Statistical Evaluation of Development on Socio-Economic Front[*]

P. Narain, S.C. Rai and Shanti Sarup
Indian Society of Agricultural Statistics, New Delhi

Summary

Special Programmes of socio-economic development have been launched in the country to improve the quality of life in different states. The present study deals with the quantification of developmental efforts effected in various socio-economic fields by constructing composite index of development based on information of fourteen important indicators in seventeen major states of the country. This study has been undertaken over two period of time i.e. 1971-72 and 1981-82 with the objective of examining the significance of change and variability in development. Attempts have also been made to estimate potential targets for the underdeveloped states to bring equity in development. The states of Haryana and Punjab are observed to be better off in socio-economic development where as the states of Assam, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh have remained at the low ebb of development during both the periods. The overall level of development is found to be significantly different between the two time periods. Though the various developmental programmes have resulted in an improvement during the second period, its impact appears to have been eroded by the rapid growth of population in most of the states. Special care should be taken to allocate resources optimally on per capita basis for improving the socio-economic conditions of under developed states.

Key Words: Composite index of development, socio-economic variables, distance matrix, potential target, slippage test, factor analysis, coefficient of variation, per capita plan outlays.

Introduction

Developmental programmes in various fields were taken up in the country in a planned way through various Five Year Plans with the main objective of enhancing the quality of life of general masses by providing the basic necessities of life as well as effecting

improvement in their social and economic well-being. The 'green revolution' in agriculture sector and the commendable progress on industrial front have certainly increased the total production in agriculture and manufactured goods, but there is no indication that these have been able to reduce substantially the inequality and poverty. It has been observed that the proportion of landless, agricultural labourers and industrial workers have increased over the years but their wages have not kept pace with the rate of inflation. However, in a large sized federal country like India, there is likely to exist wide disparities in the levels of development and the rate of growth in different regions of the country. It has been the continuous endeavour of scientists and planners to measure the level of development in different regions of the country in order to identify where a given region stands in relation to others.

Social development, by definition, is not a pre-determined state but it is a continuous process of improvement of level of living. It implies the availability to the maximum number of people of goods and services in adequate measure the existence of an agricultural, industrial and technological infrastructure which produces these goods and services and the existence of human related services of education and health which provide the trained man-power and also protect its health. As development is a multi-dimensional process, its impact cannot be captured fully by any single indicator. Moreover, a number of indicators when analysed individually, do not provide an integrated and easily comprehensible picture of reality. Hence there is a need for building up of a composite index of development based on various socio-economic variables. In the present study, an attempt has been made to quantify the socio-economic development of different states of the country by constructing composite index of development for each state and comparing them over time.

The specific objectives of the study were as follows:

(i)   to estimate the composite indices of socio-economic development for each state,

(ii)   to examine the statistical significance of over-all change in development indices over two periods,

(iii) to measure socio-economic distances of different states from each other and

(iv)   to evaluate the regional imbalances and classify the states on the basis of their socio-economic development.

2. *Method of Analysis:*

For this study, the states have been considered as the unit of analysis as in India the same have been taken as a planning unit and, moreover, the data required for analysis are generally available at the state level. All the major states of the country have been included in the analysis. The study utilizes the data on various types of socio-economic indicators such as agricultural, industrial, infrastructural, communication, education and general indicators of development over two periods of time (1971-72 and 1981-82). Various steps involved in the statistical evaluation of development are presented below:

2.1 *Estimation of Composite Index of Development:*

Let a set of n points represent states $1, 2, \ldots, n$ for a group of k indicators $1, 2, \ldots, k$. This can be represented by a matrix $[X_{ij}]$; $i = 1, 2, \ldots, n$ and $j = 1, 2, \ldots, k$. As the developmental indicators included in the analysis are in different units of measurement and since our object is to arrive at a single composite index relating to the dimension in question. There is a need for standardisation of the indicators. Hence the indicators are standardised as shown below:

$$Z_{ij} = \frac{X_{ij} - \overline{X}_j}{s_j} \tag{1}$$

$$\text{where } s_j^2 = \sum_{i=1}^{n} \frac{(X_{ij} - \overline{X}_j)^2}{n}$$

$$\overline{X}_j = \sum_{i=1}^{n} \frac{X_{ij}}{n} \qquad (i = 1, 2, \ldots, n)$$

$$(j = 1, 2, \ldots, n)$$

$[Z_{ij}]$ denotes the matrix of standardised indicators. The best state for each indicator (with maximum/minimum standardised value depending upon the direction of the indicator) is identified and from this the deviations of the value for each state are taken for all indicators in the following manner:

$$C_i = \left\{ \sum_{j=1}^{k} (Z_{ij} - Z_{oj})^2 \right\}^{1/2} \tag{2}$$

Where Z_{oj} in the standardised value of the jth indicator of the best state and C_i denotes the pattern of development of ith state. The pattern of development is useful in identifying the states which serve as 'models' and it also helps in fixing the potential target of each indicator for a given state. The composite index of development is obtained through the following formula:

$$D_i = \frac{C_i}{C} \tag{3}$$

where $C = \overline{C} + 2s,$ $\qquad \overline{C} = \sum_{i=1}^{n} \frac{C_i}{n}$

and $s = \left\{ \sum_{i=1}^{n} \frac{(C_i - \overline{C})^2}{n} \right\}$

The value of composite index is non-negative and it lies between 0 and 1. The value of index closer to zero indicates the higher level of development while the value of index closer to 1 indicates the lower level of development.

