

INDIAN STATISTICAL INSTITU

QUESTION PAPERS

for

The Computer's Certificate Examinations

March & September 1961

64

Price : Rupee One or

INDIAN STATISTICAL INSTITUTE
COMPUTER'S CERTIFICATE EXAMINATION, MARCH 1961

PART 1A—SECTION I

Time : 3 Hours

Full marks : 100

- (a) All questions carry equal marks.
 (b) Use of calculating machines is not permitted.

1. Complete the calculations given in the following table:

a	b	(a+b)	(a-b)	(a+b) ²	(a-b) ²	ab	(a ² +b ²)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.5	2.2						
0.3	3.4						
2.5	4.5						
1.2	0.7						
3.2	5.9						
2.2	4.3						
4.9	9.0						

2. The following table gives the percentage distribution of persons engaged in different sectors of activity in rural areas for some of the States (prior to States Reorganisation) and all-India as obtained from the 9th round of the Indian National Sample Survey.

Copy the table after correcting obvious mistakes, if any.

Percentage distribution of persons engaged in different sectors of activity in rural areas for some States and all-India.

state ¹	sector						total
	private		public		domestic not recorded		
	small scale	large scale	total (col.s 2 + col.s 3)				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Uttar Pradesh	97.66	0.44	98.10	1.31	0.53	0.06	100.00
2. Bihar	93.67	2.13	95.80	2.58	1.08	0.54	100.00
3. Orissa	93.25	24.24	117.49	2.68	0.83	—	100.00
4. West Bengal	10.13	5.85	15.98	2.78	1.07	0.17	100.00
5. Assam	87.88	8.57	96.45	2.70	0.76	—	100.00
6. Andhra	91.30	4.58	95.88	2.93	1.14	0.05	100.00
7. Madras	92.81	2.78	95.59	33.00	0.97	0.44	100.00
8. Bombay	95.70	1.32	97.02	2.50	30.27	0.21	100.00
9. Madhya Pradesh	9.597	0.95	10.547	2.34	0.74	—	100.00
10. Punjab	14.43	—	14.43	4.21	1.30	—	100.00
11. all-India	94.70	2.12	96.82	2.18	0.78	0.22	100.0

¹Part A States prior to States Reorganisation.

3. *Either*,

The list below shows the acreages under the crops Paddy (P), Pulses (Pu), Tobacco (T), Groundnut (G), Chillies (C), Other cereals (OC) in 17 villages.

1. *Adiviravulapadu*: T 2, Pu 115, C 15, OC 543, G 162
2. *Bandarupalli*: T 990, Pu 169, OC 1813, P 154, G 401, C 814
3. *Bandlamudi*: C 28, OC 733, T 1, Pu 28, P 4
4. *Bondapadu*: G 829, C 587, P 42, T 160, OC 2315, Pu 404
5. *Gollapadu*: Pu 94, G 273, C 140, OC 1195, P 41, T 182
6. *Katrapadu*: OC 1080, T 1631, Pu 6, C 85, P 132
7. *Madala*: C 138, P 102, G 435, OC 1380, T 1039
8. *Mittagudipadu*: P 9, C 535, Pu 110, G 60, OC 82
9. *Nallapadu*: OC 475, T 450, C 542, Pu 70, G 669
10. *Nandipahad*: G 415, P 147, Pu 261, C 6, OC 1262
11. *Pakalapadu*: T 95, Pu 124, OC 1744, C 170, G 300, P 3
12. *Padaveedu*: Pu 96, G 75, P 191, C 41, OC 1548, T 11
13. *Potavaram*: G 152, T. 394, P 1, Pu 27, C 83, OC 526
14. *Ravipadu*: T 17, Pu 2, C 170, P 28, OC 389, G 436
15. *Singareddipalem*: C 20, P 507, OC 490, T 1, Pu 30, G 60
16. *Tripuram*: Pu 410, C 10, G 1347, P 382, T 2, OC 190
17. *Vadapalli*: P 5, Pu 454, T 4, OC 2371, G 154, C 66

A village is said to be 'Commercially most important if *either* the acreage under any one of three Commercial crops (viz., Tobacco, Chillies and Groundnut) exceeds 600 acres or the total acreage under all the three commercial crops exceeds 980 acres. If, however, *either* the acreage under any single Commercial crop in a village is more than 420 acres or the total acreage under all the three commercial crops exceeds 750 acres it is called a "Commercially potential village. The rest area called 'others'.

On the basis of the above criteria, classify the villages as (i) commercially most important, (ii) commercially potential and (iii) others.

Or,

Tabulate the following details in suitable form showing the maximum and minimum temperatures for the consecutive 12 months of the year 1954 under all the six centres after they have been arranged alphabetically. Add also a remark column in your table, indicating therein the places which should be termed hot when the maximum temperature in May exceeds 102° Fahrenheit.

Maximum and Minimum temperatures in Fahrenheit degrees at six important centres during the twelve months in 1954.

September

Ambala: 9.73, 75.5, Bangalore: 81.2, 65.4

Bhubaneswar: 87.5, 76.0, Calcutta: 90.0, 79.5, Jodhpur: 94.9, 77.2;

New Delhi: 94.3, 78.0.

April

Bhubaneswar: 102.7, 79.5; Ambala: 100.5, 68.9;
Calcutta: 101.6, 80.1; Jodhpur: 102.6, 73.6; Bangalore: 93.4, 71.2;
New Delhi: 90.2, 71.2.

November

Bhubaneswar: 84.6, 6.1; Jodhpur: 80.0, 59.6; Bangalore: 80.1, 59.4;
New Delhi: 83.3, 54.1; Calcutta: 84.5, 61.2; Ambala: 84.2, 50.3.

May

Bhubaneswar: 98.0, 81.0; Ambala: 100.9, 75.7; Jodhpur: 109.5, 80.1;
Calcutta: 96.7, 80.7; Bangalore: 91.3, 68.0; New Delhi: 107.3, 82.0.

January

Calcutta: 78.3, 54.8; Bhubaneswar: 82.3, 58.4; Jodhpur: 76.6, 47.50
Bangalore: 81.2, 60.1; New Delhi: 68.8, 44.8; Ambala: 67.3, 44.2.

June

Jodhpur: 107.7, 83.7; Bangalore: 83.9, 67.0; New Delhi: 105.3, 84.6;
Calcutta: 91.7, 79.0; Ambala: 105.9, 83.4; Bhubaneswar: 91.7, 77.3.

August

Calcutta: 89.7, 79.8; Ambala: 97.7, 76.0; Bangalore: 79.6, 66.8;
New Delhi: 96.3, 80.8; Jodhpur: 95.1, 78.3; Bhubaneswar: 89.4, 77.8.

December

New Delhi: 77.0, 45.3; Bhubaneswar: 81.4, 60.7; Ambala: 75.1, 42.0;
Jodhpur: 81.7, 50.0; Bangalore: 78.3, 60.1; Calcutta: 80.5, 58.8.

February

Ambala: 72.3, 52.7; Calcutta: 89.1, 65.7; New Delhi: 74.2, 54.0;
Bhubaneswar: 61.6, 67.0; Jodhpur: 82.7, 55.3; Bangalore: 86.5, 61.2.

July

Bangalore: 79.8, 60.4; Ambala: 97.0, 79.6; Jodhpur: 97.5, 82.3;
New Delhi: 96.8, 81.3; Bhubaneswar: 89.5, 78.7; Calcutta: 90.0, 79.8.

