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Indian Statistical Series No. 6

STUDIES ON CONSUMER BEHAVIOUR

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ASHOK RUDRA and BINA ROY– DEB KUMAR BOSE
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and R. G. LAHA –A K. CHAKRAVERTI

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FOREWORD

Shri Jawaharlal Nehru, Prime Minister of India, inaugurated in the Indian Statistical Institute studies on planning for national development in November 1954. Since then the Institute is actively engaged in studies on planning in collaboration with the Planning Commission, the Central Statistical Organization and other Government agencies and a considerable amount of work has already been done. A part of the work was done either directly or under the guidance of foreign experts who visited the Institute during the last four or five years. Indian scholars were responsible for the remaining part of the work. Some of these papers, particularly those by the visting experts, are of considerable interest from the methodological and theoretical point of view. Some others are of value because they contain interesting estimates and analyses. A close collaboration of the Planning Commission. the Central Statistical Organization and the Economic Wing of the Finance Ministry was available for the preparation of a number of these studies and the findings are something more than mere speculations by isolated research workers. On the other hand there are papers which are exercises by junior staff.

All these studies were incorporated in our mimeographed series; "Studies relating to Planning for National Development" as well as in other mimeographed reports and papers. As some of our studies were tentative in character, we did not think of wider circulation. Also, it was considered sufficient to keep informed the research workers in these fields and organizations connected with planning.

As there has been continuing demand for the mimeographed papers it has been decided to bring them out in a printed form to make them available to all research workers interested in this matter. This should be of help in promoting research on planning in the country. Experience of the last few years has shown that in order to make planning real in our country it is necessary that persons outside Government agencies should also participate in thinking on planning in concrete terms. In India it is now generally accepted that planning is desirable. We have now the task of putting across to the public what planning really implies, and this has to be done at a technical and technological level. To make planning real, we must have thousands of people working at various levels who would know how to formulate, execute, and assess a plan and what concrete studies and measures are required for this purpose. Wider dissemination of ideas is, therefore, essential.

The present publication is the second in the printed series : Studies relating to Planning for National Development. We propose to bring out in this series selected papers based on both the older and current studies. We hope this series will add something of value to the growing body of literature on planning in India.

7 August 1959 *P. C. Mahalanobis*

PREFACE

Family budget data occupy top position among survey data collected in India, both from the point of view of long history and extension. Family budgets of industrial workers of Bombay were collected as early as 1921, and possibly this was the first case of collection of data by survey method in India. From that time onward this type of data has been collected in different periods for industrial workers, plantation workers, agricultural workers and middle class families in different centres and regions of India. Recently, the National Sample Survey Organization has collected huge volume of family budgets from rural and urban regions of India on a fairly extensive scale in all the fourteen rounds that it has completed since September 1951. But in most of the cases analysis has been confined to the calculation needed for determining weights for consumer index numbers. The adoption of the method of planning for national development has, of late, necessitated studies of economic relationships in various fields—specially in the field of consumer behaviour mainly because of the need of prediction of future consumption for the community which is guided towards social and economic progress.

Econometric literature has devoted much attention to the study of consumer behaviour, and highly developed theoretical formulation and applied studies covering wide field are available for guidance of research workers.

But Indian data in the present stage are not adequate both from the point of view of accuracy and comprehensiveness for the application of highly developed methods. There is scope for experimentation and development of techniques specially suited to Indian situation.

The studies presented in this volume have been made by research workers of the Indian Statistical Institute, and are connected, in most cases, with problems of planning. Leaving aside a descriptive study about consumption pattern of different classes of rural families and a study on the applicability of discriminant analysis for classification of families, all others are connected with the measurement of consumer behaviour culminating in the calculation of income elasticities for various items of consumer expenditure. In these studies on consumer behaviour various mathematical equations found in the works of Herman Wold, S. J. Prais, H. S. Houthaker, J. A. C. Brown, T. Nicholson and others have been tried. Income elasticities obtained in different studies vary to a large extent This is partly due to the fact that data used vary in the different studies and partly because of the difference in the underlying models. However, the studies will serve as guide to future research workers in the field and will give some indication about income elasticities for different items.

23 May 1958 *T. P. Chowdhury*

CONTENTS

CONSUMPTION PATTERNS IN DIFFERENT OCCUPATION GROUPS

By AMALENDU GANGULY

INTRODUCTION

The difference in consumption habits among different occupation groups for a few particular items is studied in this paper. The study has been undertaken with a view to finding out whether it is advisable to forecast consumption in terms of occupation groups. If the difference in the consumption patterns is found to be existent in the different occupation groups for the same total income or expenditure, it is reasonable to forecast the consumption for each occupation group separately. Due to the impact of planning there is expected to be a planned shift of population from one occupation to another. For example, there is likely to be a planned shift of population from the agricultural sector to the non-agricultural sector. Hence forecasting in terms of occupation groups becomes all the more appropriate.

The present study is an exploratory one, and the numerical results given in this paper should be taken with reserve. The estimates in the paper are all unweighted and based on a comparatively small sample, the purpose being to give only the broad indications.

The rural areas of the state of Uttar Pradesh have been covered in this study. All the households surveyed in this state in the 7th round (November 1953—March 1954) of the National Sample Survey (NSS) have been taken.

To start with, only the consumption habits of three occupation groups for some selected commodities have been studied. The occupation groups are (i) farmers and cultivators, (ii) agricultural labourers, and (iii) other occupations excluding share croppers. It was first decided to take the share croppers as a separate group, but the number of sample households being extremely few in this case the study was not undertaken for this group.

The number of sample households in the different occupation groups are given in Table (1).

TABLE (1): NUMBER OF SAMPLE HOUSEHOLDS IN DIFFERENT OCCUPATION GROUPS

State: Uttar Pradesh (rural)

occupation	no. of sample households
(1)	(2)
1. farmers and cultivators	461
2. agricultural labourers	80
3. share croppers	16
4. others	105
5. total	662

It may be mentioned here that only the principal occupation of the household has been taken for purposes of occupational classification. The share-cropper households being only 16 in number, were not included in the study, as no reliable estimate could be obtained from these few households.

The items, for which consumption particulars have been studied, are as follows: (i) cereals, (ii) milk, (iii) sugar, (iv) gur (molasses) and (v) mustard oil.

Consumption habits

The procedure that was adopted in this connection, was to study the change of pattern of consumption with increasing income or expenditure. As no data on income were available, the study was undertaken on the basis of total expenditure. Accordingly the households in each occupation group were classified by monthly per capita expenditure of the households and the consumption patterns were studied for the different occupations.

Table (2) gives the household per capita consumer expenditure and the per capita quantity of consumption of cereals in the different expenditure levels for the three occupations separately. In column (1) is given the per capita expenditure level of the household, in column (2) the number of sample households, in column (3) the average per capita consumer expenditure, and in column (4) the per capita quantity of consumption of cereals. It may be noted that the consumer expenditure and quantity of consumption refer to a period of 30 days.

From column (1) of the Table it will be seen that the class intervals are rather irregular and vary from occupation to occupation. This has been done with a view to having an adequate and more or less equal representation of households in each expenditure class. The sample size is rather small for the two occupation groups, agricultural labourers and others.

TABLE (2): PER CAPITA CONSUMER EXPENDITURE AND PER CAPITA QUANTITY OF CONSUMPTION OF CEREALS FOR A PERIOD OF 30 DAYS IN DIFFERENT EXPENDITURE LEVELS IN DIFFERENT OCCUPATION GROUPS

State: Uttar Pradesh (rural)

per capita expenditure level in Rs.	no. of sample households	per capita consumer expenditure in rupees	per capita quantity of consumption of cereals in seers
(1)	(2)	(3)	(4)
(i) farmers and cultivators			
1. 2.92 — 9.60	37	7.40	12.79
2. 9.61 — 11.35	42	10.59	18.20
3. 11.36 — 13.28	45	12.44	14.30
4. 13.29 — 15.23	49	14.32	17.30
5. 15.24 — 17.19	44	16.20	20.92
6. 17.20 — 19.10	47	18.07	22.96
7. 19.11 — 21.56	45	20.32	25.34
8. 21.57 — 25.67	46	23.40	21.70
9. 25.68 — 31.78	46	28.23	21.69
10. 31.79 — 126.26	60	48.56	24.78
all exp. levels	461	19.74	19.95

TABLE (2) (*contd.*)

per capita expenditure level in Rs.	no. of sample households	per capita consumer expenditure in rupees	per capita quantity of consumption of cereals in seers
(1)	(2)	(3)	(4)
	(ii) agricultural labourers		
1. 2.78 — 5.36	7	3.94	5.44
2. 5.37 — 7.59	7	6.23	9.80
3. 7.60 — 8.66	6	8.17	10.95
4. 8.67 — 9.65	8	9.11	13.29
5. 9.66 — 10.50	7	10.02	14.52
6. 10.51 — 11.34	6	11.06	19.46
7. 11.35 — 13.16	10	12.27	18.16
8. 13.17 — 14.89	6	13.93	18.88
9. 14.90 — 19.22	7	17.29	19.82
10. 19.23 — 51.18	16	27.01	27.29
all exp. levels	80	12.33	16.17
	(iii) others		
1. 3.42 — 8.06	9	6.10	9.49
2. 8.07 — 9.89	12	9.22	15.32
3. 9.90 — 11.77	7	10 77	13.91
4. 11.78 — 13.02	10	12.64	16.31
5. 13.03 — 13.98	10	13.54	17.11
6. 13.99 — 15.12	9	14.58	17.82
7. 15.13 — 17.38	11	16.11	24.13
8. 17.39 — 19.90	11	18.67	17.32
9. 19.91 — 23.96	10	21.70	19.03
10. 23.97 — 69.86	16	34.18	22.93
all exp. levels	105	15.51	17.22

It was then necessary to compare the consumption patterns in the different occupation groups. The simple way was plotting the total expenditure along the X-scale and the consumption of the particular commodity along the Y-scale for each occupation and then judge the consumption patterns from the graphs. These curves were merely slight variations of the Engel curves, where income instead of total expenditure was plotted along the X-scale. The per capita consumer expenditure is plotted along the X-scale and the per capita quantity of consumption of cereals along the Y-scale in the first graph on page 7.

From the graph it seems that upto the per capita expenditure of Rs. 15 per month, the patterns of consumption for the three occupations are rather similar. But afterwards the graphs seem to differ. For farmers and cultivators, the curve rises with increasing expenditure upto the level of the per capita expenditure of Rs. 20, and then bends a little and becomes more or less uniform afterwards. It indicates that the consumption of cereals rises with increasing expenditure upto the point of the expenditure of Rs. 20 per month and then the consumption drops down a bit, but after that the cereal consumption does not rise. For the agricultural

labourers, the trend is always upwards upto the maximum household per capita expenditure of nearly Rs. 27 per month. The consumption of cereals is rising with increasing expenditure in the case of agricultural labourers, and no 'saturation point' is reached as in the case of farmers and cultivators. For the other occupations, the curve rises upto the total per capita expenditure of Rs. 16 and then there is a fall and after that a slight rise. But for all practical purposes, the curve can be considered to be more or less steady after reaching the per capita expenditure of Rs. 16.