2.2 *The Socio-Economic Distance*:

Using the standardised variates $[Z_{ij}]$, the socio-economic distance between different states may be obtained as follows:

$$D_{ip} = \left\{ \sum_{j=1}^{k} (Z_{ij} - Z_{pj})^2 \right\}^{1/2} \tag{4}$$

$$(i = 1, 2, \ldots, n \text{ and } p = 1, 2, \ldots, n)$$

Here $D_{ii} = 0$ and $D_{ip} = D_{pi}$

The distance matrix will take the form

$$\begin{bmatrix} 0 & d_{12} & d_{13} & \cdots & d_{1n} \\ d_{21} & 0 & d_{23} & \cdots & d_{2n} \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ d_{n1} & d_{n2} & d_{n3} & \cdots & 0 \end{bmatrix} \tag{5}$$

The minimum distance for each row (d_i, i = 1, 2, . . ., n) will be obtained from the distance matrix for computation of upper and lower limits (C.D.) as indicated below:

$$C.D. = \bar{d} \pm 2\sigma_d \qquad (6)$$

Where $\bar{d} = \sum_{i=1}^{n} \dfrac{d_i}{n}$ and

$$\sigma_d = \left\{ \sum_{i=1}^{n} \frac{(d_i - \bar{d})^2}{n} \right\}$$

The distance matrix can also be used for fixing targets for different states on each indicator. For setting out the targets, for example, for state A, the model states are to be identified on the basis of composite index of development. States, having composite index lower than that of State A and their individual distance with State A not exceeding the upper limit of C.D. given in (6), will serve as model states for State A on all the indicators considered in the analysis. Thereafter, the arithmetic mean of the original value of the indicator of 'model states' will be computed. The mean value so computed is referred to as potential target for state A for a given indicator. This procedure will be repeated for a given state for all indicators considered.

2.3 *Change in Development Levels*:

After having obtained the measure of development (composite index) for each state over different time periods, it is also of interest to examine the statistical significance of changes in development indices over time. For this, the slippage test proposed by Rai [6] is utilized and is presented below:

States are arranged in the ascending order of their development indices for each time period (1, 2, . . ., t). The development indices for different time-period will now be ranked for their first order statistic, 2nd order statistic, and so on, the nth order statistic. Allot rank 1 to the smallest, 2 to the next higher and so on.

Let R_i denote the sum of ranks of the ith period for all the states and calculate the following test statistic

$$M = \frac{12}{nt(t+1)} \sum_{i=1}^{t} R_i^2 - 3n(t+1) \qquad\qquad (7)$$

which is distributed as χ^2 statistic with (t-1) d.f.

This test statistic is used to test the null hypothesis that there is no change in the development indices of states over time.

For examining the regional imbalances in development during different periods, coefficient of variation (C.V.) of development indices will be computed and compared.

3. *Indicators of Development*:

The indices of level of development in 17 major states of the country have been obtained by utilising the data on the following indicators over two periods of time (1971-72 and 1981-82).

- Net sown area (in ha.) per cultivator,

- Percentage of agricultural workers to total workers,

- Average foodgrains production (in kg.) per capita,

- Consumption of fertilizers (in kg.) per hectare of cropped area,

- Percentage of gross irrigated area to gross cropped area,

- Average daily employment of factory workers per lakh of population,

- Gross output in Industry per capita,

- Domestic consumption of electricity per capita,

- Industrial consumption of electricity per capita,

- Number of banking offices per lakh of population,

- Number of students in Primary and Secondary schools per thousand population,

- Total road length per 100 sq. km. of area,

* Per Capita Income at Current prices and

° Literacy percentage.

The above indicators which measure the different characteristics of socio-economic development are used to compute the composite indices of development for each state over two time periods and the results are presented and discussed in the succeeding section.

4. *Factor Analysis Approach:*

The most important aspect of the factor analysis is the extraction of crucial factors. This technique is used here to condense the inter-state diversities observed in terms of 14 variables into a fewer factors. The method utilises the correlation matrix based on the set of observations and condenses the matrix into smallest number of orthogonal factors. This procedure is of special interest as each successive generated factor extracts the maximum amount of variance and insures the smallest possible residual. For estimating the communalities of the correlation matrix and the proper number of factors, the technique of Principal Component is used. This analysis has resulted into three components for period 1 (1971-72) and four components for period 2, (1981-82) (based on Kaiser's criteria of Eigen value to be higher than 1). The results are presented in the following table:

Table 1. Percentage of Total Variance explained by Each factor

Period 1 (1971-72)				Period 2 (1981-82)			
Factor	Eigen Value	Percent	Cum. Percent	Factor	Eigen Value	Percent	Cum. Percent
1	6.56	46.9	46.9	1	5.70	40.8	40.8
2	2.88	20.5	67.4	2	2.64	18.8	59.6
3	2.05	14.7	82.1	3	1.82	13.0	72.6
				4	1.03	7.3	79.9

The measure of communalities reflects the percentage of inter-state variation for each of the 14 variables explained by all the three

Table 2. Percentage of Variance of Each Variable Accounted by all the Crucial Components

Variables	Period 1 (1971-72) Communality (h_j^2)	Period 2 (1981-82) Communality (h_j^2)
1	64.3	60.6
2	78.3	81.6
3	84.0	63.7
4	77.7	81.7
5	89.0	92.8
6	89.3	85.6
7	87.2	89.4
8	84.1	60.7
9	86.1	79.3
10	66.4	71.4
11	85.6	81.3
12	75.7	92.7
13	91.0	85.2
14	91.1	93.2

factors during period 1 and four factors during period 2.

A perusal of the communalities values indicates that for 12 variables for period 1 and 10 variables for period 2, the communalities exceed 75%. Thus we find a fairly high degree of representation of all the fourteen considered variables by the three factors identified crucial for the study.