March

Calcutta: 95.5, 71.0; New Delhi: 85.6, 65.5; Bhubaneswar: 90.2, 72.1;
Jodhpur: 92.4, 62.4; Ambala: 84.0, 56.8; Bangalore: 88.9, 65.7.

October

Bhubaneswar: 80.2, 65.6; Jodhpur: 94.0, 65.0; Calcutta: 88.2, 73.5;
Ambala: 89.5, 60.0; Bangalore: 80.2, 65.6; New Delhi: 87.2, 62.1.

4. Below are given the statures (in cms) and the corresponding total facial lengths (in mm) of 23 cases:

observation no.	stature (in cm)	total facial length (in mm)
1	107	115
2	101	114
3	100	114
4	101	115
5	101	115
6	103	117
7	103	112
8	104	118
9	105	116
10	101	113
11	102	114
12	103	117
13	100	120
14	104	115
15	100	114
16	108	114
17	103	112
18	102	116
19	101	113
20	100	113
21	100	114
22	103	113
23	101	105

Classify these data into four groups as follows:

- i. Those with stature 103 cm or less and total facial length 115 mm or less.
 - ii. Those with stature exceeding 103 cm but with total facial length 115 mm or less.
 - iii. Those with stature 103 cm or less but total facial length exceeding 115 mm.
- and iv. Others.

For each group find (a) the total number of cases (b) the average stature and (c) the average total facial length. Present these results in a suitable tabular form.

PART 1A—SECTION II

Time: 3 Hours

Full marks: 100

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

1. (a) Find by contracted multiplication

$$74.30672 \times 80.00951$$

correct to 3 places of decimal.

(10)

(b) Given $\log 2 = 0.3010$, $\log 3 = 0.4771$, find $\log 14.4$, $\log 0.006$ (5)

(c) Use tables to find $\log_{10} 2.3047$, $\log_4 27.83$ (5)

2. Either,

Evaluate

$$\frac{\sqrt[2]{2\pi n} e^{-n} n^n}{n}$$

for $n = 9$ correct to 5 places of decimal, where $e = 2.71828$. (15)

Or,

Evaluate

$$\frac{1}{2} (1 - e^2) \frac{mm'}{m+m'} (u-u')^2$$

when $m = 537$, $m' = 388$, $u = 43$, $u' = 19$, and $e = 0.6$. (15)

3. Either,

Solve the equation $x + 3 - \frac{7.8}{x+3} = 1$,

correct to four places of decimals. (10)

Or,

Find, correct to 5 places of decimals, the value of (10)

$$\left[1 - \frac{4}{5^2} + \frac{7}{5^4} - \frac{10}{5^6} \right] - \left[1 - \frac{3}{2^2} + \frac{5}{4^2} - \frac{7}{8^2} + \frac{9}{16^2} \right]$$

4. The marks obtained by a group of boys in a test were as follows:

15, 19, 22, 6, 14, 8, 20, 14, 18, 23, 10, 12, 16, 15, 19, 13.

Find the mean and the standard deviation. (15)

The marks obtained by a group of 10 girls in the same test had a mean of 16.5 and a variance of 18.4. Find the mean and the standard deviation of the marks of two groups combined. (10)

5. The following table gives the seasonal mortality due to small pox per 100000 in undivided Bengal:

months	1935	1936	average of 1926-34
January	0.6	4.7	2.7
February	0.8	9.6	3.5
March	1.5	16.1	5.5
April	2.4	20.6	6.7
May	2.4	15.9	6.6
June	N.A.	N.A.	N.A.
July	1.0	5.8	2.8
August	0.6	2.7	1.8
September	0.5	1.6	1.1
October	0.4	1.2	0.8
November	0.8	1.6	0.8
December	2.5	2.7	1.6

- (a) Represent the data graphically and join the plotted points by straight lines. (15)
 (b) Estimate the missing figures for June from your graph. (5)
7. The following table shows passenger fares for different distances for the Air conditioned class in the Indian Railways:

distance in kilometers	200	220	240
fare in rupees	25.50	28.18	30.76

By interpolation estimate (a) the fare for 230 kilometers (b) the distance for which the fare is 27.50 rupees. (5+5)

PART 1B—SECTION I

Time: 3 Hours

Full marks: 100

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

1. Present the following statistics in a suitable tabular form:

- (i) The number of High Schools in Burdwan is 148 with 40,511 scholars in them.
 (ii) The number of Middle Schools in Burdwan is 151. (iii) Birbhum: 1,229 Primary Schools, 105 Middle Schools, 48 High Schools. (iv) Bankura: 2,050 Primary Schools with 1,31,125 Scholars in them, 93 Middle Schools with 8,085 scholars in them, 71 High Schools with 10,782 scholars in them. (v) The information on Primary Schools in Burdwan is not available. (vi) Number of scholars in Middle Schools: In Burdwan 12,672, and in Birbhum 8,752. (vii) Birbhum: The number of scholars in High Schools is 15,215, and in Primary Schools, 0,37,00. (10)

2. The following table gives the frequency distribution of the size of the holding per cultivator.

size of holding (acres)	number of cultivators
0 — 1	612
1 — 2	1426
2 — 3	1736
3 — 4	1521
4 — 5	1130
5 — 6	912
6 — 7	837
7 — 8	312
8 — 9	100
9 — 10	45

Find the mode, mean, standard deviation and the quartiles of the distribution. (20)

3. Given below are the weights, the base period (August, 1939) prices and price quotations per seer for the month of August 1960 for a number of commodities. Calculate the average price for the month of August 1960 for each commodity and the Index number of consumer prices for these commodities for August 1960 with August 1939 as base.

commodity	weight	base period	price quotations for			
		(Aug. 39) prices	August 1960			
		nP per seer	nP per seer			
rice	22	14	82,	84,	78,	90
Wheat	6	15	55,	60,	56,	62
Jowar	3	9	44,	60,	44,	45
Maize	1	15	37,	40,	40,	37
Arhar	2	12	69,	75,	62,	69
Groundnut Oil	3	15	75,	78,	75,	78
Coconut Oil	1	19	88,	85,	88,	90
Chillies	2	12	62,	65,	60,	62
Vegetables	5	9	55,	60,	55,	62
Salt	2	12	15,	51,	15,	15

(20)

4. *Either,*

Marks in English and in French for 20 pupils are given below:

English	French	English	French
87	68	51	53
77	55	50	45
70	58	48	43
68	62	48	45
63	50	47	40
58	48	48	35
55	53	46	33
54	50	43	38
53	38	40	32
52	43	24	31

Calculate the coefficient of correlation. Plot the scatter diagram and draw the two regression lines. (25)

Or,

The table given below shows the value of sales during the years 1937 to 1953. Fit a second degree parabola to the data, and show the fitted and the observed series on the same graph.

Values of sales in lakhs of rupees

year	sales	year	sales
1937	8.3	1946	15.0
1938	7.8	1947	18.1
1939	8.8	1948	20.1
1940	9.9	1949	20.7
1941	11.7	1950	23.4
1942	13.3	1951	26.5
1943	15.5	1952	28.0
1944	16.5	1953	31.0
1945	16.1		

(26)

5. The following tables provide the information on the number of plants and the yield of lint in a varietal trial on cotton. Each variety has been replicated in 5 randomised blocks.

