of the different varieties.

Yield of varieties in a Latin Square Lay-out

B	5	D	7	E	5	A	10	C	12
C	11	A	4	B	6	E	5	D	5
D	8	C	15	A	7	B	6	E	4
E	7	B	7	C	13	D	9	A	5
A	10	E	6	D	12	C	14	B	7

Are the varieties significantly different among themselves? (15)

(b) How will you test about the equality of varietal yields in (a) of this question, if it is assumed that the five rows are the five scattered blocks of a randomised block design experiment? (10)

4. Either,

The following table gives population (as per 1951 census) of 20 villages of Uttar Pradesh.

Villago Serial Number	Population	Villago Serial Number	Population
1	305	11	418
2	206	12	481
3	1208	13	583
4	1055	14	319
5	408	15	416
6	593	16	496
7	349	17	779
8	990	18	845
9	685	19	530
10	715	20	849

Select five villages with probability proportional to population with replacement. Reference to page number of table of random numbers used should be given.

[Your computational steps should be clearly indicated and explained where necessary]. (10)

Or,

You are given a piece of land 50' x 50' sloping east west.

(i) Prepare a layout of a randomised block experiment to test the difference in yield of 5 varieties of paddy.

(ii) Prepare a layout of a Latin Square experiment to test the difference in yield of 7 varieties of paddy.

Actual sketch of layouts indicating directions also and reference to tables used should be given. (10)

GROUP C

5. The following table show the observations on 20 samples, each of size 5, of a production-process. Draw control charts for mean (\bar{X}) and range (R) on the basis of first ten samples. Work out 3σ control limits using R of the first ten samples. Then, examine all the 20 samples to see whether the production process is under control and give your comments. (15)

Sample	1	2	3	4	5	6	7	8	9	10
	2	3	1	1	9	3	6	5	8	5
	4	3	3	2	2	7	5	8	7	4
	5	7	5	3	7	6	9	2	3	3
	6	8	6	4	6	4	8	6	6	5
	8	4	5	5	6	5	4	4	6	1
Sample	11	12	13	14	15	16	17	18	19	20
	0	6	2	5	4	2	9	6	9	9
	4	5	4	5	3	2	8	3	8	9
	2	8	6	6	7	3	7	5	3	6
	9	2	8	5	8	5	1	8	7	8
	7	7	3	5	2	6	2	1	7	9

COMPUTER'S CERTIFICATE EXAMINATION—NOVEMBER 1962.

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) The numbers 37.32 and 6.00 are approximate and correct to two places of decimal. Find their product and state how many figures of the result are accurate. Explain how you have arrived at the number of accurate figures. (5)

(b) Round off the following to the indicate accuracy : (2)

(i) 0.32517 to the nearest thousandth.

(ii) 5.399 to the nearest hundredth.

(iii) 350,739,283 to the nearest million.

(iv) 0.00070215 correct to three significant digits.

2. Find the values of the following (using contracted methods) :—

(i) Either,

$$\frac{797.3586}{0.003957243} \text{ correct to the nearest thousand} \quad (5)$$

Or, Product of 327.3905 and 325.5784597 correct to the nearest whole number. (5)

(ii) Either,

$0.0057329 + 1.23012 + 0.000006 + 17.125769$, correct to three places of decimal. (3)

Or,

$0.0057329 - 17.125769$, correct to three places of decimal. (3)

$$(iii) 1 + \frac{1}{1} + \frac{1}{1 \times 2} + \frac{1}{1 \times 2 \times 3} + \frac{1}{1 \times 2 \times 3 \times 4} + \dots + \frac{1}{1 \times 2 \times 3 \times \dots \times 720}$$

correct to three places of decimal. (7)

3. (a) Find the values of any three of the following by consulting mathematical tables and mention the number of significant digits in the results. Give reference to the tables and the page numbers used. (8)

$$(i) \sqrt[3]{649910.97} \quad (ii) \frac{1}{\sqrt{06511}} \quad (iii) \log_{10} \log_{10} e$$

$$(iv) \sin 42^\circ 11' 45'' \quad (v) \log \tan 30^\circ 30' 30''$$

(b) Evaluate any two of the following. Give reference to the tables used. (10)

$$(i) \frac{\sqrt[3]{10.248 + 5.621 \times 0.003484}}{(7.9006)^{1/4} (0.0047)^{1/6}} \quad (ii) 5.70^{0.084 \cdot 87}$$

$$(iii) \sin^2 30^\circ + \sin^2 60^\circ + \dots + \sin^2 240^\circ \quad (iv) \frac{(4.58)^{2.12} (\tan 45^\circ 30')}{\sin^2 25^\circ \cos^2 25^\circ}$$

