

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1974.

Paper I (Practical): Elementary Computation

Time: 5 hours

Full marks: 100

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

GROUP A

(Attempt all questions from this group)

Use contracted method to evaluate any one of the following, correct to 5 places of decimals:

(a) 0.35612×2.731 (b) $2.44940 \div 1.41421$ (4)

2. Evaluate any three of the following with the help of suitable formulae:

i) $(-22)^2$

ii) $(3.700)^2 - (6.292)^2$

iii) $(.36 + .0016 - .6 \times .04)(.6 + .04)$

iv) $(47 + \frac{1}{47})(47 - \frac{1}{47}) - (47 - \frac{1}{47})(47 + \frac{1}{47})$

[No credit will be given for working by routine processes.] (2x3)=6

3. i) Round off the following numbers to 3 places of decimal:

(a) 72.12590 (b) 1.84219

Find also the relative and percentage errors due to rounding off in each of the above cases.

ii) Find the maximum relative error in the computed area of a rectangle, given that the sides are 52.78 ft. and 31.483 ft. both figures being correct to the last digit retained. (4x6)=10

4. i) Given $\log_{10} 2 = 0.3010300$ and $\log_{10} 3 = 0.4771213$, find the value of

$$\log_{10} \frac{(7.2)^3 \times (.016)^4}{(\frac{6}{5})^{15}}$$
 correct to 6 places of decimal.

ii) Given $\log_{10} 2 = 0.3010300$, $\log_{10} 3 = 0.4771213$ and $\log_{10} 7 = 0.8450980$, find correct to 2 decimal places, the value of x from the equation

$$7^{3x+2} \div 3^{x+2} = 7^{3x+1} + 2^{2x+6}$$

[Notes: Only the information given to you should be used, indicating in writing how these have been used.] (6x6)=12

5. Using logarithmic table, find any two of the following correct to 5 decimal places:

i) anti-log of (-2.0254) , where the base is 10.

ii) logarithm of 216.525 to the base $e = 2.71729 \dots$

iii) $\frac{1}{1.02543}$ (4x4)=8

PLEASE TURN OVER

Write the following :

$$1^2 + 2^2 + 3^2 + \dots + 100^2$$

$$\frac{1}{2 \times 2} + \frac{1}{3 \times 7} + \frac{1}{4 \times 7} + \frac{1}{5 \times 7}$$

correct to 5 places of decimal.

(3+5)=8

GROUP B

(Attempt all questions from this group)

7. The following table gives employment in agriculture in U.S.A. during 1935 to 1944 :

| Year | no. of persons employed (in lakh) | no. of persons employed (in lakh) |
|------|-----------------------------------|-----------------------------------|
| 1935 | 127 | 115 |
| 1936 | 123 | 107 |
| 1937 | 120 | 105 |
| 1938 | 116 | 104 |
| 1939 | 112 | 102 |

Draw a graph to indicate the changes in employment over time. Use this graph to estimate the values of employment in 1934 and in 1945.

OR

(6+2+2)

Plot the following points in a graph and then draw a smooth free-hand curve

| | | | | | | | | | |
|---|---|---|---|---|----|----|----|----|---|
| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| y | 2 | 6 | 7 | 8 | 10 | 11 | 11 | 10 | 9 |

From the smoothed curve, read the values of y when x = 2.5 and 6.5.

(6+2+2)=10

8. The values of a function f(x) are given below for a number of values of x :

| x | f(x) |
|-----|---------|
| 1.6 | 2.37257 |
| 1.7 | 2.62336 |
| 1.8 | 2.94217 |
| 1.9 | 3.26616 |

Find by linear interpolation

- the value of f(x) for x = 1.71
- the value of x (correct to two places of decimal) for f(x)=2.84515.

OR

(4+4)=8

Given below are the values of a function f(x, y) for different values of x and y :

| x | y | | |
|----|-------|-------|-------|
| | 67 | 68 | 69 |
| 67 | 1.422 | 1.430 | 1.438 |
| 68 | 1.452 | 1.451 | 1.450 |
| 69 | 1.465 | 1.452 | 1.452 |

Find by linear interpolation the value of f(68.5, 68.4)

(8)

(12)

9. a.) Draw the graphs of the equations :

$$3x + 2y = 6 \text{ and } y^2 - 4x = 0$$

and find the points of intersection of the line and the curve.

b) Solve algebraically:

$$\sqrt{\log_{10} x} - 1.2 = 0 \text{ correct to 2 significant digits.} \quad (6+6)=12$$

10.

Either

Find graphically the area of the triangle formed by the segments of the following intersecting lines, whose equations are

$$y = 2, \quad y = 5x + 5 \text{ and } 2x - 3y = 0 \quad (10)$$

Or

Draw the graph of $y = x^2 - 4$.

i) Hence find the minimum value of y

ii) Find also graphically, the area bounded by the x-axis and the graph drawn. (5+6)=10

11.

Two persons X and Y start from a place A and move towards a place B along the same line. X moves at the rate of 45 km./hour and leaves A at 8 a.m. Y however leaves A at 10 a.m. but moves at 60 km./hour.

Find graphically:

i) the time when X and Y meet each other

ii) the distance between A and the point where the two persons meet. (8)

NEATNESS (Groups A and B)

(4)

Paper: II (Practical): Compilation and Presentation of Statistics

5 hours

Full marks : 100

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

GROUP A

(Attempt all questions from this group)

A crop survey was conducted by the ICS during the year 1966-67. Data on acreage and yield were collected for seven cereals, namely paddy, jowar, bajra, ragi, maize, wheat and barley.

The area also under each of the above-mentioned seven cereals were estimated from the survey. The estimates were (in thousand hectares) as follows:

36627 for paddy, 22709 for jowar, 16412 for bajra, 2687 for ragi, 6176 for maize, 15479 for wheat and 4025 for barley. The total gross area under the seven cereals was thus 102213 thousand hectares;

The crop-cutting experiments were conducted in two subsamples numbered 1 and 2. The yield rates in kilograms per hectare of gross area were estimated from production estimates of these subsamples as 804 for rice, 469 for jowar, 280 for bajra, 568 for ragi, 829 for maize, 871 for wheat and 670 for barley.

During the whole year, 10225 crop-cutting experiments were conducted for paddy, 6624 for jowar, 4028 for bajra, 2280 for ragi, 3582 for maize, 6203 for wheat and 2077 for barley. In autumn, 3728 experiments were conducted in case of paddy, 396 for jowar, 3324 for bajra, 1206 for ragi and 3234 for maize. No crop-cutting experiment was done during this season for wheat and barley. In winter, 5131 experiments were conducted in case of paddy, 3920 for jowar, 528 for bajra, 596 for ragi, 8 for maize, and 2 for wheat only. However no crop-cutting experiment was conducted for barley. In the spring season, 860 experiments were carried out for paddy, 1472 for jowar, 38 for bajra, 370 for ragi, 62 for maize, 6115 for wheat and 2064 for barley. The corresponding number of experiments during summer were 514, 336, 100, 109, 70, 86 and 13 respectively.

Present the above information in a suitable statistical table with appropriate headings. (11)

An all-India rural employment-unemployment survey was conducted during the 14th and the 15th rounds of the National Sample Survey. The survey persons were classified according to their general educational standards as under -

- (i) illiterate, (ii) literate but below primary, (iii) primary and above, but below matric, (iv) matric and above, and (v) not recorded.

They were also divided into four age-groups, viz. 0-5, 6-14, 15-24, 25 and above.

Prepare a blank tabular layout with suitable headings etc. for presenting the percentage distribution of the persons in each age group (and in each round) according to general educational standard. Provision for recording the number of unemp. persons in each age-group (and each round) must also be made. (6)

Please turn over

... table relating to expenditure and apportion accounts of 165 selected public limited companies for the years 1970-71 and 1971-72.