Number of plants and yield of cotton lint in ounces.

variety	Yield of lint				
	I	II	III	IV	V
A	11	8	9	6	5
B	5	6	10	8	4
C	4	7	6	3	4

No. of plants

	blocks				
	I	II	III	IV	V
A	18	12	13	10	8
B	13	15	19	16	11
C	6	12	9	6	5

Carry out an appropriate analysis of variance and covariance to test the significance of varietal differences in the yield of lint after correcting for differences in the number of plants. (25)

PART 1B—SECTION II

Time: 3 Hours

Full marks: 100

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

1. (a) From the following tabulated values of the function

$$E = E(x, y)$$

find, by linear interpolation, the values of $E(55.4, 53.1)$ and $E(60.0, 55.0)$.

y/x	50	54	58	62
50	0.8314	0.8000	0.7988	0.7920
52	0.8414	0.8332	0.8251	0.8174
54	0.8090	0.8598	0.8508	0.8422
56	0.8052	0.8859	0.8769	0.8663

(10)

- (b) Either,

From the equation $y = ab^x$ where $a = 2.00027$ and $b = 1.00168$ find the values of y for $x = 2140, 2380, 2700$ and 3223 . (10)

Or,

By using logarithmic tables, find the value of

$$y = 5.35(x - 2.32)^{3.85} - 1.85(x - 2.32)$$

for $x = 3.29$ and 4.12 .

(10)

2. 1160 measures on the velocity of light show the following frequency distribution.

velocity interval in Km per sec.	frequency
299,691—700	1
701—710	3
711—720	5
721—730	18
731—740	40
741—750	98
751—760	165
761—770	232
771—780	242
781—790	180
791—800	105
801—810	46
811—820	16
821—830	4
831—840	3
841—850	2
1160	

Fit a normal curve to the above data.

(18)

Test the goodness of fit.

(7)

Draw the histogram and the fitted curve on the same graph

(10)

3. (a) In a sample of 1250 persons taken from country A, 735 persons were found to be adult (age 14 years and above). The number of adults in a sample of 1325 persons taken from country B was found to be 860. Examine whether the data are consistent with the hypothesis that the proportion of adults is the same in the two countries.

(6)

(b) The average income of earners in a town was obtained for the years 1950 and 1955 on the basis of the earnings of 1610 and 1423 persons respectively. The averages and the standard deviations of income for the two years are given below. Test whether the two averages are significantly different from each other at 5 percent and 1 percent levels of significance.

year	size of sample	average income (Rs.)	standard deviation of income (Rs.)
1950	1610	251	182
1955	1423	266	204

(7)

(c) The following table gives the distribution of 6800 males according to the colour of eye and hair.

Eye colour	Hair colour				
	Fair	Brown	Blouck	Red	Total
Blue	1768	807	189	47	2811
Grey or Green	946	1387	746	53	3132
Brown	116	438	288	16	867

Examine whether there is any association between hair colour and eye colour. (12)

4. Select *any five* of the following items and state for each (1) name of the publication containing the information, (2) the name of the publishing authority and (3) whether the publication is issued weekly, monthly, annually etc.

(Your are not required to compile the actual information).

- (a) The value of electric machinery, apparatus and appliances imported from the United Kingdom in September 1960.
 (b) The index number of wholesale price for cereals in August 1960 (with base: 1952-53=100).
 (c) The total number of man-days lost during July 1960 in India by industrial disputes.
 (d) The total number of persons employed in the iron and steel industry of India in 1957.
 (e) The national income of India for 1958-59.
 (f) The index of industrial production in India for June 1960,
 (g) Consumer price index number of working class at Delhi for July 1960.
 (h) Value of the total productive capital employed in the cotton textile industry of India in 1957. (20)

PART 1C—SECTION I

Time: 4 Hours

Full Marks: 100

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

1. *Either,*

The table below gives the production of coal in million tons in India for the years 1950-51 to 1959-60. Fit a third degree polynomial to the data and plot the observed and expected values on a graph. Extrapolate the value for 1960-61.

year	production of coal (in million tons)	year	production of coal (in million tons)
1950-51	32.3	1955-56	38.4
1951-52	35.0	1956-57	40.3
1952-53	30.0	1957-58	44.1
1953-54	35.6	1958-59	46.0
1954-55	37.4	1959-60	47.8

(20)

Or,

(a) Population of a country has increased from 301.8 millions in 1951 to 430.8 millions in 1961. Assuming that the growth of population has followed the compound interest law, find the annual rate of growth and estimate the population for the two years 1952 and 1960 (10)

(b) Using Barlow's Tables prepare a table of the fourth root of n , for $n=1, 2, \dots, 9, 10$. The tabulated values should be correct to four places of decimal (No marks will be given unless the method of computation is fully described). (10)

2. Evaluate to three places of decimals:

$$\begin{aligned}
 t &= x + \frac{1}{n} \left(\frac{x^2 + x}{4} \right) + \frac{1}{n^2} \left(\frac{5x^3 + 16x^2 + 3x}{96} \right) \\
 &+ \frac{1}{n^3} \left(\frac{3x^4 + 19x^3 + 17x^2 - 15x}{384} \right) \\
 &+ \frac{1}{n^4} \left(\frac{79x^5 + 778x^4 + 1482x^3 - 1920x^2 - 945x}{92160} \right) + \dots
 \end{aligned}$$

for $x=1.64485363$ and $n=100, 150, 200, 250$. (Special credit will be given to initial planning of computations and determination of accuracy needed in intermediate steps). (20)

3. Data given in the table below represent percentage moisture absorbed by different water repellent cottons tested by three laundries (L_1, L_2, L_3) under three different test conditions (T_1, T_2, T_3), each test run in duplicate.

Analyse the variance into the following components (i) between laundries, (ii) between tests, (iii) interaction between laundries and tests and (iv) error; test the significance of first three components. (25)

Percent moisture absorbed

Test	Laundry					
	L_1		L_2		L_3	
T_1	7.20	9.60	2.40	2.14	2.19	2.69
T_2	11.70	11.70	7.76	7.76	4.02	1.86
T_3	15.12	14.38	0.13	0.89	5.34	4.88

4. Either,

You are given below an extract from a computer's worksheet. Scrutinize the computations and indicate your method of scrutiny. Correct the mistakes, if any. Calculate the multiple correlation coefficient of Y on X_1 and X_2 and test its significance.

Variables			Squares and cross products					
X_1	X_2	Y	X_1^2	X_1X_2	X_1Y	X_2^2	X_2Y	Y^2
220	9	3.5	48,400	1,080	770.0	81	31.5	12.25
325	10	7.2	105,625	5,200	2340.0	256	115.2	51.84
620	8	9.0	270,400	4,160	4680.0	64	72.0	81.00
400	13	4.2	160,000	5,200	1680.0	169	54.6	17.64
285	18	16.0	81,225	5,130	4816.5	324	304.2	285.07
297	14	0.7	88,209	4,186	2880.9	100	135.8	94.00
307	11	5.2	94,249	3,377	1598.4	121	57.2	27.04
215	8	6.5	46,225	1,720	1397.5	64	52.0	42.25
220	1	8.3	48,400	220	1826.0	1	8.3	68.89
255	9	10.0	65,025	2,295	2550.0	81	90.0	100.00
225	3	5.2	50,625	675	1170.0	9	15.6	27.04
400	8	14.6	60,000	3,200	5840.0	64	116.8	213.16
135	3	5.1	18,225	405	688.5	9	15.3	26.01
148	7	4.0	21,904	1,036	592.0	49	28.0	16.00
380	4	6.2	129,360	1,440	2332.0	16	24.8	38.44

(25)

Or,

Table below gives the estimated value (in dollars) of land per acre (X_1), the percent of land in harvested crops (X_2) and the crop yield (in bushels) (X_3) of 15 U.S. countries.