(c) Find the value of any one of the following :

$$(i) \frac{1}{27} + \left(\frac{2}{3}\right)^3 + \left(\frac{3}{3}\right)^3 + \dots + \left(\frac{5}{3}\right)^3 \quad (4)$$

$$(ii) 1 + \log_{10} 5 + (\log_{10} 5)^2 + (\log_{10} 5)^3 + \dots + (\log_{10} 5)^7 \quad (4)$$

(d) Find the value of :

Either,

$$\log_{10} e^{4.57} + \log_e (4.57)^{10} + \log_{4.57} e^{10} + \log_{4.57} (4.57)^e \quad (8)$$

Or,

$$\frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}, \text{ for } x=0, \pm 1, \pm 2, \pm 3. \quad (8)$$

4. Either,

The table below gives the values of $I(p, q)$ for different values of p and q

values of 'p'	values of 'q'				
	5.0	5.5	6.0	6.5	7.0
30	.7504	.8103	.8684	.9080	.9372
32	.7103	.7822	.8402	.8856	.9200
34	.6701	.7402	.8007	.8608	.9005
36	.6290	.7089	.7773	.8336	.8786
38	.5879	.6706	.7431	.8044	.8544
40	.5472	.6318	.7077	.7733	.8281

By linear interpolation, find the values of $I(p, q)$ for (18)

(i) $p=35$ and $q=6.2$, (ii) $p=33.4$ and $q=5.6$

Or,

With the help of the following table determine by linear interpolation those values of θ for which $\sin \theta = 0.75$; 0.76 and 0.77

θ	$\sin \theta$
47°	0.73135
48°	0.74314
49°	0.75471
50°	0.76604
51°	0.77715

(18)

5. The following average monthly production figures of petroleum and petroleum products are given, expressed in "thousands of metric tons".

year	crude petroleum	diesel oil
1955	37	49
1956	45	59
1957	51	77
1958	54	90
1959	61	118
1960	78	133
1961	84	139
1962	87	135

Draw graphs to compare (i) the annual production in different years and (ii) the annual rates of increase in production of crude petroleum and diesel oil. (14)

6. Either,

(i) Find graphically a root of the equation

$$x - 0.5 \log x = 3.5 \text{ correct to two places of decimal} \quad (12)$$

(ii) For the curve plotted in (i) find the area bounded by the curve, the x-axis and the ordinates at $x=3$ and $x=5$. (8)

Or,

(i) Solve graphically the equations

$$2x - 3y = 5$$

$$3x + y = 13 \quad (8)$$

(ii) Solve the equation $3x^2 - 5x - 3 = 0$, by plotting the function $y = 3x^2 - 5x - 3$.

Find the area enclosed between the x-axis and the portion of the curve appearing below the x-axis. (9)

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. From an urban survey conducted to find the employment and unemployment position by age, sex and literacy, the following data giving the number of cases of different categories were available. Prepare a suitable table with proper title, headings, sub-totals, totals etc., and represent the information, after filling up blanks and correcting mistakes, if any.

(Note: A, B, C and D stand for the age groups (i) upto 15 years, (ii) 16 to 30 years, (iii) 31 to 60 years and (iv) above 60 years respectively; E_m and E_f stand for employed male and employed female respectively; and U_m and U_f stand for unemployed male and unemployed female respectively.)