From the graph it is evident that the patterns of consumption of cereals are different for the three occupation groups from the per capita expenditure of Rs. 15 onwards. Thus even in the case of consumption of cereals, which is considered to be less variable than the consumption of any other commodity except perhaps salt, clear distinctions in the consumption pattern are found in the three occupations. But as already mentioned, these observations are based on a small sample, and further studies in this direction are necessary before fully substantiating the results. Nevertheless, broad indications are there that there is difference in consumption from one occupation to another.

The curves in the first graph on page 7 show great fluctuations. To draw conclusions, it is always desirable to have the curves smoothed by some smoothing process. Accordingly smoothing was done by the method of moving averages, taking the number of periods or class-intervals as three. It would have been better if the number of class-intervals for purposes of smoothing could have been increased, but the total number of points being very few—only ten, it was not possible to increase the number of class-intervals for the smoothing process. The moving averages of per capita consumer expenditure and quantities of consumption of five commodities for the three different occupations are given in Table (3). In column (1) is given the average per capita consumer expenditure, and in columns (2) to (6) are shown average per capita quantities of consumption of five commodities.

In Table (3), a cross mark has been given for the consumption of milk against the average expenditure of Rs. 18.84 for the occupation group 'others'. This is because the entries for milk in this particular group have been found to be defective.

The second graph on page 7 gives the smoothed curve for the quantity of consumption of cereals based on the moving averages. Though the smoothing has not been quite satisfactory, yet many of the irregularities have disappeared, and clear distinctions are found among the consumption patterns of the three occupation groups.

The consumption curve for the quantity of consumption of milk is also shown in page 7. The consumption habits for the three occupations are found to be quite distinctly different. The consumption of milk for the agricultural labourers is found to be the least when compared with the consumption of the other two occupation groups. Farmers and cultivators consume more milk than the persons deriving

their livelihood from other occupations excepting agricultural labourers in almost all the expenditure classes excepting perhaps in the expenditure class Rs. 12 to Rs. 14, where the persons in the other occupations are seen to consume more milk than the farmers and cultivators.

TABLE (3): PER CAPITA QUANTITY OF CONSUMPTION OF SOME SPECIFIED COMMODITIES FOR DIFFERENT AVERAGE HOUSEHOLD PER CAPITA CONSUMER EXPENDITURES FOR A PERIOD OF 30 DAYS IN DIFFERENT OCCUPATION GROUPS (SMOOTHING DONE BY 3-PERIOD MOVING AVERAGES)

State: Uttar Pradesh (rural)

	average per capita consumer expenditure in Rs.	per capita quantity of consumption in seers				
		cereals	milk	sugar	gur	mustard oil
	(1)	(2)	(3)	(4)	(5)	(6)
		(i) farmers and cultivators				
1.	10.17	15.34	0.80	0.03	0.59	0.14
2.	12.29	16.73	1.15	0.06	0.77	0.17
3.	14.33	17.52	1.51	0.09	0.80	0.22
4.	16.20	20.41	2.36	0.14	1.42	0.25
5.	18.17	23.05	2.93	0.14	1.66	0.26
6.	20.60	23.32	3.63	0.14	2.23	0.26
7.	24.01	22.89	3.99	0.18	1.86	0.29
8.	33.49	22.74	5.31	0.29	1.98	0.32
total	19.74	19.95	2.81	0.15	1.34	0.24
		(ii) agricultural labourers				
1.	6.13	8.76	0.37	—	0.26	0.08
2.	7.84	11.35	0.48	0.03	0.37	0.12
3.	9.10	12.92	0.19	0.06	0.46	0.17
4.	10.07	15.79	0.47	0.08	0.44	0.16
5.	11.13	17.40	0.40	0.07	0.49	0.17
6.	12.39	19.01	0.79	0.04	0.60	0.12
7.	14.31	19.08	0.67	0.10	0.68	0.17
8.	20.40	22.89	2.00	0.10	0.63	0.22
total	12.33	16.17	0.90	0.06	0.52	0.16
		(iii) others				
1.	8.67	12.93	0.20	0.06	0.60	0.10
2.	10.84	15.20	0.90	0.07	0.89	0.10
3.	12.36	15.83	1.65	0.07	0.92	0.13
4.	13.65	17.08	1.75	0.11	1.13	0.14
5.	14.69	19.56	1.48	0.14	1.34	0.17
6.	16.51	19.66	1.57	0.17	1.32	0.17
7.	18.84	20.06	×	0.14	0.96	0.17
8.	24.49	19.63	2.70	0.21	0.75	0.20
total	15.51	17.22	1.52	0.13	0.91	0.15

The consumption curve for sugar is given in page 8. It is seen from the curve that in the lower expenditure levels farmers and cultivators consume less sugar than the persons deriving their livelihood from other sources. Even the agricultural labourers in the lower expenditure groups consume sugar in greater quantities than

the farmers and cultivators. Persons pursuing other occupations are found to consume sugar more than the persons in the other two occupation groups, Here also it is found that even for the same total per capita expenditure, the consumption patterns are different for the different occupations.

The curve showing consumption for gur is given in page 7. That gur is consumed least by the agricultural labourers in almost all the expenditure levels is evident from the graph. There is a peculiarity in the consumption pattern of the occupation group 'others'. Upto a point of about Rs. 15 per capita monthly expenditure, the quantity of consumption gradually rises—in this range the consumption is more than that of any other group—and then gradually falls down. The shape of the distribution is that of an inverse U. The consumption in the case of farmers and cultivators rises upto an expenditure of a little over Rs. 20 and then falls down a little. Here also even for the same expenditure levels, consumption is different in different occupations.

In page 8 the consumption curve for mustard oil is drawn. Farmers and cultivators in most of the expenditure levels consume more than the persons in any other occupation group, and the persons earning their livelihood from other occupations the least. The consumption for the agricultural labourers can be considered to be between the consumption for the two other occupations. There is comparatively a steep rise in the lower expenditure levels and then a slight drop, and after that again a rise.

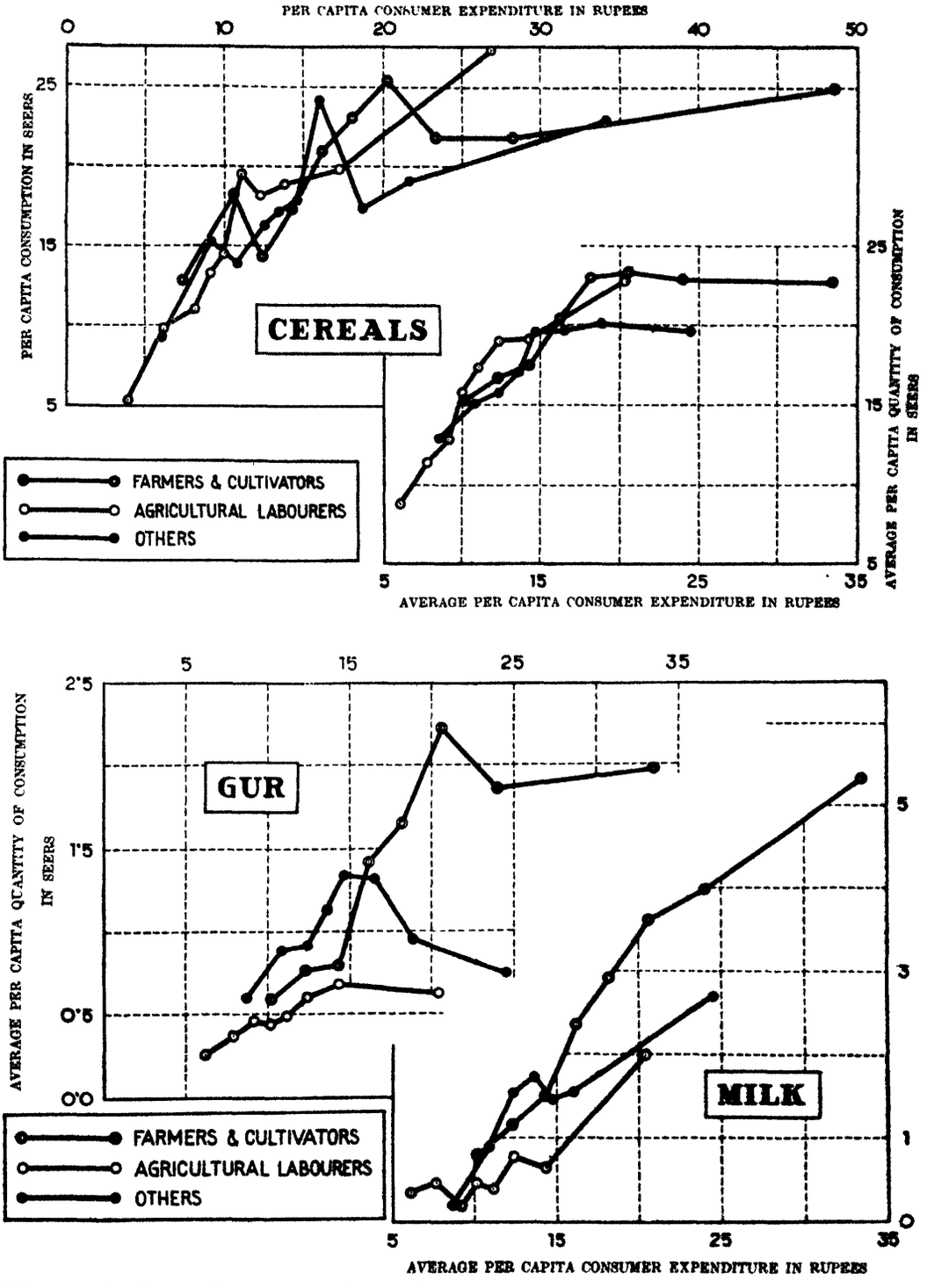
In all the above cases one thing becomes clear that merely the total consumer expenditure cannot explain away the differences in the consumption habits among the persons in the different occupations. Households with the same per capita expenditure but belonging to different occupation groups will not necessarily have the same consumption habits. It is found different occupation groups display different consumption patterns though belonging to the same consumer expenditure group. Hence mere economic grouping will not be sufficient for purposes of forecasting consumption. In fact, it will be definitely faulty, if there is a shift of population from one occupation to another, which is bound to happen due to planning considering the needs of the various sectors.

But, as already mentioned, the results given in this paper are indicative rather than definitive. Further studies are necessary in this direction to ascertain the exact nature of the consumption patterns. Moreover, the consumption patterns of only five commodities have been studied in the paper. For the rest of the commodities also, occupation-wise consumption patterns should be studied. Further, the results cover only the rural area of a particular state, and similar studies in other regions and for urban areas may reveal more interesting features.