Tables Expenditure and apportion accounts of selected public limited companies.

| Expenditure and apportionments | 1970-71 | | 1971-72 | |
|---|----------------|--------------|----------------|--------------|
| | Lakh Rs. | % | Lakh Rs. | % |
| 1. raw materials/components etc. consumed | 3595,24 | 65.1 | 3062,51 | 55.0 |
| 2. tools and spares consumed | 492,07 | 7.7 | 420,14 | 7.5 |
| 3. power and fuel | 243,03 | 4.5 | 247,11 | 4.4 |
| 4. other manufacturing expenses | 154,62 | 2.4 | 125,98 | 2.3 |
| 5. salaries, wages, etc. | 999,99 | 15.4 | 800,47 | 14.5 |
| 6. provident fund | 66,60 | 1.1 | 54,32 | 1.0 |
| 7. welfare expenses | 56,77 | 0.9 | 47,96 | 0.9 |
| 8. depreciation provision | 297,99 | 4.6 | 260,98 | 4.7 |
| 9. other expenses | 470,85 | 7.3 | 539,79 | 7.9 |
| Total : | 6409,01 | 100.0 | 5659,68 | 100.0 |

Scrutinise carefully the above table and re-write it after removing any irregularities as may appear to you. (a)

Here are the official publications which provide current statistics for any four of the following. Mention also the name of the agency issuing the publication and its periodicity.

- area and population of India by States;
- wages, hours of work and productivity of workers in coal mines in India;
- number of compensated injuries and amount of compensation paid to workmen in India;
- 'first' and 'final' estimates of area and production of principal crops in India.
- exchange rates of various currencies of the world in terms of US dollars;
- short and medium-term advances of the Reserve Bank of India to State Co-operative Banks in India (4x2)=8

From the official publications supplied collect information for any three of the following. Mention with your answer the name of the publication consulted, its reference period, and page number. State also the periodicity of the publication consulted.

- total milk production in Bihar and Haryana in any two recent years and the corresponding quantities consumed as fluid milk.
- money supply in India as on the last Friday of any two recent years.
- total reported area for land utilisation purposes in West Bengal during two recent years and the corresponding figures for total cropped area.
- total production of any three heavy organic chemicals in India during two recent months.
- total value of exports from India to Canada, East Germany and Latin America, during latest two available years.
- infant mortality rates for Hungary and Indonesia for any two recent years. (4x3)=12

GROUP B

(Except 22 questions from this group)

The following data show the distribution of earners by educational status and sex in rural areas of West Bengal, as obtained in a survey in the recent past.

| Educational status | No. of earners (in thousand) | | |
|---------------------------------|------------------------------|--------|--------|
| | total | male | female |
| (1) | (2) | (3) | (4) |
| 1. Illiterate | 5150.3 | 4167.0 | 982.5 |
| 2. Below Matric | 2322.0 | 2263.1 | 54.7 |
| 3. Matriculate and not Graduate | 165.1 | 150.6 | 6.5 |
| 4. Graduate and Post-graduate | 24.0 | 22.3 | 1.7 |

Present the data in cols. (3) and (4) in a suitable diagrammatic form. Also present the data in col. (2) in another appropriate diagram.

(10+6)=16

The following figures relate to Index Number of Wholesale Prices in Calcutta (Base: 1952-53 = 100) for broad groups of articles in a number of years:

| group of articles | Year | | | | |
|-------------------|---------|---------|---------|---------|---------|
| | 1967-68 | 1968-69 | 1969-70 | 1970-71 | 1971-72 |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1. All combined | 185 | 205 | 211 | 223 | 236 |
| 2. Food articles | 207 | 220 | 219 | 229 | 237 |
| 3. Manufactures | 152 | 170 | 191 | 211 | 230 |

Present the above data in a suitable graphical form.

(10)

The following data represent a frequency distribution of average monthly income of a group of earners:

| average monthly income (Rs.) | number of earners |
|------------------------------|-------------------|
| (1) | (2) |
| upto Rs. 50 | 593 |
| Rs. 51 - 100 | 1152 |
| Rs. 101 - 200 | 478 |
| Rs. 201 - 350 | 141 |
| Rs. 351 - 750 | 62 |

Draw an 'ogive' of the 'greater than' type, for the above frequency distribution.

(8)

Please turn over

The following figures relate to height and weight of a group of 50 persons. Prepare a two-way frequency table from the data using suitable class-intervals.

| serial no. of person | height (in inches) | weight (in lbs.) |
|-------------------------|-----------------------|---------------------|
| (1) | (2) | (3) |
| 1 | 56 | 111 |
| 2 | 66 | 110 |
| 3 | 50 | 108 |
| 4 | 50 | 100 |
| 5 | 54 | 114 |
| 6 | 53 | 112 |
| 7 | 59 | 128 |
| 8 | 60 | 132 |
| 9 | 67 | 126 |
| 10 | 51 | 116 |
| 11 | 57 | 109 |
| 12 | 54 | 114 |
| 13 | 51 | 105 |
| 14 | 53 | 118 |
| 15 | 49 | 100 |
| 16 | 70 | 130 |
| 17 | 61 | 122 |
| 18 | 66 | 122 |
| 19 | 52 | 122 |
| 20 | 56 | 118 |
| 21 | 57 | 115 |
| 22 | 59 | 103 |
| 23 | 50 | 101 |
| 24 | 55 | 116 |
| 25 | 61 | 120 |
| 26 | 69 | 126 |
| 27 | 68 | 121 |
| 28 | 52 | 109 |
| 29 | 55 | 114 |
| 30 | 54 | 114 |
| 31 | 56 | 105 |
| 32 | 53 | 115 |
| 33 | 40 | 102 |
| 34 | 60 | 125 |
| 35 | 66 | 124 |
| 36 | 54 | 112 |
| 37 | 55 | 109 |
| 38 | 65 | 120 |
| 39 | 65 | 120 |
| 40 | 66 | 125 |
| 41 | 60 | 116 |
| 42 | 54 | 110 |
| 43 | 54 | 114 |
| 44 | 60 | 100 |
| 45 | 52 | 104 |
| 46 | 55 | 116 |
| 47 | 65 | 122 |
| 48 | 69 | 122 |
| 49 | 61 | 110 |
| 50 | 56 | 116 |

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1974

Paper III (Practical): Selected Techniques of Computation

Time: 5 hours

Full marks: 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

GROUP A

(Attempt any four questions from this group)

1. Making use of a suitable tabular layout, compute the values of $y = 2.7 - 3x + \frac{1}{x^2}$ for the following values of x as indicated

$x = -0.4, -0.3, \dots, 0, 0.1, \dots, 0.4$

Find the sum of the minimum values of y as computed above.

[Your calculations should be correct to 4 places of decimal.] (12)

2. The following table gives the values of a function $f(x)$ for different values of x :

| x | $f(x)$ |
|-----|---------|
| 0 | 858.314 |
| 1 | 869.716 |
| 2 | 880.976 |
| 3 | 892.704 |
| 4 | 905.690 |

Calculate the value of $f(0.7)$ by using Newton's Forward Formula.

Also calculate $f(2.5)$ by the same method. (4+4+4)=12

3. EITHER

Given the following values, calculate $f(1)$ by using Lagrange's interpolation formula:

| x | $f(x)$ |
|-----|--------|
| 0 | 7603 |
| 2 | 8149 |
| 3 | 8590 |
| 7 | 9405 |
| 9 | 9947 |

OR

If $\cos x = 1.285$, find x by a suitable entry using the data in the following tables:

| x | $\cos x$ |
|-------|----------|
| 0.735 | 1.282494 |
| 0.736 | 1.283297 |
| 0.737 | 1.284102 |
| 0.738 | 1.284908 |

4. Evaluate $\int_2^{10} \frac{dx}{\log_{10} x}$ by (i) trapezoidal rule

(ii) Simpson's one-third rule, taking twelve ordinates upto six decimal places.

