QUESTION PAPERS

for

Computer's Certificate Examinations
April & September 1960

INDIAN STATISTICAL INSTITUTE

PART 1A—SECTION I

Time : 3 Hours   Full marks : 100

    (a) Figures in the margin indicate full marks.

    (b) Use of calculating machines is not permitted.

1. (a) Complete the calculations in the following table. How will you check the correctness of the totals ?   (17)

f	x	fx	x^2	fx^2	$(x-1)$	$(x-1)^2$	$f(x-1)^2$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	8						
1	9						
1	10						
2	15						
5	20						
11	25						
4	30						
1	35						
0	40						
total 25							

(b) In a market, there are 6 shops selling sugar. The stock of sugar held by each shop and the respective selling price is given below. Find the average selling price per seer for the entire stock of sugar in the market.   (8)

shop number	stock of sugar (seers)	price per seer (Rs.)
(1)	(2)	(3)
1	60	1.12
2	32	1.10
3	10	1.25
4	90	1.19
5	42	1.22
6	25	1.00

2. The age (in years) and height (in inches) of 70 school boys are given below. Copy out the heights separately for the different ages. Find out the maximum and minimum height at each age. (20)

(1) Virendra Kumar Mishra, age 14, height 56.

(2) T. Vallabdas, age 17, height 63

(3) Swapan Mukherjee, age 13, height 60

(4) V. Narayan Neta, age 15, height 58

(5) Amal Kumar Sanyal, age 14, height 63

(6) Rana Harish Chandra, age 18, height 64

(7) Abani Kumar Devnath, age 12, height 51

(8) Sankar Chandra Das, age 15, height 61

(9) P. Chandra Guha, age 17, height 64

(10) Sangram Singh Chaudhri, age 13, height 58

(11) Amir Chandra Goyal, age 16, height 65

(12) Munna Lal, age 12, height 52

(13) Jethwa Kantilal, age 17, height 54

(14) Neel Danial, age 13, height 59

(15) Chajan Lal, age 18, height 65

(16) Asoke Kumar Khanra, age 15, height 68

(17) Mrityunjay Basu, age 12, height 60

(18) Manohar Lal, age 18, height 70

(19) Om Prakash Sharma, age 14, height 60

(20) Lalji Higorani, age 17, height 63

(21) Tryanbank Namdeorao Karade, age 13, height 51

(22) Nilkanth Meshram, age 16, height 68

(23) Pradip Gupta, age 14, height 61

(24) Nakul Chandra Pal, age 18, height 63

(25) Sadhan Kumar Das, age 15, height 63

(26) Uma Shankar, age 17, height 61

(27) Girja Nandan Pathak, age 15, height 63

(28) Mohd. Said Mohd. Nabi Sheikh, age 18, height 64

(29) Biram Nandi, age 13, height 60

(30) Ramnik G. Sukhadayal, age 17, height 64

(31) C. Dalat, age 15, height 60

(32) Satish Chandra Tare, age 12, height 58

(33) Jadhav Dnyanaba Eknath, age 18, height 66

(34) Sanjiv Babhakar Jagirdar, age 15, height 59

(35) Lakshman Prasad Srivastava, age 12, height 51

(36) Satish Kumar Shukla, age 13, height 55

(37) Puran Lal Padrya, age 17, height 65

(38) Mohan Lal Chiman Lal Marbate, age 16, height 64

(39) Noel Patrick Jones, age 18, height 60

(40) Lakshmikant, age 12, height 59

(41) Sharad Gulabrao Gawanoe, age 18, height 64

(42) Samir Kishore Nandi, age 12, height 52

(43) Chandan Paliwal, age 15, height 65

(44) Sudhakar Jobathan Thombe, age 18, height 60

(45) Umesh Uttam Bone, age 13, height 62

(46) Pratip Sarkar, age 14, height 64

(47) Sanat Kumar Pal, age 17, height 64

(48) Padmaraj Singh Thakur, age 15, height 64

(49) Kashinath Sitaram Kelwade, age 18, height 64

(50) Om Prakash, age 12, height 54

(51) Anand Mohan Ghosh, age 16, height 62

(52) Rajkumar Das, age 13, height 57

(53) Maganlal, age 16, height 64

(54) Sunder Lal Dhurvey, age 14, height 59

(55) Bashir Ahmed, age 16, height 60

(56) Sanjoy Gunakar Mitra, age 14, height 63

(57) Janaklal Soni, age 13, height 63

(58) Haribhau Narayanrao Bandro, age 16, height 65

(59) Dhir Singh, age 14, height 63

(60) Bahadur Singh, age 17, height 64.

(61) Pankaj Kumar Sikdar, age 14, height 63

(62) Mahesh Prasad Rai, age 16, height 64

(63) Jayendra Singh, age 13, height 58

(64) Chang Kin Young, age 17, height 64

(65) A. Kunjeshwar Singh, age 15, height 59

(66) Bishan Singh, age 12, height 59

(67) Shah Jayasukh Premchand, age 16, height 59

(68) P. Ranjit Singh, age 14, height 55.

(69) Samungo Singh, age 12, height 54

(70) Peshbhan Fakir Raji, age 16, height 63.

3. *Either,*

Results of census tabulation relating to ten villages are given below. Present the information in a better tabular form. (30)

1	Kallur North	17	Brahman households with 69 persons
	Kallur North	107	Kayastha households with 628 persons
	Kallur North	19	Vaish households with 92 persons
	Kallur North	2	Parsi households with 12 persons
2	Kodassery	8	Brahman households with 48 persons
	Kodassery	22	Kayastha households with 99 persons
	Kodassery	42	Vaish households with 208 persons
	Koddassery	1	Scheduled caste household with 5 persons
	Kodassery	92	Sikh households with 495 persons
	Kodassery	3	Jews households with 24 persons
3	Kottanellore	9	Brahmin households with 44 persons
	Kottanellore	105	Kayastha households with 578 persons

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	Kottanellore	1	Vaish household with 1 person
	Kottanellore	66	Scheduled caste households with 308 persons
	Kottanellore	59	Sikh households with 325 persons
	Kottanellore	2	Christian households with 6 persons
	Kottanellore	4	Parsi households with 20 persons
4	Potta	2	Brahman households with 3 persons
	Potta	26	Kayastha households with 175 persons
5	Poyya	5	Brahman households with 32 persons
	Poyya	56	Kayastha households with 369 persons
	Poyya	26	Vaish households with 137 persons
	Poyya	4	Scheduled caste households with 20 persons
	Poyya	8	Parsi households with 54 persons
6	Vellokhara	6	Brahman households with 31 persons
	Vellokhara	47	Kayastha households with 268 persons
	Vellokhara	63	Vaish households with 358 persons
7	Belwa Balwa	219	Kayastha households with 1331 persons
	Belwa Balwa	2	Vaish households with 11 persons
	Belwa Balwa	3	Scheduled caste households with 8 persons
	Belwa Balwa	14	Mulsim households with 75 persons
	Belwa Balwa	9	Sikh households with 54 persons
	Belwa Balwa	45	Christian households with 229 persons
8	Bharsarkhas	7	Brahman households with 50 persons
	Bharsarkhas	160	Kayastha households with 987 persons
	Bharsarkhas	1	Vaish household with 2 persons
	Bharsarkhas	1	Scheduled caste household with 8 persons
	Bharsarkhas	1	Muslim household with 3 persons
	Bharsarkhas	29	Christian households with 153 persons
9	Bhewea and Hasan Ganj	1	Brahman household with 6 persons
	Bhewea and Hasan Ganj	180	Kayastha households with 1204 persons
	Bhewea and Hasan Ganj	1	Scheduled caste household with 3 persons
	Bhewea and Hasan Gunj	31	Christian households with 177 persons
	Bhewea and Hasan Gunj	1	Jew household with 3 persons
10	Gangari	57	Kayastha households with 385 persons
	Gangari	8	Christian households with 58 persons.

Or,

Monthly import figures (in tons) for some selected commodities in a port is given below. Complete these figures in a neat tabular form. The commodities should be divided

into two groups, viz., (i) food group and (ii) non-food group and the items within each group should be arranged alphabetically.

(30)

1. June : Coal and coke-310384, Fish -3059, Raw Jute-16069, Rape and Mustard -5462, Rice-14794, Wheat-2803, Sugar-24503, Iron ore-37065, Paddy-695, Cotton-1586, Tea-436, Tobacco-1164.