ACKNOWLEDGEMENTS

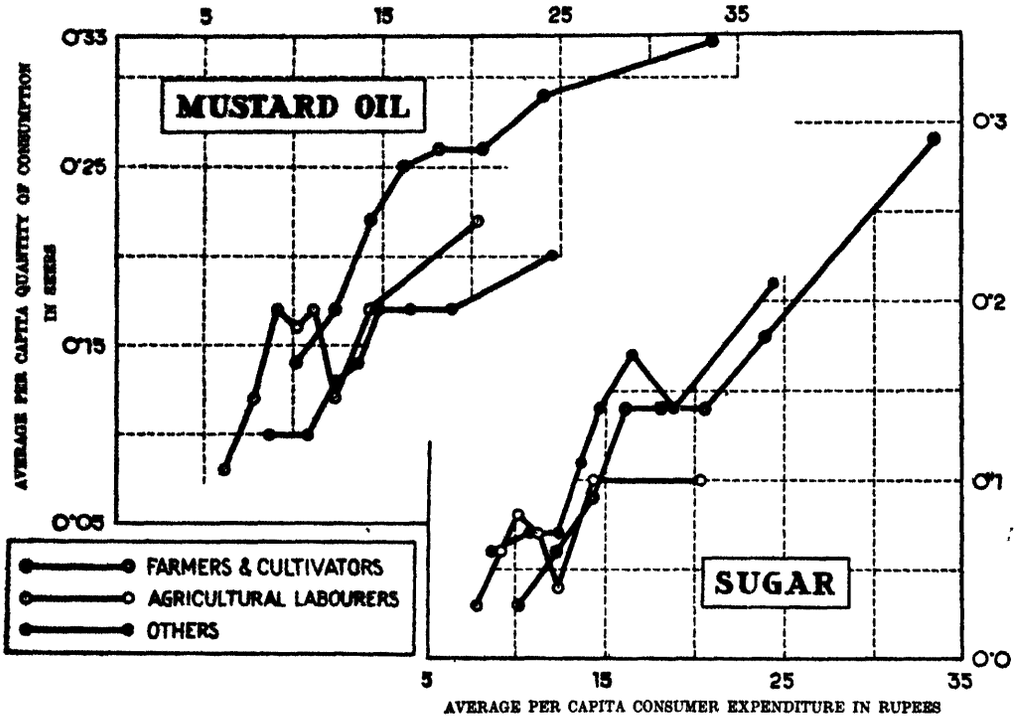
I am particularly thankful to the computing staff of the NSS Section, especially to Shri Shyam Bose and Shri Sukomal Das, for the work they had done in the preparation of the tables and graphs included in this paper.

QUANTITY AND VALUE OF CONSUMPTION OF CEREALS, GUR AND MILK BY LEVELS OF PER CAPITA CONSUMEP EXPENDITURE FOR DIFFERENT CLASSES OF RURAL POPULATION*



* Notes on the Figures: Source: NSS 7th Round (November 1953 to March 1954), Uttar Pradesh, Rural
Smoothing done by the Method of Moving Average

QUANTITY AND VALUE OF CONSUMPTION OF MUSTARD OIL AND SUGAR BY LEVELS OF PER CAPITA CONSUMER EXPENDITURE FOR DIFFERENT CLASSES OF RURAL POPULATION*



* Notes on the Figures: Source: NSS 7th Round (November 1953 to March 1954), Uttar Pradesh, Rural
Smoothing done by the Method of Moving Average

PRELIMINARY ESTIMATES OF RELATIVE INCREASE IN CONSUMER DEMAND IN RURAL AND URBAN INDIA

By J. ROY AND R. G. LAHA

THE PROBLEM OF ESTIMATING INCREASE IN CONSUMER DEMAND

Any planned programme of governmental investment is expected to raise the real income of individuals. This, in turn, will increase consumer demand for different commodities and unless provision is made for meeting, at least partially, this increased demand, prices may rise and cause serious difficulties. Estimates of expected increase in expenditure on different items of expenditure are, therefore, very useful to the planner.

If the relationship (R) between the average expenditure per household on a particular item and the income of the household is known then given any postulated future pattern of distribution of income, and assuming that the above relationship remains invariant, the expected expenditure on any particular item, may be obtained by a rather straightforward but very laborious method of computation. However, if the relationship (R) is linear in double logarithmic scale and if the increase in overall expenditure is assumed to be the same for all households, the percentage increase in expenditure on different items may be computed very easily.

ESTIMATES BASED ON THE NATIONAL SAMPLE SURVEY (NSS) MATERIAL

Here we present separately for urban and rural India a set of estimates of the percentage increase in average expenditure per household on different items when the overall percentage increase in expenditure is given under the simplifying assumptions discussed above. Overall household expenditure was taken because statistics of household income were not available. The relationship between the average expenditure per household on a particular item and the average overall expenditure was built up from the material collected by the NSS in the 4th round from April to September 1952. The relationship (R) was found to be approximately linear in the double logarithmic scale for most of the items of expenditure. The relative increase in the average expenditure per household on each item for unit relative increase in overall household expenditure was obtained graphically. If this coefficient is ϵ for a particular item and the overall household expenditure increases by 100α percent the increase in average expenditure per household on the particular item will be $100\{(1+\alpha)^{\epsilon}-1\}$ per cent.

The estimates obtained in this way and presented here are very rough, based as they are on so many restrictive assumptions. Graphical methods of estimation were used, because there is no point in trying to be very accurate in the method of

estimation when what we have to estimate is not very precisely defined. However, it is hoped that they may not be inadequate for the purpose for which they are presented.

To examine how the results are affected if the relationship (R) in the double logarithmic scale is approximated by separate lines over different ranges of overall expenditures, another set of estimates for the percentage increase in expenditure on food grains, salt and silk clothing in rural India were obtained by this second method. The agreement is quite good when the increase in overall expenditure is not very large.

Some methodological comments

It will be seen that the only unknown parameter occurring in the expression for the percentage increase in the expenditure on a particular item is the coefficient ϵ for that item. This coefficient ϵ is roughly equivalent to Engel's coefficient of elasticity. The value of this coefficient for different items covering separately the whole of rural and urban India could be estimated only from the material collected by the NSS.

The tabulated material gave the average expenditure per household on an item and the average overall expenditure per household for different groupings of households by monthly overall household expenditure level. The class-intervals were, however, rather wide for our purposes. For every group the average expenditure on an item was plotted against the average overall expenditure for the particular group on double logarithmic paper and a straight line was fitted by eye to the points plotted. The slope of this line was taken as an estimate of the coefficient ϵ for the particular item.

This graphical method should be quite good if the groupings are not wide, but certain difficulties arise because of the coarseness of the grouping in the present material used. (From the convexity of the assumed relationship (R) it follows that the average expenditure on an item by a group is a biased estimate of the average expenditure on the item by all household having overall expenditure equal to the average overall expenditure of the group, it is consistently an over estimate for all items with $\epsilon > 1$ and an underestimate for all items with $\epsilon < 1$.) However, we are interested only in the slope of the curve and an unbiased estimate of the slope can be obtained, if in the logarithmic scale the groups are of equal width and if the distribution of overall expenditure is of the Pareto type. Since these assumptions approximately hold for our material, the estimates of ϵ may not be wide off the mark, though an estimate of the demand function by this method is likely to be biased.

This suggests that in the absence of detailed information about the pattern of distribution of overall household expenditure, classification of households by expenditure, classification of households by expenditure level should be in groups that are of equal width in the logarithmic scale.

RELATIVE INCREASE IN CONSUMER DEMAND IN RURAL AND URBAN INDIA

Estimates on the assumption of diminished concentration of income

The assumption that the increase in income (or overall expenditure) will be same for all households may not, however, appeal to all. The alternative assumption may be that the increase in income (or overall expenditure) will be higher for the poor than for the already rich, so that the concentration curve for income (or overall expenditure) will be closer to the egalitarian line than before. This suggestion was made by Professor P. C. Mahalanobis.

As the required statistics are not available we restrict ourselves to the case when the distribution of income (or overall expenditure) per household is of the Pareto type and the relationship (R) is linear in the double logarithmic scale and is invariant. Under the further restriction that the altered distribution will remain Paretoan, it is possible to compute the percentage increase in expenditure on a particular item for a given percentage rise in average income (or overall expenditure) affected in such a way as to diminish the concentration by a certain fixed percentage. Because of the highly restrictive nature of the assumptions, the results are mainly of academic interest but a comparison with Tables (1) and (2) may be instructive. The Tables have been constructed, by taking the Pareto constant as 2.0 which gives a rough fit to the distribution of household overall expenditure for both rural and urban India. The computations are based on the assumption that concentration will be reduced by 10 percent and 20 percent.

Derivation of the formulae used

For a household, let x denote the overall expenditure and y the expenditure on a particular item. Let the marginal probability density function of x be denoted by $g(x)$ and let $\psi(x) = E(y/x)$ stand for the conditional expectation of y for a given value of x. Suppose that planned investment alters the marginal probability density function of x to $g^*(x)$. Then under the assumption that the functional form of ψ remains invariant, the percentage increase in average expenditure per household on the item is given by

$$I = 100\left\{ \int_0^\infty \psi(x)g^*(x)dx - \int_0^\infty \psi(x)\, g(x)dx \right\} \Big/ \int_0^\infty \psi(x)g(x)dx \qquad \ldots \quad (1)$$

Let us suppose that every household increases its overall expenditure by 100α percent. This implies that $g^*(x) = g(x/(1+\alpha))/(1+\alpha)$. Under the further assumption that $\psi(x) = A_0x^\epsilon$ (1) reduces to

$$I = 100\{(1+\alpha)^\epsilon - 1\} \qquad \ldots \quad (2)$$

On the other hand if in addition to the assumption that $\psi(x) = Ax^\epsilon$ we assume further that the distribution of x is Paretoan and remains so even afterwards,

with the parameters so changing that average overall household expenditure increases by 100α percent and the concentration index decreases by 100β percent, we have,

$$g(x) = \nu c^{\nu} x^{-(\nu+1)} \quad \text{for} \quad x \geqq c$$
$$= 0 \text{ otherwise}$$

$$g^*(x) = \nu^* c^{*\nu^*} x^{-(\nu^*+1)} \text{ for } x \geqslant c^*$$

$$= 0 \text{ otherwise, so that the}$$

condition of a 100α percent increase in average expenditure gives

$$\nu^* c^*/(\nu^*-1) = (1+\alpha)\nu c/(\nu-1) \quad \ldots \quad (3)$$

and the condition of 100β percent decrease in the index of concentration gives :

$$(1-\beta)/(2\nu-1) = 1/(2\nu^*-1) \quad \ldots \quad (4)$$

Then (1) reduces to

$$I = 100\{(c^*/c)^{\epsilon}(1-\epsilon/\nu)/(1-\epsilon/\nu^*)-1\} \quad \ldots \quad (5)$$

where c^* and ν^* are given by (3) and (4).

