INDIAN STATISTICAL INSTITUTE

STATISTICIAN'S DIPLOMA EXAMINATION, PART I—AUGUST 1946

FIRST PAPER.

Time allowed 4 hours. Maximum marks 100.

(It is not necessary to answer all the questions in order to secure full marks. Attempt as many as you like remembering that the questions do not carry equal marks and credit will be given according to the quality of the answer.)

1. (a) What is the expectation of the number of failures preceding the first success in an indefinite series of indefinite trials with the probability 'p' ?

(b) In a certain book of 100 pages, no page contains more than three errors. Twenty pages contain one error on each page, ten pages two errors and five pages three errors. The rest are free from error. Two copies of the book were opened randomly. What is the probability that the total number of errors in these pages is not more than four.

2. (a) For the binomial distribution

$$p(x) = {}^{n}C_{x}\, p^{x}\, (1-p)^{n-x}$$

show that the probability that x is greater than or equal to k is

$$\int_{0}^{p} x^{k-1}(1-x)^{n-x}dx \Big/ \int_{0}^{1} x^{k-1}(1-x)^{n-x}dx$$

(b) A sample of n is drawn at random from an infinite population in which the proportion of individuals bearing a certain character A is p. In the sample only x have the character A. If p is not known how will you determine numbers α and β such that

$$Prob.\ [\alpha < p < \beta] = 0{\cdot}95$$

3. (a) Explain the relation between a frequency curve and its ogive. Show that a point of inflexion on the ogive corresponds to a mode of the frequency curve. Illustrate how you will compute the quartiles of a frequency distribution, and derive from them a measure of asymmetry of the distribution.

(b) Show that for the distribution

$$dF = y_0 e^{-\frac{x}{\sigma}} dx \qquad 0 \leqslant x \leqslant \infty$$

the interquartile range is $\sigma \log_e 3$.

4. (a) Explain the term partial correlation coefficient and in the usual notation obtain the values of $r_{12\cdot3}$ in terms of the ordinary correlation coefficients. Find the limits to the values of r_{12} when r_{13} and r_{23} are known.

If the relation $ax_1 + bx_2 + cx_3 = 0$ holds for all sets of values of the variables x_1, x_2, x_3 what must the partial correlations be?

(b) If $\eta_{y.x}$ represents the correlation ratio of y on x, state under what circumstances

(*i*) $\eta_{y.x}=1$, (*ii*) $\eta_{x.y}=1$, (*iii*) $\eta_{y.x}=\eta_{x.y}=1$

Show that when the correlation coefficient is equal to unity, the correlation ratios are also equal to unity, but not *vice versa*.

5. (a) Explain clearly the *t*-test for discriminating between the means of two normal populations (with the same variance) when two random samples of sizes n_1 and n_2 are available from the two populations, and compare it with classical test based on the standard error of the difference of the sample means.

(b) Comment on the following observations by Fisher :-

The use of student's distribution enables us to appreciate the values of observing a sufficient number of parallel cases ; their value lies, not only in the fact that the standard error of a mean decreases inversely as the square root of the number of parallels, but in the fact that the accuracy of the estimate of our standard error increases simultaneously.

6. How would you use the *z*-statistic to test whether

(i) Two samples of sizes n_1 and n_2 can be supposed to have come from normal populations with the same standard deviation.

(ii) Five samples of size n_1 can be supposed to have come from normal populations with the same mean (it being assumed that the standard deviations are equal).

(iii) An observed coefficient of multiple correlation based on n readings, between the dependent character y, and the characters x_1, x_2, x_3 is significant.

7. Write a note on Fisher's *z*-transformation of the correlation coefficient and point out its various uses.

The correlation coefficient between performances in mathematics and in language for a group of 20 girls is .62. For a group of 25 boys it is .75. Does sex make a difference in correlation? If the answer is in the negative obtain the best pooled estimate of the correlation.

8. (a) Explain giving examples how the following transformations enable the extension of the use of the technique of analysis of variance to certain types of data.