Number of cases under different categories

AE_m	illiterate :	924	BU_m	literate :	2411
AE_f	.. :	538	BU_f	.. :	130
AE_m	literate :	632	DE_m	illiterate :	405
AE_f	.. :	162	DE_f	.. :	208
BE_f	illiterate :	3286	DE_m	literate :	703
BE_m	literate :	13557	DE_f	.. :	12
BE_f	.. :	706	AU_m	illiterate :	15659
BU_m	illiterate :	262	AU_f	.. :	260
BU_f	.. :	258	AU_f	literate :	118
CE_m	literate :	11098	CE_m	illiterate :	6540
CE_f	.. :	552	CE_f	.. :	3245
CU_m	illiterate :	531	DU_m	illiterate :	588
CU_f	.. :	271	DU_f	.. :	42
CU_m	literate :	2201	DU_m	literate :	813
CU_f	.. :	68	DU_f	.. :	4

- (i) total employed male and female : 48746
 (ii) total employed literate : 28282
 (iii) total employed female illiterate : 6825
 (iv) total employed male and female illiterate under age group 'B' : 8516
 (v) total employed and unemployed literate : 47755
 (vi) total unemployed female literate : 320
 (vii) total unemployed male and female literate in age group 'A' : 13488. (20)

2. Draw up a blank tabular form with proper headings and providing space for meaningful sub-totals and totals, for presenting the distribution of gainfully employed persons, classified under public and private sector and by eight industry groups.

Under private sector the distribution is again to be shown by small scale and large scale establishments with further break down for power-operated and non-power operated establishments. (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 publication in each case. (Answer any five).

- (a) Monthly hours flown under the scheduled internal and international services of the Indian Airlines Corporation.
- (b) Monthly receipt of the total small savings in India.
- (c) Number of cheques cleared in each month at Calcutta, New Delhi, Bombay and Madras.
- (d) Weekly Index numbers of wholesale prices in India (Base 1952-53=100).
- (e) Monthly approximate number of Air Conditioned and 1st class passengers booked in Government Railways.
- (f) Annual external debt position of the Government of India.
- (g) Monthly index number of the following industrial production (Base 1951=100).
 - (i) Sulphuric acid, (ii) Foot wear, (iii) Sheet glass, (iv) Conduit pipes and (v) Radio receivers.
- (h) Direct expenditure on primary schools by states for the years 1950-57 and 1957-58. (10)

4. 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) Total number of compensational accidents in industries and the total amount of compensation paid during any five years under the workmen's compensation act 1923. The corresponding average daily number of industrial workers covered in each year should also be mentioned.
- (b) The crude birth rates (number of live births per 1000 population) for any two years at interval of 10 years, of the following countries :
 - (i) Canada (ii) United States (iii) Belgium (iv) France (v) Sweden (vi) United Kingdom (vii) Japan (viii) Singapur (ix) Newzeland and (x) Austria.
- (c) Number, membership and the total working capital of the Co-operative Societies for the different states of India for any one year along with the total for the whole of India. (10)

Note : Mention in each case the year or years for which data have been compiled.

5. The following data give the over-all heights (in inches) of 145 fragmentation bomb bases.

0.831	0.834	0.836	0.816	0.830
0.829	0.826	0.833	0.831	0.831
0.836	0.831	0.826	0.835	0.831
0.840	0.831	0.831	0.831	0.833
0.826	0.831	0.822	0.833	0.820
0.829	0.835	0.818	0.841	0.832
0.828	0.833	0.838	0.831	0.828
0.828	0.829	0.835	0.831	0.830
0.832	0.830	0.834	0.833	0.832
0.841	0.841	0.830	0.832	0.825
0.831	0.831	0.838	0.815	0.831
0.838	0.820	0.822	0.832	0.833
0.844	0.828	0.835	0.831	0.831
0.827	0.832	0.830	0.831	0.834
0.826	0.827	0.830	0.838	0.832
0.830	0.826	0.813	0.832	0.831
0.819	0.830	0.833	0.831	0.838
0.810	0.842	0.819	0.825	0.833
0.844	0.835	0.834	0.831	0.831
0.832	0.830	0.836	0.850	0.833
0.823	0.835	0.833	0.826	0.833
0.830	0.829	0.836	0.835	0.823
0.832	0.834	0.831	0.842	0.816
0.835	0.826	0.832	0.832	0.831
0.835	0.828	0.832	0.831	0.838
0.829	0.850	0.835	0.831	0.833
0.830	0.834	0.846	0.832	0.822
0.830	0.827	0.829	0.834	0.835
0.833	0.831	0.833	0.826	0.831

(a) Rearrange the data in the form of a frequency distribution with suitably chosen class intervals. (18)

(b) Draw a histogram for the distribution (A graph paper should be used for this purpose). (7)

6. (a) The following table relates to foreign trade of India and gives the value of trade (merchandise) by currency areas. Present the information in suitable charts.