The analysis reveals that there are three independent factors identified during period 1 and four factors during period 2. The first factor had significantly high loading in average daily employment for factory workers, per capita gross industrial out puts and per capita industrial consumption of electricity during both the periods. This factor could be taken as indicator of 'industrial development'. The second factor common to both the periods is identified as 'social development' as it loads very heavy on variables like students in primary and secondary schools, literacy percentage and total road

length. The third factor 'agricultural development' loads very high during period 1 on the proportion of gross irrigated area, per capita average food grain production and fertilizer consumption while during period 2, it loads high on proportion of irrigated area only. During period 2, the fourth additional factor identified is the 'banking development'.

It may be concluded that a broad and fair representation of the whole spectrum of inter-state disparities for the fourteen variables can be made in a simple structure of three or four orthogonal factors which account for about 80 percent of the total variance.

5.   *Results and Discussions*:

The development indices based on 14 Indicators regarding agricultural, industrial, social and banking developments have been computed as per procedure indicated in section 2 for the period 1971-72 and 1981-82 for each state and presented in Table 3. The states included in the analysis covered about 94 percent of geographical area and about 98 percent of the population of the country. Table 3 presents the values of 'pattern' and 'composite index' for each state alongwith the rank allotted on the basis of these indices.

It may be observed from the table that of the 17 states included in the analysis, the state of Punjab ranked the first and the state of Bihar ranked the last in socio-economic development during 1971-72. The values of composite indices varied from 0.37 to 0.89 during this period. If we consider the composite index upto 0.60 as high level development, index from 0.61 to 0.75 as middle level development and index greater than 0.75 as low level development, we observe that Punjab, Haryana, Tamil Nadu, Gujarat, Kerala and Maharashtra were highly developed states; West Bengal, Karnataka and Andhra Pradesh were middle level developed states and the states of Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir, Assam, Orissa, Rajasthan, Madhya Pradesh and Bihar were low developed states during 1971-72.

The analysis of the relative level of development in these states during the period 1981-82, indicated that the state of Haryana ranked the first and the state of Bihar continued to occupy the last position in respect of socio- economic development. The values of composite indices varied from 0.49 to 0.92 during this period. The classification of states into the three groups of development indicated that only Haryana and Punjab were in the category of highly developed states; the states of Kerala, Maharashtra, Tamil

Table 3. Pattern and Index of Development

	States	1971-72			1981-82		
		Pattern (C_i)	Index (D_i)	Rank	Pattern (C_i)	Index (D_i)	Rank
1.	Andhra Pradesh	10.44	0.75	9	13.37	0.79	11
2.	Assam	11.94	0.85	13	15.41	0.91	16
3.	Bihar	12.47	0.89	17	15.57	0.92	17
4.	Gujarat	8.33	0.59	4	11.46	0.67	6
5.	Haryana	7.78	0.56	2	8.27	0.49	1
6.	Himachal Pradesh	11.20	0.80	11	12.26	0.73	9
7.	Jammu and Kashmir	11.54	0.82	12	11.99	0.71	8
8.	Karnataka	9.10	0.65	8	11.70	0.69	7
9.	Kerala	8.40	0.60	5	10.56	0.62	3
10.	Madhya Pradesh	12.04	0.86	16	14.74	0.87	13
11.	Maharashtra	8.42	0.60	6	10.69	0.63	4
12.	Orissa	12.01	0.86	14	14.88	0.88	14
13.	Punjab	5.21	0.37	1	8.87	0.52	2
14.	Rajasthan	12.02	0.86	15	15.01	0.88	15
15.	Tamil Nadu	8.30	0.59	3	11.23	0.66	5
16.	Uttar Pradesh	11.01	0.79	10	14.46	0.85	12
17.	West Bengal	8.56	0.61	7	13.22	0.78	10

Nadu, Gujarat, Karnataka, Jammu and Kashmir and Himachal Pradesh were in the category of middle level development and the states of West Bengal, Andra Pradesh, Uttar Pradesh, Madhya Pradesh, Orissa, Rajasthan, Assam and Bihar were in the low developed cateogry. It was also observed that the level of development in 14 states, out of 17 considered, had gone down during 1981-82 over their development index of 1971-72.

The states of Tamil Nadu, Gujarat, Kerala and Maharashtra, which occupied position under high category of development during 1971-72, moved down to the medium category during 1981-82 and the states of West Bengal and Andhra Pradesh shifted from the medium category to low category during this period. Among the low developed category of states during 1971-72, the states of Jammu and Kashmir and Himachal Pradesh could improve their position marginally during 1981-82 and these could be classified into medium category. It will be of interest to study the relative share of area and population affected under different levels of development during two periods. Table 4 below describes the percentage area and population covered by the states under different levels of development.

Table 4. Area and population under different levels of development

Levels of development	Year	Number of states	Area (%)	Population (%)
High	1971-72	6	23.29	29.77
	1981-82	2	2.87	4.32
Medium	1971-72	3	16.90	21.36
	1981-82	7	34.70	31.82
Low	1971-72	8	53.73	46.90
	1981-82	8	56.35	61.56

From the above table, it is evident that during 1981-82, there is a significant reduction in area and population covered by the highly developed states due to the shifting of four major states to the medium category. On the other hand, the area and the population under the low category have increased even though the number of

states remained the same. It implies that the level of development has gone down during the later period. This is, perhaps, due to the fact that some bigger states which were categorized under medium category have shifted to low category during the second period.

An other important aspect of the study viz. changes in development indices over two periods of time, has been statistically examined by the slippage test explained in the earlier section. The value of test statistic M (eq. 7) is worked out to be 4.76 which comes out to be significant at 5% level of significance. This indicates the rejection of null hypothesis of no change in development indicates in states over time. From this, it can, thus, be concluded that the level of development is significantly different between the two periods of time. The perusal of Table 3 further reveals that the level of development in almost all the states has gone down during the second period inspite of various development programmes initiated to improve the socio-economic structure of the masses. Those may be due to the fact that all developmental achievements have been, perhaps, erored by the rapid growth of population during this period.