(*i*) $u=Sin^{-1}\sqrt{x}$, (*ii*) $u=\sqrt{x}$

(b) Write a short note on the 2×2 contingency table. In order to test the efficacy of a serum, it was administered to 10 out of 22 animals, and of these 3 died, while among the 12 untreated 9 died. Does this demonstrate the efficacy of the serum ?

9. Write short notes on any four of the following :

(a) Law of large numbers
(b) Tetrachoric functions
(c) Sheppard's corrections
(d) Principle of maximum likelihood
(e) *k*-statistics
(f) Rank correlation.

STATISTICIAN'S DIPLOMA EXAMINATION, PART I—AUGUST 1946

SECOND PAPER.

Time allowed 4 hours. Maximum marks 100.

(It is not necessary to answer all the questions in order to secure full marks. Attempt as many as you like remembering that the questions do not carry equal marks and credit will be given according to the quality of the answer.)

1. You are asked to conduct a statistical investigation into the working of a bus company with a view to ascertaining whether the service is being increasingly used by the public and the undertaking is proving more remunerative than before. Describe briefly :

(a) The basic data you would require for the purpose.
(b) The steps you would take to assemble such data, and
(c) The method you would employ to analyse such data.

2. Explain what is meant by the term " Cost of of Living Index Number ". Sketch the general lines on which you would proceed to construct such an index number of middle class families in Calcutta. What special problems are encountered in constructing such an index number in times of rapid changes in consumption habits and how would you tackle them?

3. Explain as fully as you can the method you would follow in making a comparative study of (1) long term and (2) short term fluctuations in two time series data expressed in dissimilar units, say in tons and in rupees.

4. Give a short account of the history and development of the official system of collection of agricultural statistics in India, commenting on their adequacy and reliability and making suggestions for their improvement, if you have any.

5. Write critical notes on any two of the following subjects :—

(1). Quantum and Price level of Overseas trade.
(2). Pareto's Income Law.
(3). Gross and net reproduction rates.
(4). Sensitive Index Number of prices.
(5). National income.

6. As part of post-war planning and development in India, suppose it is proposed to provide for a certain length of road mileage under each of three categories of roads (inter-provincial roads, provincial roads connecting towns, and roads connecting villages). Discuss what statistical data would be needed and how you would propose to collect them so as to settle the question of a proper allocation as among different provinces and also in any province as among different parts.

7. Sketch the outlines and main components of a fertility table and a mortality table and explain what data would be needed (and how you would look for them) to construct these tables. To what uses can you put these tables?

8. Devise a scheme of large scale sample survey and statistical analysis thereof by which you can assess the extent of either (i) rural indebtedness or (ii) rural unemployment, or (iii) both under a joint scheme. Only the barest outlines need be given.

9. What is genetical linkage and how does it help us in preparing autosomial maps? Indicate broadly the statistical methods by which we can (i) detect, and (ii) estimate linkage for the wellknown types of genetical data.

10. Give a critical account of the uses and limitations of the method of factor analysis as it has been used in education and psychology.

STATISTICIAN'S DIPLOMA EXAMINATION, PART I—AUGUST 1946

Third Paper—Practical.

Time allowed 4 hours. Full marks 100.

1. "Between May '43 and Sept. '45 there were 4,660 applications of all kinds, in India including the stocks for a capital issue of Rs. 385 crores. Of these 4,371 applications were from British India for an issue of Rs. 342 crores, and 289 from outside British India, practically all from the Indian States—for an issue of Rs.43 crores. Consent was given in respect of 3,784 applications, involving a capital issue of Rs. 261 crores—3,575 applications and Rs.228 crores relating to British India and 209 applications and Rs.33 crores relating to Indian States.

There were 876 rejections asking for a capital issue of Rs.89 crores. It should be mentioned that this amount refers to only complete refusals; partial refusals are not included. Permission was refused for Rs. 82 crores, in respect of 706 applications from British India and Rs.7 crores from Indian States.