Please turn over

Approximate numerically, the value of the following integral

$$I = \int_0^1 \frac{\ln_{10}(1+x)}{1+x^2} dx$$

The ordinates should be plotted at $x = 0, 0.2, \dots, 1.0$

GROUP B

(Attempt all questions from this group)

Attempt any two of the following :

- (a) Find the root of the following equation lying between 2 and 3 correct to 3 places of decimal, by any numerical method:

$$e^x - e^{-x} - 4x = 0$$

- (b) One of the roots of the equation $2x^4 + 5x^3 + 4x^2 + 3x - 8002 = 0$ lies between 7 and 8. Find the root correct to 4 places of decimal by any numerical method.

- (c) Solve, graphically, correct to one place of decimal, the equations

i) $4x^2 + 9y^2 = 24x - 36y + 36.25 = 0$

ii) $x - 2y + 1 = 0$

(16x2)

7. Answer any one of the following

- (a) Evaluate the determinant given below, correct to four places of decimal. Write down also the minor of the element in the third row and the second column.

$$\begin{vmatrix} 0.55 & 3.45 & 2.35 & -1.55 \\ -3.45 & 0.55 & 1.25 & -2.75 \\ -2.35 & -1.25 & 0.55 & -3.85 \\ 1.65 & 2.75 & 3.85 & 0.55 \end{vmatrix}$$

- (b) Solve the following equations for a, b and c correct to ²/₂ places of decimal:

$$5.237a + 1.324b + 3.975c = -4.001$$

$$4.113a + 2.174b + 2.329c = 3.119$$

$$2.072a + 3.576b + 4.160c = -2.192$$

QUESTIONS (Groups A and B)

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - May 1974

Paper IV (Practical) - Descriptive Statistics

Time : 5 hours.

Full marks: 100

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

GROUP A

(Attempt all questions in this group)

The following gives the frequency distribution of 1000 telephone calls by length in seconds (rounded to the nearest second).

| length (in seconds) | frequency | length (in seconds) | frequency |
|---------------------|-----------|---------------------|-------------|
| (1) | (2) | (1) | (2) |
| 0 - 99 | 5 | 500 - 599 | 250 |
| 100 - 199 | 29 | 600 - 699 | 133 |
| 200 - 299 | 30 | 700 - 799 | 42 |
| 300 - 399 | 100 | 800 - 899 | 11 |
| 400 - 499 | 247 | 900 - 999 | 5 |
| | | Total | 1000 |

- (a) Calculate the mean, mode and standard deviation.
 (b) Find the second and the third quartiles. $(2+2+4+2+2)=12$

The following table gives the diameter at breast height (X) in inches and height (Y) in feet, of 20 trees:

| X | Y | X | Y |
|-----|----|-----|----|
| 2.3 | 7 | 4.2 | 8 |
| 2.5 | 8 | 4.4 | 7 |
| 2.6 | 4 | 4.7 | 9 |
| 2.8 | 4 | 5.1 | 10 |
| 3.4 | 6 | 5.5 | 13 |
| 3.7 | 6 | 5.8 | 7 |
| 3.9 | 12 | 6.2 | 11 |
| 4.0 | 8 | 6.9 | 11 |
| 4.1 | 5 | 6.9 | 16 |
| 4.1 | 7 | 7.3 | 14 |

- (a) Calculate the correlation coefficient between X and Y.
 (b) Obtain the linear regression of Y on X.
 (c) Draw the scatter diagram of X and Y. On the same graph draw the regression line of Y on X. $(5+2+3+2)=12$

EITHER

- 1) The table below gives the percentage distribution of male and female population of a town by age-groups. Obtain the percentage distribution of the combined population.

| number of persons | age-groups (in years) | | | | | total | |
|-------------------|-----------------------|-------|-------|-------|------------|-------|-------|
| | 0-14 | 15-24 | 25-39 | 40-59 | 60 & above | | |
| Males | 10339 | 41.90 | 10.74 | 17.52 | 15.83 | 6.31 | 100.0 |
| Females | 17518 | 43.20 | 16.28 | 19.43 | 14.01 | 7.08 | 100.0 |

Please turn over

(2)

The standard variance of scores on a subject obtained by a group of students are 2.1 and 20, respectively. Calculate the revised mean score and variance of scores, if 10 marks are added to all the scores.

111) Compute the geometric mean and also the harmonic mean of the following numbers:

60.9, 52.4, 110.2, 20.0 (3+3+10) = 12

OR

Draw the concentration curve for the following distribution giving monthly income of 500 middle class households.

| monthly income (Rs.) | frequency | average income (Rs.) |
|----------------------|-----------|----------------------|
| 50 - 100. | 53 | 72 |
| 100 - 150 | 81 | 128 |
| 150 - 200 | 114 | 173 |
| 200 - 250 | 195 | 224 |
| 250 - 300 | 63 | 281 |
| 300 - 350 | 52 | 322 |
| 350 - 400 | 20 | 376 |
| 400 - 450 | 11 | 425 |
| 450 - 500 | 9 | 470 |
| 500 - 550 | 3 | 515 |
| Total | 500 | - |

The table below gives the wholesale prices (p) in rupees per cwan and quantities marketed (q) in thousand tons, of certain foodgrains for the years 1965 and 1970.

| commodity | 1965 | | 1970 | |
|-----------|-------|-------|-------|-------|
| | p | q | p | q |
| 1. Rice | 17.50 | 22537 | 25.50 | 27760 |
| 2. Jawar | 11.95 | 7245 | 13.00 | 7251 |
| 3. Bhatta | 13.33 | 3147 | 13.33 | 4471 |
| 4. Maize | 15.67 | 2925 | 14.70 | 2991 |
| 5. Bajra | 9.30 | 1337 | 15.96 | 1846 |
| 6. Wheat | 23.67 | 7302 | 21.95 | 7090 |
| 7. Barley | 17.29 | 2682 | 13.00 | 2905 |
| 8. Gram | 19.61 | 4142 | 19.60 | 4756 |

Calculate Laspeyres' Paasche's and Fisher's Ideal Index numbers of prices for the year 1970 with year 1965 as base.

(5+5+2)=12

Please turn over

GROUP B

(Answer All questions from this group.)

5. The following data relate to index of exports (x_1), index of gross domestic product (x_2) and general price index (x_3) for the years 1948-1956.

| year | x_1 | x_2 | x_3 |
|------|-------|-------|-------|
| 1948 | 100 | 100 | 100 |
| 1949 | 106 | 104 | 99 |
| 1950 | 107 | 106 | 110 |
| 1951 | 120 | 111 | 126 |
| 1952 | 110 | 111 | 115 |
| 1953 | 116 | 115 | 103 |
| 1954 | 123 | 120 | 102 |
| 1955 | 133 | 124 | 103 |
| 1956 | 137 | 126 | 98 |

Find the multiple regression equation of x_1 on x_2 and x_3 and compute the multiple correlation coefficient $R_{1.23}$. Also find the partial correlation coefficient $r_{13.2}$. (10+5+7)=22

6. Fit an equation $y = ab^t$ to the following time series by the method of least squares and plot both observed and trend values against time in a graph paper.

| year | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 |
|------|------|------|------|------|------|------|------|
| y | 114 | 115 | 116 | 119 | 122 | 124 | 129 |