We may examine the allocation of plan outlays of different states during various plans for ascertaining the developmental efforts, which may help to investigate the causes for inter-state variation in developmental indices. Per-capita Plan Outlays will throw light on the adequacy of funds and efforts in relation to the population of different states. Therefore, per capita Plan Outlays are computed for various Plans up to 1979-80 and presented in Table 5.

It may be seen from the table that resource allocation on per capita basis in the low developed states of Bihar, Madhya Pradesh, Rajasthan, Orissa and Uttar Pradesh, has been consistently lower compared to the states falling in the other categories. Though in the state of Orissa, the plan allocation during the first and the third plan period was satisfactory but its benefit in development indices is not visible. It may, perhaps, be due to the poor base of the state. Because of better resource allocation, the states of Himachal Pradesh and Jammu and Kashmir could improve their positions to the medium category during the later period. This suggests that there is a need to improve the resource allocation on per capita basis in the under developed states so as to reduce the inter-state disparities in development.

Economic planning has been used in the country as an instrument for bringing about uniform regional development over

Table 5. Percapita Plan Outlays (in Rs.)

	State	Plan I	Plan II	Plan III	Annual Plans	Plan IV	Plan V	Annual Plan
1.	Andhra Pradesh	29.73	58.00	96.00	64.00	97.00	369.00	96.77
2.	Assam	25.84	71.00	114.00	75.00	179.00	334.00	105.98
3.	Bihar	21.96	46.00	72.00	48.00	199.00	212.00	63.35
4.	Gujarat	47.98	90.00	15.00	101.00	170.00	462.00	149.83
5.	Haryana	–	86.00	118.00	96.00	225.00	615.00	226.16
6.	Himachal Pradesh	17.78	88.00	118.00	–	347.00	778.00	210.98
7.	Jammu and Kashmir	36.51	83.00	172.00	174.00	343.00	1038.00	255.57
8.	Karnataka	39.85	72.00	106.00	78.00	120.00	328.00	102.05
9.	Kerala	26.03	58.00	107.00	83.00	129.00	277.00	79.64
10.	Madhya Pradesh	29.04	56.00	89.00	53.00	329.00	329.00	109.23
11.	Maharashtra	31.60	67.00	109.00	103.00	178.00	447.00	151.35
12.	Orissa	48.43	61.00	128.00	75.00	102.00	306.00	87.03
13.	Punjab	146.38	88.00	110.00	102.00	216.00	604.00	191.87
14.	Rajasthan	32.74	63.00	104.00	67.00	117.00	351.00	106.73
15.	Tamil Nadu	25.23	62.00	102.00	74.00	126.00	221.00	74.53
16.	Uttar Pradesh	22.51	36.00	76.00	62.00	109.00	321.00	78.11
17.	West Bengal	44.09	59.00	86.00	47.00	73.00	268.00	101.55

time. In this context, it would be of interest to examine the extent of variability in developmental indices over different periods of time. For this purpose, the coefficient of variation (C.V.) of development indices have been worked out for 1971-72 and 1981-82 to be 19.72 and 20.27 respectively, which are almost identical. This indicates that the extent of variability in developmental indices of different states over the two time periods has been almost of the same order.

The potential targets for the low developed states have been estimated by using the distance matrix obtained pertaining to the later period 1981-82. The estimates of the potential targets for each indicator alongwith the actually achieved values are given in the *appendix*. It shows the direction of inequality existing among the indicators in different states. It may be mentioned that the higher percentage of Agricultural workers to the total workers has been hypothized to be in the negative direction of development where as the higher values of other indicators contributed positively. Such information may help the planners and administrators to readjust the resources for bringing equity among different states. Estimates of potential targets of different socio-economic indicators reveal that in Assam there is a great need of effecting improvement in almost all the indicators understudy except for facility for primary and secondary schooling. It is observed that in case of Bihar, the level of irrigation is already higher than the potential targets but other thirteen indicators require improvement. Similarly in respect of Madhya Pradesh, it is observed that the values of indicators for net sown area and industrial electric consumption are almost equal to the required potential where as the other indicators need further improvement. Road communication in Orissa, fertilizer consumption and irrigation facility in Uttar Pardesh and per capita net sown area in Rajasthan are found to be satisfactory at present but there is a need of raising the levels of other indicators in these states. However, the foodgrain output per capita in the states of Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh appear to be quite satisfactory.

6. *Conclusions:*

The broad conclusions emerging from the study are as follows:

* The states of Haryana and Punjab are observed to be better off in socio-economic development where as the states of Assam, Bihar, MAdhya Pradesh, Orrisa, Rajasthan and Uttar Pradesh have remained at the low ebb of development during both the periods.

- The over-all level of development is found to be significantly different between the two time periods.

- Though the various developmental programmes have resulted in an improvement in Agricultural, Industrial and Socio-economic factors during the second period, its impact appears to have been eroded by the rapid growth of population in most of the states.

- Special care should be taken to allocate resources optimally on per capita basis for improving the socio-economic conditions of under developed states.

REFERENCES

[1] Agarwal, A.N., Verma, H.O. and Gupta R.C., 1989. Indian Economic Information year Book. 1988-89.

[2] Gore, M.S., 1988. Social Development: The Asian Experience; Presidential Address, XIII Indian Social Science Congress.

[3] Joshi, B.M., 1987. Inter-state disparities and economic development, *Yojna*, **31**, 4: 4-10.

[4] Namasivayam, D., C. Gajentra Naidu and N. Mohana, 1987. NREP in Tamil Nadu, Comparison of Growth and Equity by Taxanomic Method, 56-73.

[5] Narain, P., 1975. Factor Analysis in Social Research. *Jl. Extn. Edn.*, **11**; 63-70.