(Rs. crores)

Area	Year			
	1960	1959	1958	1957
IMPORTS: Dollar	275	219	198	184
Sterling	337	275	307	300
Other soft currency	426	393	350	475
Total	1038	887	864	1025
EXPORTS: Dollar	126	116	117	156
Sterling	294	296	294	300
Other soft currency	214	211	168	187
Total	634	623	579	643

Source: D.G.C.I. & S., Ministry of Commerce and Industry.

(15)

(b) The following table gives the spot prices of bar gold in Bombay during 1950-1960. Give a suitable graphic presentation of the data.

Year	Gold (per gram)		
	Highest (Rs.)	Lowest (Rs.)	Average* (Rs.)
1950-51	10.3	9.0	9.7
1951-52	10.2	6.8	9.4
1952-53	8.2	6.6	7.5
1953-54	8.0	6.8	7.4
1954-55	8.2	7.1	7.6
1955-56	9.2	7.7	8.2
1956-57	9.4	8.5	9.0
1957-58	9.8	9.0	9.3
1958-59	10.3	8.0	9.6
1959-60	10.8	10.0	10.4

Source: Reserve Bank of India

*Average of closing quotations for working days.

10)

PAPER III (PRACTICAL) : SELECTED TECHNIQUES OF COMPUTATION

Time : 5 hours

Full marks : 100

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

1. (a) Find the number of terms required in the expansion

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \dots \text{ to compute } e \text{ correct to seven places of decimal. (6)}$$

(b) Using properties of differences, tabulate the polynomial

$$f(x) = 212x^3 - 438x^2 + 152x - 19 \text{ for values of } x \text{ in the range } 0 \text{ to } 1, \text{ at intervals of } 0.1. \quad (8)$$

(c) Either,

Evaluate using four point interpolations coefficients, the 1% values of Chisquare for (i) 52 d.f. and (ii) 59 d.f., from the values given in the following table.

d.f.	1% value of Chisquare
30	14.05
40	22.16
50	29.71
60	37.49
70	45.44
80	53.54
90	61.76
100	70.07

(16)

Or,

Using a suitable interpolation formula, find the value of $\tan \theta$, as accurately as possible from the values given below, for $\theta = 22^\circ 25'$.

θ		$\tan \theta$
degrees	minutes	
22	0	0.4000579
22	7	0.4063968
22	8	0.4067358
22	9	0.4070748
22	10	0.4074139
22	11	0.4077531

(16)

2. Either,

(a) Find by quadrature the value of π from the relations $\frac{\pi}{4} = \int_0^1 \frac{1}{1+x^2} dx$ correct to six places of decimal, by taking 11 ordinates and using trapezoidal rule. (15)

(b) Verify the result by using Simpson's one-third rule. (5)

Or,

(a) Evaluate $\sum_{25}^{43} (3x+1)^{-2}$, correct to four places of decimal. (8)

(b) By taking 11 ordinates at equal intervals, plot the graph of $\frac{1}{x}$ in the range 1 to 2. (4)

(i) Estimate the area under the curve bounded by the x-axis and the two extreme ordinates. (3)

(ii) Find by quadrature $\int_1^2 \frac{1}{x} dx$ (5)

3. Find the real root of the equation $3x = \cos x + 1$,

by: (i) Graphical method (12)

(ii) Numerical method (13)

4. (a) (i) Evaluate the following determinant.

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

(iii) Find the minor of the element in the first row and the second column. (6)

$$\begin{vmatrix} \frac{1}{2} & 1 & 0 \\ \frac{1}{3} & \frac{1}{2} & 1 \\ \frac{1}{4} & \frac{1}{3} & \frac{1}{2} \end{vmatrix}$$

(b) Evaluate any one of the following determinants:

Either,
$$\begin{vmatrix} 1 & 45 & 45^2 & 45^3 \\ 1 & 46 & 46^2 & 46^3 \\ 1 & 47 & 47^2 & 47^3 \\ 1 & 48 & 48^2 & 48^3 \end{vmatrix} \quad (7)$$