2. August : Rice-16098, Jute-13786, Paddy-1179, Tea-2179, Rape and Mustard-12326, Cotton-273, Tobacco-845, Sugar-39631, Fish-1936, Iron ore-29043, Wheat -747, Coal and coke-397865.

3. May : Tobacco-1,654, Rice-17431, Iron ore-38070, Cotton-1379, Tea-606, Raw jute-19864, Wheat-390, Rape and mustard-16137, Fish-2329, Paddy-3175, Sugar-25749, Coal and coke-345139.

4. October : Fish-2416, Iron ore-45614, Rape and mustard-10077, Paddy-5252, Tea-1826, Rice-11515, Tobacco-524, Wheat-2783, Coal and coke-439086, Cotton -476, Raw jute-26913, Sugar-14477.

5. September : Raw jute-21790, Wheat-2074, Tobacco-608, Sugar-20356, Iron ore-47950, Coal and coke-420585, Fish-1985, Tea-2589, Rape and mustard--6460, Rice-14901, Paddy-2484, Cotton-114.

6. February : Tea-170, Cotton-2825, Fish-2587, Coal and coke-382923, Paddy-5246, Tobacco-1016, Iron ore-55076, Raw jute-27614, Wheat-1183, Sugar-14137, Rape and mustard-10,226, Rice-10024.

7. December : Paddy-5797, Rape and mustard-6674, Cotton-1416, Wheat-1171, Sugar -7561, Fish-2193, Coal and coke-353157, Rice-24391, Iron ore-51214, Tobacco -1236, Raw jute-28512, Tea-2667.

8. April : Cotton-2579, Paddy-3000, Wheat-1301, Iron ore-13240, Tobacco-1076, Sugar-24729, Rape and mustard-21157, Fish-1986, Rice-18182, Tea-256, Coal and coke-376131, Raw jute-17106.

9. November : Sugar-18906, Tobacco-1810, Rice-29206, Raw jute-12576, Coal and coke-415712, Rape and mustard-14821, Tea-2857, Paddy-2111, Iron ore -39002, Wheat-2723, Cotton-911, Fish-1888.

10. January : Rape and mustard-8336, Tea-1806, Coal and coke-371369, Fish-2619, Cotton-2625, Paddy-3065, Rice-9415, Iron ore-42339, Sugar-8427, Raw jute-36038, Tobacco-1249, Wheat-1544.

11. March : Wheat-859, Sugar-14183, Iron ore-48946, Rice-12831, Fish-2053, Tea. -36, Raw jute-23014, Coal and coke-379500, Tobacco-1404, Cotton-4710, Paddy-4688, Rape and Mustard-15404.

12. July : Iron ore-40897, Coal and coke-385105, Sugar-21797, Rice-21083, Wheat 2264, Raw jute-13963, Paddy-634, Tobacco-995, Tea-2272, Rape and mustard -413, Fish-2569, Cotton-1473.

4. *Either,*

Copy out the following two tables after correcting obvious mistakes and omissions.
(25)

month	pig iron			ferro alloys	direct castings	total
(1)	basic (2)	foundry (3)	total 4)	(5)	(6)	(7)
January	134.3	28.3	162.6	4.9	7.5	375.0
February	131.2	28.6	159.8	4.9	0.3	170.0
March	131.8	29.0	60.8	5.0	5.4	171.2
April	133.8	34.6	168.4	1.1	6.8	176.3
May	89.5	39.2	128.7	0.5	8.0	137.2
June	118.0	36.9	154.9	0.7	4.6	160.2
July	1380.0	40.3	178.3	0.4	8.3	182.5
August	148.5	35.0	183.5	0.2	2.9	186.6
September	134.6	5.7	170.3	3.6	4.0	177.9
October	138.6	39.6	–	2.5	2.9	183.6
November	135.6	38.5	–	1.2	7.2	182.6
December	146.0	45.6	–	1.4	14.0	207.0
Total	1579.9	431.3	2011.2	26.4	72.4	2110.0

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TABLE 2. AGES OF HUSBAND AND WIFE AT MARRIAGE

age of husband	age of wife								total
	9–12	13–16	17–20	21–24	25–28	29–32	33–36	37–40	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
9–12	40	–	1	–	–	–	–	–	5
13–16	5	19	1	–	–	–	–	–	25
17–20	1	46	53	2	–	1	–	–	103
21–24	1	36	102	46	–	–	–	–	245
25–28	–	220	182	16.4	38	2	–	–	408
29–32	–	5	47	79	42	7	–	–	18
33–36	–	–	9	17	170	3	1	–	47
37–40	–	–	–	5	3	4	2	1	15
41–44	–	–	–	–	–	1	–	–	1
Total	51	128	395	313	100	18	3	1	1029

Or,

Fill up the missing figures and correct mistakes, if any, in the following table and copy the table neatly with necessary improvements in presentation.   (25

district	recognised institutions				unrecog- nised insti- tutions	total
	schools for general education	schools for professional education	schools for special education	sub-total		
1. Burdwan	9134	..	150	9371	23	9394
2. Birbhum	4951	24	96	..	21	5092
3. Bankura	5871	45	80	5956	Nil	..
4. Midnapore	14968	2098	405	15201	16	15217
5. Howrah	5956	133	175	6264	1133	6297
6. Hooghly	6857	66	224	7147	33	7180
7. 24 Parganas	..	136	241	15322	37	15359
8. Calcutta	265448	663	387	6498	65	6563
9. Nadia	6057	99	116	266272	Nil	6272
10. Murshidabad	5066	16	3107	5189	3	5192
11. West Dinajpur	2531	Nil	28	2559	16	2575
12. Maldah	2887 .	8	32	2927	Nil	642927
13. Jalpaiguri	2448	48	3	2539	6	22545
14. Darjeeling	1258	44	19	..	10	1331
15. Cooch Bihar	2015	38	31	2084	..	2091
16. Purulia	3114	15	..	3137	66	3203
	93276	1520	2102	96898	336	97234

PART IA—SECTION II

Time : 3 Hours.   Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is not permitted.

1. *Either*,

   (a) Using appropriate tables, obtain the values of the function

$$\frac{1}{\sqrt{\sqrt{x-\sqrt[3]{y}}}}$$

for the following pairs of values of x and y.

	x	y
(i)	47.61	101.81
(ii)	52.35	118.62
(iii)	60.67	141.20
(iv)	71.25	175.15

(13)

   (b) Solve $3^{0 \cdot 2 x^2} = 1478 \times 2^{6 x - 3}$.   (12)

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Or,

(a) If $\log_e x = \log_{10} y$ and $y = 82.67$, find x. (8)

(b) If $(26.5)^{1.8z} = (49.8)^{2.4y} = (81.2)^{3.25}$ and $x = 8.6$, find y and z. (8)

(c) Simplify :- (9)

$$\frac{47.5 \times (11.2)^{0.9} \times (15.2)^{-1.3}}{68.7 \times (7.3)^{1.6} \times (22.1)^{-1.8}}$$

2. *Either,*

Projected population of India (in millions as on March 1st of the year) is shown below by sex. Obtain by simple interpolation the male population as on 1st June 1963, female population as on 1st September,, 1962 and the total population as on 1st December 1960. (20)

PROJECTED POPULATION OF INDIA BY SEX (IN MILLIONS AS ON MARCH 1ST OF THE YEAR)

	year				
sex	1956	1959	1961	1966	1971
male	201.2	213.1	221.1	245.6	269.5
female	190.2	201.9	209.7 ·	234.0	258.3
total	391.4	415.0	430.8	479.6	527.8

Or,

Number of stoppages, workers involved and man-days lost in Industrial disputes are shown for dieffrent months. Calculate the workers involved and man-days lost per stoppage and present the results together with the given figures in a neat form. (20)

year	month	number of		
		stoppages	workers involved	man-days lost
1957	October	224	103,150	534,327
1958	January	142	57,561	366,215
	April	176	65,124	597,269
	July	170	101,757	468,474
	October	121	34,445	292,722
1959	January	152	60,114	306,998
	April	158	42,425	383,741
	July	142	57,913	745,436

3. *Either,*

A clinical test was performed on 25 batches of men, each consisting of 100 individuals. The number of persons who reacted positively to the test in these batches were as follows :-

69, 45, 72, 58, 39, 48, 42, 64
49, 53, 70, 61, 58, 36, 45, 41,
66, 48, 42, 49, 57, 65, 44, 59 and 61

Estimate the percentage of men in the population who are positive to the test and also calculate its standard error.