Industrial Issues: Of the consents, immediate and long range schemes combined 1,766 applications amounting to Rs.160 crores related to Industrial and applications amounting to Rs.101 crores to non-industrial issues such as plantation and other agricultural objects, trade and transport etc. Under long range schemes 249 applications asked for a capital issue of Rs.96 crores of which assent was given in the case of 247 applications for a capital issue of about Rs.95 crores. Of these 216 applications in respect of Rs. 82 crores belong to Industrial and 31 applications in respect of about 12 crores, to non-Industrial issues. Of the consented applications 2,118 for an issue of Rs.162 crores, relate to initial and 1,056 for an issue of Rs.98 crores to further issues. Of the consented Industrial issues 961 applications for a capital issue of Rs.103 crores belong to initial and 805 applications for an issue of Rs. 57 crores to further issues—the consented of non-Industrial applications 1,157, in respect of Rs.60 crores were concerned with initial and 861 applications with respect to Rs.41crores with further issues. Of the long range schemes consented 182 applications for an issue of Rs.67 crores belong to Industrial and 85 applications for an issue of Rs. 27 crores to further issues. In respect of such Industrial schemes 158 applications for an issue of Rs. 100 crores relate to initial and 58 applications for an issue of Rs. 22 crores, to further issues. As regards such non-Industrial issues 24 applications for an issue of more than Rs. 7 crores belong to initial and 7 applications for an issue of about Rs. 5 crores to further issues".

(a) Condense the relevant information quoted above from Indian Economist in suitable tabular forms, table A for para (1) and (2) and table B for the rest.

(b) Find out the number of Immediate Schemes consented to both for Industrial and non-Industrial Issues, and mention how many of them are for initial issues and how many for further issues, incorporate the same information in its relevant place in the table.

2. The table below gives the yields of two types of fodder crop with the varying age of the crop in months

Age of Fodder crop in months	Yield of Fodder Crop in suitable units	
	Type A	Type B
1	85	55
2	75	52
3	65	40
4	41	36
5	29	54
6	36	22
7	16	29
8	24	24
9	—	18
10	—	20

Find out if (i) the yield significantly differs with the age for both the varieties, (ii) the rates are significantly different for the varieties A and B.

3. Find the Seasonal Index number for the Inland trade in tea from the following data (use the moving average method on the logarithm of the data).

Tea (in thousand maunds)

	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39
April	75·10	96·12	92·87	110·20	132·40	138·31
May	157·40	150·70	161·70	178·30	158·40	212·58
June	303·30	301·10	303·60	376·70	348·70	458·03
July	420·80	432·00	400·20	530·60	555·70	594·86
August	501·90	595·30	538·80	574·30	653·40	752·65
September	535·00	549·90	534·90	580·90	701·80	754·87
October	535·30	565·60	560·80	604·00	708·50	688·96
November	478·40	494·70	474·80	540·40	629·80	611·86
December	344·10	354·00	335·70	339·90	431·10	401·15
January	232·20	218·90	210·00	214·80	207·30	248·62
February	148·10	122·90	120·90	110·80	125·30	157·15
March	97·57	85·79	95·48	94·47	127·33	131·50

STATISTICIAN'S DIPLOMA EXAMINATION, PART I—AUGUST 1946

FOURTH PAPER—(Practical).

Time allowed 4 hours. Full marks 100.

1. (a) In a public preference survey the following table classifies the people interviewed according to their opinion regarding inter-caste marriage :

Opinion	Age in years			
	19-25	26-35	36-55	over 55
Unconditional support	76	125	96	10
Conditional support	69	117	126	17
Condone	14	27	35	4
Oppose unconditionally	60	168	210	46

Examine whether the nature of opinion changes with age. If the answer is in the affirmative, then assess the strength of association.

(b) In a certain Family Budget Enquiry the number of children in a particular group of families is 3 daughters and 6 sons. Is this consistant with the hypothesis that sons and daughters are equal in number in the population ?

2. You are required to submit the total estimated cost of a scheme purporting to impart free primary education to all children in Bengal between the ages 5 and 10. On the basis of a scale of expenditure as deduced from official statistics for the pre-war year 1939-40 arrive at what you consider to be a reasonable estimate.

3. The following correlation table is made up from the results of an investigation of the living expenses of 200 families.