(9+5)=14

7. The quarterly production of coal in thousands of tons are given below for a period of 4 years.

| year | quarters | | | |
|------|----------|-------|-------|-------|
| | I | II | III | IV |
| 1954 | 35.20 | 39.17 | 34.01 | 36.11 |
| 1955 | 36.00 | 41.58 | 38.16 | 40.80 |
| 1956 | 36.10 | 40.05 | 35.15 | 45.00 |
| 1957 | 40.18 | 46.35 | 39.10 | 45.81 |

Calculate the quarterly indices of seasonal variation by the method of moving averages. (14)

MEASURES (Groups A and B)

(4)

Paper II (Practical) : Elementary Statistical Methods

500.00

Full marks: 100

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

GROUP A

(Answer all questions from this group)

The following shows the frequency distribution of accidents occurring in the course of a period of 5 weeks to 647 women, working on the manufacture of shells.

| n. of accidents : | 0 | 1 | 2 | 3 | 4 | 5 or more |
|-------------------|-----|-----|----|----|---|-----------|
| n. of women : | 447 | 132 | 42 | 21 | 3 | 2 |

Fit appropriate distribution to the data and test the goodness of fit.
 (3+7+5)=15

The figures given below, represent the 'denier' values of two samples of silk coccons reared in two baths of different temperature.

| temperature of the cocoon bath | sample size | Denier values* (in milligrams) |
|--------------------------------|-------------|--|
| 105° F | 20 | 250, 229, 206, 220, 245, 226, 255, 250, 272, 221, 215, 205, 220, 249, 237, 205, 214, 236, 225, 243, |
| 110° F | 10 | 235, 250, 225, 201, 260, 269, 256, 220, 224, 240, 230, 245, 315, 250, 247, 254, 251, 225 |

'Denier value' is a number expressing the weight of a fixed length of silk and is accepted as a measure of quality of the product.

Examine whether the average denier values at the two temperatures are different, assuming that the true variances are equal.

Test also, whether the true variances are equal for the two series of measurements.

EITHER

- (a) The following table gives the joint distribution of a number of handicapped school children according to the degree of their speech defects and physical defects.

| Physical defect | Speech defect | | |
|-----------------|---------------|--------------|------|
| | Serious | Intermediate | Mild |
| Serious | 45 | 26 | 12 |
| Intermediate | 32 | 50 | 21 |
| Mild | 4 | 19 | 17 |

Examine whether there is any significant association between the two types of defects.

PAPER II (Practical)

- (b) The following table gives the values of the means, standard deviations and the correlation coefficient computed from the data on score in written tests (X) and score in psychological tests (Y), administered to 45 candidates appearing in an interview.

| | mean | standard deviation | correlation coefficient |
|---|------|--------------------|-------------------------|
| X | 65.8 | 8.57 | |
| Y | 53.4 | 7.31 | 0.638 |

Test whether the regression coefficient of Y on X is significantly different from 0.5.

OR

- (a) Estimates of percentage of employed persons in a certain city obtained from two independent sample surveys are given below. Examine whether the difference between the two estimates can be so ascribed as due to sampling fluctuations alone.

| Survey | Sample size | Percent employed |
|--------|-------------|------------------|
| A | 2350 | 39.66 |
| B | 1675 | 38.68 |

- (b) The correlation coefficient between the score in Mathematics (X) and the score in General Ability (Y), of 60 students selected at random from a large number of students appearing in an admission test, was found to be 0.62. Examine whether the correlation coefficient is significantly different from zero.

GROUP B

(Answer all questions from this group)

Attempt any two of the following, describing the method followed in each case as clearly as possible:

- (a) It has been decided to pick out randomly 6 days from the year 1972. To that end, you are first required to select 3 different months from the year 1972. The probability of selection of a month is proportional to the number of days of the month in that year. Then from each selected month, draw a simple random sample (without replacement) of 2 days.
- (b) Draw a random sample of size 5 from a normal population with mean = 50 and standard deviation = 25.
- (c) Locate 5 random points in a square plot of size 80 m. x 80 m. by making use of rectangular co-ordinates.

[You are expected to refer to a random number table, to choose 5 pairs of random numbers x and y , representing the two co-ordinates of the points and read x and y correct to one-tenth of a meter.]

Please turn over

eighteen homogeneous plots of uniform size are available for growing paddy. Five varieties A, B, C, D and E, of paddy are to be compared for mean yields. It is desired to try the first three varieties in 4 plots each and the last two in 3 plots each.

- 1) Obtain a lay-out of a completely randomized design for the experiment.
- ii) Below are given the yield figures (in suitable units) as obtained from one such experiment.

| Varieties | Yield | | | |
|-----------|-------|------|-------|------|
| | A | 9.2, | 10.1, | 7.6, |
| B | 8.1, | 7.2, | 7.9, | 8.4 |
| C | 10.2, | 8.1, | 8.3, | 8.7 |
| D | 6.9 | 7.1, | 7.3 | |
| E | 9.2 | 9.8, | 7.9 | |

Analyse the data to test if the varieties differ in respect of average yield.

OR

An experiment was conducted to determine the effects of 4 different varieties V_1, V_2, V_3 and V_4 of peas and 3 different spacings namely $S_1 = 4''$, $S_2 = 9''$ and $S_3 = 12''$ apart, in a row. The data below give the yield of each 2 plots for each variety-spacing combination.

| Variety | Spacing | | |
|---------|---------|--------|--------|
| | S_1 | S_2 | S_3 |
| V_1 | 45, 43 | 50, 45 | 57, 50 |
| V_2 | 55, 50 | 59, 54 | 51, 55 |
| V_3 | 53, 49 | 56, 50 | 52, 58 |
| V_4 | 60, 65 | 56, 60 | 53, 49 |

- i) Carry out an analysis of variance for the data to test the appropriate hypothesis.
- ii) Also, test, whether there is significant interaction between varieties and spacings.

In a production process a workman produces, fairly consistently 600 units in every shift. He is also expected to produce on an average 3.6 defectives per shift when the process is under a state of statistical control. The following data relate to the number of defectives he has produced in 20 consecutive shifts.

Number of defectives

3, 1, 0, 7, 4, 9, 4, 5, 3

2, 3, 3, 5, 2, 2, 5, 2, 5

- 1) Draw a suitable control chart.
- ii) Comment on the state of control of the process.

(12+2)=14

REMARKS: (Groups A and B)

(4)

HELM GEOMETRICAL INSTRUMENTS

Computer's Certificate Examination : November 1974

Paper I (Practical) : Elementary Computation

Time: 5 hours

Full marks : 100

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

GROUP A

(Attempt all questions from this group)

- Use contracted method to evaluate any one of the following, correct to 3 places of decimal:
 - $21.325 \times 32 \times 0.453027$
 - $0.453024 \div 0.0624$ (4)
- Evaluate any three of the following with the help of suitable formulae:
 - $(1.006)^2$
 - $10^3 - (3.7)^3 - (3.3)^3$
 - $(3.25 + \frac{1}{3.25})(3.25 + \frac{1}{3.25}) - (3.25 - \frac{1}{3.25})(3.25 - \frac{1}{3.25})$
 - $(0.04 + 0.0025 + 0.01)(0.2 - 0.05)$

[No credit will be given for working by routine processes.] (2x3)=6

- Round off the following numbers to 4 significant digits:
 - 4.34125
 - 0.0031504

Find also the absolute and percentage errors due to rounding off in each of the above cases.
- The length and breadth of a rectangle are found to be 3.37 ft. and 2.45 ft. respectively, each figure being correct to 2 places of decimal. Determine the limits within which the true area of the rectangle lies. (4+3)=10
- Answer any two of the following:
 - Given $\log_{10} 2 = 0.3010300$ and $\log_{10} 3 = 0.4771213$,
 find the common logarithm of $\left\{ \frac{6^{\frac{3}{2}} \cdot (12.5)^2}{\sqrt{5^2 - 10}} \right\}^{1/3}$.
 - Given $\log_{10} 2 = 0.3010300$, solve the equation for x :
 (correct to 3 places of decimal) $5^{-3x} + 4^{\frac{2x+3}{2}} = 5^7 - 3x - 2^{x+5}$
 - Find the logarithm of 1720 to the base $2\sqrt{3}$ without using logarithmic table.