Or,
$$\begin{vmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{3} \\ \frac{1}{3} & \frac{1}{2} & 1 & \frac{1}{2} \\ \frac{1}{4} & \frac{1}{3} & \frac{1}{2} & 1 \end{vmatrix} \quad (7)$$

(c) Find the values of x_1, x_2, x_3, x_4 , that satisfy the following four equations:

$$\begin{aligned} 9x_1 + 3x_2 + 4x_3 + 2x_4 &= 28 \\ 3x_1 + 5x_3 - 4x_4 &= 12 \\ x_2 + x_3 + x_4 &= 5 \\ 6x_1 - x_2 + 3x_4 &= 19 \end{aligned} \quad (12)$$

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 of Group B only in $2\frac{1}{2}$ 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.
- (c) Use of Calculating machines is permitted.

GROUP A

1. *Either,*

The results of an Accountancy examination are given below:

marks secured	number of examinees securing marks	marks secured	number of examinees securing marks
20-29	4	80-89	140
30-39	48	70-79	39
40-49	120	80-89	10
50-59	235	90-99	7

- (i) Rewrite the class boundaries to make the scale continuous and also note down the class marks (i.e. mid points of class intervals). (3)
- (ii) Calculate the mean, the standard deviation and the co-efficient of variation of "marks secured". (3)
- (iii) Evaluate Sheppard's correction for grouping, for the second moment. (3)
- (iv) Find the percentage of examinees securing 33 marks and below, and 75 marks and above. (5)

Or,

An association of stenographers in America collected information on the weekly earning of its working members and got the following distribution:

Weekly earning (in dollars)	Number of stenographers
35.00-39.99	27
40.00-44.99	129
45.00-49.99	606
50.00-54.99	1057
55.00-59.99	1384
60.00-64.99	1490
65.00-69.99	893
70.00-74.99	281
75.00-79.99	190
80.00 and more	68
Total	6125

- (i) Calculate the median and modal value of weekly earning of stenographers. (10)
 (ii) From the values obtained in (i) deduce the mean value of earning. State assumptions if any, in the formula used. (5)
 (iii) Calculate the co-efficient of variation of weekly earning assuming that the standard deviation is 8.35 dollars. (5)

2. An investigation on the length (cms) of green plant and the weight (gms) of dry jute fibre yielded the following results :

weight of dry jute fibre (gms)	length of green plant (cms)—class marks							Total
	111.5	127.5	143.5	159.5	175.5	191.5	207.5	
1.175	12	25	15	1	—	—	—	53
2.775	1	4	33	59	29	3	—	129
4.375	1	—	4	28	35	14	2	84
5.975				2	20	18	1	41
7.575				1	1	14	5	21
9.175					4	8	2	14
10.775						3	2	5
12.375							3	3
Total	14	29	52	91	89	60	15	350

- (i) Compute the coefficient of correlation between the length and the weight. (12)
 (ii) Obtain the linear regression equation of weight of dry fibre on length of green plant. (5)
 (iii) Evaluate the average weight of dry fibre of jute corresponding to an average length of the green plant of 180 cms. (3)

3. Either,

Two types of weighted price indices are generally available, of which one make use of the current year quantity and the other the base year quantities, for weighting purposes. Name the two types and give the formula for each.

Construct two such weighted price indices for Indian Forest produce in 1957-58 with 1951-52 as base year, by making use of the following data : (10)

Forest produce of India (Major product)	1951-52		1957-58	
	Quantity (in thousand cubic metres)	Value (in lakhs of rupees)	Quantity (in thousand cubic metres)	Value (in lakhs of rupees)
(i) Timber	2,828	1,435	3,773	2,070
(ii) Round wood	1,149	86	840	237
(iii) Pulp and Matchwood	13	3	56	19
(iv) Firewood	10,159	445	10,200	520
(v) Charcoal	550	7	776	38

Or,

The following details are available with regard to Foreign trade of India, for the year 1960.