Compute the coefficients of partial correlation $r_{12.3}$ and $r_{13.2}$ and test their significance. (25)

X_1	X_2	X_3	X_1	X_2	X_3
40	52	32	27	54	29
20	43	28	35	59	33
45	51	35	40	62	37
49	69	31	42	57	40
59	60	41	39	60	33
45	70	36	30	50	26
48	72	38	33	61	29
31	53	32			

5. Using tables of ordinates and areas of the Normal Curve, evaluate the following:

(a)
$$\frac{1}{12.6 \sqrt{2\pi}} e^{-\frac{1}{2}(0.23)^2}$$

(b) the area under the Normal curve with mean 0.375 and standard deviation 0.008 between the ordinates at 0.305 and 0.380. (10)

PART IC—SECTION II

Time: 4 Hours

Full marks: 100

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

1. *Either,*

The following table gives the value of a function $y=f(x)$ for $x=40$ to 45 at intervals of 1.

x	$f(x)$
40	73.2394
41	73.3197
42	73.3994
43	73.4800
44	73.5599
45	73.6397

Find the value of y , when (i) $x=40.6$, (ii) $x=42.5$ by using suitable interpolation formulae. (10)

Or,

Using the following table of values of $F(x)$, find the value of x for which $F(x)=0.64$:

x	$F(x)$
0.62	0.61914
0.63	0.62705
0.64	0.63459
0.65	0.64203
0.66	0.64938
0.67	0.65663
0.68	0.66378

 (10)

2. Electricity generated (million Kwh) in the Indian Union by months from January 1956 to December 1959 are given below:

	1956	1957	1958	1959
January	575	869	974	1156
February	750	811	920	1112
March	800	895	969	1171
April	781	901	1004	1162
May	826	932	1046	1242
June	796	898	1014	1202
July	798	928	1057	1250
August	795	923	1041	1244
September	813	925	1053	1237
October	824	918	1073	1267
November	811	930	1050	1235
December	881	959	1113	1301

Calculate indices of seasonal variation (20)

3. A manurial trial was conducted with six manures (A, B, C, D, E and F) in five randomised blocks of 6 plots each. The layout and the yields per plot are given below:

Block 1	Block 2	Block 3	Block 4	Block 5
B-38	C-36	D-35	F-40	A-40
E-37	F-23	C-40	B-50	D-45
D-25	E-49	F-38	A-40	B-21
F-38	B-30	A-40	E-40	C-37
A-32	D-31	B-36	C-36	E-35
C-35	A-42	E-37	D-32	F-35

Analyse the data and test whether the manures differ significantly from one another in yielding capacity. (25)

4.

midpoint of class (x)	frequency (f)
1	1
2	7
3	37
4	144
5	245
6	410
7	420
8	400
9	365
10	145
11	76
12	28
13	12
14	5
15	3

You are given the following statistics based on the frequency table above:

$$\Sigma fx = 16802$$

$$\Sigma fx^2 = 131750$$

$$\Sigma fx^3 = 1100336$$

$$\Sigma fx^4 = 9715634$$

- (a) You are asked to fit a Pearsonian Type VII curve to the above distribution. Evaluate the constants of the curve. (13)
- (b) Find the ordinates of this curve at least at five suitable points and plot the curve and the histogram on the same graph. (12)
- (c) On the basis of the values of β_1 and β_2 coefficients that you have computed, do you think that the Pearsonian type chosen has been appropriate? (5)
5. Find out any five of the following from the published sources and indicate in each case the source or sources used. (15)
- (i) Value of Central Government contracts placed in India and outside India for any five years between 1950 and 1959.
- (ii) Quantity and value of imports into and exports out of India for any 3 years between 1949-50 and 1953-54 for (a) pencils and (b) fountain pens.

- (iii) Quantity of production of coal in 1958 and 1959 in the states of Assam, Andhra, Madhya Pradesh and Orissa.
- (iv) Passenger-kilometer borne by Civil Aviation from 1955 to 1959 in Japan, Phillippines, Thailand and U.K.
- (v) India's Foreign Exchange Reserves at the end of the years from 1955 to 1959.
- (vi) Number of applications for patents in India for the years 1951 to 1955 for
 (a) calculating, counting and cash-registering apparatus and (b) motor cars.

PART 2A—SECTION I

Time: 6 Hours

Full Marks: 100

- (a) Attempt any three questions.
 (b) All questions carry equal marks.

1. The following table gives the summary of measurements taken on two groups of school children in the primary stage. Calculate the generalised distance (D^2) between the two groups.

Characters	Mean		Pooled S.D.	Pooled correlations			
	Group A n=50	Group B n=50		X_1	X_2	X_3	X_4
X_1 stature (mm)	1135.61	1181.20	56.44	×	.8282	.7337	.8053
X_2 weight (hectagram)	175.71	192.70	23.40		×	.8307	.6628
X_3 Girth of thorax (mm)	548.43	561.21	29.85			×	.5301
X_4 length of humerus (mm)	210.06	218.21	18.01				×

2. The following table gives 18 sets of average values of land cultivated in acres (X_1), land owned in acres (X_2), size of family (X_3) and number of plough cattle (X_4).

Obtain the regression of X_1 , on X_2 , X_3 and X_4 . Compute the multiple correlation coefficient $R_{1.234}$ and the partial correlation coefficient $r_{12.34}$ and test for their significance.

Serial No.	X_1	X_2	X_3	X_4
1	3.44	2.33	5.13	1.81
2	4.27	3.30	5.70	2.06
3	5.07	4.14	6.14	2.30
4	5.80	5.28	6.84	2.50
5	6.54	6.36	6.83	2.70
6	7.17	7.28	7.06	3.04
7	8.38	8.20	7.58	3.34
8	8.68	9.26	7.31	3.09
9	9.87	10.12	8.71	3.78
10	10.70	11.35	8.01	4.25
11	11.99	13.34	8.12	3.82
12	12.33	14.26	9.24	4.13
13	14.45	15.64	9.68	4.36
14	13.05	17.24	8.47	4.00
15	15.87	18.86	9.04	5.20
16	17.29	19.09	10.20	5.70
17	17.67	20.59	10.37	6.76
18	19.65	20.24	13.61	5.87

3. The table on page 17 gives the total facial length (TFL) and the upper facial length (UFL) in millimetres of 150 individuals.

(a) Prepare a bivariate frequency table using a class interval of 4 mm for TFL and 3 mm for UFL.

(b) Test the linearity of regression of TFL on UFL.

4. Draw 50 random samples each of size three (with replacement) from the individuals whose TFL and UFL measurements are given in Q.3.

For each sample of size three compute the range R_1 of TFL and the range R_2 of UFL measurements and compute the ratio $z = R_1/R_2$.

Prepare the frequency distribution of z in about eight classes of equal width. Compute the mean and the standard deviation of this distribution of z .

TABLE RELATING TO Q.3.