Percentage of income spent on food	Family income						
	$ 500 to $ 800	$ 800 to $ 1100	$ 1100 to $ 1400	$ 1400 to $ 1700	$ 1700 to $ 2000	$ 2000 to $ 2300	$ 2300 to $ 2600
28-30						2	6
30-32					3	2	5
32-34				4	7	11	6
34-36				10	9	9	4
36-38			7	7	7	5	2
38-40	3	3	11	6	5		
40-42	—	10	8	3	1		
42-44	5	10	3	1			
44-46	7	5	1				
46-48	5	1					
48-50	4	2					

Compute the correlation coefficient, and the two regression equations. Test for the significance of the correlation coefficient.

Assuming that the data given in the correlation table is representative of families in the income groups shown, estimate the probable amount spent for food in a community of 3000 families whose income is $1900. How might such an estimate be of use to a retail grocer ?

Find also the correlation ratios and test for the significance of the linearity of the regression.

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COMPUTER'S CERTIFICATE EXAMINATION,—MAY 1946

PART IA, SECTION I

(Time allowed : 2½ hours)

(No machine or table to be allowed. No credit will be given for incomplete or scrappy answer).

1. Calculate the value of y from the formula

$$y = 168 + 7x - 2x^2$$

for values of x equal to 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12. Arrange your calculation in a tabular form.

2. Readings of blood pressure of 120 different persons are given below. Find out how many of these persons have blood pressure between 79 and 99, how many have between 100 and 119, how many have between 120 and 139 and how many have more than 139. Find out also the percentage of persons with blood pressure more than 139.

80	110	110	115	115	110	105	115	110	110	160	130	105	105	115
105	105	110	100	105	100	130	101	85	110	95	110	115	110	110
110	100	105	105	105	100	115	100	125	120	115	110	115	115	110
110	100	105	115	100	100	105	100	105	95	110	110	95	105	95
110	95	110	90	105	100	100	115	115	110	95	105	110	90	105
115	115	110	95	105	90	95	105	110	115	120	115	120	110	95
105	115	105	110	105	90	110	105	120	120	120	125	115	135	110
135	110	135	115	130	110	105	100	140	115	135	115	105	125	145

3. The following is an account of the accidents (killed and injured) that happened to passengers in 5 different railways(A, B, C, D and E) in a particular year.

In A, 12 people were killed and an equal number were injured while in B and C only 10 and 4 people were injured but none killed. In D, as many as 39 people were injured and 28 killed, while in E, 9 people were killed and 10 injured. These were all cases of accidents due to 'Falling between trains and platforms'.

Deaths and accidents due to 'Crossing of the lines at stations' were not as numerous. In E, however, 6 people were injured, and 5 killed while in C and D, only 4 and 2 people were killed and 2 and 1 people injured. A had 1 case of injury and 3 deaths.

'Closing of carriage doors' did result in serious injuries but happily no deaths—33 people were injured in C, 2 in E and 4 in A.

The largest number of accidents however happned due to "falling or jumping out during running of trains." As many as 218, 202 116, 101 and 74 cases of injuries happened in the railways C, E, B, D, & A respectively while the cases of deaths due to the same cause in these railways were respectively 35, 37, 26, 30, and 27.

Show the above information in a tabular form and find out the total number of accidents in the 5 railways, due to the 4 causes.

4. Copy the following table, correcting any obvious mistakes.

South Africa. Deaths by Age and Sex. Actual figures.

Age	1939			1940			1941		
	Male	Female	Total	Males	Females	Total	Males	Females	Total
0– 1	1486	1162	2648	1572	1153	2725	1599	1181	2780
1– 4	504	427	931	520	442	962	509	463	972
5– 9	199	156	355	165	161	362	181	146	327
10–24	147	98	245	145	91	236	142	102	244
15–19	220	116	336	184	130	314	179	146	325
20–24	306	220	526	275	195	470	218	181	399
25–29	302	245	947	270	236	506	225	210	435
30–34	280	259	539	310	241	551	248	252	500
35–39	277	255	532	326	259	585	268	243	511
40–44	344	331	675	337	260	597	1367	290	1657
45–49	524	352	876	547	376	923	544	378	922
50–54	678	482	1160	695	429	1124	735	484	1219
55–59	846	545	1391	83·2	49·9	133·1	812	551	1393
60–64	1069	613	1682	1082	632	1714	1133	689	1822
65–69	1168	758	1926	1227	785	3012	1240	776	2016
70–74	1056	751	1807	1157	859	3016	1235	872	2107
75–	1971	1754	3725	1945	1940	3885	2210	1894	4104
Total	10063	7638	17701	11589	8688	20277	11875	8858	20733