TABLE (1) : PROJECTION OF CONSUMPTION — ALL INDIA (RURAL)

Based on data collected by the National Sample Survey, 4th round April—September 1952

sl. no.	items of expendiure	elasti-city	percentage increase in average expenditure per household on item when the percentage increase in average overall expenditure per household is												
			5%	10%	15%	20%	25%	30%	40%	50%	60%	70%	80%	90%	100%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1.	food grains	0.750	3.7	7.4	11.0	14.6	18.2	21.8	28.7	35.5	42.3	48.2	55.4	61.9	68.2
2.	pulses	0.757	3.8	7.5	11.Z	14.8	18.4	22.0	29.0	35.9	42.7	49.4	56.2	62.6	69.0
3.	edible oil	0.904	4.5	9.0	13.5	17.9	22.4	26.8	35.6	44.3	52.9	61.6	70.1	78.6	87.1
4.	vegetables	0.897	4.5	8.9	13.4	17.8	22.1	26.5	35.2	43.9	52.4	61.0	69.4	77.8	86.2
5.	milk and milk products	1.368	6.9	13.9	21.1	28.3	35.7	43.2	58.4	74.1	90.2	106.7	123.5	140.6	158.1
6.	meat, egg, fish	0.897	4.5	8.9	13.4	17.8	22.1	26.5	35.2	43.9	52.4	61.0	69.4	77.8	86.2
7.	fruits	0.971	4.9	9.7	14.5	19.4	24.2	29.0	38.6	48.2	57.8	67.0	77.0	86.5	96.0
8.	refreshments	0.912	4.6	9.1	13.6	18.1	22.6	27.0	35.9	44.7	53.5	62.2	70.9	79.6	83.2
9.	salt	0.551	2.7	5.4	8.0	10.6	13.1	15.6	20.4	25.0	29.6	34.0	38.2	42.4	45.5
10.	spices	0.669	3.3	6.6	9.8	13.0	16.1	19.2	25.2	31.2	36.9	42.6	48.2	53.6	59.0
11.	sugar	1.081	5.4	10.8	16.3	21.8	27.3	32.8	43.9	55.0	66.2	77.5	88.8	100.1	111.6
12.	pan (betel leaves)	0.890	4.4	8.9	13.2	17.6	22.0	26.3	34.9	43.4	51.9	60.3	68.7	77.0	85.3
13.	tobacco	0.882	4.4	8.8	13.1	17.4	21.8	26.0	34.6	43.0	51.4	59.7	67.9	76.1	84.3
14.	intoxicants	1.113	5.6	11.2	16.9	22.6	28.3	34.1	45.8	57.4	69.1	81.0	92.9	105.0	117.0
15.	fuel and light	0.669	3.3	6.6	9.8	13.0	16.1	19.2	25.2	31.2	36.9	42.6	48.2	53.6	59.0
16.	clothing : cotton	0.801	4.0	7.9	11.8	15.7	19.6	23.4	30.9	38.4	45.7	52.9	60.1	67.2	74.2
17.	clothing : silk	2.029	10.4	21.3	32.8	44.8	57.3	70.3	97.9	127.7	159.5	193.5	229.6	267.8	308.1
18.	clothing : woollen	1.809	9.2	18.8	28.8	39.1	49.7	60.7	83.8	108.2	134.0	161.1	189.6	219.3	250.4
19.	bedding	1.309	6.6	13.3	20.1	27.0	33.9	41.0	55.3	70.0	85.0	100.3	115.8	131.7	147.8
20.	amusements	1.338	6.8	13.6	20.6	27.6	34.8	42.0	56.9	72.0	87.5	103.4	119.6	136.0	152.8
21.	education	1.824	9.3	19.0	29.0	39.4	50.2	61.4	84.7	109.5	135.7	163.2	192.1	222.4	254.1
22.	medicine	1.529	7.8	15.7	23.8	32.2	40.7	49.4	67.3	85.9	105.2	125.1	145.6	166.8	188.6
23.	toilet	0.904	4.5	9.0	13.5	17.9	22.3	26.8	35.6	44.3	52.9	61.6	70.1	78.6	87.1
24.	petty articles	0.971	4.8	9.7	14.5	19.4	24.2	29.0	38.6	48.2	57.8	67.4	77.0	86.5	96.0
25.	conveyance	1.243	6.2	12.6	19.0	24.5	32.0	38.6	51.9	65.5	79.4	93.0	107.6	122.1	136.7
26.	services	1.721	8.8	17.8	27.2	36.9	46.8	57.1	78.4	100.9	124.5	149.2	175.0	201.8	229.7
27.	furniture	1.507	7.6	15.4	23.4	31.6	40.0	48.5	66.0	84.2	103.0	122.5	142.5	163.1	184.2
28.	sundry equipments	1.926	9.8	20.1	30.9	42.1	53.7	65.8	91.2	118.3	147.2	177.9	210.2	244.2	280.0
29.	musical instruments	0.809	4.0	8.0	12.0	15.9	19.8	23.6	31.3	38.8	46.3	53.6	60.9	68.1	75.2
30.	ornaments	2.044	10.5	21.5	33.1	45.2	57.8	71.0	98.9	129.0	161.4	195.8	232.5	271.3	312.4
31.	foot wear	1.132	5.7	11.4	17.1	22.9	28.7	34.6	46.4	58.2	70.2	82.3	94.5	106.8	119.2
32.	utensils	1.037	5.2	10.4	15.6	20.8	26.0	31.3	41.8	52.3	62.8	73.4	84.0	94.6	105.2
33.	ceremonials	1.500	7.6	15.4	23.3	31.5	39.8	48.2	65.7	83.7	102.4	121.7	141.5	161.9	182.8
34.	rent	1.309	6.6	13.3	20.1	27.0	33.9	41.0	55.3	70.0	85.0	100.3	115.8	131.7	147.8
35.	taxes	1.294	6.5	13.1	19.8	26.6	33.5	40.4	54.6	69.0	83.7	98.7	114.0	129.5	145.2

TABLE (2) : PROJECTION OF CONSUMPTION — ALL INDIA (URBAN)

Based on data collected by the National Sample Survey, 4th round April—September 1952

sl. no.	items of expenditure	elasti-city	percentage increase in average expenditure per household on item when the percentage increase in average overall expenditure per household is												
			5%	10%	15%	20%	25%	30%	40%	50%	60%	70%	80%	90%	100%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1.	food grains	0.522	2.6	5.1	7.5	10.0	12.3	14.6	19.2	23.5	27.8	31.9	35.9	39.8	43.6
2.	pulses	0.745	3.7	7.3	10.9	14.5	18.1	21.6	28.5	35.3	42.0	48.5	54.9	61.3	67.6
3.	edible oil	0.845	4.2	8.4	12.5	16.6	20.7	24.8	32.9	40.8	48.7	56.5	64.3	71.9	79.6
4.	vegetables	0.752	3.7	7.4	11.0	14.6	18.2	21.8	28.8	35.6	42.4	49.0	55.6	62.0	68.4
5.	milk and milk products	1.348	6.8	13.7	20.7	27.8	35.0	42.4	57.4	70.7	88.4	104.5	120.9	137.5	154.5
6.	meat, egg, fish	1.025	5.1	10.2	15.4	20.6	25.7	30.8	41.1	51.5	61.9	72.2	82.6	93.0	103.5
7.	fruits	1.492	7.5	15.3	23.2	31.3	39.5	48.0	65.2	83.1	101.6	120.7	140.3	160.5	181.2
8.	refreshments	0.875	4.3	8.7	13.0	17.3	21.5	25.8	34.2	42.6	50.8	59.0	67.2	75.3	83.4
9.	salt	0.478	2.3	4.6	6.9	9.1	11.2	13.3	17.4	21.4	25.2	28.8	32.4	35.9	39.2
10.	spices	0.621	3.0	6.1	9.0	12.0	14.8	17.7	23.2	28.6	33.9	39.0	43.0	48.9	53.7
11.	sugar	0.932	4.6	9.3	13.9	18.5	23.1	27.7	36.8	45.9	54.9	63.9	72.9	81.8	90.7
12.	pan (betel leaves)	0.696	3.4	S6.8	10.2	13.5	16.7	20.0	26.3	32.6	38.7	44.6	50.52	56.3	62.0
13.	tobacco	0.770	3.8	7.6	11.3	15.0	18.7	22.3	29.5	36.6	43.6	50.4	57.0	63.9	70.5
14.	intoxicants	1.180	5.9	11.9	17.9	24.0	30.1	36.2	48.7	61.3	74.1	87.0	100.8	113.2	126.5
15.	fuel and light	0.733	3.6	7.2	10.8	14.2	17.7	21.2	27.9	34.6	41.1	47.5	53.8	60.0	66.2
16.	clothing : cotton	0.894	4.4	8.9	13.3	17.6	22.0	26.4	35.0	43.6	52.2	60.7	69.1	77.5	85.8
17.	clothing : silk	2.075	10.6	21.8	33.6	45.9	58.9	72.3	101.0	131.9	165.1	200.7	238.6	278.8	321.3
18.	clohting : woollen	1.826	9.3	19.0	29.0	39.5	50.3	61.4	84.8	109.6	135.9	163.5	192.5	222.8	254.6
19.	bedding	1.273	6.4	12.9	19.5	26.1	32.6	39.6	53.5	67.6	81.9	96.5	111.4	126.4	141.7
20.	amusements	1.236	6.2	12.5	18.9	25.3	31.8	38.3	51.6	56.0	78.8	92.7	106.8	121.1	135.6
21.	education	1.627	8.3	16.8	25.6	34.5	43.8	53.2	72.9	93.4	114.8	137.1	160.2	184.1	208.9
22.	medicine	1.516	7.7	15.5	23.6	31.8	40.2	48.8	66.5	84.9	103.9	123.6	143.8	164.6	186.0
23.	toilet	1.056	5.3	10.6	15.9	21.2	26.6	31.9	42.7	53.5	64.3	75.2	86.0	97.0	107.9
24.	petty articles	0.839	4.2	8.3	12.4	16.5	20.6	24.6	32.6	40.5	48.4	56.1	63.8	71.4	78.9
25.	conveyance	1.205	6.0	12.2	18.3	24.6	30.9	37.2	50.0	63.0	76.2	89.5	103.1	116.7	130.5
26.	services	1.441	7.3	14.7	22.3	30.0	36.8	46.0	62.4	79.4	96.8	114.8	133.2	152.2	171.5
27.	furniture	1.665	8.5	17.2	26.2	35.5	45.0	54.0	73.1	96.4	118.7	141.9	166.1	191.1	217.1
28.	sundry equipments	1.910	9.7	19.9	30.4	41.4	52.8	64.7	89.6	116.1	144.4	174.2	205.7	238.8	273.5
29.	musical insrtuments	2.000	10.3	21.0	32.3	44.0	56.2	69.0	96.0	25.0	156.0	189.0	224.0	261.0	300.0
30.	ornaments	2.248	11.6	23.9	36.9	50.7	65.2	80.4	113.1	148.4	187.7	229.7	274.8	323.3	375.0
31.	foot wear	1.087	5.4	10.9	16.4	21.9	27.4	33.0	44.2	55.4	66.7	78.0	89.5	100.9	112.4
32.	utensils	1.231	6.2	12.4	18.8	25.2	31.6	38.1	51.3	64.7	78.4	92.2	106.2	120.4	134.8
33.	ceremonials	1.491	7.6	15.3	23.2	31.3	39.5	47.9	65.2	83.1	101.5	120.6	140.2	160.4	181.1
34.	rent	1.155	5.8	11.6	17.5	23.5	29.4	35.4	47.5	59.7	72.1	84.6	97.2	109.9	122.7
35.	taxes	2.025	10.4	21.3	32.7	44.6	57.1	70.1	97.7	127.3	159.0	192.9	228.8	269.3	307.0