Sl. No.	TFL	UFL	Sl. No.	TFL	UFL	Sl. No.	TFL	UFL
1	104	59	51	125	66	101	108	54
2	115	64	52	107	58	102	110	61
3	122	68	53	112	67	103	114	61
4	114	65	54	116	58	104	112	67
5	116	67	55	108	61	105	108	65
6	114	62	56	117	62	106	110	69
7	125	66	57	100	58	107	118	65
8	106	57	58	114	60	108	105	58
9	107	63	59	115	65	109	107	62
10	117	60	60	102	53	110	115	63
11	114	58	61	108	64	111	114	61
12	110	62	62	107	61	112	116	55
13	112	67	63	125	67	113	109	62
14	110	61	64	115	66	114	114	60
15	112	61	65	118	65	115	112	62
16	110	61	66	105	61	116	105	58
17	115	65	67	114	61	117	120	69
18	114	60	68	115	65	118	102	58
19	120	66	69	116	61	119	120	69
20	120	65	70	122	71	120	102	58
21	120	66	71	124	69	121	128	69
22	117	64	72	120	68	122	100	53
23	114	64	73	119	64	123	117	64
24	125	68	74	105	57	124	107	58
25	112	61	75	109	56	125	112	58
26	118	63	76	103	59	126	114	59
27	106	63	77	118	64	127	114	58
28	117	65	78	110	65	128	108	59
29	107	57	79	115	63	129	114	57
30	125	68	80	110	62	130	128	67
31	113	63	81	95	48	131	110	58
32	107	59	82	110	58	132	110	67
33	106	80	83	115	60	133	117	62
34	114	65	84	104	59	134	109	60
35	105	84	85	119	60	135	114	58
36	119	66	86	114	67	136	107	65
37	110	64	87	112	65	137	102	56
38	114	67	88	114	68	138	107	58
39	117	62	89	106	55	139	123	64
40	110	62	90	110	61	140	110	56
41	161	69	91	103	64	141	113	62
42	114	65	92	104	56	142	124	82
43	124	67	93	98	48	143	105	55
44	99	54	94	114	63	144	102	49
45	120	65	95	108	65	145	117	63
46	112	63	96	108	59	146	106	56
47	110	62	97	108	69	147	108	59
48	104	64	98	115	57	148	112	57
49	105	60	99	109	64	149	109	63
50	125	66	100	109	65	150	107	58

COMPUTER S CERTIFICATE EXAMINATION, SEPTEMBER 1961

PART 1A—SECTION I

Time: 3 Hours

Full marks: 100

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

1. In the third and fourth rounds of the Indian National Sample Survey, the following estimates of consumer expenditure for the urban areas of India were obtained.

The per capita expenditure on food grains was Rs. 8.86 per month in the third round and Rs. 6.14 per month in the fourth round. The corresponding expenditures on milk and milk products were Rs. 3.00 in the third round and Rs. 2.46 in the fourth round, the expenditures on other food items (other than food grains and milk and milk products) being Rs. 8.52 in the third round and Rs. 6.29 in the fourth round. In the third round the per capita expenditure per month on clothing was Rs. 1.48 and on the remaining non-food items Rs. 14.81. In the fourth round the corresponding figures of expenditure on clothing and remaining non-food items were respectively Rs. 2.44 and Rs. 12.47.

Present the above details in a neat tabular form with suitable headings, bringing out the comparison between the third and fourth rounds. The table should also show separately the expenditures incurred on (i) food items, (ii) non-food items and (iii) all items. For each item express the expenditure in the fourth round as a percentage of the corresponding expenditure in the third round. (15)

2. Either,

The following table shows the percentage distribution of population by age-group x sex classifications for urban India during the third, fourth, fifth and sixth rounds of the National Sample Survey.

- (a) Copy the table after correcting all the mistakes that you can detect. (20)
 (b) Give a blank lay-out for a different way of tabular presentation of the same data. (10)

PERCENT DISTRIBUTION OF POPULATION IN AGE GROUPS BY SEX: ALL-INDIA

age group (years)	sex	NSS round			
		3rd	4th	6th	7th
(1)	(2)	(3)	(4)	(5)	(6)
1. 0—14	male	39.09	4.117	1.30	40.7
2. "	female	38.29	30.01	40.20	40.56
3. "	total	39.16	40.54	40.76	40.68
4. 15—44	male	44.92	3.87	44.59	44.80
5. "	female	44.86	44.40	4.568	44.65
6. "	total	4.90	44.13	45.12	44.72
7. 45—64	male	12.40	1.240	119.5	12.09
8. "	female	13.59	12.82	11.69	12.02
9. "	total	129.8	12.06	11.83	12.05
10. 65 and above	male	2.09	2.47	2.15	2.33
11. "	female	3.20	2.87	2.43	2.77
12. "	total	2.06	.67	2.29	2.55
13. all ages	male	100.00	100.00	100.00	100.00
14. "	female	100.00	100.00	100.00	100.00
15. "	total	100.00	100.00	100.00	100.00

Or,

The following table gives production of milk and milk products (in lakh mds.) in different states of India in 1950. Correct obvious mistakes and supply the missing figures and then present the data in a suitable tabular form, arranging the states under each part alphabetically. (30)

Table showing the production of milk, ghee and butter
(in lakhs mds.) in different states in India in 1950.

serial no.	name of state	classification as part A or part B	cow milk	buffalaw milk	goat milk	ghee	total of milk	butter	total of milk and milk products
1.	Andhra Pradesh	A	11.14	218.80	113333	7.97	331.27	0.13	339.37
2.	Bihar	A	2276.61	200.92	1.85	8.95	479.38	1.30	489.63
3.	Assam	A	26.39	..	1.28	0.43	33.41	0.10	1133.04
4.	W. Bengal	A	140.85	16.05	21.99	0.45	178.89	49	179.83
5.	M. Bharat	B	80.68	81.32	3.57	834	165.57	0.05	169.46
6.	Uttar pradesh	A	434.01	772.46	18.08	..	1222.15	3.06	..
7.	Orissa	A	77.87	19.91	2.24	1.09	100.02	nil	102.01
8.	Punjab	A	169.30	279.74	5.18	9.68	..	9.15	463.05
9.	Total of Part A states		1226.17	1613.82	49.85	59.78	2789.34	14.23	2854.35
10.	Total of Part B states		323.43	326.14	..	25.83	708.15	1.66	735.64
11.	Hydrabad	B	51.24	91.65	..	5.61	150.88
12.	Rajasthan	B	1.9151	153.17	47.02	18.38	391.70	1.48	409.58
13.	Grand total		1549.60	1839.76	108.13	76.61	3497.49	..	3589.99

3. Complete the calculations in the following table and copy it.

(25)

x	f	xf	x^2	x^2f	$x+1$	$(x+1)^2 \cdot (x+1)^2f$
-2.5	8					
-1.8	9					
-1.2	17					
-0.7	20					
-0.1	24					
0.3	19					
0.9	14					
1.4	8					
2.0	5					
4.0	3					
Total						

4. The following are the measurements of height in inches (h) weight in lbs (w) and chest expansion in inches (c) of some students in a college.