[6] Rai, S.C., 1987. Multi-Sample Slippage test for ordered observations. *Biom J.* **29**, 4: 449-454.

[7] Rao, B. Appa, 1987. Balanced Regional Development through five year plans. Yojana, **31**, April 1-15, 4-9.

APPENDIX

Estimates of Potential Targets and Actual Achievements

	Development Indicators	Assam	Bihar	Madhya Pradesh	Orissa	Rajasthan	Uttar pradesh
1.	Net sown area (ha.)	1.5 (0.5)	1.3 (0.9)	1.7 (1.8)	1.7 (1.5)	1.3 (2.4)	1.8 (0.9)
2.	Agri. workers to total workers (%)	67.6 (72.5)	68.8 (79.1)	65.3 (76.2)	67.1 (74.7)	66.7 (68.9)	64.3 (74.5)
3.	Foodgrain output per capita (kg)	193 (127)	192 (123)	172 (248)	185 (216)	188 (238)	164 (244)
4.	Fertilizer consumption (kg/ha)	45.7 (4.0)	41.5 (35.9)	55.6 (17.1)	54.1 (12.9)	47.6 (11.2)	58.5 (65.1)
5.	Gross irrigated area to gross cropped area (%)	26.6 (16.6)	25.9 (33.6)	28.1 (11.5)	27.8 (22.9)	29.6 (20.0)	27.4 (46.9)
6.	Employment of Factory workers (lakh popln.)	976 (430)	827 (593)	1238 (760)	1106 (411)	967 (504)	1271 (462)
7.	Gross industrial output (Rs.) per capita	923.5 (353.4)	718.7 (630.1)	1286.1 (575.7)	1024.2 (491.4)	887.3 (549.9)	1187.2 (494.3)
8.	Domestic Electric Consumption per capita (kwh.)	18.8 (4.8)	16.3 (2.6)	25.0 (12.4)	21.4 (5.9)	20.4 (10.5)	24.3 (13.1)

APPENDIX - contd....

	Development Indicators	Assam	Bihar	Madhya Pradesh	Orissa	Rajasthan	Uttar pradesh
9.	Industrial electric consumption per capita (kwh.)	93.3 (24.9)	78.9 (49.3)	103.5 (107.9)	97.9 (95.3)	90.8 (54.0)	106.7 (35.2)
10.	Banking offices per lakh popln.	7.5 (4.3)	7.1 (5.4)	7.8 (6.4)	7.7 (6.0)	7.9 (6.9)	8.2 (6.0)
11.	Students in Primary and Sec. Schools per thousand.	170 (175)	169 (135)	183 (155)	177 (142)	171 (142)	187 (143)
12.	Road length (km) per 100 sq. km. of area	53 (41)	54 (48)	58 (26)	54 (77)	52 (22)	59 (53)
13.	Per capita Income.	1977 (1821)	1959 (1369)	2248 (1716)	2062 (1534)	2010 (1838)	2169 (1764)
14.	Literacy (%)	35.4 (28.1)	33.8 (19.9)	39.4 (27.8)	37.0 (34.1)	34.9 (24.1)	40.1 (27.4)

* Actual values are already higher than the potential targets.

INDIAN SOCIETY OF AGRICULTURAL STATISTICS, Library Avenue, Pusa, New Delhi

Balance Sheet as on 31st March, 1991

Previous Year	Liabilities		Current Year	Previous Year	Assets		Current Year
	Corpus Fund		4,00,000.00		Cash & Bank Balances		
6,21,463.25	General Reserve			1,224.48	Cash in Hand	874.17	
	Balance as per last B/sheet	6,21,463.25		19,047.66	State Bank Of India, Parliament Street, C/A	29,884.66	
	Less : Amount trfd. to Corpus Fund	4,00,000.00		12,715.96	State Bank Of India, Parliament Street, Savings A/C	13,327.51	
		2,21,463.25					
	Add : Excess of Income over Expenditure	30,776.57	2,52,239.82	62,448.23	Syndicate Bank, Pusa, New Delhi, Savings A/C	29,519.63	
	Publication Reserve			55.27	Syndicate Bank, Pusa, New Delhi, C/A	2,408.77	76,014.74
50,000.00	Balance as per last B/Sheet		50,000.00				
445.00	Membership Fees Received in Advance for 1992		—		Fixed Deposits		
				1,10,000.00	State Bank of India, Parliament Street, New Delhi	1,10,000.00	
	Capital Reserve (Life Membership Fees)						
1,08,474.00	Balance as per last B/Sheet	1,08,474.00		1,50,000.00	State Bank of Indore, Connaught Place, New Delhi	1,50,000.00	
	Add : Additions during the year			50,000.00	Syndicate Bank, Pusa, New Delhi	1,00,000.00	
	i) From Individuals	9,045.00					
	ii) From Institutional Members	500.00	1,18,019.00	50,000.00	Canara Bank, Connaught Place, New Delhi	50,000.00	

15,048.20	Advance Subscription for Journal (Vol. 43)		14,934.00	1,17,000.00	With Other Companies (As per list)	1,12,000.00	5,22,000.00
	Expenses Payable				**Stock in Hand**		
600.00	Audit Fees	900.00		1.00	Journals	1.00	
600.00	Remuneration	600.00	1,500.00	1.00	Symposium	1.00	
				39,782.04	Published Books	40,040.62	40,042.62
					Deficiency Account (Journal)		
				7,903.97	Balance as per last B/Sheet	7,903.97	
					Add : Deficit for the year	6,837.10	14,741.07
					Advance to Research Unit		
				1,76,450.84	Balance as per last B/sheet	1,76,450.84	
					Add : Advance during the year	7,443.55	1,83,894.39
7,96,630.45			**8,36,692.82**	**7,96,630.45**			**8,36,692.82**