What would be the standard error of the estimated percentage of persons negative to the test ? (30)

Or,

(a) Number of Joint Stock Companies which ceased to work in different months of 1958 are shown. Calculate the monthly average number and the standard error of the average. (18)

January	174	July	125
February	108	August	158
March	142	September	164
April	186	October	116
May	153	November	162
June	203	December	176

(b) Value of imports and exports in lakhs of rupees are given for 8 months. Plot the two series on a graph paper and comment.

months		imports	exports	
January	1958	6,605	5,324	
February	,,	6,621	4,136	
March	,,	7,056	4,621	
April	,,	5,998	4,142	
May	,,	6,329	4,408	
June	,,	6,393	2,778	
July	,,	6,679	5,350	
August	,,,	5,592	4,877	(12)

4. The following table gives the annual rainfall (in cms) at 3 stations A, B and C in a country over a period of 7 years. Station A is representative of 25 percent of the area of the country and so is Station B. Station C is representative of the remaining area.

year	rainfall in cms.		
	A	B	C
1951	115.2	88.5	147.2
1952	108.5	78.8	159.6
1953	98.4	76.2	162.7
1954	125.6	100.3	175.5
1955	80.4	71.6	133.9
1956	110.6	93.2	158.0
1957	102.4	85.7	160.3

Taking the year 1951 as base, obtain the index numbers for rainfall in the subsequent years at each station separately and also for the country as a whole. (25)

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Time : 3 Hours   Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

1. *Either,*

(a) Put the following information in a tabular form :

'On a certain date the number of registered unemployed persons aged 16-64 was 1,804,218, of whom 1,380,304 were men (aged 18 and over), 371,550 were women, 29,028 were boys (aged under 18) and the rest were girls. The total number on the registers of the Employment Exchange on the same day were : Men : 1,384,922 women : 356580, boys : 45549 and girls : 44321.' Explain the difference between the two sets of figures. (10)

(b) The following figures represent the monthly average production of a certain commodity in units of 10,000 tons for different years.

1924	1925	1926	1927	1928	1929	1930	1931
609	522	205	608	551	632	516	314

1932	1933	1934	1935	1936	1937	1938
298	345	497	535	640	708	564

Plot the figures on graph paper and then find and plot their moving averages. Give reasons for your choice of period. (10)

Or,

The table below shows the diastolic blood pressure of proposers of life assurance. The readings were taken by medical examiners at a number of centres.

blood pressure (mm)	number of readings	blood pressure (mm)	number of readings
60	3	78	20
61	–	79	1
62	1	80	80
63	–	81	–
64	1	82	13
65	3	83	1
66	1	84	10
67	–	85	11
68	2	86	8
69	–	87	–
70	24	88	8
71	–	89	–
72	5	90	16
73	–	91	–
74	7	92	1
75	20	93	–
76	12	94	1
77	–	95	1

Calculate the mean and the standard deviation of blood pressure.

For these calculations, group the data into about six groups. Explain the reason for the grouping you adopt, commenting on any peculiarity of the data. (20)

2. *Either,*

For a certain country, the consumption of coal in its blast furnaces and the production of pig iron over a decade is given in the following table :

year	coal consumed in blast furnaces (in million tons)	pig iron produced (in million tons)
1941	14.51	7.59
1942	11.69	6.19
1943	7.11	3.77
1944	6.53	3.57
1945	7.37	4.14
1946	10.47	5.97
1947	10.79	6.42
1948	12.84	7.72
1949	14.76	8.49
1950	11.56	6.76

From these figures, obtain a linear regression formula giving pig iron production in terms of coal consumption.

Calculate also the coefficient of correlation between the two variables.   (25)

Or,

The yield of wheat (cwt/acre) and potato (tons/acre) from 30 districts are given below. Find the correlation coefficient between yield of wheat and that of potato. Plot the data on a scatter diagram.   (25)

district number	yield of		district number	yield of		district number	yield of	
	wheat	potato		wheat	potato		wheat	potato
1	16.0	5.3	11	21.8	5.7	21	12.0	6.5
2	16.0	6.6	12	15.5	6.2	22	15.6	5.2
3	16.4	6.1	13	15.8	6.0	23	15.8	5.2
4	20.5	5.5	14	16.0	6.1	24	16.6	7.1
5	18.2	6.9	15	18.5	6.6	25	14.3	4.9
6	16.3	6.1	16	12.7	4.8	26	14.4	5.6
7	17.7	6.4	17	15.7	4.9	27	15.2	6.4
8	15.3	6.3	18	14.3	5.1	28	14.1	6.9
9	16.5	7.8	19	13.8	5.5	29	15.4	5.6
10	16.9	8.3	20	12.8	6.7	30	16.5	6.1

3. *Either,*

The following gives the yearly average prices of some food items for the period 1950-1954. Construct the Index Numbers of the food prices for different years by use of the Arithmetic Means of price relatives—weighted by figures given in column (3) and taking 1950 as base year.   (25)

food items	unit	weight	average price per unit (Rs)				
			1950	1951	1952	1953	1954 ·
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rice	md.	12	19.0	21.5	18.5	22.0	24.5
Wheat	md.	15	15.5	17.0	14.5	19.5	20.0
Pulses	md.	8	28.0	30.5	31.5	31.5	32.0
Potato	md.	20	18.5	20.5	22.5	21.5	23.5
Fish	sr.	15	2.8	3.2	3.1	2.9	3.0
Meat	sr.	10	2.2	2.5	2.5	2.8	2.8
Egg	100	2	10.0	10.5	11.0 :	11.0	12.5
Salt	md.	1	3.5	3.5	4.0	4.0	4.0
Milk	sr.	8	0.5	0.8	0.8	0.9	1.0
Ghee	sr.	2	8.5	8.5	9.5	10.0	11.5
Sugar	sr.	5	0.6	0.6	0.7	0.7	0.8
Tea	lb.	2	3.0	3.0	3.5	3.7	3.7

Or,

The following table gives Index Numbers of Industrial Production (1926 = 100)

industry	year			weights .
	1938	1939	1940	
Mining	195	215	238	11.1
Manufacture	107	119	147	67.5
Electrical power	218	238	252	5.6
Building	52	51	88	15.8

(i) Obtain the general index number of industrial production for the three years, with 1926 = 100.

(ii) Obtain the index numbers for 1939 and 1940 with 1938 as base. (25)

4. In the following table intitial weights (x lbs) and average daily gains (y lbs.) of three lots of swine, each lot fed on a different ration are given :—

pig number	lot 1		lot 2		lot 3	
	x	y	x	y	x	· y
1	62	1.2	79	2.0	71	· 1.2
2	73	1.4	· 65	1.8	60	· 1.3
3	58	1.3	· 57	1.6	54	· 1.4
4	43	1.3	. 51	1.8	50	. 1.4
5	50	1.4	· 57	1.9	60	1.2
6	44	1.2	66	1.5	61	· 1.2
7	48	1.0	44	1.6	44	. 1.2
8	51	1.6	41	1.5	53	1.0

Carry out an analysis of covariance and test if the differences between lot gains are significant, after eliminating the effect of initial weight. (30)

Time : 3 Hours   Full marks : 100

    (a) Figures in the margin indicate full marks.

    (b) Use of calculating machines is permitted.

    1. The following data show the frequency-distribution of heights (inches) of 1164 male persons :

height (inches)	frequency
58–59	1
60–61	4
62–63	41
64–65	134
66–67	306
68–69	326
70–71	230
72–73	91
74–75	24
76–77	4
78–79	3

Fit a normal curve to the data and draw the histogram and the fitted frequency curve. Test the goodness of fit. (35)

    2. (a) Sample size (n), mean value (m) and standard deviation (s) of a set of observations are given as : $n = 1000$, $m = 3.57$ and $s = 70.32$.