COMPUTER'S CERTIFICATE EXAMATION,—MAY 1946

PART 1A, SECTION 2

(Time allowed : 2½ hours)

(No machine to be allowed. No credit will be given for incomplete or scrappy answers).

1. Records of the height measurements of individual students of a city school show that 3 boys had a height between 30 and 33 inches, 11 boys between 33 and 36 inches, 18 boys between 36 and 39 inches, 23 boys between 39 and 42 inches, 41 boys between 42 and 45 inches, 29 boys between 45 and 48 inches, 18 boys between 48 and 51 inches, 12 boys between 51 and 54 inches and only one boy was found in the group 72–75 inches.

(i) Find the Mean height of all the boys of the schools with the standard deviation of the Mean.

(ii) Recalculate Mean and S. D. and Coefficient of Variation excluding the one boy in the extreme high group.

Estimate within what range about the Mean, you may expect (a) 68%, (b) 95%, and (c) 99% of the students to be included.

2. (i) Draw the graphs of $x^2 = 2y$, $x = 1/y$ within the range $x = 0$ and $x = 3$. Find graphically the coordinates of the point of intersection.

(ii) Draw the graph of $x^2 - 3x + 7 = y$ in the range $x = 0$ to $x = 3$. and find graphically the minimum value.

(In each graph at least ten points are to be plotted.)

3. If $r_{hk.i}=\frac{r_{hk}-r_{hi}r_{ki}}{\sqrt{(1-r_{hi}^2)(1-r_{ki}^2)}}$, find the values of $r_{12.3}$, $r_{23.1}$ and $r_{31.2}$ where $r_{12}=0{\cdot}3286$, $r_{23}=0{\cdot}2731$, $r_{31}=0{\cdot}3042$.

(ii) If $1-R^2_{h(ij)}=(1-r_{hi}^2)(1-r^2_{h(i)j})$, find the values of $R_{1(23)}$, $R_{2(31)}$ and $R_{3(12)}$.

4. (i)

x	 4725	4727
$x^{\frac{1}{2}}$	.... 68·738635	68·753182
$x^{\frac{1}{4}}$	.... 16·780334	16·782701
x^{-1}	.... 0·000,2116402	0·000,2115507
$log_{10}x$	.... 3·6744018	3·6745856

Find by simple interpolation the value of $x^{\frac{1}{2}}$, $x^{\frac{1}{4}}$, x^{-1} and $log_{10}x$ when $x=4726.2$

(ii) Find the value of the series

$1+1+\frac{1}{1\cdot2}+\frac{1}{1\cdot2\cdot3}+\frac{1}{1\cdot2\cdot3\cdot4}+\ldots$ correct up to 6 decimal places.

COMPUTER'S CERTIFICATE EXAMINATION,—MAY 1946

PART IB, SECTION I

Time allowed : 3 hours

(Machines and tables allowed. No credit will be given for incomplete and scrappy answer).

1. The following table gives figures of exports of tea from British India :

	(in million pounds)			
	1930	1931	1932	1933
January	32	27	30	29
February	14	17	16	20
March	7	9	5	14
April	8	4	6	7
May	11	6	7	7
June	14	19	22	15
July	44	31	35	27
August	43	37	44	43
September	52	55	60	37
October	47	47	51	44
November	48	43	53	48
December	40	48	40	34

Calculate Moving Averages (based on 13 months) from the above table. Draw on the same sheet graphs indicating the original values and the graduated average values.

2. (a) Draw a table in blanks in which could be shown for two years import into, and export from, Bengal of four kinds of commodities at the two ports of Calcutta and Chittagong. Pay special attention to spacings, headings, and outlines.