Place : 64, Regal Building,
Connaught Circus,
New Delhi 110001

Dated : 23rd Sept. 1991

Subject to our report of even date

for C. S. BHATNAGAR & Co.
Chartered Accountants
Sd/-
(G. S. Bhatnagar)
Partner

INDIAN SOCIETY OF AGRICULTURAL STATISTICS, Library Avenue, Pusa, New Delhi

Income & Expenditure Account for the year ending 31st March, 1991

Previous Year	Expenditure		Current Year	Previous Year	Income	Current Year
3,975.00	To Salaries & Honorarium	4,575.00		4,266.70	By Ordinary Membership Fees & Registration Fees	5,314.00
2,981.25	Less : 3/4 trfd. to Journal Account	3,431.25	1,143.75	1,620.00	By Sessional Membership Fees	2,520.00
993.75				3,792.49	By Interest on Savings Bank	3,044.15
	To Other Expenses			84,545.00	By Interest on Fixed Deposits	44,285.00
2,843.60	Postage	2,432.20		4,161.09	By Profit on Published Books	2,294.48
731.67	Printing & Stationary	1,292.70		123.00	By Sale of Symposium Books	50.50
216.00	Bank Charges	196.20		10,000.00	By Grant in aid from ICAR for Annual Conference	—
65.00	Conveyance	—			By CSO Project	45,000.00
234.00	General Charges	319.50			By Misc. Income	163.00
600.00	Audit Fees	900.00				
4,690.27		5140.60				
3,517.70	Less : 3/4 trfd to Journal Account	3855.45	1,285.15			
1,172.57						
18,161.11	To 44th Annual Conference Expenses		22,509.70			

500.00	To Membership Fees to Indian Association of Social Science Institute	500.00	
4,431.00	To Expenses on V. G. Pause Memorial Lecture	1265.60	
3,509.00	To ISI Conference Fees	1,396.00	
1,898.00	To Membership Fees to International Statistical Institute	1,198.00	
—	To Expenses on C.S.O. Project	33,153.16	
17,446.80	To Expenses on Sankhyaki Bhushan Award	7,707.00	
4,408.00	To Best Paper Auditor's Award Exp.	—	
663.80	To Young Scientist Award Exp.	1,597.50	
3,190.00	To Publication Exp. of News Letter	—	
273.40	To Executive Meeting Expenses	138.70	
51,860.85	To Excess of Income over Expenditure C/o to General Reserve A/c	30,776.57	
1,08,508.28		**1,02,551.13**	**1,08,508.28**

(right side totals) 1,08,508.28   1,02,551.13

INDIAN SOCIETY OF AGRICULTURAL STATISTICS (Research Unit), Library Avenue, Pusa, New Delhi

Balance Sheet as on 31st March, 1991

Previous Year	Liabilities		Current Year	Previous Year	Assets		Current Year
	Indian Society of Agricultural Statistics				**Fixed Assets**		
1,76,450.84	Balance as per last B/sheet	1,76,450.84		9,871.76	As per Schedule attached		8,909.76
	Add : Advance during the year	7,443.55	1,83,894.39	4,175.80	Deposit with Post Office (PF A/c)		2046.20
	Expenses Payable			30,000.00	Grant in Aid Receivable		30,000.00
600.00	Audit Fees Payable	900.00			**Deficit A/c**		
330.00	Telephone Bill Payable	330.00		1,37,149.08	Balance as per last B/sheet	1,37,149.08	
4,175.80	P.F.A./c of Sh. Bhawani Dutt	2046.20	3,276.20		*Add* : Deficit for the year	8,745.55	1,45,894.63
				360.00	**Advance to Staff**		
					Sh. Bhawani Dutt	120.00	
					Sh. Satish Kumar	200.00	320.00
1,81,556.64			1,87,170.59	1,81,556.64			1,87,170.59

Income & Expenditure Account for the year ending 31st March, 1991

Previous Year	Expenditure	Current Year	Previous Year	Income	Current Year
43,715.70	To Establishment Expenses	38,491.00	40,000.00	By Grant in Aid from Govt. of India, Ministry of Agriculture, Dept. of Agri. Co-operation	40,000.00
—	To Printing & Stationary	2,447.75			
160.00	To General Expenses	—	602.00	By Profit on Sale of Assets	
600.00	To Audit fee	900.00	10,483.08	By Deficit for the year trfd. to B/sheet	8,745.55
206.00	To Employer's Contribution to PF	—			
1,980.00	To Telephone Expenses	1,980.00			
826.50	To Travelling & Conveyance	2,720.95			
939.80	To Liveries to Staff	298.65			
947.90	To Postage Expenses	810.70			
436.18	To Repairs	134.50			
153.00	To Loss on lost articles	—			
1,120.00	To Depreciation of Assets	962.00			
51,085.08		**48,745.55**	**51,085.08**		**48,745.55**

INDIAN SOCIETY OF AGRICULTURAL STATISTICS, Library Avenue, Pusa, New Delhi
RESEARCH UNIT
Receipt & Payment Account for the year ending 31st March, 1991

Previous Year	Receipts	Current Year	Previous Year	Payments	Current Year
10,000.00	By Grant in Aid Received from Govt. of India, Ministry of Agri. Dept. of Agriculture & Co-operation	40,000.00		**By Revenue Expenditure**	
			43,715.70	Salaries	38,491.00
			—	Stationery & Printing	2,447.75
1,300.00	By Sale of Assets	—	600.00	Audit Fees	600.00
40,472.08	By Indian Society of Agricultural Statistics	7,443.55	1,980.00	Telephone Charges	1,980.00
			826.50	Travelling & Conveyance	2,720.95
	By Recovery of Festival Loan from Bhawani Dutt	240.00	939.80	Liveries to Staff	298.65
			947.90	Postage	810.70
			436.18	Repairs	134.50
			160.00	General Charges	—
			206.00	Employees Contribution to PF	—
			360.00	Loan to Staff (Sh. Satish K..mar)	200.00
			1,600.00	Purchase of Cooler	—
51,772.08		**47,683.55**	**51,772.08**		**47,683.55**