    Is the mean significantly different from zero ? (5)

    (b) Of two samples, the first of 20 pairs gives a correlation 0.6, the second of 25 pairs gives a correlation 0.8. Are the values of correlation significatly different ? (10)

    (c) To determine whether regular smoking causes cancer of the lungs, a sample of 430 non-smokers and 570 regular smokers were kept under observation for a period of ten years. 19 of the non-smokers and 42 regular smokers got cancer of the lungs in this period. Test whether there is any association between cancer and smoking. (10)

    3. *Either,*

    (a) The distribution of scores in an intelligence test given to 1000 boys was found to be normal. The average score was 50 and the standard deviation was 10. Find out :-

        (i) how many boys scored between 40 and 70,

        (ii) the minimum score obtained by the best 10 percent of the boys. (10)

    (b) Find the values of

        (i) $1000 \left(1 + \dfrac{x^2}{4}\right)^{-0.25} \left(1 - \dfrac{x^2}{25}\right)^{0.50}$

        for $x = 0, 1, 2, 3, 4$ and 5.

        (ii) $\dfrac{500}{1.08 \sqrt{2\pi}} \cdot e^{\dfrac{-(x-3)^2}{2(1.08)^2}}$

        for $x = 0, 1, 2, 3, 4, 5, 6$ (15)

Or,

The following two-way table shows the values of z for different pairs of values of x and y :-

y	x		
	50	60	70
50	0.81	0.80	0.78
60	0.95	0.92	0.89
70	1.08	1.03	0.98

Find, by linear interpolation, the values of z, when (i) $y = 50.14$ and $x = 50.63$, (ii) $y = 60.52$ and $x = 60.37$. (10)

(d) X_t is a function of t which satisfies the equation

$$X_t + 3X_{t-1} + 5X_{t-2} = 0$$

Given that $X_0 = 0$ and $X_1 = -2$, find X_t for all integral values of t from 0 to 20. (15)

4. It is required to compile items of information listed below.

Select any *five* of them and state for each item (a) complete name of the publication containing the information, (b) the name of the publishing authority, and (c) whether it is a weekly, fortnightly, monthly, quarterly or annual publication. (15)

(i) The index number of cost of living in Bombay for 1958.
(ii) Number of registered trade unions in Bihar in 1953-54.
(iii) Number of engineering students in various universities in India in 1957.
(iv) Per capita national income at current prices in India in 1953.
(v) Value of export of pig iron from India in December 1957.
(vi) Area under forest in West Bengal during 1948.
(vii) Number of depositors in the Post Office savings banks at the end of the year 1949-50.
(viii) Amount of electrical energy generated and sold during 1956-57, in U.P.
(ix) Index number of wholesale prices for week ending 3rd January 1959.
(x) General index of industrial production in May 1959 (base $1951 = 100$).

PART IC—SECTION I

Time : 4 Hours   Full marks : 100

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

1. *Either,*

The following table gives the growth rate (in lbs. per week) of 30 pigs classified by pen, sex and type of food. Set up a complete analysis of variance table and test the significance of all the main effects and the first order interaction (Food × sex) (30)

pen	sex	Type of food		
		A	B	C
I	M	9.94	10.00	9.75
	F	9.52	8.51	9.11
II	M	9–48	9.24	8.66
	F	8.21	9.95	8.50
III	M	9.32	9.34	7.63
	F	9.32	8.43	8.90
IV	M	10.98	9.68	10.37
	F	10.56	8.86	9.51
V	M	8.82	9.67	8.57
	F	10.42	9.20	8.76

Or,

The following table gives the wet weights of fish in gms. (x) and total oxygen consumption in cubic mm. (y) of trout fish in swift and slow water. Prepare an analysis of variance of y after corection for x by the method of analysis of covariance, and test whether average consumption of oxygen by trouts of same weight is different in swift and slow water. (30)

series	wet weight of fish (x)	total oxygen consumption (y)
swift water	7.1	767
	7.0	854
	7.5	1080
	7.4	955
	7.5	802
	7.5	862
	4.4	502
	4.3	417
	6.2	595
	8.2	1033
slow water	7.2	612
	6.2	942
	4.4	365
	4.0	276
	7.7	732
	5.6	487
	5.2	369
	5.3	498
	5.6	465
	7.1	667

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2. Given $n = 86$, $\bar{y} = 3.168$, $\bar{x}_1 = 2.275$, $\bar{x}_2 = 2.152$ d corrected sums of squares and products as follows :-

	x_1	x_2	y
x_1	0.0188	0.0085	0.0303
x_2		0.0290	0.0441
y			0.8275

find (i) the multiple regression of y on x_1 and x_2, (ii) the multiple correlation coefficient of y on x_1 and x_2 and (iii) the partial correlation coefficient of y and x_2 correcting for x_1. Test the significance of the computed multiple and the partial correlation coefficients. (25)

3. *Either,*

(a) Prepare a table from the following data giving suitable headings:-

'According to the Census of Manufacturers Report, 1945, the John Smith Manufacturing Company employed 400 non-union and 1,250 union employees in 1941. Of these 220 were females of which 140 were non-union. In 1942 the number of union employees increased to 1,475 of which 1,300 were males. Of the 250 non-union employees 200 were males. In 1943, 1700 employees were union members and 50 were non-union. Of all the employees in 1943, 250 were females of which 240 were union members. In 1944, the total number of employees were 2,000 of which one percent were non-union. Of all the employees in 1944, 300 were females of which only 5 were non-union.' (5)

(b) Scrutinise the following table and correct the entries if necessary. You may assume that the figures in columns (2), (3), and (6) are correct. (10)

country	population (millions)			sex ratios*	area in thousand (Km)*	density **
	male	female	total			
(1)	(2)	(3).	(4)	(5)	(6)	(7)
Canada	83	81	166	104	9974	2
Japan	41	43	92	98	370	246
Ceylon	4.8	4.6	9.2	103	66	140
Switzerland	28	24	51	112	41	124
Italy	24	26	48	94	301	161

* $\dfrac{\text{Male}}{\text{female}} \times 100$; ** population per square kilometre.

Or,

Find graphically, or otherwise, a root of the equation :
$$x^2 + 6x = 1200$$
(15)

4. Obtain the equation of the third degree polynomial which best fits the data given below according to the principle of least squares.

year	death rate of Ceylon per 1000 population
1943	21.3
1944	21.2
1945	21.9
1946	20.2
1947	14.3
1948	13.2
1949	12.6
1950	12.6
1951	12.9
1952	12.0
1953	10.9
1954	10.4
1955	11.0

(20)

5. The population of four countries for 1953 and 1957 are given below. Find for each country, the geometric (compound interest) rate of increase of population between 1953 and 1957 and using these rates estimate the population for 1961, for these countries separately.

country	estimated population (millions)	
	1953	1957
USA	160	171
India	372	392
China	583	640
UK	50.9	51.7

(10)

PART 1C—SECTION II

Time : 4 Hours   Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

(c) Attempt *any four* questions.

1. Five types of raticides A, B, C, D and E obtained from five different manufacturers were tried on five different types of rats, in a latin square design. The number of rats dead amongst hundred rats treated in each case is given below :

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NUMBER OF RATS DEAD OUT OF HUNDRED RATS

manufacturers	type of rats				
	I	II	III	IV	V
1	B 55	D 71	E 38	A 87	C 61
2	C 79	A 46	B 64	E 57	D 60
3	E 79	B 74	C 69	D 57	A 51
4	A 59	E 81	D 67	C 74	B 57
5	D 76	C 69	A 81	B 83	E 78

Carry out an analysis of variance of this data and test separately the significance of differences between (a) types of rats (b) raticides and (c) manufacturers.   (25)

2. A family budget enquiry was recently carried out in a city to determine the weights to be attached to different items of expenditure. One set of weights was calculated and was used for sometime. Subsequently a major error in the calculation was discovered and another set of weights were fixed. Both these sets of weights are given below, along with prices at the base period and in January 1960.

Calculate the Index number of food prices according to both the sets of weights and comment on the results.   (25)

Item	original weight	revised weight	base price NP	price in January 1960 NP
Rice	17	16	64	84
Wheat	12	13	43	57
Jowar	6	5	41	49
Bajri	4	3 .	37	52
Maize	1	1	36	47
Tur	3	4	42	48
Gram	1	1 .	41	43
Ghee	2	1	256	. 342
Vanaspati	0	3	98	113
Sugar	3	2	51	56
Gur	1	1	47	55
Salt	2	2	16	16
Milk	4	3	98	101
Snacks	0	4	104	126

3. Using the data given below, calculate monthly indices of seasonal variation in th· number of registrations in Employment Exchanges.