[Note: Use only the information given above and indicate clearly all the steps.] (3x2)=12

- 1) Using appropriate tables, find any one of the following, correct to 3 places of decimal:

(a) antilog of $(.65370)$, where the base is 10.

(b) $(6.625321)^{1/3}$

- ii) $e^{-2/2}$ when $x = 3.3$, where e is the well known mathematical constant. (4+1)=5

2. Evaluate the following:

i) $1 \times 2 + 2 \times 3 + \dots + 100 \times 101$

ii) $x = \frac{x^3}{3} + \frac{x^5}{3.5} - \frac{x^7}{3.5.7}$ when $x = 0.2$, correct to 4 places of decimal. (4+1)=5

GROUP D

(Attempt all questions from this group)

7. (a) The following table gives the value of a function $I(x)$ for a number of values of x :

| x | $I(x)$ |
|------|----------|
| 0.01 | 0.075217 |
| 0.02 | 0.055230 |
| 0.03 | 0.035235 |
| 0.04 | 0.015240 |
| 0.05 | 0.005239 |

Calculate $I(x)$ for $x = 0.0253$ by linear interpolation.

- (b) 210-22

Given below the logarithms of certain numbers, find by linear interpolation the number whose logarithm is 2.52027.

| number | logarithm |
|--------|-----------|
| 310 | 2.49136 |
| 320 | 2.50515 |
| 330 | 2.51851 |
| 340 | 2.53143 |
| 350 | 2.54407 |

23

The following table gives the time corresponding to certain altitudes (a) of the Sun in various declinations (δ) at a place. Find the time corresponding to $a = 13^\circ$ $\delta = 12^\circ$, by linear interpolation:

| | $a = 10^\circ$ (alt.) | | | $a = 14^\circ$ (alt.) | | |
|---------------------|-----------------------|-----------------|-----------------|-----------------------|-----------------|-----------------|
| $\delta = 25^\circ$ | 0 ^h | 11 ^m | 20 ^s | 5 ^h | 50 ^m | 17 ^s |
| $\delta = 15^\circ$ | 0 ^h | 55 ^m | 41 ^s | 5 ^h | 35 ^m | 5 ^s |
| $\delta = 10^\circ$ | 5 ^h | 40 ^m | 10 ^s | 5 ^h | 19 ^m | 50 ^s |

(4+0)=10

Please turn over

9. The following table gives the number of motor cycles produced by a company during different years. Represent the data graph and draw a smooth free hand curve through the plotted points. Hence estimate the production figures for the years 1941, 1943, 1947, and 1950.

| Year | Production of motor cycles (000) |
|------|----------------------------------|
| (1) | (2) |
| 1940 | 134 |
| 1942 | 143 |
| 1945 | 158 |
| 1946 | 153 |
| 1947 | 130 |
| 1949 | 217 |

(2+2)=4

9. Solve graphically (any two) :

(a) $x \log_{10} x = 10$

(b) $\sin x = 2 \cos x = 0$ (where x lies between C and π)

(c) $x^2 + y^2 = 134$ and $x - y = 2$ (2+2)=4

10. QUESTION

Find graphically the area bounded by the circle $x^2 + y^2 - 8x + 5 = 0$ and the two straight lines whose equations are $x + y = 1$ and $x + y = 5$.

(3+1+5)=9

ANSWER

Find graphically the points of intersection of the following straight lines :

$$3x + 2y = 7$$

$$2x + 3y = 4$$

$$3x - 2y + 5 = 0$$

What is the area of the triangle formed by these three lines?

(2+2+5)=9

11. Two trains leaving a station A for another station B run at 80 kilometers per hour and 60 kilometers per hour respectively. If the first train leaves at 3 pm and the second at 4 pm, find graphically the distance from station A of the place where the two trains meet and also the time of the meeting.

(2+2)=4

REMARKS (for Groups A and B)

(2)

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - November 1974

Paper II (Practical) : Compilation and Presentation of Statistics

Time 5 hours

Full marks : 100

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

GROUP A

(Attempt all questions from this group)

The returns for a particular year were collected by the Registrar of Joint Stock Companies. From the returns collected, the statistics of "the number of joint stock companies at work" and their "paid-up capital", were compiled separately for industries (classified according to international standard classification of economic activity) and also for different States. The broad industry classes chosen for the purpose of compiling the statistics were: agriculture and allied activities, mining and quarrying, processing and manufacture, construction and utilities, commerce (trade and finance), transport, communication and storage, community and business services, and personal and other services. "Processing and manufacture" class was sub-divided into a number of sub-classes, namely, sugar industries, tobacco, textile, iron and steel, chemicals and the rest. "Commerce (trade and finance)" class was sub-divided into trade (whole-sale and retail), real estate, insurance companies and banking loan companies.

Prepare a blank tabular lay-out with suitable headings for presenting the data compiled in the above manner, making provision for monthly sub-totals and totals. (10)

2. Name the official publications which provide current statistics for any three of the following. Also mention in each case the name of the agency issuing the publication and the periodicity of the publication.
- Road statistics for India classified according to surface.
 - Data on electricity sold to ultimate consumers by public electricity undertakings in India.
 - Data on national income originating in different sectors of the Indian economy, e.g., agriculture and large-scale manufacturing.
 - Net area under irrigation in India by sources of irrigation.
 - Crude birth rates for different countries in Asia. (3x3)=9

3. The report on the consumer expenditure enquiry carried out during July 1964 - June 1965 presented the distribution of sample households, over a number of monthly per capita expenditure classes separately for the three sectors - rural, urban and city. It also gave the corresponding estimates of the average number of persons per household, and the percentages of total consumer expenditure spent on food and non-food items. The monthly per capita expenditure classes chosen for the purpose were : Rs.0-8, 8-11, 11-13, 13-15, 15-18, 18-21, 21-24, 24-28, 28-32, 34-43, 43-55, 55-75 and 75 and above. The number

Please turn over

3. of sample households falling in the above-mentioned expenditure classes were respectively, 121, 601, 698, 953, 1622, 1024, 1670, 1831, 1967, 1612, 1005, 582 and 493, for the rural sector; 45, 140, 192, 328, 650, 701, 729, 985, 1254, 1230, 1142, 1151 and 1394 for the urban sector; and 1, 2, 4, 7, 30, 32, 39, 78, 156, 167, 250, 318 and 476, for the city sector. Thus in all, 14774 sample households were covered in the rural sector, 9943 in the urban sector, and 1582 in the city sector. The average number of persons per household worked out to 5.78, 6.07, 5.94 5.80, 5.61, 5.42, 5.42, 5.22, 5.01, 4.69, 4.11, 3.74 and 3.53 in the rural sector for the above-mentioned monthly per capita expenditure classes. The corresponding figures for the urban sector were 4.76, 6.27, 6.23, 6.23, 6.15, 6.08, 5.66, 5.40, 4.95, 4.22, 3.89, 3.25 and 2.55, while those for the city sector were 7.00, 5.00, 6.36, 9.08, 6.68, 6.16, 6.39, 5.65, 5.29, 4.57, 3.73, 3.20 and 2.85. The "all classes" that is, overall average number of persons per household was 5.17 for rural, 4.65 for urban and 3.96 for city. The percentages of total consumer expenditure spent on food were 80.74, 82.62, 82.79, 82.25, 81.90, 80.73, 79.39, 77.30, 75.49, 71.29, 66.91, 61.85 and 46.31 for households in the 13 expenditure classes in the rural sector; 78.19, 77.65, 79.33, 77.61, 78.10, 76.13, 74.95, 72.27, 69.90, 65.94, 63.11, 53.61, and 45.37 in the urban sector; and 87.14, 70.83, 73.78, 74.77, 76.14, 70.71, 73.87, 70.65, 67.62, 64.67, 61.08, 60.19 and 45.59 in the city sector. For "all classes", the percentage expenditure on food was 72.96 for rural, 62.75 for urban and 55.43 for city.