RELATIVE INCREASE IN CONSUMER DEMAND IN RURAL AND URBAN INDIA

TABLE (3) : PROJECTION OF CONSUMPTION ALL INDIA—RURAL and URBAN

GROUPS OF ITEMS WITH APPROXIMATE ELASTICITIES

	items of expenditure	
elasticity	rural	urban
0.55	(1) salt	(1) food grains
(.478—.551)		(2) salt
0.65	(1) spices	(1) spices
(.612—.696)	(2) fuel and light	(2) pan (betel leaves)
0.75	(1) food grains	(1) pulses
(.733—.770)	(2) pulses	(2) vegetables
		(3) tobacco
		(4) fuel and light
0.80	(1) clothing : cotton	(1) edible oil
(.801—.845)	(2) musical instruments	(2) petty articles
0.90	(1) edible oil	(1) refreshments
(.875—.932)	(2) vegetables	(2) sugar
	(3) meat, egg, fish	(3) clothing : cotton
	(4) refreshments	
	(5) pan (betel leaves)	
	(6) tobacco	
	(7) toilet	
1.00	(1) fruits	(1) meat, egg, fish
(.971—1.205)	(2) sugar	(2) intoxicants
	(3) intoxicants	(3) toilet
	(4) petty articles	(4) conveyance
	(5) utensils	(5) foot-wear
	(6) foot-wear	(6) rent
1.30	(1) milk and milk products	(1) milk and milk products
(1.231—1.368)	(2) bedding	(2) bedding
	(3) amusements	(3) amusements
	(4) conveyance	(4) utensils
	(5) rent	
	(6) taxes	
1.50	(1) medicine	(1) fruits
(1.441—1.721)	(2) services	(2) education
	(3) furniture	(3) medicine
	(4) ceremonials	(4) services
		(5) furniture
		(6) ceremonials

TABLE (4) : PROJECTION OF CONSUMPTION **ALL INDIA—RURAL and URBAN**

sl. no.	elasticity	percentage increase in average expenditure per household on item when concentration is reduced by 10 percent and increase in average overall expenditure per household is									
		10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	0.55	6.7	11.8	16.9	21.7	26.5	31.1	35.5	39.8	44.1	48.2
2	0.66	7.6	13.0	20.0	25.9	31.7	37.3	42.9	48.3	53.6	58.8
3	0.75	8.3	15.7	22.8	29.9	36.8	43.5	50.2	56.8	63.3	69.7
4	0.80	8.9	16.8	24.5	32.1	39.6	47.0	54.3	61.5	68.7	75.7
5	0.90	9.6	18.5	27.4	36.1	44.9	53.5	62.1	70.7	79.2	87.7
6	1.00	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
7	1.30	9.0	22.2	35.5	49.2	63.2	77.5	92.1	106.8	121.9	137.2
8	1.50	4.7	19.4	34.5	50.4	66.8	83.8	101.3	119.3	137.8	156.8

sl. no.	elasticity	percentage increase in average expenditure per household on item when concentration is reduced by 20 percent and increase in average overall expenditure per household is									
		10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1	0.55	7.7	13.0	18.1	23.0	27.8	32.5	36.9	41.3	45.6	49.7
2	0.65	8.7	15.1	21.3	27.2	33.1	38.8	44.3	49.8	55.1	60.4
3	0.75	9.5	16.9	24.1	31.3	38.2	45.1	51.8	58.5	65.0	71.5
4	0.80	9.8	17.7	25.5	33.2	40.7	48.2	55.5	62.9	70.0	77.2
5	0.90	10.1	19.0	28.0	36.6	45.6	54.3	62.9	71.5	80.0	88.5
6	1.00	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
7	1.30	5.9	18.6	31.6	44.9	58.5	72.4	86.5	100.9	115.5	130.4
8	1.50	2.5	11.2	25.3	40.1	55.3	71.1	87.4	104.2	121.4	139.1

TABLE (5): PROJECTION OF CONSUMPTION **ALL INDIA : RURAL**

estimates of percentage increase in expenditure on food-grains, salt and silk clothing in rural India

(obtained by linear interpolation in double logarithms)

items of expenditure	percentage increase in expenditure on the item when percentage increase in overall expenditure is		
	5 percent	25 percent	100 percent
1. food-grains	3.8	18.5	49.0
2. salt	3.2	16.1	48.4
3. silk clothing	6.2	56.2	300.0

SOME RESULTS IN CONSUMPTION STUDIES

By ASHOK RUDRA AND BINA ROY

INTRODUCTION

We are interested in consumption studies from two points of view. Firstly, we want to know for a number of items chosen for study, the factors that determine the level of their consumption in a household. This we want to do by classifying households in terms of regional, occupational, income, etc., differences and obtaining averages. We also want to know how these levels are affected by price changes.

Secondly, we are interested in obtaining statistical tools by which one may be able to make rough predictions about the total national demand for a given consumer commodity when prices and income distribution and its level change in specified ways.

To start with, we have to make a selection of commodities which will be studied in detail. How to make the selection? One may study demand for commodities from the point of view of their indirect tax yields; or of their necessity; or from the point of view of the effect on the national economy of price changes in them. In the following study we concentrate on items of essential consumption. In order to justify our selection of commodities we reproduce the following Table based on the family budgets collected in the 3rd round of National Sample Survey (NSS).

TABLE (1)

items	proportion of national consumption	characteristics essential/non-essential
group 1 *items*		
food grains	36.8	essential
other food	26.4	mostly essential
total food	63.2	
cotton and woollen textiles		
bedding and footwear	7.0	essential
fuel and light	6.5	essential
other household equipment	2.0	mostly essential
group 1 total	78.7	mostly essential
group 2 *items*		
intoxicants	3.3	non-essential
silken textile	.2	non-essential
amusements	.5	non-essential
ceremonials	6.0	non-essential
ornaments	1.3	non-essential
group 2 total	11.3	non-essential
group 3 *items*		
education and medicine	2.6	extremely essential
services	4.1	partly essential
conveyance	1.4	partly essential
lodging	1.5	extremely essential
tax	.4	
group 3 total	10.0	
total	100.0	

The commodities have been classified in three groups. The items in the first group are mostly 'essential'. It goes without saying that as far as members of the higher income group are concerned, more than necessary amount are consumed even of consumer items belonging to this group : but by and large, items belonging to this group are such that any price rise in these items is likely to hit the masses badly.

The items of consumption belonging to the second group are such that they are not essential, in the sense that any short supply in these items are not likely to hit the ordinary consumer badly. The items in the third group are distinguished from the first two groups by the common feature that though some of them are partly essential and some of them are extremely essential, consumption study regarding these items cannot be of direct help to the planner. Thus, education, health and housing are of such great importance to the community that the planner has to plan for them from considerations other than that of satisfying consumer demand. It may be possible to obtain statistical relations between the expenditure level and other characteristics of a household and its expenditure on these items, but such relations cannot be made the basis of a plan for the development of educational and health services or of slum clearance and housing schemes. Again the term 'services' cover items of expenditure in exchange of which services are obtained from workers in the capacity of domestic servants, cobblers, barbers, washermen, etc. This is a part of the national economy about which there is very little that the planner has to do, especially when his main preoccupation is the industrial development of the country. It is not suggested that these services are not important to the consumer. There is, however, hardly any chance of shortage in supply of these services, for there is a very large volume of underemployment amongst these workers. Even if in certain areas there is some rise in the prices of these services, the planner can scarcely be called upon to do anything about it, for price rise will simply mean a higher money income for the workers providing these services at the cost of the masses of consumers, a result which can hardly be grudged. The same remarks apply to conveyance in so far as it refers to decentralised small scale transport services.

Consumption patterns

We reproduce in this section a number of graphs which illustrate to some extent the nature of dependence of consumption habit in India on some of the more important environmental factors. We shall briefly explain how we propose to study this variation.

Though the ultimate unit to be reckoned with in a consumption study is the individual consumer, it is not possible for us to reach it, as our data consists of family budgets. Our utlimate unit, therefore, has to be the household. Average consumption per consumer of a particular commodity varies from household to household. The variation arises due to environmental differences distinguishing the different households. Pattern study involves the study of these factors that give rise to this variation. The factors that cause the largest amount of variation

are the differences in the standard of living (which can be variously and differently measured by the household income, household per capita income, household total monthly and yearly expenditure, household per capita total and monthly expenditure, etc.), in the size of the household, in the main source of income, in the geographical background, in the prices of the market at which the households make its purchases, etc. Apart from these there are, of course, innumerable minor factors that affect the individual households' individual tastes and preferences and cause variation. This variation can, however, be regarded as unsystematic in nature and treated as 'random' in the sense of the theory of probability.

Our approach in studying the effects of the different factors is to classify the households concerned into a number of groups according to some of the factors under consideration and then obtain average consumption per capita of the different commodities by the households of the different groups. The process of averaging gets rid of most of the so called 'random' variation from one household to the other and sharply brings out the systematic variation due to the factors under study. As the NSS does not give information as to the income of a household, we have as a matter of fact to replace it by the total monthly expenditure of the household. The total monthly expenditure alone is, however, not a good index of the prosperity level of a household; a better (though by no means completely satisfactory) index is the *per capita* monthly total expenditure of a household and it is this that we use. The graphs that follow have for abscissa x this index; as for the ordinate y we have the average per capita monthly consumption of the commodity by households whose monthly per capita total consumption is x.

There are separate graphs for rural and urban households and for the 4th, 6th and the 7th rounds. They enable us to study the variations as between different prosperity levels, as between rural and urban environments, and as between the different rounds. Variation between the different rounds arise chiefly due to price changes; while we are unable to make quantitative estimates of effects of price changes, the between-rounds comparison helps us to form certain qualitative ideas.

In drawing the graphs we proceed as follows : A class of households is first isolated, (e.g., all-India urban households); they are then further classified into a number of groups on the basis of per capita total monthly expenditure of each household. Thus the first group may be such that each household belonging to it has a per capita total monthly expenditure lying between Rs. 0 and 10; the second group will correspond to the interval Rs. 10 and 20; and so on. Two statistical estimates are then carried out; one, of the number of consumers in each group; and the other, of the amount consumed of a particular commodity by those consumers. If for the i-th group the estimates are N_i and C_i then $\frac{C_i}{N_i}$ is the quantity that is plotted against the midpoint of the interval in x corresponding to the ith group.

The first series of twelve graphs (page 21 to 22) are based all on the 6th round survey. The ordinate, i.e., the per capita monthly household consumption is measured in value in the first seven of them.

The first graph stands for all food taken together (food excludes pan, tobacco, etc.). The two curves for rural and urban households are very similar in appearance and are typical of demand curves for food. They slope up as x increases, but the slope falls off at the same time, i.e., while demand for food rises as the standard of living increases, the former does so at a comparatively lower rate than the latter. It is interesting to note that the curves do not reach any asymptotes. This conforms to the common knowledge that consumption of individual items of food may reach saturation in terms of quantity, but the total amount spent on food does not, because of the increasing diversification of the dining table menu.