(a) Find the average chest expansion of the candidates whose weight ranges from 121 lbs. to 130 lbs. and whose height ranges from 61" to 64". (10)

(b) Find the average weight of candidates whose chest expansion is 3 inches and whose height ranges from 59" to 64". (10)

(c) The number of students whose height ranges from 58" to 62" and the chest expansion ranges from 2" to 3" and whose weight is 120 lbs. (10)

V. K. Rao: $h61, w128, c1$, M. A. Khadar: $w120, h60, c4$, M. M. Sheriff: $c2, h58, w120$, M. B. Iyer: $w134, c3, h62$, M. L. Sharma: $h64, c2, w123$, U. M. Ghokael: $c3, w112, h60$, K. Swaminathan: $h61, w128, c3$, N. Basappa: $h59, c2, w118$, Y. K. Kurian: $w132, c1, h63$, M. K. B. Menon: $w136, h65, c2$, Alfred Joseph: $c3, h60, w116$, A. M. Hilton: $c2, w122, h59$, Syed Ali: $h61, w119, c2$, J. P. Srivastava: $h62, c2, w123$, N. K. Bhatia: $w131, c3, h63$, D. M. Swarup: $c2, h66, w127$, V. K. Desikar: $h60, c3, w119$, Patra Jones: $w115, h59, c1$, A. M. Sarkar: $c4, w121, h61$, H. N. Bando: $h63, c2, w132$, M.V. Murthy: $w120, h60, c3$, S. B. Nandi: $w124, c3, h64$, Bashir Ali: $h66, w139, c3$, Phakir Raji: $c3, w128, h56$, Prasad Rai: $h59, c2, w126$, Chang Kui Young: $h63, w117, c3$, V. Dalpat: $w131, c2, h61$, Uma Shankar: $c3, w120, h60$, G. N. Pathak: $w127, h62, c3$, W. C. Williams: $h57, w117, c2$, G. D. Soni: $c2, h64, w131$, A. M. Ghosh: $c4, w120, h63$, V. P. Rao: $h61, w120, c3$.

PART 1A—SECTION II

Time: 3 Hours

Full marks: 100

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

1. (a) Find by contracted method of multiplication

$$0.76398 \times 5.01028$$

correct to five decimal places.

(10)

- (b) Evaluate the following:

$$(i) \frac{\sqrt[8]{0.07197}}{\sqrt[5]{27}}$$

$$(ii) (2.307)^{0.65} - (23.07)^{-1.75}$$

(15)

2. Either,

Obtain the roots of the quadratic

$$x^2 - 4.231x + 2 = 0$$

correct to 6 decimal places.

(12)

Or,

Find, correct to 5 places of decimals, the value of

$$5 \left[\frac{1}{3} + \frac{1}{3 \times 3^3} + \frac{1}{5 \times 3^5} + \frac{1}{7 \times 3^7} + \dots \right] - \frac{117}{125}$$

(12)

3. The following are 24 temperature readings in degrees centigrade.

33	31	30	28	27	28	27	27
25	27	30	32	33	31	20	27
27	28	28	27	28	32	34	20

(a) Find the mean and the standard deviation of these observations. (12)

(b) If six more observations are available, namely,

32,	24,	30,	27,	34,	28
-----	-----	-----	-----	-----	----

what will be the modified values of the mean and the standard deviation? (8)

(c) Calculate also the standard error of the mean of all the thirty observations. (5)

4. The following table gives the yearly average fertiliser prices in England and Wales during the years 1938 and 1946:

fertiliser	weights	price per ton			
		1938		1946	
		£	Sh	£	Sh
ground rock phosphate	5	2	19	4	7
nitro chalk	8	7	11	9	15
sodium nitrate	6	6	15	10	10
ammonium nitrate	33	7	12	9	19
super phosphate	36	3	2	4	10
basic slag	12	1	16	2	3
	100				

Calculate an index number of fertiliser prices for the year 1946 taking 1938 as the base and using the weighted arithmetic mean of price relatives. (16)

5. The following table gives the cosines of various angles expressed in radians.

Angle in radians	0.8727	0.8901	0.0076
Cosine	0.0428	0.6293	0.6157

By interpolation estimate (a) the cosine of 0.0000 radians, (b) the angle in radians whose cosine is 0.6400. (12)

6. The following table gives the values of paid-up capital of joint stock companies in India. Plot the data on a graph and draw a smooth free-hand curve through the plotted points. From the smooth curve find the figures for the year 1958, (10)

Year	Paid-up capital (in crores of rupees)
1951	755
1952	850
1953	808
1954	945
1955	970
1956	1024
1957	1078
1958	..
1959	1276

PART 1B—SECTION I

Time: 3 Hours

Full marks: 100

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

1. Given below is the frequency distribution for the transparencies of red blood cells taken from a patient suffering from primary anaemia.

class range for transparency	frequency
0.6—1.5	4
1.6—2.5	15
2.6—3.5	18
3.6—4.5	35
4.6—5.5	50
5.6—6.5	41
6.6—7.5	29
7.6—8.5	16
8.6—9.5	6
	214

Calculate the standard deviation and the coefficients, β_1 and β_2 , from the above data. (35)

2. *Either*

Given below are the prices (p_0) of food items prevailing during the base period (August, 1939) the expenditures (p_0q_0) incurred on them during the same base period and the prices (p_1) of the food items for the period, September 1944.

food items	price per unit during August 1939 (p_0)	price per unit during September 1944 (p_1)	expenditure incurred in August 1939 on the items (p_0q_0) (weights)
cereals	6.00	7.50	24.25
pulses	0.48	0.50	5.32
fish	1.50	2.00	16.25
meat	1.75	2.50	8.62
leafy vegetables	0.62	1.00	12.92
other vegetables	0.50	0.40	10.65
refreshments	0.95	1.12	3.65
milk	0.65	0.75	9.25
other food articles	0.02	0.73	5.24

From the data given above compute the overall index number of prices in respect of food items for September 1944 with reference to August 1939 as the base. (15)

Or,

Calculate the coefficient of correlation between X and Y on the basis of the following pairs of observations. (15)

X	Y
78	16.72
112	14.96
94	14.99
132	13.12
90	18.42
129	17.12
134	14.26
99	16.10
128	15.56
140	14.79
94	17.84
119	16.80
128	16.84
104	17.36

3. Performance tests of an automobile made under ideal conditions resulted in the following data on the relationship between gasoline consumption and speed:

x Speed of automobile (miles per hour)	y Average number of miles per gallon
20	21.7
30	19.9
40	18.0
50	16.0
60	13.8
70	11.4
80	9.2

Fit a second degree parabola to the above data using speed figures (x) as the independent variable. (25)

4. A comparative feeding trial with three treatments A , B and C yielded the following results. Carry out the appropriate analysis of variance and co-variance to test for the difference between the treatments. (25)

replications	A		B		C	
	initial wt.	final wt.	initial wt.	final wt.	initial wt.	final wt.
1	30	105	26	194	39	203
2	21	177	24	204	34	190
3	21	180	20	200	32	221
4	33	200	35	201	35	173
5	27	197	25	195	32	185
6	24	170	28	187	35	225
7	20	160	20	191	30	190
8	29	180	31	200	29	201

PART 1B—SECTION II

Time: 3 hours

Full marks : 100

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

(b) Use of calculating machines is permitted.