Present the above information in a suitable table with appropriate headings, incorporating also the figures for percentage of total expenditure spent on non-food items.

[You have to derive these figures from the information given above.]

4. From the official publications supplied, collect the information on any three of the following. Mention also the name of the publication consulted, its reference period, page number and the periodicity of the publication, in each case.
- Production of any two important minerals in India during a recent period.
 - Index number of the quantum of imports to India for two recent years.
 - Life-insurance claims by death in India for the latest five years.
 - Number of vessels in foreign trade entered and cleared with cargo and in ballast for the port of Bombay, during any two consecutive years.
 - Forest area in Madhya Pradesh by legal status, for any two consecutive periods. (3x3)=9

Please turn over

5. The table below was copied out from a report of the Annual Survey of Industries.

Table 2 - Fixed Capital Employed (in rupees)

| item | Bihar | Madhya Pradesh | Orissa | Others | Total |
|------------------------------|----------|----------------|----------|----------|-----------|
| 1. Land | 1008111 | 174568 | 193269 | 330280 | 1700937 |
| 2. Improvement to land | 246031 | 97411 | 2062434 | 222302 | 3429038 |
| 3. Buildings | 1294975 | 1660021 | 15226725 | 5420217 | 35267058 |
| 4. Plant & machine | 31769329 | 1595425 | 30499777 | 9494435 | 73338960 |
| 5. Tools etc. | 3990091 | 401266 | 1504020 | 1170914 | 7067099 |
| 6. Assets under construction | 149717 | 00620 | - | 205603 | 436028 |
| 7. Total | 50109134 | 4007019 | 50277735 | 16055840 | 121246028 |

There is one copying mistake in the inside cells and two copying mistakes in the row totals and two mistakes in column totals. Row and column totals corresponding to the inside cell with the wrong figure are however correct.

Locate all the mistakes in the above table, assuming the grand total as correct. Write down the incorrect and correct figures side by side. (10)

GROUP B

(Attempt all questions from this group)

6. The following data show the production of certain agricultural products in West Bengal during the year 1970-71.

| Crop | Production (in thousand tonnes) |
|-----------------|---------------------------------|
| (1) | (2) |
| Rice | 6140.1 |
| Wheat | 060.1 |
| Pulses | 375.0 |
| Sugarcane (Cur) | 2075.2 |
| Potato | 917.5 |

Present the above data in a bar diagram and also in a pie diagram. (8+0)=16

7. The following figures relate to Consumer Price Index Number for Calcutta (Base: 1960=100) for households in the monthly expenditure levels (Rs. 1 - Rs. 100) and (Rs. 201 - Rs. 350) for a number of years.

| Year | Monthly expenditure levels (Rs.) | |
|---------|----------------------------------|---------|
| | 1-100 | 201-350 |
| (1) | (2) | (3) |
| 1968-69 | 165.6 | 158.8 |
| 1969-70 | 170.7 | 164.2 |
| 1970-71 | 179.0 | 171.3 |
| 1971-72 | 183.6 | 176.1 |

Present the above data in a suitable graphical form. (10)

Please turn over

24. The following data show the age distributions (in percentages) of the male population of West Bengal in the year 1961.

| Age-group (in years) | Percentage of male population. | Age-group (in years) | Percentage of male population |
|-------------------------|-----------------------------------|-------------------------|----------------------------------|
| (1) | (2) | (1) | (2) |
| 0 - 9 | 28.6 | 40 - 49 | 9.8 |
| 10 - 19 | 19.7 | 50 - 59 | 6.1 |
| 20 - 29 | 17.7 | 60 - 69 | 3.1 |
| 30 - 39 | 14.5 | 70 and above | 1.5 |

Draw an ogive of the less than type for the above frequency distribution.

(8)

9. The following data show the lengths of jute plants (in cm.) and weights of dry fibres (in gm.) as obtained from the records supplied by the Doona farm (Source: Crop estimating survey - Jute, 1940). Prepare a two-way frequency table from the data, using suitable class-intervals.

| sl. no. | length of jute plants (cm.) | weight of dry fibre (gm.) | sl. no. | length of jute plants (cm.) | weight of dry fibre (gm.) |
|---------|-----------------------------|---------------------------|---------|-----------------------------|---------------------------|
| (1) | (2) | (3) | (1) | (2) | (3) |
| 1 | 151 | 3.42 | 26 | 144 | 3.97 |
| 2 | 140 | 3.03 | 27 | 170 | 5.77 |
| 3 | 148 | 2.59 | 28 | 160 | 3.00 |
| 4 | 151 | 2.99 | 29 | 179 | 4.49 |
| 5 | 115 | 1.51 | 30 | 166 | 4.00 |
| 6 | 132 | 1.52 | 31 | 175 | 3.71 |
| 7 | 159 | 4.61 | 32 | 176 | 4.25 |
| 8 | 125 | 1.66 | 33 | 170 | 3.19 |
| 9 | 104 | 5.29 | 34 | 167 | 4.06 |
| 10 | 132 | 1.40 | 35 | 176 | 0.55 |
| 11 | 160 | 6.41 | 36 | 100 | 4.05 |
| 12 | 154 | 2.52 | 37 | 190 | 6.50 |
| 13 | 174 | 3.23 | 38 | 174 | 0.61 |
| 14 | 139 | 1.90 | 39 | 167 | 2.68 |
| 15 | 147 | 2.64 | 40 | 166 | 2.90 |
| 16 | 136 | 1.70 | 41 | 105 | 6.00 |
| 17 | 164 | 2.54 | 42 | 196 | 7.70 |
| 18 | 164 | 2.89 | 43 | 167 | 3.79 |
| 19 | 158 | 4.79 | 44 | 140 | 2.18 |
| 20 | 172 | 3.92 | 45 | 155 | 3.13 |
| 21 | 160 | 3.97 | 46 | 175 | 4.60 |
| 22 | 179 | 9.09 | 47 | 176 | 5.05 |
| 23 | 139 | 2.01 | 48 | 130 | 1.32 |
| 24 | 131 | 1.59 | 49 | 163 | 3.59 |
| 25 | 150 | 5.91 | 50 | 166 | 2.73 |

(4+10)=1

NEATNESS (Groups A and B)

(4)

Time: 5 hours

Full marks: 100

(a) Figures in the margin indicate full marks.

(b) Use of calculating machines is permitted.

GROUP A

(Attempt all questions from this group)

Complete the missing entries in the following table:

| a | b | a+b | a ² | b ² | ab | a ² - b ² | (a+b) ² |
|------|------|-----|----------------|----------------|-----|---------------------------------|--------------------|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1.7 | -1.1 | | | | | | |
| -2.8 | +1.7 | | | | | | |
| -1.9 | -0.6 | | | | | | |
| 2.7 | +1.2 | | | | | | |
| 3.6 | +2.1 | | | | | | |
| 2.8 | +1.0 | | | | | | |

Total

Apply suitable checks on the totals of Cols. (5), (7) and (8).