Income & Expenditure Account (Journal) for the year ending 31st March, 1991

Previous Year	Expenditure	Current Year	Previous Year	Income	Current Year
1.00	To Opening Stock (Token value))	1.00	33,503.32	By Sale & Subs. of Vol. 42	32,421.20
37,350.60	To Printing Charges Vol. 42	42,296.60	6,054.74	By Sale of Back Volumes	3,884.00
2,981.25	To Staff Salaries	3,431.25	1.00	By Closing Stock	1.00
3,517.70	To Other Expenses	3,855.45	434.00	By Sale of Re-Prints	214.00
344.50	To Printing & Stationery	612.50	15,000.00	By Grant in Aid from ICAR	15,000.00
5,103.30	To Postage Expenses	8,196.50		By Misc. Income (Sale of Raddi)	1,176.00
3,696.95	To Packing Expenses	1,140.00		By Excess of Expenditure over Income	6,837.10
1,997.76	To Excess of Income over Expenditure trfd. to Balance Sheet	—			
54,993.06		**59,533.30**	**54,993.06**		**59,533.30**

I. SAMPLING THEORY OF SURVEYS WITH APPLICATIONS

P.V. Sukhatme, B.V. Sukhatme, S. Sukhatme and C. Asok

It is the third Revised Edition containing all the principal developments in the theory of sampling with examples and exercises.

The book contains 11 chapters

Price : Rs. 35.00 (Paper back) and Rs. 60.00 (Hard bound)

II. STATISTICAL METHODS IN ANIMAL SCIENCES
V.N.Amble

The book has been prepared for specially meeting the needs of the students and the research workers in animal sciences wishing to learn the basic principles and the principal procedures of statistics for use in planning investigation and in analysing and interpreting the data. The emphasis in the book is on the principles and procedures with an attempt at elucidating the logic without too much of mathematics. A special feature of the book is the illustrations of the procedures through examples all taken from the field of animal sciences which would help the researchwoeker in animal sciences in understanding the applications all the more easily. Only basic knowledge of algebra at elementary level is assumed and the few derivations of procedures from statistical theory given in the book have been presented in such a manner that while they meet to some extent the logical inquisitiveness of a class of readers they could be omitted without loss of a clear understanding of the procedures.

The book consists of 17 chapters. The first 9 deal with statistical methods of inference and the next 7 with the planning of experiments and the analysis mainly on experimental data. The last chapter deals with the elements of sampling.

Price : Rs. 30.00 (Inland) and $10.00 (Foriegn)

III. IMPACT OF P.V. SUKHATME ON AGRICULTURAL STATISTICS AND NUTRITION
Edited by Prem Narain

It contains articles by eminent statisticians and other scientists in the country and abroad covering topics on Agricultural Statistics and Nutrition in which Prof. Sukhatme has made significant contributions.

Price : Rs. 15.00 (Paper back) and Rs. 50.00 (Hard bound)

IV. CONTRIBUTION IN STATISTICS AND AGRICULTURAL SCIENCES

This volume contains a number of scientific papers in the field of ststistics, agriculture, animal husbandry, agricultural economics and allied fields contributed by eminent research workers engaged in theoretical as well as practical development of statistics in relation to agriculture.

Price : Rs. 15.00 (Inland) and $ 4.50 (Foreign)

V. REPORT OF SYMPOSIUM
(i) Measurement of impact of green revolution, and
(ii) Statistical assessment of intensive cattle development programme.

Price : Rs. 10.00 (Inland) and $ 3.00 (Foreign)

LATEST PUBLICATION (December, 1990)
STATISTICAL DATA—THEIR CARE AND MAINTENANCE
By David J. Finney

This bulletin is extremely useful for students and research workers engaged in data collection and analysis. It describes in a lucid manner how data can be scientifically gathered for drawing sound inference. The various topics dealt with are : acquisition of data, design of data gathering, care for data, types and units of data, analysis and databases, copying, statistical ethics, data-entry to the computer, data scrutiny, integrity and some illustrations.

Price : Rs. 10.00 (Inland) and $ 3.00 (Foreign)

Please order your copies from :
The Secretary
INDIAN SOCIETY OF AGRICULTURAL STATISTICS
C/o I.A.S.R.I., Library Avenue,
New Delhi-110012

NEWS AND NOTES

1. Prof. Prem Narain, Director, Indian Agricultural Statistics Research Institute, New Delhi was on deputation to attend the 48th Session of the International Statistical Institute held at Cairo (Egypt) in September, 1991. He was Discussant in Sessions 1-17 and 1-30. He also represented the Indian Society of Agricultural Statistics as Secretary at the Session.

2. Prof. Prem Narain, Director, Indian Agricultural Statistics Research Institute, New Delhi received the prestigious "Sankhyiki Bhushan Award" for his outstanding contribution in the field of Agricultural Statistics. The award has been instituted by the Indian Society of Agricultural Statistics and carries a plaque, a scroll, a citation and a shawl. It was presented by Hon'ble Shri K.C. Lenka, Union Minister of State for Agriculture, Government of India on 27 November, 1991 during the 45th Annual Conference of the Society held at National Dairy Research Institute, Karnal.

3. "ISAS Young Scientist Award" was received by Dr. D. Shukla, Lecturer, Devi Ahilya University, Indore for his presentation of the paper "On a class for chain estimators for estimating population parameters" judged best during the 45th Annual Conference of the Society held at N D R I, Karnal.