1. The frequency distribution of heights of a number of students is given below:

height in centimeters (midpoint of class interval)	number of students
154.5	4
157.5	8
160.5	26
163.5	53
166.5	89
169.5	146
172.5	188
175.5	181
178.5	125
181.5	92
184.5	60
187.5	22
190.5	4
193.5	1
196.5	1

Fit a normal curve to the data and test the goodness of fit. Draw the histogram and the fitted curve on the same graph. (35)

2. Given below are tabulated values of the function
- $f=f(x, y)$
- . Find by linear interpolation, the values of

$$f(21.3, 43.1) \text{ and } f(27.2, 45.6) \quad (15)$$

y	x		
	20	24	28
40	1.0000	0.9988	0.9920
42	1.0332	1.0251	1.0174
44	1.0598	1.0508	1.0422
46	1.0859	1.0759	1.0663

3. (a) A random sample of 1000 farms in a certain year gives an average yield of wheat of 2,000 lbs. per acre, and a standard deviation of 102 lbs. A random sample of 1000 farms in the following year gives an average yield of 2100 lbs. per acre, and a standard deviation of 224 lbs. Show that these data are consistent with the hypothesis that the average yield in the country as a whole had not varied during the two years. (10)

(b) From a random sample of 1825 persons in a town, the proportion of earners was found to be 45.23 percent in 1955. In 1960, another random sample of 2015 persons taken from the same town showed the proportion of earners to be 44.88. Test whether the proportion of earners has changed significantly between the two years. (10)

(c) In a school final examination 5282 candidates appeared from the cities, 3825 candidates from the towns and 4675 candidates from the villages. The results for these candidates are given below. Examine whether there is any association between the results in the examination and the place of residence of the candidates. (20)

place of residence	number of students				
	passed in			failed	total
	1st div.	2nd div.	3rd div.		
cities	783	1025	830	2658	5282
towns	425	1032	645	1723	3825
villages	352	622	1119	2582	4675
total	1540	2679	2600	6963	13782

4. Select any two of the following items and state for each

- the name of the publication containing the information
- the name of the publishing authority, and
- whether the publication is issued weekly, monthly, annually etc.

[You are not required to compile the actual information]. (10)

- The national income of India in 1957-58.
- The total yield of wheat in India in 1959-60.
- The volume of production of Iron in India in July 1960.
- The general index of industrial production (base: 1951=100) of India in August 1960.
- The total number of man-days lost by industrial dispute in manufacturing industries of India in June 1960.
- The index number of agricultural production for rice in India in 1959-60.

PART IC—SECTION I

Time: 4 Hours

Full marks: 100

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

1. An agency wanted to determine whether five makes of automobiles would average the same number of miles per gallon of petrol. A random sample of two cars of each make was taken from each of three cities and each car had a test run with 1 gallon of petrol. The table below records the number of miles travelled.

makes	cities					
	X		Y		Z	
A	20.3	19.8	21.6	22.4	19.8	18.6
B	19.5	18.6	20.1	19.9	19.6	18.3
C	2.21	23.0	20.1	21.0	22.3	22.0
D	17.6	18.3	19.5	19.2	19.4	18.5
E	23.0	24.5	17.6	18.3	22.1	24.3

Perform the analysis of variance and test the significance of the following components: (i) between cities, (ii) between makes, (iii) interaction: cities \times makes.

2. The following statistics were derived from data collected on 223 college students to study the relation between instruction in a course in college biology and the student's belief in the efficacy of certain home remedies. The criterion was X_0 , the score in a psychological test designed to measure the student's degree of belief in the remedies and the independent variates X_1 , X_2 were the student's scores in two tests on biology.

	X_0	X_1	X_2
mean score	32.08	22.52	80.54
standard deviation of scores	4.89	6.50	23.78
zero-order correlations			
	$r_{01} = 0.514$		$r_{12} = 0.452$
	$r_{02} = 0.621$		

Set up the multiple regression equation for predicting X_0 from X_1 , X_2 and test the significance of the partial regression coefficients appearing in this equation. (25)

3. *Either,*

The table below gives the number of recipients of scholarships, stipends, free studentships and other financial assistance in an Indian State during 1949-50 to 1958-59.

Fit a third degree polynomial and from it estimate the number of recipients of financial assistance in 1959-60. (20)

Year	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59
number of students (in 000)	15.5	18.2	18.8	17.1	21.0	29.0	34.0	75.2	64.1	93.9

Or,

(a) Solve graphically (to two places of decimals) the equation

$$\frac{m}{1-e^{-m}} = \frac{122}{91} \quad (10)$$

(b) Compute (correct to 4 decimal places) the individual terms

$$n \binom{n}{r} p^r q^{n-r} \text{ in the binomial expansion of } (p+q)^n \text{ with} \quad (10)$$

$$n=8, p=0.457, q=1-p=0.543.$$

4. The following table gives the quantity of petroleum produced in U.S.A. during eight consecutive years.

Petroleum production in USA
(millions of barrels)

year (x)	production (y)
1922	558
1923	732
1924	714
1925	764
1926	711
1927	901
1928	902
1929	1007

(a) Fit an equation of the type $y = AB^x$ (linear in $\log y$ and x).

(b) Represent graphically the actual production figures and the line of trend as determined by the fitted curve.

(c) Estimate the production in the year 1930. (25)

PART IC—SECTION II

Time: 4 Hours

Full marks: 100

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

1. Quantities of consumption of news prints in thousands of short tons, by publishers in U.S.A. is given below by months from 1945 to 1949:

Month	Year	1945	1946	1947	1948	1949
January		185	221	266	293	333
February		175	223	258	297	300
March		203	268	302	338	367
April		203	259	298	343	369
May		206	262	303	349	392
June		191	259	293	327	350
July		178	243	264	303	313
August		203	257	281	314	318
September		213	266	300	337	356
October		237	292	339	382	399
November		236	292	338	364	379
December		225	295	322	364	373

Calculate indices of seasonal variation by the link-relative method. (30)

2. An experiment was conducted in a Latin Square arrangement to compare the effect of 6 different manures (A, B, C, D, E and F) on yield-rate. The layout of the experiment and yields are given below:

B	C	A	F	D	E
116	121	63	133	98	114
E	A	F	C	B	D
118	83	99	130	113	92
D	F	C	E	A	B
103	108	106	121	85	110
C	B	E	D	F	A
119	115	106	100	112	90
F	D	B	A	E	C
105	99	115	75	110	110
A	E	D	B	C	F
73	107	96	123	105	100

Prepare the analysis of variance table and test for the significance of the differences between manures. (25)

3. For a certain frequency distribution of the Pearsonian type, mean = 0, standard variation = 1, $\beta_1 = 1.60$, $\beta_2 = 5.25$ and μ_3 is positive. Find the relative frequencies in the following classes:

$$(i) \ 0 \text{ to } 0.25 \qquad (ii) \ -0.25 \text{ to } 0. \qquad (25)$$

4. *Either,*

Find the value of

(8)

$$(a) \begin{vmatrix} 81 & 84 & 78 \\ 82 & 85 & 88 \\ 83 & 86 & 89 \end{vmatrix} \qquad (b) \begin{vmatrix} 67 & 29 & 21 \\ 39 & 13 & 14 \\ 81 & 24 & 20 \end{vmatrix}$$

Or,

Apply suitable interpolation formulæ to calculate the expectation of life at age 24 using the following data:

age	expectation of life
10	35.45
15	32.20
20	29.08
25	26.03
30	23.11
35	20.41

(8)

5. Collect figures from published official statistics on *any three* of the following subjects and present them neatly in tabular form and indicate the source or sources in each case: (12)

- production of electric lamps (all kinds) in India for any ten consecutive years.
- production of crude steel during *any three* consecutive years in Australia, Canada, Japan and India.
- revenue receipts of the Central Government by months for all the months of any recent year.
- prices of Gold-sovereign in Bombay for *any five* consecutive years.
- number of (i) registered medical practitioners and (ii) nurses in India for any consecutive five years.

PAPER 2A—SECTION I

Time: 6 Hours

Full marks: 100

- (a) Attempt any four questions.
- (b) All questions carry equal marks.
- (c) Use of calculating machines is permitted.