What is really important to note is that the curve for rural consumers is everywhere above that for urban ones. Thus, consumers having the same standard of living spend more on food and less on non-food items if they happen to be in the countryside than in the urban sector; and this means that they actually consume more (in physical quantity) of food items and less of non-food items compared to their urban counterparts, for prices of most food articles are likely to be lower in the countryside than in urban areas. We shall see later on that this fact is of crucial importance to the planners' attitude towards 'urbanisation' or 'migration' from agricultural to non-agricultural occupations.

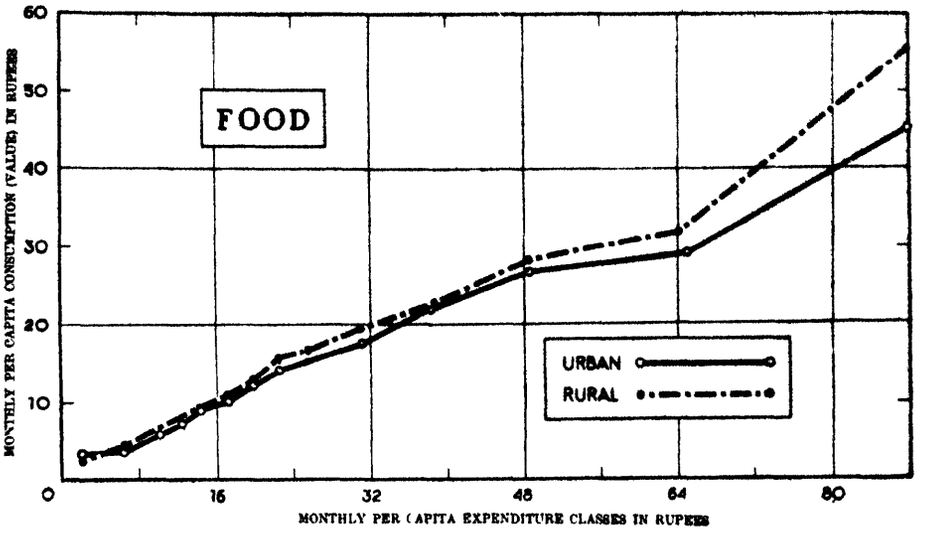
The same facts are revealed in a different way in the second graph on page 23; plotted against the mid-points of the per capita monthly total expenditure groups are the proportions of the total expenditure of each group that is spent on food. Here again, we find that the curves reveal a similar nature : the proportion spent on food is about 70 percent for the lowest income groups and it falls off from their level as income rises, steadily, though gently. The higher income groups spend about 50 percent to 60 percent on food.

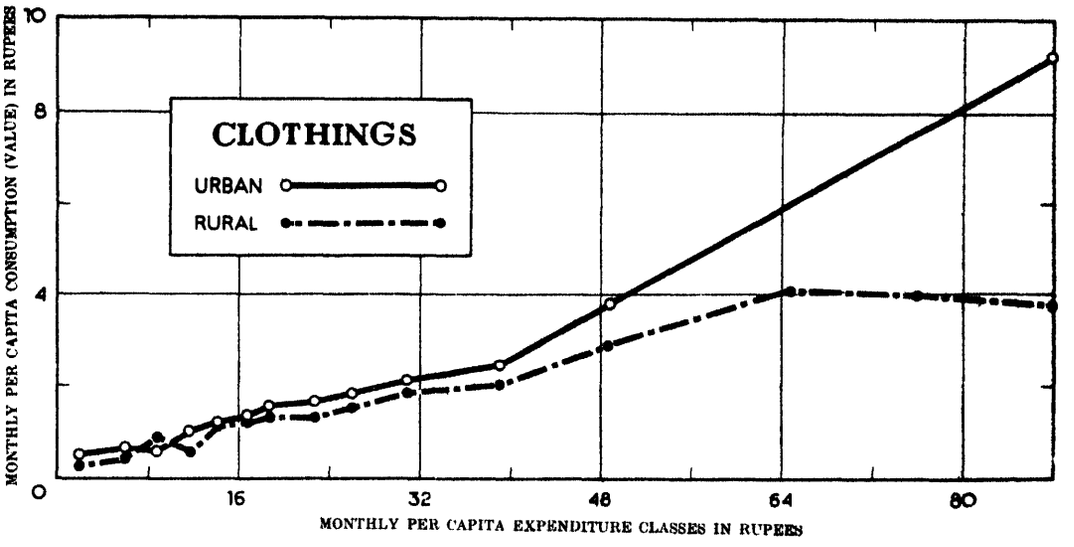
The next graph of importance is the second one on page 21, that for clothings. The curves are altogether at a very much lower level than the one for food, reflecting the fact that clothings (and for that matter any non-food consumer item) represent a very much smaller part of the average family budget than food. Two points deserve attention. Firstly, the nature of the two curves; while more or less alike between themselves, they are significantly different from the two curves for food. The demand curves of clothings are such that the slope *increases* as we move right along the x-axis; that is to say, demand for clothings rises at a proportionately greater rate than the standard of living.

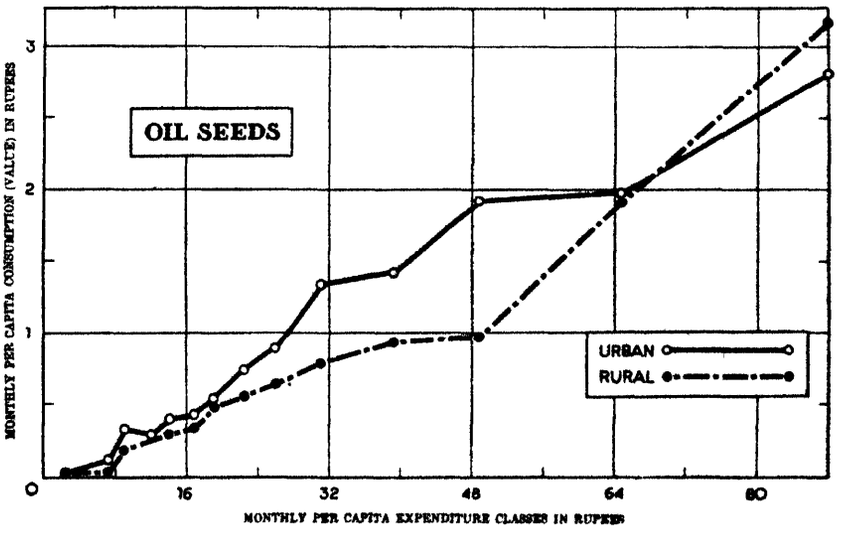
The second point to note is that the relation between the curves for urban consumers and for rural consumers is exactly the opposite to that in the case of food. The demand curve for urban consumers is everywhere above that of rural consumers.

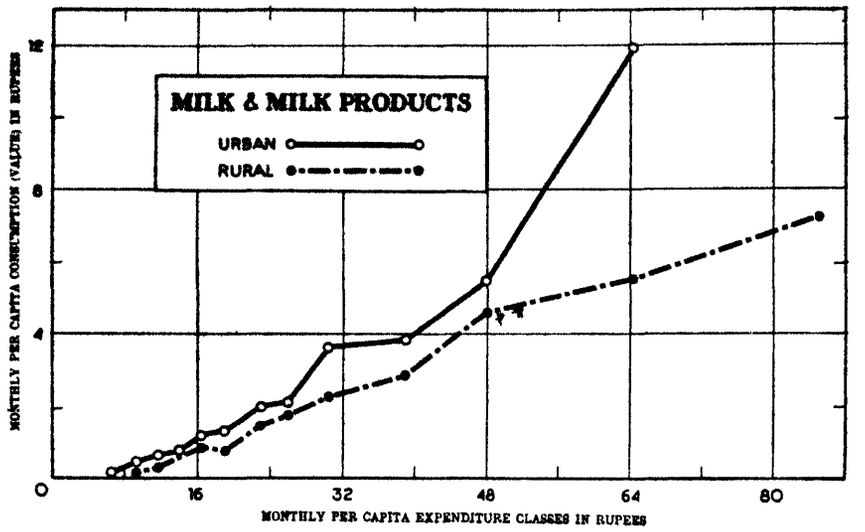
The remaining curves refer to different individual items of food : foodgrains, milk and milk products, meat and fish, fuel and light, and oil seeds. No other non-food items are considered, as there is no other single non-food item of consumption that occupies a significant place in average family budget.