(9+3)=12

2. The following table gives the values of a function $f(x)$ for different values of x :

| x | f(x) |
|----|--------|
| 25 | 16.195 |
| 26 | 15.919 |
| 27 | 15.630 |
| 28 | 15.326 |
| 29 | 15.006 |

By using Newton's Forward Formula, obtain the values of $f(x)$ for (i) $x = 27.5$ (ii) $x = 24.8$

(4+4+4)=12

ORFind by Lagrange's interpolation formula, the value of x corresponding to $y = 89.0$ from the data given below:

| x | y |
|----|------|
| 11 | 87.6 |
| 12 | 88.7 |
| 13 | 90.1 |
| 14 | 92.4 |

(12)

ORGiven below are four values of y corresponding to four different values of x :

| x | y |
|----|-------|
| 20 | 15.64 |
| 22 | 14.89 |
| 25 | 14.14 |
| 29 | 12.63 |

Use Newton's divided difference interpolation formula to find the value of y when $x = 21.3$.

(12)

C(47:III(2)

4. Evaluate by numerical integration the integral $\int_1^{2.2} \frac{dx}{1+x^2}$ correct to six decimal places, by making use of (i) Simpson's one-third rule and (ii) trapezoidal rule, taking at least seven ordinates. (4+4)=12

GROUP B

(Attempt all questions from this group)

5. Evaluate the determinant D, correct to 4 decimal places, where

$$D = \begin{vmatrix} 1.364 & 4.321 & -3.479 \\ -0.762 & 3.231 & 2.647 \\ 1.652 & 4.792 & -0.762 \end{vmatrix}$$

Compute the co-factors of the elements (i) 1.652, (ii) 2.647 and (iii) 4.321 in the above determinant. (10+6)=16

OR
Solve the following equations correct to 3 places of decimal :

$$9.076x_1 + 0.765x_2 + 7.654x_3 = 79.274$$

$$6.565x_1 + 7.687x_2 + 5.470x_3 = 39.541$$

$$5.092x_1 + 9.456x_2 + 3.145x_3 = -0.583 \quad (16)$$

6. Attempt any two of the following :

- (a) Obtain graphically the root of the equation $x = 10 \log_{10} x$ which lies between 1 and 2, correct to 2 places of decimal.
- (b) Find by any numerical method the root of $3x^4 - 4x^3 - 12x^2 + 12x + 9 = 0$ in the interval (1, 2) correct to 3 places of decimal.
- (c) Solve the equation $\frac{x}{1-x} = 3.02$, graphically or otherwise, correct to 3 places of decimal. (16x2)=32

NEATNESS (Groups A and B)

(2)

INDIAN STATISTICAL INSTITUTE

University of Calicut, India, November 1974

Paper IV (Practical) : Descriptive Statistics

Time : 5 hours

Full marks : 100

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

GROUP A

(Attempt all questions from this group)

1. An incomplete frequency distribution is given as follows :

| | | | | | | | | |
|-------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Interval : | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | Total |
| Frequency : | 12 | 30 | ? | 65 | ? | 25 | 10 | 220 |

You are given that the median value is 43. Using the standard formula for computing the median, find out the missing frequencies.

Also compute the value of the mean deviation from mean. (4+6)=10

2. (a) Compute the upper 10% point and the quartiles of the frequency distribution given below.

| | | | | | | | |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|
| Height (in inches) : | 57.5- | 60.0- | 62.5- | 65.0- | 67.5- | 70.0- | 72.5- |
| Frequency : | 6 | 28 | 100 | 261 | 412 | 127 | 30 |

Compute also a measure of skewness using the quartiles of the distribution.

- (b) The mean and standard deviation of a group of 25 observations were found to be 30 and 3 respectively. After the calculations were made it was found that two of the observations which were recorded as 29 and 31 were incorrect. Find the mean and standard deviation, excluding these incorrect observations.

- (c) The mean and standard deviations of life (in days) for two types of electric bulbs are given below :

| | Mean life (in days) | Standard deviation (in days) |
|---------|---------------------|---------------------------------|
| Type I | 210 | 11 |
| Type II | 260 | 9 |

Compute the coefficients of variation of life of the two types of bulbs. (7+5+2)=14

3. From the following bivariate frequency distribution, calculate

- i) the coefficient of correlation,
 ii) the linear regression equation of marks on age, and
 iii) the correlation ratio of marks on age.

| Marks | Age (years) | | | | | Total |
|-------|-------------|-------|-------|-------|-------|-------|
| | 15-20 | 20-25 | 25-30 | 30-35 | 35-40 | |
| 0-10 | 4 | 2 | | | | 6 |
| 20-30 | 6 | 5 | 3 | 1 | | 15 |
| 40-50 | | 9 | 2 | 2 | 1 | 13 |
| 60-70 | | 7 | 4 | 1 | | 12 |
| 80-90 | | | 1 | | | 1 |
| Total | 10 | 23 | 12 | 4 | 1 | 50 |

(5+3+3+3)=14

4. (a) The expenditure of a certain business firm on materials, can be grouped under three main heads. The expenditure under the three heads were in the ratio 6:5:3. If average prices in these groups rise by 42, 30 and 20%, respectively, by what percentage will the aggregate expenditure on materials increase, if the same quantity of materials are purchased, as before?
- (b) The following shows the indices of two series of consumer price index numbers for working class in a city:

| Year | Index (base:1951) | Index (base:1950) |
|------|----------------------|----------------------|
| 1951 | 100 | |
| 1952 | 110 | |
| 1953 | 113 | |
| 1954 | 102 | |
| 1955 | 94 | |
| 1956 | 121 | |
| 1957 | 124 | |
| 1958 | 122 | 100 |
| 1959 | | 105 |
| 1960 | | 121 |
| 1961 | | 125 |

Combine the two series of indices to obtain a single series of index numbers on base 1951 = 100 for the years 1951 to 1961. (12+3)=15

GROUP D

(Attempt all questions from this group)

5. The following table gives the index number of production in a certain factory for the years 1946-57 with the year 1947 as base (=100). Fit a second degree polynomial trend using orthogonal polynomials. Compute trend values for the years 1949 and 1956.

Index Number of Production In a Factory during 1946-57
(base: 1947 = 100)

| Year | Index | Year | Index |
|------|-------|------|-------|
| 1948 | 102.1 | 1953 | 120.9 |
| 1949 | 105.1 | 1954 | 123.1 |
| 1950 | 112.0 | 1955 | 125.9 |
| 1951 | 113.0 | 1956 | 124.1 |
| 1952 | 115.7 | 1957 | 124.9 |

(12+4)=16

6. To the data given below fit a curve of the type: $Y = \alpha + \beta \log x$ by the method of least squares.

| x | 10 | 15 | 20 | 25 | 30 |
|---|-------|-------|-------|-------|-------|
| y | 16.20 | 15.13 | 13.10 | 20.62 | 22.35 |

Plot y against $\log x$ on a graph paper and draw the fitted line on the same graph paper.

(10+6)=16

Please turn over

7. The table below gives the scores X_1 and X_2 of 15 workers in a factory on two psychological tests and also their efficiency index Y . Obtain the multiple regression equation for the efficiency index Y in terms of the scores X_1 and X_2 .