Commodity	'unit value' index (base 1958=100)	'Quantum' index (base 1958=100)
1. Food	110	92
2. Beverages and Tobacco	107	75
3. Crude materials etc.	102	109
4. Mineral fuels and lubricants	99	99
5. Animal, vegetable oils and fats	100	146
6. Chemicals	158	100
7. Manufactured goods (classified)	111	109
8. Machinery and Transport equipments	89	246
9. Miscellaneous manufactures	112	126

Using the corresponding quantum indices as weights, construct an 'unit value' general index for all commodities, for 1960, with 1958 as base. (Use the geometric mean for your average). (10)

GROUP B

4. The following constants were obtained from measurements of length in mm (x_1), volume in cc (x_2) and weight in gm (x_3) on 300 eggs.

$\bar{x}_1 = 55.95$	$s_1 = 2.26$	$r_{12} = 0.578$
$\bar{x}_2 = 51.48$	$s_2 = 4.39$	$r_{13} = 0.581$
$\bar{x}_3 = 56.03$	$s_3 = 4.41$	$r_{23} = 0.074$

where \bar{x} , s , and r stand for mean, standard deviation and correlation coefficient respectively.

Obtain the linear regression equation of egg weight on egg-length and egg volume. (10)

Hence estimate the weight of an egg whose length is 58.0 mm and volume is 52.5 cc. (2)

5. On the basis of observations made on 35 cotton plants, with respect to yield of cotton (x_1), number of seed-vessels (x_2) and height (x_3) the correlation co-efficients are found to be $r_{12} = 0.863$, $r_{13} = 0.648$ and $r_{23} = 0.709$.

Determine the multiple correlation $R_{1.23}$ and the partial correlations $r_{12.3}$, $r_{13.2}$, and interpret the results. (4+2+2)

6. Determine the seasonal fluctuations in time series given below, indicating clearly the procedure followed:

year	summer	monsoon	autumn	winter
1	30	81	62	119
2	33	104	86	171
3	42	133	99	221
4	56	172	129	235
5	67	201	136	302

(15)

7. Either,

Fit a modified exponential curve of the form $y = K + ab^x$ to the following data.

x	y
0	50
1	60
2	78
3	87
4	93.75
5	98.8125

(15)

Or,

Fit a third degree polynomial to the following data by the method of grouped averages or by orthogonal polynomials.

x	y
1920	180
1921	200
1922	210
1923	250
1924	290
1925	330
1926	380
1927	420
1928	450
1929	510
1930	550

(15)

PAPER V (PRACTICAL) : ELEMENTARY STATISTICAL METHODS

Time : 5 hours

Full marks : 100

(a) Those who have passed (according to old rules) in Part IB Section II only (and not in Section I of Part IB or in Section I of Part IC) should answer questions of Groups B and C only in $2\frac{1}{2}$ hours.

(b) Those who have passed (according to old rules) in Part IC Section I only (and not in Section I of Part IB or in Section II of Part IB) should answer questions of Groups A and C only in $3\frac{1}{2}$ hours.

(c) All others should answer the full paper.

(d) Figures in the margin indicate full marks.

(e) Use of Calculating machines is permitted.

GROUP A

1. The following table gives the frequency distribution of daily wage rates of a certain class of workers.

Wages (Rs.)	Frequency	Wages (Rs.)	Frequency
0.25—	5	4.75—	523
0.75—	14	5.25—	202
1.25—	564	5.75—	118
1.75—	1243	6.25—	64
2.25—	2045	6.75—	43
2.75—	2339	7.25—	27
3.25—	1815	7.75—	15
3.75—	1432	8.25—	9
4.25—	854		
<hr/>		<hr/>	
Total		11372	

- (a) Compute the mean, the first four central moments, β_1 and β_2 . (17)
- (b) Determine the type of Pearsonian curve, which would fit the above distribution. (4)
- (c) Write down the equation to this curve. (4)

2. *Either,*

In a certain survey 6210 employed persons were classified according to their own occupation and that of their fathers.