NUMBER OF REGISTRATIONS IN EMPLOYMENT EXCHANGES

month	year				
	1950	1951	1952	1953	1954
January	117	142	135	168	188
February	109	128	112	135	174
March	120	121	111	148	163
April	125	134	145	159	198
May	125	141	148	179	194
June	145	171	142	195	230
July	157	171	180	241	265
August	141	145	160	208	219
September	145	143	161	199	228
October	122	121	139	192	
November	129	124	174	168	
December	148	130	169	213	

(25)

4. (a) Evaluate the following determinant (7)

$$\begin{vmatrix} -1 & 76 & 91 \\ 24 & -1 & 19 \\ 34 & 42 & 1 \end{vmatrix}$$

(b) From the table below giving values of x and $f(x)$, find by interpolation the values of $f(25.6)$, $f(27.5)$ and $f(29.4)$

x	$f(x)$
25	10.5197
26	11.1603
27	11.8076
28	12.4613
29	13.1211
30	13.7867

(18)

5. The moment coefficients of a Pearsonian frequency distribution are as follows:-

mean $= 0$,   variance $= 1$, $\beta_1 = 0.5$, $\beta_2 = 3.2$

Find (a) the equation of the frequency density function and (b) the relative frequency of individuals with characteristic greater than or equal to 1.96, but less than 2.00.

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PART 1A : SECTION I

Time : 3 Hours   Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is not permitted.

1. Complete the calculations in the following table and copy it.   (15)
   How will you check the correctness of your computation ?   (5)
   Deduce the total of $(X^2 + Y^2)$ from the totals obtained in the last row.   (5)

X	Y	XY	$(X+Y)$	$(X-Y)$	$(X+Y)^2$	$(X-Y)^2$
(1)	(2)	(3)	(4)	(5)	(6)	(7)
-12.5	10.0					
-7.5	7.5					
-2.5	5.0					
0.0	2.5					
2.5	0.0					
7.5	-2.5					
12.5	-5.0					
17.5	-7.5					

Total

2. The following table gives the yield of rice in lbs. per plot of 400 square yards.
Make a frequency table by grouping the data into intervals : 0-4, 5-9, 10-14, etc.   (15)
   Find the average yield directly from the values given.   (10)

57, 64, 58, 51, 64, 96, 78, 28, 94, 79, 44, 66, 83,
30, 56, 48, 54, 88, 90, 33, 8, 72, 20, 17, 80, 20, 55, 38,
38, 38, 75, 51, 70, 93, 73, 64, 52, 33, 84, 60, 0, 69, 57,
64, 24, 50, 66, 20, 30, 61, 18, 34, 28, 36, 46, 63, 8, 54, 58,
36, 45, 56, 22, 34, 48, 47, 53, 52, 20, 10, 14, 22, 38, 37.
 0, 4, 50, 0, 48, 0, 34, 46, 91, 27, 34.

3. *Either,*

The following are the values of imports during 1952-53 into India of some principal
articles of merchandise (grouped into five categories) from (i) Hard Currency' area (U.S.A.,
Canada), (ii) Sterling area (U.K., Ceylon, Burma, Australia, Pakistan), and (iii) Soft
Currency area (Belgium, Italy, West Germany, France, Japan).

Represent this information relating to imports in a neat tabular form countrywise
according to the three categories of currency areas mentioned above. Within each currency
area, represent the countries in alphabetical order.   (20)

Indicate in each area, the item under which maximum imports are being made.   (5)

(Values in thousands of rupees)

1. *Food, drink and tobacco :*

Canada 228567, Pakistan 37223, Italy 3858, U.K. 20090, U.S.A. 767507, Burma
241528, France 2137, Belgium 679, Ceylon 8521, West Germany 2033, Australia 104022,
Japan 1429.

2. *Raw materials and produce and articles mainly unmanufactured.*

U. K. 41690, West Germany 9816, U.S.A. 595649, Ceylon 31303, Belgium 1850 Burma 18383, Australia 7741, Canda 59433, Japan 12006, Pakistan 178474, Italy 54804, France 67893.

3. *Articles wholly or mainly manufactured.*

Japan 144396, U.S.A. 446128, Australia 14111, France 65134, West Germany 213199, Ceylon 1833, Belgium 63419, Pakistan 1973, U.K.1 1301063, Italy 60708, Burma 4224, Canada 59433.

4. *Living animals.*

France 99, Canada nil, U.K. 827, Burma nil, Belgium 6, Italy nil, Ceylon 15, West Germany 11, Australia 1288, U.S.A. 14, Pakistan 1069, Japan nil.

5. *Postal articles and baggage not specified.*

Ceylon 1272, Belgium 5, Burma 158, West Germany 444, Italy 595, Pakistan 72, France 156, U.K. 24337, Australia 180, Canada 82, Japan 324, U.S.A. 4435.

Or,

The montly figures for a certain year for the types of occupations desired by the applicants registered with Employment Exchange are given below. Compile the data in a neat tabular form. (25)

June : Others—4162, clerical -42012, educational-474, unskilled-108376, industrial supervisory-1121, placed in employment-1048, domestic service-2030, total-176302 skilled and semi-skilled-18127.

November : unskilled-128818, placed in employment-716, industrial supervisory-1220, total-208973, educational-517, skilled and semi-skilled-21540, clerical-48171, domestic service-2723, others-5921.

January : industrial supervisory-1040, skilled and semi-skilled-17816, domestic service-1888, placed in employment-1571, educational-509, unskilled-99574, total-169937, others-3960, clerical-45144.

May : clerical-41336, industrial supervisory-1109, domestic service-2008, educational-475, skilled and semi-skilled-18539, others-4734, placed in employment-1678, unskilled-105198, total-173399.

September : Domestic services-2263, others-5692, total-197379, clerical-47448 placed in employment-1187, industrial supervisory-1158, Unskilled-119607, skilled and unskilled-20707, edudational-504.

February : Total-173187, educational-495, clerical-45204, others-3905, industrial supervisory-1041, placed in employment-1967, unskilled-103133, skilled and unskilled-17774, Domestic service-1635.

December : Others-6445, educational-406, clerical-47643, placed in employment -1349, industrial supervisory-1349, unskilled-131928, domestic service-3048, skilled and semi skilled-24097, total-214916.

July : Educational-482, total-181536, placed in employment-1627, industrial supervisory-1114, clerical-43062, unskilled-110484, skilled and semi-skilled-18888, domestic service -2231, others-5275.

March : Skilled and semi-skilled-18291, domestic service-1837, industrial super-visory-1216, total-163705, unskilled-99263, clerical-38496, others-4098, educational-504, placed in employment-2294.

October : Clerical-40122, industrial supervisory-1173, placed in employment-827, others-5921, unskilled-123824, total-202147, domestic service-2602, educational-515, skilled and semi-skilled-27990.

August : Unskilled-117131, placed in employment-1637, skilled and semi skilled-20094, domestic service-2325, others-5036, total-192179, educational-510, clerical-45964, industrial supervisory-1119.

April : Placed in employment-1928, unskilled-104218, others-4167, skilled and semi-skilled-18539, total-168975, domestic service -2114, clerical-39096, industrial super-visory-1067, educational-447.

4. *Either,*

The following are the marks obtained by candiates in an examination consisting of two theory papers and two practical papers. The maximum of each of the four papers is 100.

A candidate is deemed to have passed the examination if he obtains at least 50 percent on the aggregate of the theory papers and the practicals, subject to a minimum of 40 percent in the two theory papers together and a minimum of 45 percent in the two practicals together.