4. The authors of the following papers considered best among the papers published in the Journal of the Society, Volume 41(1989) and Volume 42(1990) were awarded prizes.

   Design of Experiments :

   GDTORD in Non-Orthogonal Blocks
   (Vol. 42, No. 2, August, 1990)
   Rajendranath Panda and Archana Das Roy
   University of Kalyani, Kalyani.

   Statistical Genetics :

   Triallel Experiments with Reciprocal Effects
   (Vol. 41, No. 1, April, 1989)
   B.S. Arora and K.R. Aggarwal
   Punjab Agricultural University, Ludhiana.

   Statistical Theory and Methodology :

   Sequential Procedures for Estimating the Mean of an Inverse Gaussian Distribution
   (Vol. 41, No. 3, December, 1989.)
   R. Karan Singh and Ajit Chaturvedi
   University of Lucknow & University of Jammu.

भारतीय कृषि सांख्यिकी संस्था की पत्रिका

(हिन्दी परिशिष्ट)

अनुक्रमणिका

परिवर्ती प्रायिकताओं के उपयोग से दो कालों के प्रतिचयन पर

द्वारा

रघुनाथ अर्नब*

भारतीय सांख्यिकीय संस्थान, कलकत्ता

सारांश

वर्तमान काल में परिमित समष्टि के योग के आकलन के लिए तीन युक्तियों का प्रस्ताव एवं अध्ययन किया गया है जिनमें पूर्व काल में परिवर्ती प्रायिकताओं के द्वारा प्रतिदर्श का चयन करना, प्रारम्भिक प्रतिदर्श से तीन विभिन्न प्रकार से स्तरीय उप-प्रतिदर्श का चयन तथा वर्तमान काल में सम्पूर्ण समष्टि से स्वतंत्र रूप से प्रतिदर्श का चयन एवं प्रतिदर्शी आंकड़े तथा किसी सहायक चर के प्राप्त मानों का यथोचित मिश्रण सम्मिलित है । इनमें से कुछ युक्तियां प्राप्त तुलनीय युक्तियों से श्रेष्ठ पाई गई हैं ।

* वर्तमान पता : लेसोथो राष्ट्रीय विश्वविद्यालय, पो० रोमा, १८०. लेसोथो, अफ्रीका,

अपूर्ण ब्लॉक अभिकल्पनाओं के युग्म से द्वितीय कोटि ढाल घूर्णी अभिकल्पनाओं का निर्माण

द्वारा

बी.आर. विक्टर बाबू तथा वी.एल. नरसिंहमम, नागार्जुन विश्वविद्यालय, गुंटूर

सारांश

दो अनुकूल प्रकार से चयनित संतुलित अपूर्ण ब्लॉक अभिकल्पनाओं के उपयोग से द्वितीय कोटि ढाल घूर्णी अभिकल्पनाओं के निर्माण की एक नवीन पद्धति का सुझाव दिया गया है । इस पद्धति के प्रयोग से हैदर तथा पार्क (४) द्वारा प्रस्तावित ढाल घूर्णी केन्द्रीय मिश्र अभिकल्पना (एस.आर. सी.सी.डी.) प्राप्त की जा सकती है । ऐसा पाया गया है कि कभी कभी इस पद्धति द्वारा ऐसी अभिकल्पनाओं को प्राप्त किया गया है जिनमें साहित्य में उपलब्ध अभिकल्पनाओं की अपेक्षा कम अभिकल्पना बिन्दु होते हैं ।

बहुविमितीय अभिकल्पनाओं की संबद्धता एवं विश्लेषण

द्वारा

विजय कन्याल ' तथा सत्यजत पाल '

सारांश

बहुविमितीय अभिकल्पनाओं के अति व्यापक स्वरूप में सम्भावित प्रासम्भाव्य समीकरणों का एक आव्यूह प्राप्त करने का प्रयत्न किया गया है । संबद्धता के सन्दर्भ में कुछ प्रमेयों को स्थापित किया गया है ।

9. जूट कृषि अनुसंधान संस्थान, बैरकपुर, पश्चिम बंगाल
   वर्तमान पता : डी.सी.एस.आर., मेदीपुरम, उत्तर प्रदेश

२. बिधान चन्द्र कृषि विश्वविद्यालय, मोहनपुर, नादिया, पश्चिम बंगाल

विछिन्न प्रेक्षणों वाले यादृच्छिकीकृत ब्लॉक अभिकल्पना का विश्लेषण

द्वारा

शीला एस. देव

सांख्यिकी विभाग, पूना विश्वविद्यालय, पूना

सारांश

एक यादृच्छिकीकृत ब्लॉक अभिकल्पना (आर.बी.डी.) लीजिए जिसमें विछिन्न प्रेक्षण हैं जो विभिन्न उपचार- ब्लॉक से प्राप्त होते हैं । प्राय: विछिन्न प्रेक्षणों के स्थान पर उनके उन आकलकों को लिया जाता है जो त्रुटि वर्ग योग को न्यूनतम बनाते हों । विछिन्न प्रेक्षणों के स्थान पर उनके आकलकों के प्रयोग से हम त्रुटि वर्ग योग का यथातथ मान प्राप्त करते हैं परन्तु परिकल्पना वर्ग योग का मान सत्य नहीं होता । यादृच्छिकीकृत ब्लॉक अभिकल्पना में हमारी रुचि उपचारों के प्रभावों के समानता परीक्षण में होती है । इस प्रश्न में आकलकों के प्रयोग से प्राप्त उपचार वर्ग योग का बंटन एक मानक बंटन नहीं होता है । यह χ^2 - वर्ग का मिश्रण होता है । इस यथातथ बंटन के प्रयोग से प्राप्त होता है तथा इसे उदाहरण द्वारा स्पष्ट किया गया है ।