Son	Father		
	White collar	Skilled or semi-skilled	Unskilled
White collar	1205	782	440
Skilled or semi-skilled	387	889	438
Unskilled	288	506	1275

Test if son's occupation is independent of father's occupation. (15)

Or,

(a) In a report of the results of physical examinations of over 100,000 draftees the National Selective Service (U.S.A.) reported the number accepted and rejected by race as follows :

	White	Negro
Rejected	38,920	5,200
Accepted	60,783	7,393
	<hr/>	<hr/>
	99,712	12,002

Compute the percentage rejection for each race and test if it is significantly higher for Negroes. (7)

(b) Statistics collected to examine significant differences in length of eggs laid by cuckoos, in the nests of species of foster parents, are shown below :

Species of foster parent	Number of eggs	Length of egg (m.m.)	
		mean	standard deviation
Garden Warbler	91	21.9	0.7860
White Wagtail	115	22.4	0.7606

Use large sample tests for difference in mean lengths and give your findings. (8)

3. A sample of 12 packages of butter were taken from a lot, each package being labelled '100 gms. net weight'. The individual weights in gms. were :

97, 95, 102, 98, 103, 102, 96, 98, 99, 98, 101, 100.

Test whether these values are consistent with a population mean of 100 (You may assume a normal distribution for the distribution of weight). (10)

GROUP B

4. The results of a Randomized Block paddy-variety experiment conducted in an agricultural experimental station, are given below :

Variety	Yields of paddy (maunds per ten bighas)			
	block			
	I	II	III	IV
1	115	118	116	120
2	128	125	125	122
3	123	122	124	119
4	130	126	121	125
5	131	130	126	131
6	119	118	122	115
7	111	114	114	110
8	127	122	119	128

(a) Prepare the appropriate analysis of variance table. (12)

(b) (i) Test if the variety differences are significant. (5)

(ii) Do the blocks have significant effect in the experiment? (2)

(iii) Sketch a bar diagram to show the mean yields of varieties and on it indicate significant variety differences, if any. (6)

5. Either,

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

- (i) Draw a random sample of size 15 *with replacement* from a population of size 100.
- (ii) Draw a random sample of size 18 *without replacement* from a population of size 209.
- (iii) Draw a random sample *without replacement* of 5 households from 6 streets containing, 17, 32, 18, 37, 56 and 12 households respectively.
- (iv) Obtain a random permutation of the letters.
A, B, C, D, E, F, G, H, I. (10)

Or,

Sketch the lay-out of each of the following experiments to be conducted on a square piece of land 60 ft. x 60 ft., for investigating yield differences in varieties of rice;

- (i) a Randomized Block experiment involving 5 varieties and 6 blocks.
 - (ii) a Randomized Block experiment involving 6 varieties and 5 blocks.
 - (iii) a Latin Square experiment involving 5 varieties. (10)
- (Give full reference of any table that you use to answer this question).

GROUP C

6. The length of exposed extremity of immersion heater, has been measured (in suitable units) on 75 heaters forming 15 samples of size 5 and the results are given below.

Sample number	Length				
	1	2	3	4	5
1	3.5	4.1	2.9	6.2	4.1
2	3.8	3.2	2.0	4.2	3.5
3	3.2	2.9	3.8	2.6	3.5
4	4.8	4.2	4.2	5.4	5.1
5	5.0	2.9	3.2	3.5	2.9
6	3.2	2.8	4.0	2.6	3.0
7	3.7	4.4	4.0	2.1	3.0
8	3.1	2.0	3.5	3.1	4.1
9	3.3	4.6	2.6	3.8	3.6
10	2.9	2.5	3.3	2.3	3.9
11	3.0	2.3	2.7	4.3	3.8
12	3.0	2.1	3.0	1.8	3.6
13	2.5	3.7	3.5	2.5	2.8
14	3.0	4.2	2.2	3.8	2.8
15	2.1	4.4	3.5	3.3	3.1

- (a) Obtain the values necessary for fixing up the central line and the upper and lower control limits for (i) \bar{x} chart and (ii) R-chart.
- (b) Using the above values plot the \bar{x} and R charts.
- (c) Write your conclusions based on the two charts. (15)

COMPUTOR'S CERTIFICATE EXAMINATION—NOVEMBER 1962

PART 2A SECTION II [UNDER OLD SYLLABUS]

Time : 5 hours

Full marks : 100

- (a) Answer all the questions.
 (b) Figures in the margin indicate full marks.
 (c) Use of Calculating machines is permitted.

1. Prepare a complete set of computation forms that can be used for arriving at the results mentioed below. (Column and row headings used in each form should be explained where necessary. Provision should be made for checks on the accuracy of computation. Assume that calculating machines and suitable Mathematical Tables will be available for computation. How the entries against each heading in the form will be arrived at should be separately indicated. If any of the entries are expected to be copied out from any published tables, the title of the tables should be mentioned).