Tabulate the marks in a suggestive form and indicate the passes by putting 'P' in the last column.   (20)

Write down separately in order the candiates obtaining the first five ranks, on the basis of the total marks.   (5)

Ranadhir, V; Paper II 50, Practical I 49, Paper I 45, Practical II 60; Puri, S : Paper I 82, Practical II 70, Paper II 45, Practical I 10; Panda, M : Paper II 50, Paper I 45, Practical I 49, Practical II 60; Chaudhri, A : Practical I 40, Paper II 50, Practical II 60, Paper I 45; Vimalendu Bose : Paper I 42, Paper II 35, Practical I 75, Practical II 80; Manoharilal: Practical II 58, Practical I 62, Paper I 52, Paper II 28; Malhotra, B : Paper II 82, Practical I absent, Practical II 90, Paper I 80; Thomas, V : Practical I 69, Paper I 40, Practical II 47, Paper II 53; Nilakanta Gupta: Paper II 44, Paper I 65, Practical I 59, Practical II 46; Girija, K. (w) : Practical I 86, Practical II 62, Paper I 60, Paper II 46 Sarma, C. S. : Paper I 38, Paper II 62, Practical I 71, Practical II 19; Nandi, K. M. : Practical II 69, Practical I 45, Paper I absent, Paper II absent; Pande, K. P. : Paper II absent, Paper I 17, Practical II 50, Practical I 59; Jagirdar, S. : Paper I 45, Paper II 59, Practical I 61, Practical II absent; Lakshmi, V.(w) : Practical I 72, Paper II 10, Practical II 37, Paper I 29.

Or,

Copy out the following table neatly, after correcting obvious mistakes and omissions, giving brief reasons in each case.   (25)

MAXIMUM DEMAND AND ELECTRICITY GENERATED

month	steam		hydro		oil		total	
	(Hundred kilowatt hours)							
	maxi-mum demand	generated	maxi-mum de-mand	gene-rated	maxi-mum de-mand	gene-rated	maxi-mum demand	generated
(1)	(2.1)	(2.2)	(3.1)	(3.2)	(4.1)	(4.2)	(5.1)	(5.2)
January	3250	..	17	3469	14	3704	3281	1265702
February	3174	1409611	17	3935	2614	3799	_ 3205	1417345
March	..	1417611	17	3468	15	3984	3352	..
April	3435	1441333	..	4427	13	706	3467	1449466
May	3374	1591162	18	64566	13	3725	3405	1599453
June	63404	71460754	18	5329	14	3078	3436	1469161
July	3363	1550285	17	5713	11	2605	..	1558603
August	3343	1499971	19	6512	13	..	375	1508984
September	3477	1505400	1220	6425	..	2570	3512	1511395
October	3593	1432742	21	5797	15	2766	..	71441305
November	243604	1438087	20	6722	16	2917	3640	1447726
December	3559	1541290	17	..	15	3436	3591	1549603
Total	40896	17546775	..	61240	168	38791	41285	17646806 /

PART 1A : SECTION II

Time : 3 Hours Full marks : 100

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

1. (a) *Either,*
   Using appropriate tables, obtain the values of
   (i) $\log_{10} 1.0163$ (2)
   (ii) antilog of 2.230081 (base 10) (2)
   (iii) $\log_2 10$ (3)

   Or,
   Find by contracted multiplication the product
   $27.624152 \times 319.61286$ correct to 3 places of decimals (7)
   ..
   (b) *Either,* ·
   Find the value of

   $$16\left[\frac{1}{5}-\frac{1}{3}\cdot\frac{1}{5^3}+\frac{1}{5}\cdot\frac{1}{5^4}-\frac{1}{7}\cdot\frac{1}{5^7}\right]-\frac{4}{239}$$

correct to five decimal places. (12)

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Or,

Obtain the roots of the quadratic,

$$X^2 - 3.5125X + 1 = 0 \tag{12}$$

correct to four decimal places.

(c) *Either,*

Given that $\sqrt[3]{x} - \sqrt[3]{y} = \sqrt[3]{z}$

and that $y = 7.284$; $z = -2.315$; and x $\hspace{2cm}$ (6)

Or

If $\dfrac{1}{+\sqrt{a}}$ is greater than $\dfrac{1}{+\sqrt{b}}$ by .2875 and $a = .7829$, find b. $\hspace{1cm}$ (6)

2. *Either,*

The following table gives the growth of population in Andaman and Nicober islands during the years 1921 to 1951 :-

year	population as on Jauary 1
1921	27086
1931	29463
1941	33768
1951	30971

Prepare a table showing against these years the logarithms of the populations. $\hspace{1cm}$ (4)

Find by interpolation (by proportional parts)
the logarithm of the population in 1925
the lobarithm of the population in 1947.

Hence find the populations of these two years. $\hspace{2cm}$ (10)

Estimate in which year the population was 30,000. $\hspace{2cm}$ (6)

Or,

Table 1 gives corresponding values of variables A and B. Similarly Table 2 gives corresponding values of variables A and C. Using simple interpolation, fill up the blanks in Table 3 which is to show corresponding values of B and C.

TABLE 1		TABLE 2		TABLE 3	
A	B	A	C	B	C
.51504	.60086	.51800	1.0378	.61008	..
.52250	.61280	.52547	1.1725	..	1.2568
.52992	.62487	.53288	1.3152		
.53730	.63707	.54024	1.4587		

(20)

3. Obtain the mean and the standard deviation of the following observations : $\hspace{0.5cm}$ (15)

26, 32, 35, 28, 21, 29, 34, 18, 29, 39, 36, 29, 22, 30, 32, and 20.

If four more observations namely 30, 32, 28, 25 are now available, what will be the modified values of the mean and the standard deviation? (10)   (10)

4. The following table gives the cumulative percentages of

(i) the total number of persons (x)

(ii) the total consumer expenditure (y)

in different montly per capita expenditure groups for rural India during June and July 1958.

serial number	monthly per capita expen- diture groups (in rupees)	cumulative percentages of	
		total number of persons (x)	total consumer expenditure (y)
(1)	(2)	(3)	(4)
1	0– 8	9.09	2.80
2	8–11	23.14	9.52
3	11–13	35.52	17.02
4	13–15	46.52	24.81
5	15–18	56:73	33.20
6	18–21	66.79	43.07
7	21–24	74.12	51.48
8	24–28	81.49	60.95
9	28–34	87.61	70.12
10	34–43	95.22	84.66
11	43–55	97.83	91.26
12	55 and above	100.00	100.00

(i) Plot y against x on a graph paper and draw a smooth curve through the plotted points.   (15)

(ii) Draw the line $y = x$ on the same diagram.

(iii) Find the area between the line $y = x$ and the smooth curve.

(iv) Express this as a fraction of the area of the triangle bounded by the lines

$$y = 0, x = 100 \text{ and } y = x.$$ (15)

PART IB : SECTION I

Time : 3 Hours.   Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

1. (a) The following particulars have been collected from a report on the administration of criminal justice in a certain area for the year 1955.

Present the statistics in a tabular form. Comment on any peculiarities you notice in the data.   (12)

(i) Against public tranquility : 4444 offenders reported, 2804 cases returned as true, (ii) relating to Government stamps : 16 offences reported, 10 brought to trial, (iii) relating to weights and measures : 4954 offences reported, (iv) theft : 14,012 cases brought to trial, 13044 cases returned as true, (v) Against public tranquility : 2878 cases brought to trial, (vi) Theft : 24,206 cases of offence reported, (vii) relating to weights and measures : 4636 cases brought to trial and 4526 cases returned as true, (viii) relating to Government stamps : 10 cases returned as true.

(b) Calculate by graphical method the median value as also the quartiles of the price per unit of steel tubes.   (13)

PRICE AND OUTPUT OF STEEL TUBES

price per unit (lb)	number of units sold
20	6
21	8
22	17
23	15
24	19
25	21
26	25
27	27
28	31
29	40
30	38
31	35
32	15
33	10
34	6
35	4

2. *Either,*

The following table gives the results obtained in an experiment with 20 wheat varieties on the number of days from seeding to heading and the number of days from seeding to maturity.   Find out the linear equation for regression of days-to-mature on days-to-head and calculate the coefficient of correlation between the two characters.   (18)

Draw the scatter diagram and on it show the regression line.   (7)

variety	days to head	days to mature	variety	days to head	days to mature
1	60.0	94.4	11	59.2	93.8
2	53.6	89.0	12	59.0	92.8
3	59.0	94.0	13	58.6	94.2
4	61.8	95.4	14	58.2	92.4
5	53.8	88.2	15	58.0	91.6
6	57.8	93.4	16	59.4	94.0
7	57.8	92.0	17	55.4	90.8
8	58.4	92.0	18	61.6	95.2
9	57.8	92.8	19	63.0	97.2
10	59.0	93.4	20	60.0	94.6