Scores on psychological tests and efficiency index of 15 workers

| serial number | scores | | Efficiency index Y |
|---------------|--------|-------|----------------------|
| | X_1 | X_2 | |
| 1 | 15 | 33 | 47 |
| 2 | 77 | 70 | 67 |
| 3 | 18 | 53 | 38 |
| 4 | 8 | 33 | 30 |
| 5 | 19 | 12 | 28 |
| 6 | 51 | 34 | 41 |
| 7 | 95 | 61 | 72 |
| 8 | 22 | 31 | 40 |
| 9 | 69 | 52 | 67 |
| 10 | 75 | 75 | 72 |
| 11 | 8 | 61 | 43 |
| 12 | 4 | 46 | 36 |
| 13 | 67 | 66 | 72 |
| 14 | 53 | 31 | 51 |
| 15 | 20 | 61 | 35 |

Estimate the efficiency index Y for a worker whose scores are $X_1 = 33$, and $X_2 = 49$.

(13+3)=16

ANSWERS (Groups A and B)

(2)

INDIAN STATISTICAL INSTITUTE

Computer's Certificate Examination - November 1974

Paper V (Practical) : Elementary Statistical Methods

Time: 5 hours

Full Marks: 100

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

G R O U P A

(Attempt all questions from this group)

1. The following table gives the frequency distribution of scores in English of 250 candidates selected at random from among those appearing at a certain examination. Assuming normal distribution, find the expected frequencies for the different intervals and test the goodness of fit. (5+9+5) = 19

| <u>Class limits</u> | <u>Frequency</u> | <u>Class limits</u> | <u>Frequency</u> |
|---------------------|------------------|---------------------|------------------|
| 14.5 - 19.5 | 9 | 44.5 - 49.5 | 37 |
| 19.5 - 24.5 | 11 | 49.5 - 54.5 | 26 |
| 24.5 - 29.5 | 10 | 54.5 - 59.5 | 8 |
| 29.5 - 34.5 | 44 | 59.5 - 64.5 | 5 |
| 34.5 - 39.5 | 45 | 64.5 - 69.5 | 1 |
| 39.5 - 44.5 | 54 | Total | <u>250</u> |

2. Answer any one from the following :-

- a) An opinion survey was conducted among the students of a residential university classified according to seniority and the results appear below :

| <u>Examination system preferred</u> | <u>Number of students favouring each system</u> | | |
|---|---|---|-----------------------|
| | <u>1st & 2nd year under-graduates</u> | <u>3rd & 4th year under-graduates</u> | <u>Post-graduates</u> |
| i) Only one Examination at the end of a term | 73 | 17 | 10 |
| ii) Weekly Tests and take-home assignments besides the usual terminal Exam. | 15 | 33 | 52 |
| iii) One terminal exam. and one mid-term test | 85 | 72 | 21 |

Examine whether the academic seniority among the students has any significant influence on the type of system preferred. (12)

- b) The following correlation coefficients were obtained from the data on (i) score in psychological test (x); (ii) score in a test on Mathematical knowledge (y); and (iii) score in a test on general knowledge (z), of 38 candidates appearing in an admission test :

$$r_{12} (= r_{xy}) = 0.70 \quad r_{13} (= r_{xz}) = 0.65 \quad r_{23} (= r_{yz}) = 0.40$$

Compute the partial correlation coefficient $r_{13.2}$ and the multiple correlation coefficient $R_{1.23}$ and test whether they are significantly different from zero or not. (2+2+4+4) = 12

3. Answer any two from the following :

- a) The following table relates to the number of defective items found in samples taken from two lots produced by two different machines :

| Machine | Sample Size | No. of defectives |
|---------|-------------|-------------------|
| A | 250 | 29 |
| B | 332 | 43 |

Examine whether the proportion of defectives produced by Machine B is significantly higher than that produced by machine A. (3)

- b) The following data were obtained in an experiment conducted in a dairy farm, to examine the effect of two types of feed on the yield of milk:

| Type of feed | No. of Cows treated | Yield of milk (in litres) | | | | |
|--------------|---------------------|---------------------------|------|------|------|------|
| | | 10.5 | 9.4 | 5.3 | 6.7 | 4.9 |
| A | 15 | 12.7 | 5.9 | 15.8 | 10.7 | 15.0 |
| | | 17.2 | 8.4 | 6.5 | 7.9 | 9.0 |
| | | 12.5 | 17.3 | 14.9 | 15.4 | 6.5 |
| B | 17 | 7.8 | 10.9 | 11.2 | 4.3 | 6.3 |
| | | 8.5 | 12.5 | 13.1 | 5.0 | 8.1 |
| | | 10.5 | 11.5 | | | |
| | | | | | | |

Examine whether the feed B is different from the feed A, with regard to its effect on average yield of milk. (3)

- c) The standard deviations of stature (inches) of two groups of boys, belonging to the age-groups 11-13 years and 14-16 years, were obtained from two random samples of sizes 10 and 15 respectively. The sample standard deviation turned out to be 1.15 and 2.26 inches. Does this mean that in respect of stature, adolescent boys (age: 14-16 years) are more heterogeneous than the boys of the younger group. (3)

GROUP B

(Attempt all questions from this group)

- 1.a) The following table gives the distribution of 200 households according to their size in terms of number of persons :

| Household size | Frequency | Household size | Frequency |
|----------------|-----------|----------------|-----------|
| 1 | 2 | 5 | 61 |
| 2 | 5 | 6 | 32 |
| 3 | 29 | 7 | 4 |
| 4 | 61 | 8 | 3 |
| | | Total | 200 |

Draw a simple random sample of 5 households (without replacement) indicating the procedure followed. Compare the mean household size of the sample drawn by you with the mean of the parent distribution. (7+3) = 10

- b) A triangular region is bounded by the straight line $x + y = 99$ and the two co-ordinate axes. Select 5 points at random from this region, mentioning the co-ordinates correct to the nearest integer. Describe the procedure followed by you.

CINCHEA

Twenty observations on the yield of a plant grown in earthen pots are given below. The observations are split into five groups of four observations each, according to the fertiliser used :

| <u>Fertiliser used</u> | <u>Yield</u> | | | |
|------------------------|--------------|----|----|----|
| A (No fertiliser) | 67 | 67 | 57 | 62 |
| B | 98 | 98 | 91 | 66 |
| C | 60 | 69 | 50 | 35 |
| D | 79 | 61 | 81 | 70 |
| E | 90 | 70 | 79 | 88 |

- i) Analyse the data to test if the average yield varies significantly among the five groups.
 ii) Also test if the groups B, C, D & E differ significantly among themselves in respect of average yields. $(12 + 6) = 18$

OR

In a weaving experiment conducted in a Latin square design there were four warps marked A, B, C and D. The table below gives the lay-out and the number of warp breaks per 10,000 picks.

| Period | Warp-breaks (per 10,000 picks) by looms | | | |
|--------|---|--------|--------|--------|
| | over periods | | | |
| | Loom | | | |
| | 1 | 2 | 3 | 4 |
| 1 | 1.4(D) | 5.3(L) | 7.1(B) | 3.2(C) |
| 2 | 2.2(C) | 4.1(B) | 8.8(A) | 1.6(D) |
| 3 | 2.1(B) | 2.2(D) | 4.8(C) | 4.7(A) |
| 4 | 2.4(L) | 2.3(C) | 2.6(D) | 4.3(B) |

Carry out the analysis of variance of the above set of observations.

Does the breakage rate of warp differ significantly from that of Warp D? $(14+4) = 18$

The following data show the number of defects found in 15 successive groups of 5 radio sets each, drawn at random at one hour intervals in a certain radio manufacturing concern. Draw a control chart for the number of defects. Comment on the process control:

| | | | | | | | | | | |
|----------------|----|----|----|----|----|----|----|----|----|----|
| Group No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| No. of defects | 77 | 64 | 75 | 93 | 45 | 61 | 49 | 65 | 45 | 77 |
| Group No. | 11 | 12 | 13 | 14 | 15 | | | | | |
| No. of defects | 59 | 54 | 41 | 87 | 40 | | | | | |

$(12+2) = 14$

Hint: use (Groups A & B)