(b) The following table shows the number of persons in a certain establishment classified according to salary groups. Find the mean and standard deviation for the the distribution. Also obtain the median and the upper quartile of the distribution.

Salary Group	Number of persons
30 – 99	38
100 – 169	102
170 – 239	74
240 – 309	53
310 – 379	16
380 – 449	9
450 – 519	3
520 – 589	2
590 – 659	1

3. The following table shows 283 male lives on whom life assurance policies were issued classified by the age of the insured at issue of the policy (x) and the age at death (y). Find the regression line giving y on x. What is the probable age at death corresponding to a life whose age at entry was 33 years.

x	15	20	25	30	35	40	45	50	55	60	Total
y \											
70									1	2	3
65								4	9	3	16
60							6	5	7	1	19
55				1		2	12	20	4		39
50					2	13	13	8			36
45				1	12	12	8				33
40			3	13	19	12					47
35		1	8	14	14						37
30		5	10	7							22
25		11	10								21
20	6	4									10
Total	6	21	31	36	47	39	39	37	21	6	283

4. Paper bags, selected from consignments supplied by six different manufacturers were tested for their breaking strength. The tension (in lbs. '000) at the breaking point are recorded below :

Bag no.	Manufacturers					
	1	2	3	4	5	6
1	5·2	4·9	7·7	8·0	4·9	7·2
2	6·7	5·7	8·2	6·7	4·2	6·1
3	7·0	6·8	3·1	6·1	6·0	7·3
4	5·8	7·0	3·0	3.1	5.2	5.2

Test by the method of Analysis of Variance whether the breaking strength of bags of the six manufacturers are significantly different.

COMPUTER'S CERTIFICATE EXAMINATION,—MAY 1946

PART IB, SECTION II

(Time allowed : 3 hours.)

(Machines and tables allowed. No credit will be given for incomplete and scrappy answer).

1. Estimate Sweden's population in the years 1810, 1830, and 1850 given that the population growth of that country is described by the equation

$$y = 1.56 + \frac{6.10}{1 + 7.086e^{-.0317t}}$$

where y is the population in millions at the time when t years elapse from the year 1800. $e = 2.7183$.

2. Fit a normal curve to the following observed frequency distribution of 1000 red blood cell diameters of a monkey. Test the goodness of fit and comment on it.

r. b. c. diameter	frequency	r. b. c. diameter	frequency
5.75	1	7.50	227
6.00	5	7.75	97
6·25	6	8·00	93
6·50	37	8·25	44
6·75	66	8·50	12
7·00	146	8·75	6
7·25	258	9·00	2

You may assume the mean and the standard deviation to be 7·380 and 0·4661 respectively.

3. 968 cases of tuberculosis attending a clinic have been classified in the table below in regard to their age and the character of the lesion. Test whether and how age affects character of the lesion.

Character of lesion	Age			Total
	under 30 years	over 30 years under 50 years	over 50 years	
Exudative	286	108	10	404
Intermediate	249	212	26	487
Productive	25	37	15	77
Total	560	357	51	968

4. (a) A random sample of 1000 farms in a certain year gives an average yield of wheat of 2000 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 2100 lbs. per acre with a standard deviation of 2100 per acre. Are these data consistent with the hypothesis that the average yields in the country were the same in these two years.

(b) If it costs an anna to draw one member of a sample from a normal population with mean 100, standard deviation 10, how much would it cost to take sufficient members to ensure the mean of the sample should be within ·01 per cent of the true value (in 99 cases out of 100).

COMPUTER'S CERTIFICATE EXAMINATION,—MAY 1946

PART IC, SECTION I

Time allowed: 4 hours.

(Machines and tables allowed. No credit will be given for incomplete and scrappy answer)

1. Expand $\left(3+\frac{5x}{8}\right)^{8}$ by the Binomial theorem, and find correct to four places of decimals, the value of the 5th term, when $x=2\cdot67$.

2. Tabulate the value of the function

$$y=\tfrac{1}{2}\log_e\frac{1+\cos\theta}{1-\cos\theta}$$

from $\theta=0^\circ$ to 90°, at intervals of 10°. Arrange your calculation in a tabular form.