Or,

The distribution of the percentages of ash content in 250 specimens of coal is given in the following table :-

percentage ash content	number of specimens	percentage ash content	number of specimens
9–10	1	18–19	34
10–11	3	19–20	19
11–12	3	20–21	14
12–13	9	21–22	10
13–14	13	22–23	4
14–15	27	23–24	3
15–16	28	24–25	–
16–17	39	25–26	1
17–18	42		
		Total	250

(a) Calculate the β_1 and β_2 coefficients of the distribution. (20)

(b) Find the number of specimens with ash content between mean $\pm$ standard deviation. (5)

3. Given below are the prices of food items during August 1939 and during September, 1960 and the weights (i.e. proportions of expenditure expressed in percentage) prevailing during the periods. Taking August 1939 as the base period, construct an index of Food prices for September, 1960 using (i) 1939-weights and (ii) 1960-weights. (20)

Food items	unit	price per unit in August 1939	price per unit in September 1960	weights during August 1939	weights during September 1960
		Rs.	Rs.		
1. cereals and cereal products	md.	19.00	21.50	27	25
2. pulses	sr.	0.70	0.90	8	8
3. vegetables	-do-	0.60	1.20	20	24
4. fish, meat etc.	-do-	2.50	3.80	27	26
4. salt, etc.	-do-	0.20	0.30	8	6
6. other food materials	-do-	1.60	1.90	10	11

4. *Either,*

The data given below are grain and straw yields for 5 manurial treatments and 3 replications of each. Carry out an analysis of covariance to test the significance of the differences in grain yield for the treatments, after correction for straw yields.

treatments	Replication I		Replication II		Replication III	
	straw	grain	straw	grain	straw	grain
A	242	620	321	634	261	681
B	267	644	382	645	201	542
C	215	523	330	713	298	686
D	212	601	292	693	265	685
E	322	664	370	693	284	666

(30)

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Or,

(a) Fit a second degree parabola to the following series of observations, taking the year as the independent variable :-

Year	1934	1937	1940	1943	1946	1949	1952
Index of mineral prices	187	142	133	129	136	169	279

Use your results to estimate the value of the index for 1935. (15)

(b) Four rations A, B, C, D were each tried on four pigs over a period. The figures in the table below denote increases in weight in lbs. per pig at the end of the period Carry out an analysis of variance and test whether the average increase in weight is different for different rations.

Rations			
A	B	C	D
6.1	14.6	15.5	13.4
13.8	15.7	16.0	20.2
8.7	11.8	9.0	12.9
12.0	16.5	13.3	12.5

(15)

PART IB : SECTION II

Time : 3 Hours. Full marks : 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

1. The following data show the frequency distribution of weight in pounds of 1000 school girls, eight years old.

weight (mid values)	frequency
29.5	1
33.5	14
37.5	56
41.5	172
45.5	245
49.5	263
53.5	156
57.5	67
61.5	23
65.5	3

(i) Fit a normal curve to the above data. (18)

(ii) Draw the histogram and the fitted curve. (10)

(iii) Test the goodness of fit. (7)

2. *Either,*

(a) Two sample polls of votes for two candidates A and B for a public office are taken, one from among residents of urban areas, and other from the residents of rural areas. The results are given below. Examine whether the nature of area is related to voting preference in the election.

area	A	B	total
rural	527	257	784
urban	324	432	756
total	851	689	1540

(10)

(b) A random sample of 1000 farms in a certain year gives an average yield of 2100 lbs. per acre with a standard deviation of 192 lbs. A random sample of 1000 farms in the following year gives an average yield of 2130 lbs. per acre with a standard deviation of 224 lbs. Show that these data are inconsistent with the hypothesis that the average yields in the country as a whole were the same in the two years. (10)

(c) From the following tabulated values of the function

$$x = f(i, p)$$

find the values of x by linear interpolation when

(a) $i = 0.0137, \quad p = 6$
(b) $i = 0.0183, \quad p = 10$

| p | 2 | $.:4$ | 12 |
i			
0.0100	1.00249	1.00373	1.00450
0.0125	·1.00311	1.00466	1.00566
0.0150	1.00373	1.00560	1.00685
0.0175	1.00436	1.00653	1.00797
0.0200	1.00497	1.00748	1.00912

(10)

Or,

(a) The following table gives the Intelligence Quotient (IQ) and also the marks secured in a language examination by 246 students.

Test whether these figures give evidence of an association between I. Q. and language-scores.

I.Q.	scors in language examination			
	80-707	0-50	50-35	total
-92	23	8	11	42
92-82	20	16	17	53
82-70	19	22	20	61
70-	24	29	37	90
total	86	75	85	246

(20)

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(b)   The average consumption per person of mill-made cloth in (i) district towns, (ii) villages in India were obtained from data on 1105 and 953 persons respectively. Averages together with the standard deviations (s.d.) of consumption of mill-made cloth are given below.

Test whether the two averages are significantly different from each other at 1 percent and 5 percent levels of significance.

area	size of sample	per capita consumption (Rs.)	s.d. (Rs.)
District town	1105	29.97	2.11
village	953	29.39	1.86

(10)

3. *Either,*

(a)   Find the values of

$$\frac{200\ e^{-0.81}\ (0.61)^x}{x!}$$

for $x = 0, 1, 2, 3$ (10)

(b)   Mark out the portion of the curve (10)
$y = 3x^2 + 4x - 32$ which lies below the x-axis.

Or,

By using logarithmic tables, find

(a)   the cube roots and the fourth roots of

49.640 and 0.00882418 (6)

(b)   the 306 th power of 1.0751, and the 12th power of 2.2196. (4)

(c)   the value of

$$y = \frac{\left(1 + \dfrac{k}{m}\right)^{-mn}}{t\left(1 + \dfrac{k}{mn}\right)^{\frac{m}{p}}}$$

(10)

for $k = 0.1$ and 0.5; $m = 1/3$, $n = 1/4$, $p = 21$, $t = 0.05$.

4.   Select any six of the following items and state for each (i) name of the publication containing the information, (ii) the name of the publishing authority and (c) whether the publication is issued weekly, monthly, annually etc.

(a)   Total number of employers, employees and independent workers in all indus-industries and services in 1951 in West Bengal.

(b)   Shares of the custom zones—Calcutta and Madras—in the grand total of import duty and export duty collected during the month of December 1958.

(c) Value of export of pig iron from India in December 1958.

(d) Whole sale price index number in Calcutta for December 1959.

(e) Area under paddy in West Bengal in 1950.

(f) Index number of industrial production in India in July 1958.

(g) Number of workers engaged in Match industries in India in 1952.

(h) Area under wheat in Bihar in 1956. (15)

PART IC : SECTION I

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

1. *Either,*

In testing out a machine for producing rings of a given circumference three adjustments of the machine designated A, B, and C were employed and were tried on 5 kinds of metals with the help of two techniques. The following differences in the measurement (in cms.) from the given specification were noted :-

technique	machine setting	Kinds of metal				
		1	2	3	4	5
I	A	1.05	0.25	0.95	1.25	−0.50
	B	3.15	4.25	1.25	0.85	2.50
	C	−1.50	−3.50	−2.50	1.25	1.35
II	A	4.35	2.25	3.50	2.50	2.00
	B	5.60	3.50	4.75	1.35	6.20
	C	1.50	2.50	1.30	0.35	1.20

Set up an analysis of variance table and test the significance of the main effects and two-factor interactions, using the three-factor interaction as error. (30)

Or,

The following is a record of replicated measurements of profile distances of three subjects (S_1, S_2, S_3) taken by three observers $(0_1, 0_2, 0_3)$. Analyse the variance into the following components (i) between observers, (ii) between subjects, (iii) interaction between observers and subjects and (iv) error, and carry out tests of significance of the first three components. (30)

MEASUREMENTS OF PROFILE DISTANCE

observers	subjects		
	S_1	S_2	S_3
0_1	9.88	9.22	9.60
	9.84	9.26	9.66
0_2	10.08	9.10	9.82
	9.98	9.24	9.54
0_3	10.08	9.20	9.50
	9.80	9.16	9.32

2. *Either,*

Fit a third degree polynomial to the following data and represent graphically the expected values together with the original data. (20)

year	national income of India (ahja)
1948–49	86.5
1949–50	88.5
1950–51	89.7
1951–52	96.3
1952–53	94.3
1953–54	92.4
1954–55	102.8
1955–56	104.8
1956–57	110.0
1957–58	108.9
1958–59	116.9