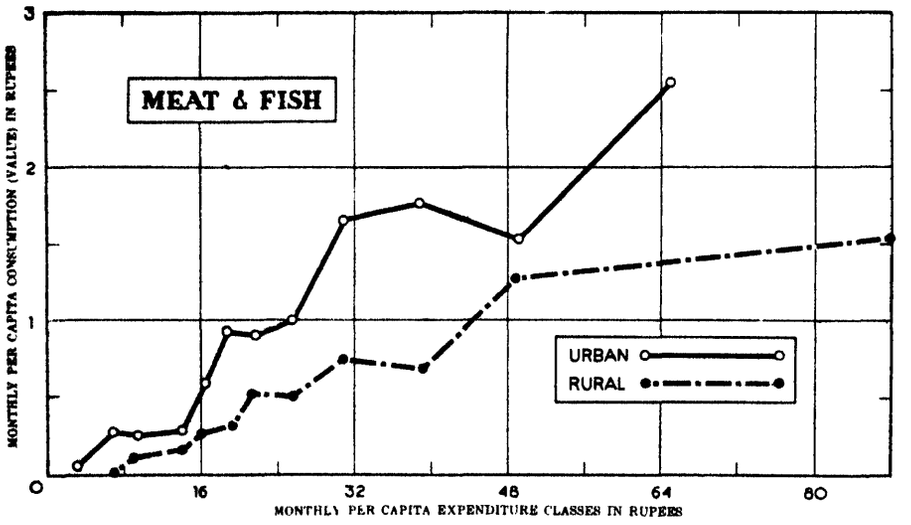
SOME RESULTS IN CONSUMPTION STUDIES

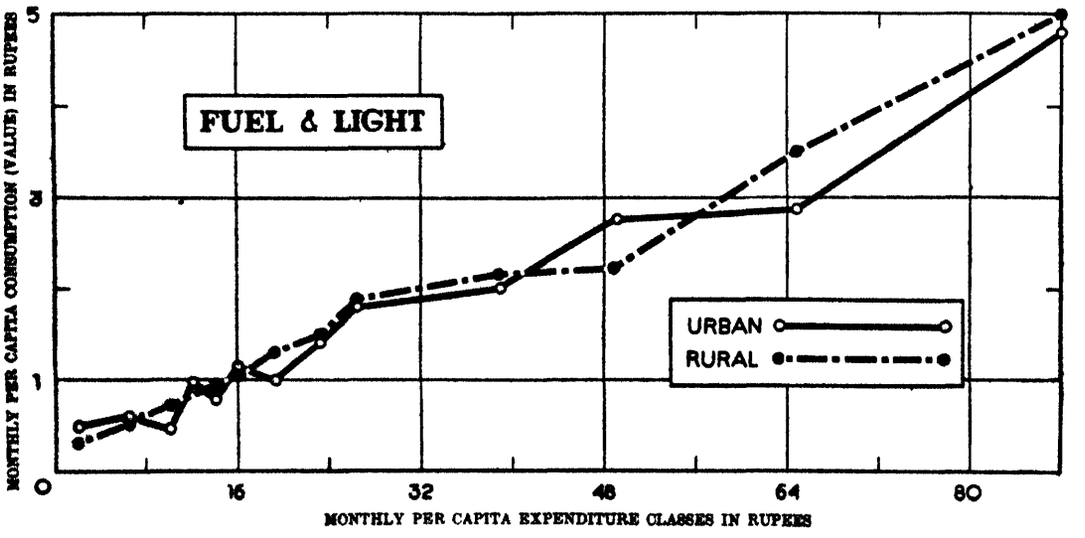




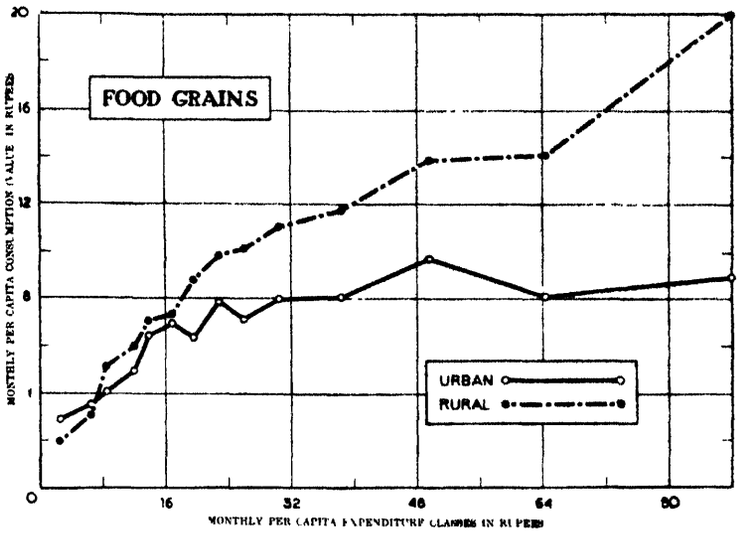


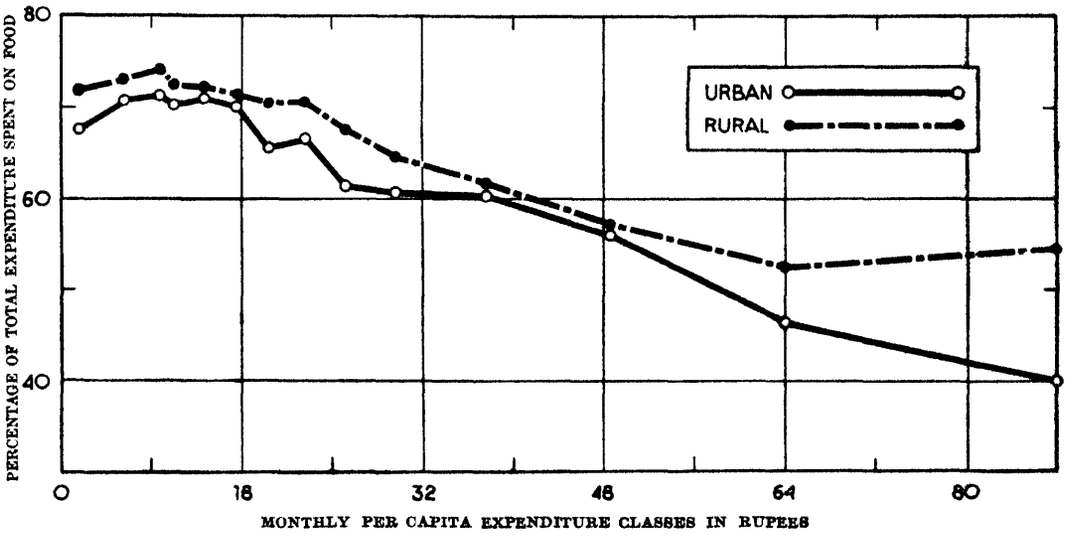

MILK & MILK PRODUCTS
URBAN
RURAL
MONTHLY PER CAPITA CONSUMPTION (VALUE) IN RUPEES
0
4
8
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

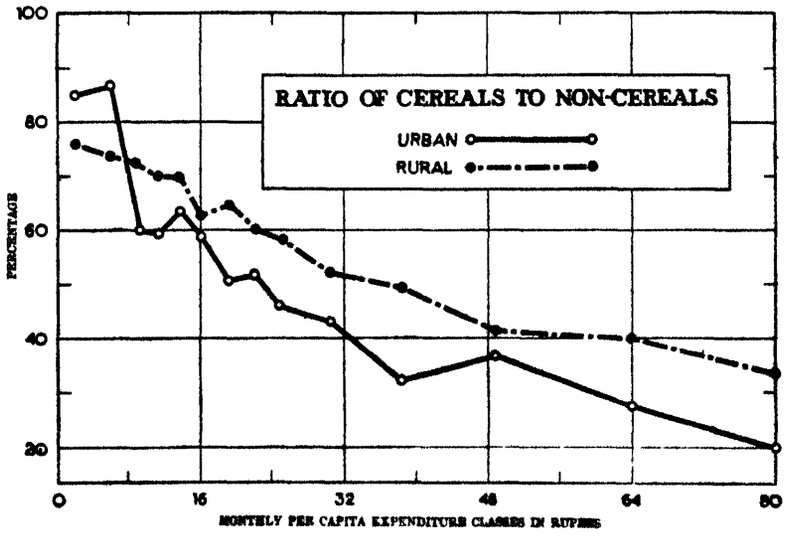

MEAT & FISH
URBAN
RURAL
MONTHLY PER CAPITA CONSUMPTION (VALUE) IN RUPEES
0
1
2
3
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

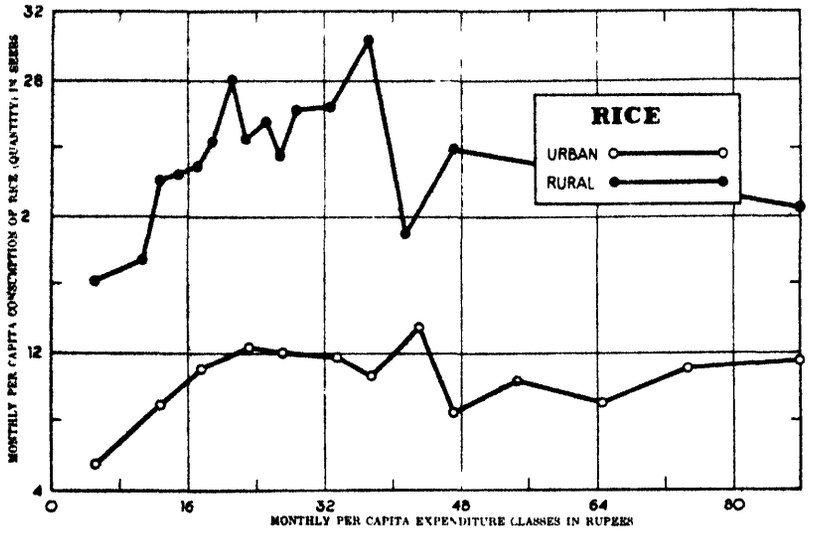

FUEL & LIGHT
URBAN
RURAL
MONTHLY PER CAPITA CONSUMPTION (VALUE) IN RUPEES
0
1
2
3
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