Represent these values on a graph, and hence approximately determine the value of θ for which $y=2$.

3. The following table gives the values of a statistical variate z, corresponding to two other variates x and y.

x	y	z
44	30	79
37	26	65
36	24	62
38	25	63
32	21	52
36	25	60

Test the significance of—

(a) The regression of z on x.

(b) Coefficient of correlation between x and y.

(c) Coefficient of partial correlation between z and y, when x is held constant.

Can the variances of x and y be regarded as equal?

4. Values of ratio

$$G=\frac{\text{Weight at 20 weeks}}{\text{Weight at birth}}$$ for 12 infants are given below.

Infant No.	G	Infant no.	G
1	2·07	7	2·06
2	1·91	8	2·03
3	1·93	9	2·25
4	2·10	10	1·92
5	2·18	11	1·69
6	1·96	12	1·77

Calculate

m = mean of the sample

D = Sum of squares of the deviations from the mean

$s=\sqrt{D/11}$

$t=\dfrac{(m-2)}{s\sqrt{\frac{1}{12}}}$

Compare it with the 5% and 1% values of t (with the appropriate degrees of freedom) from Fisher's table, and hence test whether infants in the community double their birth weight at 20 weeks.

5. If you are given a set of 100 observations on school boys, giving the heights and corresponding weights, draw up a suitable computaion form for fitting a cubic line of regression of weight on height.

6. Estimate the missing data using a graphical metnod.

Year	Import of Sugar in tons
1927	90065
1928	94114
1929	81522
1930	64106
1931	41015
1932	—
1933	—
1934	—
1935	26108
1936	38060
1937	41150
1938	45100
1939	—

COMPUTER'S CERTIFICATE EXAMINATION,—MAY 1946

PART IC, SECTION II

Time allowed : 4 hours.

(Machines and tables allowed. No credit will be given for incomplete or scrapr, answer).

1. Obtain the numerical value of the determinant

$$\begin{vmatrix} 23\cdot1 & 41\cdot9 & 20\cdot17 \\ 46\cdot2 & 83\cdot7 & 41\cdot72 \\ 34\cdot6 & 60\cdot5 & 30\cdot32 \end{vmatrix}$$

2. Prepare an index of seasonal variation for the data given below.

Monthly fire loss—United States

Month	1930	1931	1932	1933	1934
January	42	44	39	36	28
February	43	42	40	37	32
March	43	44	49	36	32
April	43	41	44	28	22
May	38	37	39	24	25
June	32	33	34	22	20
July	35	33	33	20	19
August	36	32	32	24	20
September	35	33	31	20	16
October	37	35	31	22	18
November	36	35	31	23	20
December	43	40	39	27	24

3. Given the following values of β_1 and β_2 indicate what curves you will use for graduation.

$$\beta_1 = \quad 0{\cdot}51 \quad 0{\cdot}05 \quad 0{\cdot}83 \quad 1{\cdot}5$$
$$\beta_2 = \quad 4{\cdot}3 \quad 3{\cdot}2 \quad 4{\cdot}57 \quad 2{\cdot}9$$

The total frequency is 400 in every case.

4. Analyse the data in the following Latin square lay out by the analysis of variance where the letters represent different fertilizer treatments and the numbers give yields, of a certain variety of corn in pounds.

N 72	P 64	K 54	C 60	M 78
C 56	K 52	M 80	P 61	N 71
M 75	N 67	C 63	K 58	P 60
P 57	C 58	N 70	M 83	K 62
K 55	M 73	P 54	N 66	C 59

5. The following table gives the area $A(x)$ of the curve $y = e^{-x^2}$ from x to infinity

x	$A(x)$
·00	0·88622692
·01	0·87622724
·02	0·86622957
·03	0·85623590
·04	0·84624822
·05	0·83626853

Calculate by using any suitable interpolation formula the value of $A(x)$, when $x = 0{\cdot}025$, and verify your result by use of the formula

$$A(0) - A(x) = x - \frac{x^3}{3} + \frac{x^5}{5.2!} - \frac{x^7}{7.3!} + \cdots$$