Or,

Find graphically or otherwise a root of the equation

$$x \log_{10} x = 1.2$$

You are told that the root lies between 2 and 3 and you are required to determine its value correct to 4 decimal places. (20)

3. In an experiment to explore the possibility of estimating the gasoline yield (X_0) from crude oil gravity (X_1) and gasoline end point (X_2), $n = 32$ specimens of crude oil were examined and the following statistics were obtained (units of measurements unspecified)

$$n = 32$$

$T_0 = 6.291$	$S_{00} = 1.5932$	$S_{01} = 2.5154$	$S_{02} = 2.2542$
$T_1 = 12.560$		$S_{11} = 5.0083$	$S_{12} = 4.1319$
$T_2 = 10.627$			$S_{22} = 3.6800$

where $\quad T_i = \Sigma\, X_i, \quad \overline{X}_i = T_i/n, \quad S_{ij} = \Sigma\, (X_i - \overline{X}_i)(X_j - \overline{X}_j)$

$$i, j = 0, 1, 2.$$

Obtain (i) the regression equation of X_0 on X_1, (ii) the multiple regression equation of X_0 on X_1 and X_2. Test the significance of (i) the correlation coefficient of X_0 on X_1, (ii) the multiple correlation coefficient of X_0 on X_1 and X_2 and (*iii*) the partial correlation coefficient of X_0 on X_2 eliminating the effect of X_1. (25)

4. *Either*

The total outlay on health programmes was stepped up from Rs. 150 corres in the First Plan to Rs. 225 crores anticipated for the second plan. The tentative provision for the third plan has been placed at Rs. 300 crores. Of the total outlay in the first plan 20 percent was spent on the programmes of water supply and sanitation, 25 percent on primary health units, 40 percent on education and training, 5 percent on family planning and the remaining was spent on other health programmes. The anticipated outlay

in the second plan on the first four programmes is 90 crores, 50 crores, 70 crores and 5 crores respectively, while the proposed outlay in the third plan on these programmes is of the order of 100 crores, 50 crores, 110 crores and 30 crores respectively.

Considering individual states the outlay during the 1st and 2nd plan periods on the various health programmes has been found to be in proportion to the population of the respective states. In the third plan, however, the share of each state is proposed to be on the basis of incidence of mortality. The following table gives the statewise population and incidence of mortality.[*]

State	population (in crores)	mortality per 1000 persons
1. Punjab	2.7	18
2. Rajasthan	1.1	14
3. U.P.	6.3	17
4. Madhya Pradesh	4.5	22
5. Maharashtra	3.8	17
6. Gujarat	2.9	12
7. West Bengal	3.0	21
8. Orissa	4.0	25
9. Bihar	3.8	17
10. Assam	1.2	15
11. Andhra Pradesh	1.6	18
12. Madras	2.0	14
13. Others	2.1	17

Prepare a table showing the distribution of outlay under different health programmes for various States and India as a whole, indicating also the percentage share of each programme, for each of three plans. (25)

Or,

(a) Find the sum of the approximate numbers 2316.5721, 29.12598, 62591.6 and 71.83 each being rounded off to its last figure. Round off the answer so that the error does not exceed a half of the last digit retained. (5)

(b) Find the product of

$$723416 \times 29815 \times 9635 \times 813610 \times 875$$

correct to six significant figures. Also find its exact value, showing intermediate steps in the computation, if any. (5)

(c) The normal approximation to the Binomial distribution

$$P(n, r) = \sum_{x=0}^{r} \binom{n}{x} p^x (1-p)^{n-x}$$

is given by the formula

$$\phi(r^*) = \int_{-\infty}^{r^*} \frac{1}{\sqrt{2\pi}} \, e^{-\frac{1}{2}t^2} \, dt$$

where $r^* = (r + \frac{1}{2} - np)/\sqrt{np(1-p)}$. Evaluate $P(n, r)$ and $\phi(r^*)$ for $n = 5$, $r = 2$ and $p = 0.2$ & 0.5

Hence find out the percentage error in the Normal approximation to the Binomial distribution for these values of n, r and p. (15)

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(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

1. The following table shows the wholesale price of Katla fish (in Rs. per md.) in Calcutta for the years 1954, 1955, 1956 and 1957.

(a) Calculate seasonal indices for different months. (20)

month	year			
	1954	1955	1956	1957
January	53.8	58.0	76.0	82.5
February	57.5	57.5	78.8	93.8
March	58.0	67.5	82.5	92.5
April	71.2	87.5	83.0	84.0
May	78.0	94.0	96.2	80.0
June	65.0	93.1	88.8	91.2
July	70.2	86.2	98.0	87.0
August	75.0	99.0	101.2	102.5
September	63.8	86.2	97.5	99.0
October	63.8	89.0	85.0	86.2
November	57.0	83.2	82.5	96.2
December	57.5	80.0	78.0	89.0

(b) If the wholesale price for August 1960 is given as Rs. 112.5 per md., what prediction can be made with the knowledge acquired about the wholesale price in November 1960 ? (5)

2. Either,

The following table shows the actual field layout of an experiment with a Latin Square design, along with the yields in grams of the crop. A, B, C, D and E represent 5 different treatments.

B 257	E 230	A 279	C 287	D 202
D 245	A 283	E 245	B 280	C 260
E 182	B 252	C 280	D 246	A 250
A 203	C 204	D 227	E 193	B 259
C 231	D 271	B 266	A 334	E 338

(a) Analyse the variance and test if the treatment differences are significant. (20) ·

(b) How will you modify the analysis of variance if the above experiment is considered as a randomised block experiment with the 5 horizontal rows as 5 different blocks ? (5)

Or,

Six varieties of wheat numbered 1 to 6 were put in a randomised block trial in a field experiment. The plan of the experiment, and the yields of each plot in suitable unit

are given in the following table. Carry out an analysis of variance of this data and comment on the results. Find the critical difference (at the 5 percent level) between the average yields of two varieties and use this to arrange the varieties in decreasing order of yields.

Block I			Block II	
varieties	yield		varieties	yield
4	19.5		6	27.0
6	25.0		2	15.0
3	22.0		3	21.0
5	21.0		1	22.0
1	17.5		5	20.0
2	27.0		4	11.5

Block III			Block IV	
varieties	yield		varieties	yield
2	19.5		3	13.5
3	24.5		2	20.5
6	29.0		4	19.0
5	24.5		1	15.0
1	31.5		5	5.5
4	19.0		6	12.0

(25)

3. (a) Find the value of

$$\begin{vmatrix} 901 & 1002 & 1103 \\ 77 & 76 & 75 \\ 11 & 13 & 16 \end{vmatrix}$$

(5)

(b) Find by interpolation in the following table the value of

$$f(x) \text{ when } x = 0.375 \tag{8}$$

x	$f(x)$
0.36	0.6746
0.37	0.7048
0.38	0.8437
0.39	0.8919

4. *Either,*

Obtain any four of the following from published sources, and indicate in each case the source used. (12)

(i) Estimate of national income of India, Burma, Ceylon and Pakistan for 1950 to 1955.

(ii) Number of Central Government employees of India in 1955 and 1959.

(iii) Savings Deposits with the scheduled banks in India in 1955-56, 1956-57 and 1957-58.

(iv) Production of Vanaspati (Vegetable oil products) in Andhra, Bihar and Bombay either in 1958 or in 1959.

(v) Estimate of population in 1956 of Indonesia, Burma, Ceylon and Pakistan.

(vi) Occupational Distribution of Applicants on Live Registers of Employment Exchanges for any month of 1958 in Kerala and Madhya Pradesh.

Or,

Prepare a neat statement showing the wholesale prices index numbers, each year, for the following countries for the period 1954 to 1959. Obtain the series of annual percentage increase (or decrease) in these index numbers for each country. Plot the results on a graph paper and comment on the results.

Countries : (a) Brazil, (b) United Arab Republic, (c) Canada, (d) Indonesia, (e) India. (12)

5. The mean and the central moments of a certain frequency distribution are :-

$$\text{mean} = 9.4$$
$$\mu_2 = 19.0$$
$$\mu_3 = 73.0$$
$$\mu_4 = 1480.4$$

Find the equation of the appropriate Pearsonian type of frequency curve together with the values of the parameters. Find also the proportion of the population with variate-values between 10 and 12. (by quadrature method). (25)

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