1. Monthly expenditure figures in rupees relating to middle-class families in a city were reported in the following manner:

The averages for 23 one-member families were: food: 32.25 rent and tax: 22.12 clothing: 93.75 fuel and light: 8.00 other items: 25.52. For the monthly expenditures per family, for 48 families each of size 2, the corresponding figures were 54.12, 36.25, 174.72, 18.63 and 46.13, while 52 families each having 3 members showed per capita expenditures: food: 29.67, rent: 15.12, tax: 15.12, clothing 89.50, fuel and light: 8.37, other: 28.62. The per capita expenditures under the five item groups based on 59 families each of size 4 and 82 families of size 5 and above (involving 564 members), respectively were 25.12, 12.30, 73.85, 7.62, 27.44 and 19.31, 9.67, 65.73, 6.86, 25.32.

- (i) Scrutinize the data and rectify obvious mistakes.
- (ii) Present the information (after scrutiny and rectification) neatly in a table.
- (iii) In a suitable graphical form present the different per capita expenditures, for each family size as well as for all family sizes.

2. A particular moving average model is defined by

$$y_t = x_t + \frac{1}{2} x_{t-1}$$

where the x 's are independent normal variates with zero mean and unit standard deviation.

By selecting suitable sets of values of x from a Table of Random Normal Deviates, construct two different series of y_t , for values of $t=1, 2, 3, \dots, 30$.

For each series, calculate the first order and second order serial correlation coefficients (i.e. the correlation between y_t and y_{t+1} and the correlation between y_t and y_{t+2}).

3. The arithmetic means and dispersion matrix of four variables X_1, X_2, X_3 and X_4 based on a sample of size $n=50$ are given below:

	X_1	X_2	X_3	X_4
means	142.64	433.12	131.09	572.67
variances and covariances				
X_1	15.12	23.78	1.07	1.00
X_2		54.78	3.36	3.61
X_3			18.32	21.21
X_4				60.50

- (i) Obtain the regression of X_1 on X_2 , X_3 and X_4
- (ii) Compute the multiple correlation coefficient $R_{1.234}$
- (iii) Compute the partial correlation coefficient $r_{12.34}$
- (iv) Test for the significance of the above two correlation coefficients.
4. From appropriate statistical publications, compile a table of wholesale prices of as many of the following commodities as possible, for January 1950 and January 1960, for the United Kingdom.

Commodities

bacon and pork	hides	palm kernels	iron scrap	wool yarn
Beef	rubber	soybeans	iron ore	rayon yarn
Butter	lumber	lard	pig iron	cotton yarn
Wheat	wood pulp	tallow	steel	cotton fabric
Wheat flour	hemp	coconut oil	tin	burial
Rice	wool	groundnut oil	aluminium	
maize	jute	olive oil	lead	
Coffee	cotton	palm oil	zinc	
cocoa	flax	crude petroleum	nickel	
tea	copra	coal	copper	
sugar	groundnuts	petroleum- products	newsprint	

Using the data so compiled, obtain an index number of wholesale prices for the month January 1960 with January 1950 as base using

- (a) the arithmetic mean
- (b) the geometric mean of price relatives.
5. The table below gives the means and corrected sums of squares and products of two variables x and y , for three groups of individuals.

group	sample size	mean		corrected sum of		
		x	y	squares of x	products of x and y	squares of y
1	70	27.52	80.03	03.85	53.27	383.03
2	80	27.01	81.21	136.72	73.12	130.53
3	120	26.72	80.42	380.26	123.05	504.76

Examine:

- (i) the linearity of regression of y on x in each of the three groups,
- (ii) whether the linear regression equations of y on x for the three groups are identical,
- (iii) whether the linear regression of y on x for the three groups are parallel.

PART 2A—SECTION II

Time: 4 Hours

Full marks: 100

- (a) Answers to the different groups are to be given in separate books.
 (b) All questions carry equal marks.
 (c) Use of Calculating machines is permitted.

Group A

1. (a) Solve the following system of equations by determinants (12)

$$\begin{aligned} -x + 2y + z &= 1 \\ x - y + 3z &= 16 \\ 2x + 2y &= -11 \end{aligned}$$

- (b) By means of a suitable quadrature formula, find the value of
- π
- from the relation (13)

$$\frac{\pi}{4} = \int_0^1 \frac{dx}{1+x^2}$$

(use intervals of 0.1 for x).

2. A table of reciprocals
- $1/x$
- is to be constructed for suitable values of
- x
- at equal intervals in the range
- $x=1$
- to
- $x=2$
- . Linear interpolation in the tables should give value of
- $1/x$
- correct to 7 places of decimals.

Determine for what values of x you need tabulate the function and to how many places of decimals. (25)

Or,

It is required to tabulate the cumulative binomial probability

$$\sum_{x=0}^r \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$$

for $p=0.1, 0.2, \dots, 0.8, 0.9$ $r=1, 2, \dots, n$ and $n=2, 3, \dots, 10$. Prepare blank computational forms for all the stages of computation (with column headings and necessary instructions) remembering that the only computational aids available are hand-operated calculating machines and tables of logarithms. Also prepare a blank specimen of the final tables. (25)

Group B

3. Fit a third degree curve to the following data by the method of orthogonal polynomials:

Year	Quantity of meat consumed
1020	71.5
1030	67.0
1031	54.6
1032	60.3
1033	70.4
1034	70.2
1035	72.6
1036	70.5
1037	68.6
1038	64.7
1039	63.0
1040	62.1
1941	60.2
1042	61.2
1943	65.8

(25)

Plot the graduated values.

4. (a) A fertilizer experiment involving 3 fertilizers N, P, K each at 2 levels was carried out in a latin square arrangement. The layout and the yields are shown below. Analyse the data and write a short note on your findings. (13)

Yield of wheat (in suitable unit) in an 8x8 Latin square fertilizer experiment

P	N	NP	K	NK	O	NPK	PK
18	12	18	15	11	11	10	18
N	NK	PK	NPK	P	K	NP	O
12	7	17	17	10	12	10	15
NK	NP	N	P	O	NPK	PK	K
10	17	10	18	9	10	17	14
PK	K	NPK	O	N	NP	P	NK
18	12	14	12	11	14	16	16
NP	O	NK	N	PK	P	K	NPK
17	12	13	11	16	15	10	17
K	PK	O	NP	NPK	N	NK	P
14	18	12	17	15	9	8	20
NPK	P	K	PK	NP	NK	O	N
19	18	11	17	17	8	10	14
O	NPK	P	NK	K	PK	N	NP
17	20	20	16	16	18	13	23

(b) The following table gives the link relatives for daily average production of cement in USA. Calcutta the seasonal indices: (12)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	October	Nov.	Dec.
	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	October	Nov.
1925	84	103	121	129	109	102	98	105	100	07	83	76
1926	74	103	121	124	128	100	98	99	101	07	88	73
1927	77	99	140	127	115	107	98	103	99	95	87	80
1928	81	90	109	136	124	104	97	107	99	95	89	78
1929	81	90	106	142	114	107	100	107	90	94	87	77
1930	76	100	125	124	123	103	98	104	93	80	80	74
1931	78	99	125	141	121	104	95	97	97	86	78	71
1932	84	84	114	117	122	118	94	102	108	94	84	64
1933	70	102	121	117	145	129	107	96	81	87	90	73
1934	107	122	114	129	126	107	89	96	101	84	89	74