Either,

The results are available of a two-stage random sample survey conducted to estimate the proportion of area under paddy cultivation in a certain region. The first stage unit was the village and there were 15 such; the second stage units were plots of land, but the number of plots selected from each village varied; there were a total of 235 plots observed with respect to proportion of area under paddy. It is required to obtain an estimate of the proportion as also the standard error of the estimate. [Note : Both first and second stage units are chosen with equal probability with replacements]. (25)

Or,

Two quantities c_2 and c_3 are to be tabulated, for integer values of n from 2 to 25, using the formulæ:

$$c_2 = \frac{\sqrt{\frac{2}{n} \left(\frac{n-2}{2} \right)!}}{\left(\frac{n-3}{2} \right)!}$$

$$c_3 = \left(\frac{n-1}{n} - c_2^2 \right)^{\frac{1}{2}} \quad (25)$$

2. *Either,*

Solve the following equations for x , y , z and w by the method of determinants :

$$\begin{aligned} 2.1x + 0.7y + 0.5z &= 3.7 \\ 5.6x + 8.9y - 9.2w &= 8.6 \\ 4.2y + 6.2z + 6.9w &= 15.2 \\ 6.5x + 3.5z + 4.7w &= 12.3 \end{aligned} \quad (25)$$

Or,

By tabulating values of the two integrands involved, and by using suitable rules for numerical integration, find, correct to four places of decimal, the value of

$$\frac{1}{n! B\left(\frac{1}{2}, \frac{n}{2}\right)} \int_0^{\frac{1}{2}} \left(1 + \frac{t^2}{n}\right)^{-1^{(n+1)}} dt$$

where $n=5$ and $B(a, b) = \int_0^1 u^{a-1} (1-u)^{b-1} du$. (25)

3. The mean yields per plot at different levels of temperature for seed treatment, obtained in an experiment, were as follows:

Temperature	60°F	75°F	90°F	105°F	120°F
Mean yield per plot	60.74	80.01	87.90	89.48	80.59

Fit a polynomial regression (of maximum degree possible) of mean yield per plot on temperature, by the method of orthogonal polynomials. (15)

4. From the following data consisting of quarterly sales of a product, determine indices of seasonal variations. Give reasons for the choice of the method adopted.

Year	Quarter				Annual average
	first	second	third	final	
1953	6234	8321	5457	4392	6101
1954	6107	8296	5374	3903	5935
1955	5507	5716	6216	4012	5365
1956	5039	6715	4822	4624	5300
1957	4213	7623	3870	3537	4812

(15)

5. Either,

The following table compiled from output records of computers in a statistics office give data about performance in "copying and adding" figures consisting of different digits.

number of digits in figures	number of figures copied and added	time taken (hours)
1	1823	2.24
2	2142	4.02
3	1653	4.84
4	3296	11.75
5	2653	11.13
6	1325	6.06
7	983	6.32
8	457	3.02

(a) using the data, determine a suitable relationship between y =time taken to copy and add 1000 figures, and x =number of digits in figures. (15)

(b) if a computer is paid at the rate of Rs. 1.25 per hour, use the relationship obtained in (a) to estimate the total remuneration to be paid to computers for doing a piece of work involving the copying and adding of 6600, 3700 and 4300 respectively of 5, 4 and 3 digit figures. (5)

Or,

A specimen each of a drug taken from a particular production batch, was sent to each of twelve laboratories for determination of potency. In each laboratory, two independent determinations were made. The results are given below.

(a) Prepare the analysis of variance table and make appropriate tests. (10)

(b) If significant differences between laboratories are noted, group the laboratories into sets of "similar" performance. If there are no significant differences between laboratories explain as to how it could be so. (6)

(c) Estimate the mean potency of the batch and give its standard error. (4)

laboratory	determination 1	determination 2
1	99.75	99.62
2	100.02	99.98
3	96.53	97.02
4	98.67	98.67
5	97.98	98.05
6	99.02	99.03
7	100.67	100.65
8	98.73	98.25
9	99.02	99.38
10	98.05	97.99
11	98.57	99.12
12	99.87	99.70