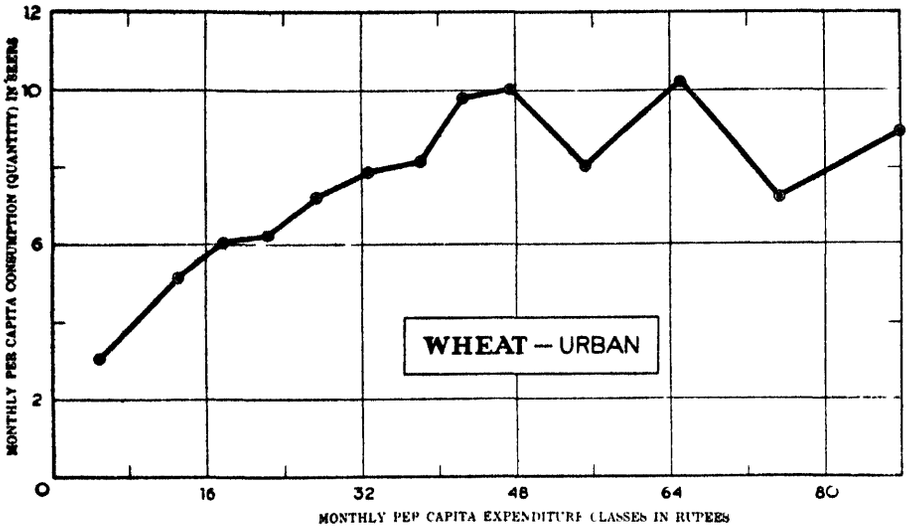
SOME RESULTS IN CONSUMPTION STUDIES

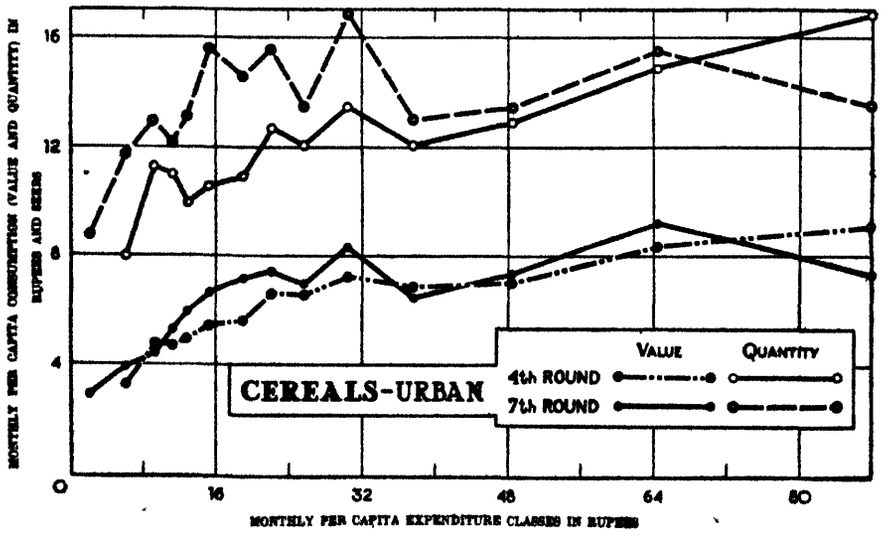




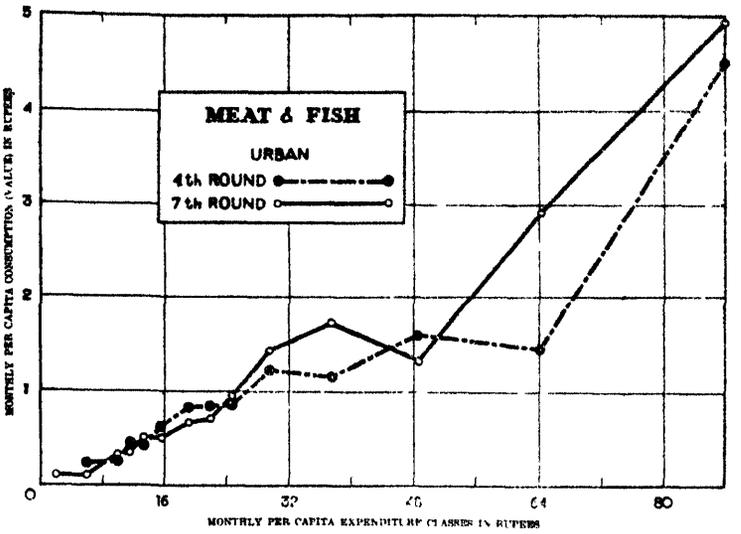


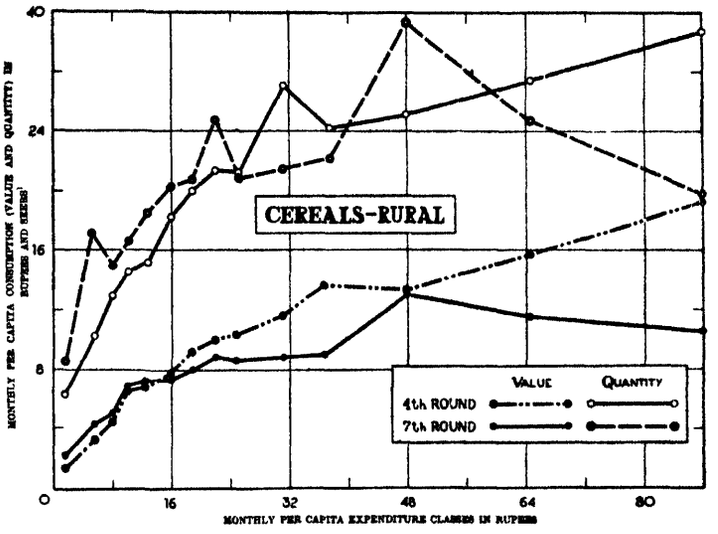

RICE
URBAN
RURAL
32
28
2
12
4
0
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

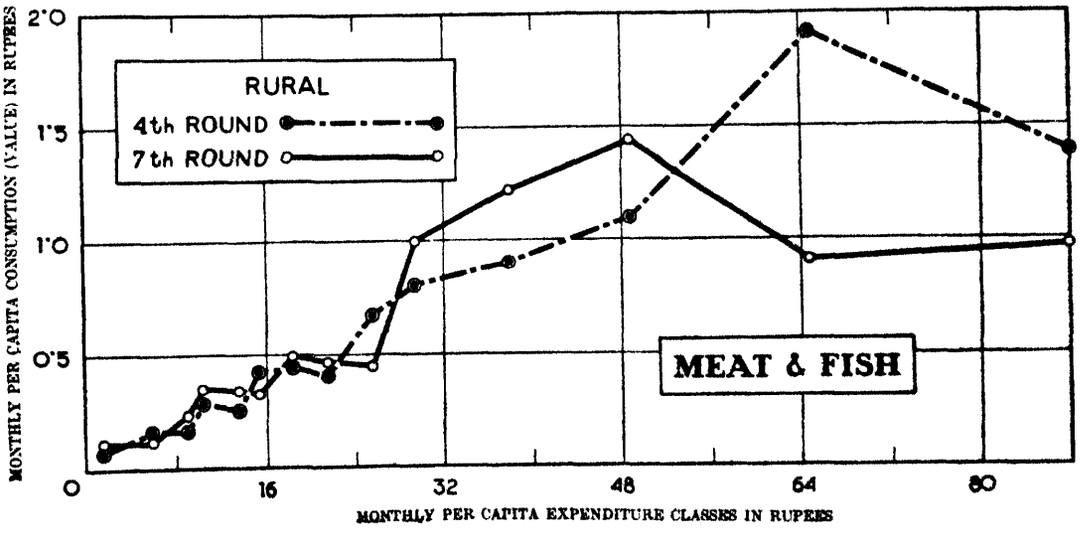

WHEAT — URBAN
12
10
6
2
0
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

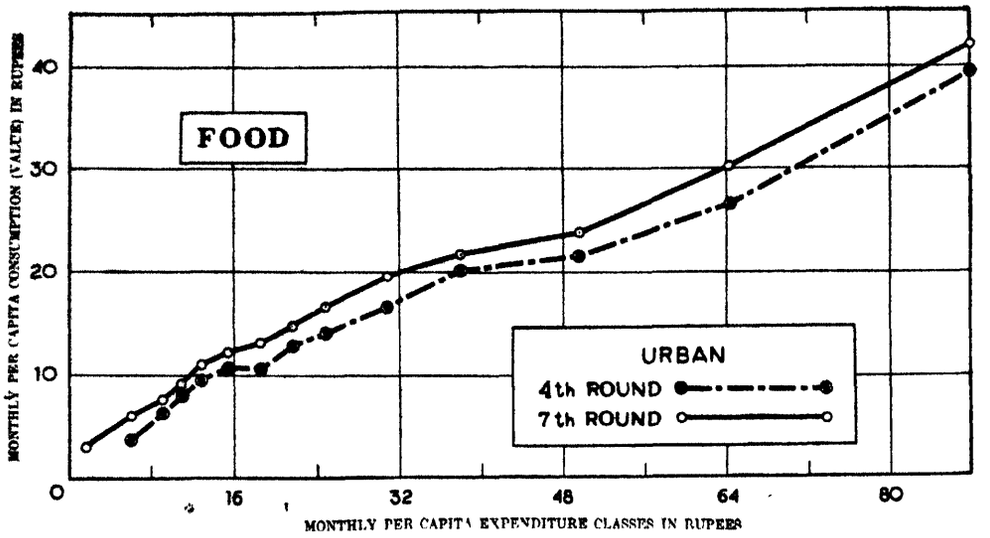

CEREALS-URBAN
VALUE
QUANTITY
4th ROUND
7th ROUND
16
12
8
4
0
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

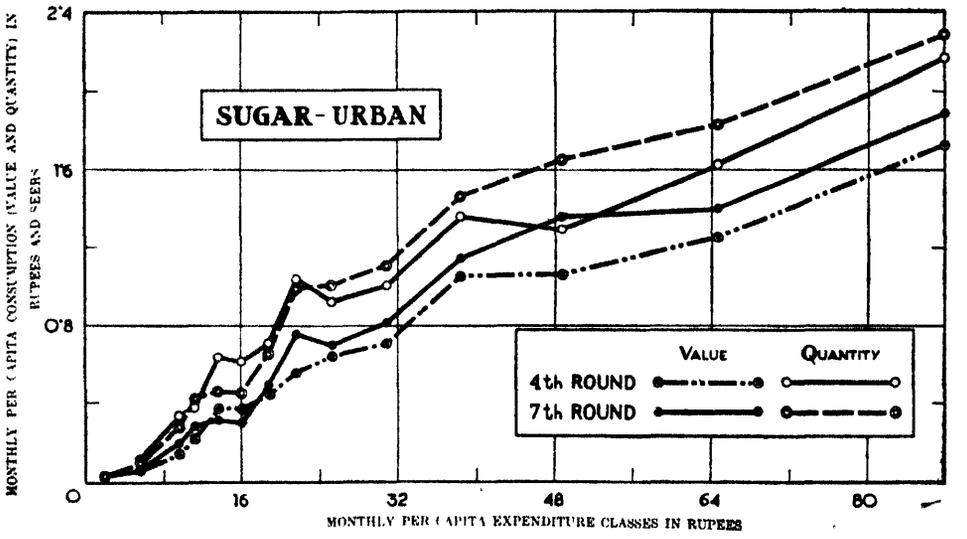
SOME RESULTS IN CONSUMPTION STUDIES

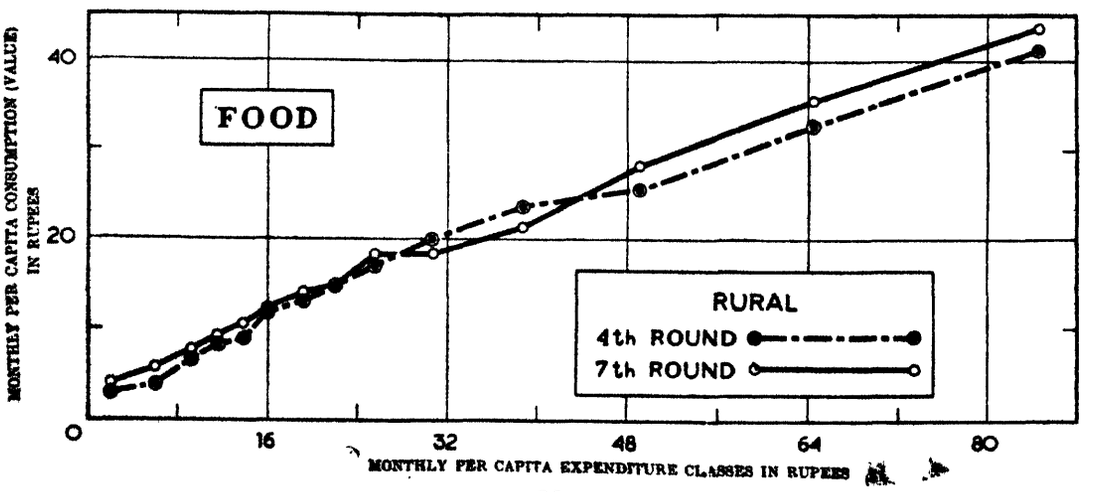




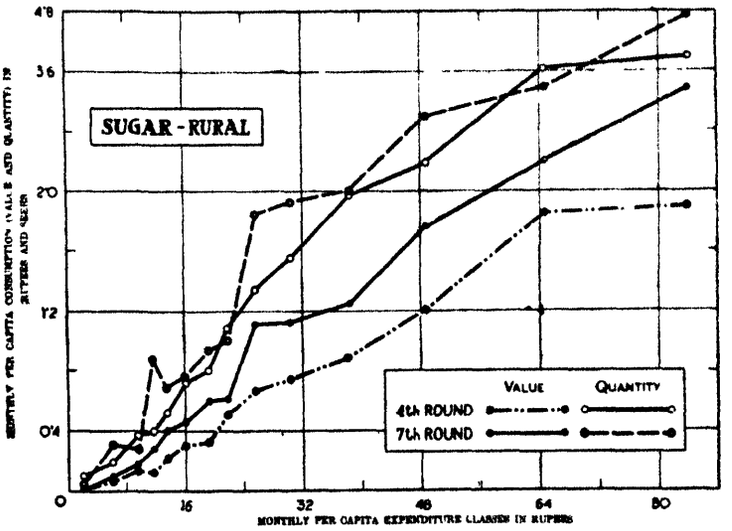


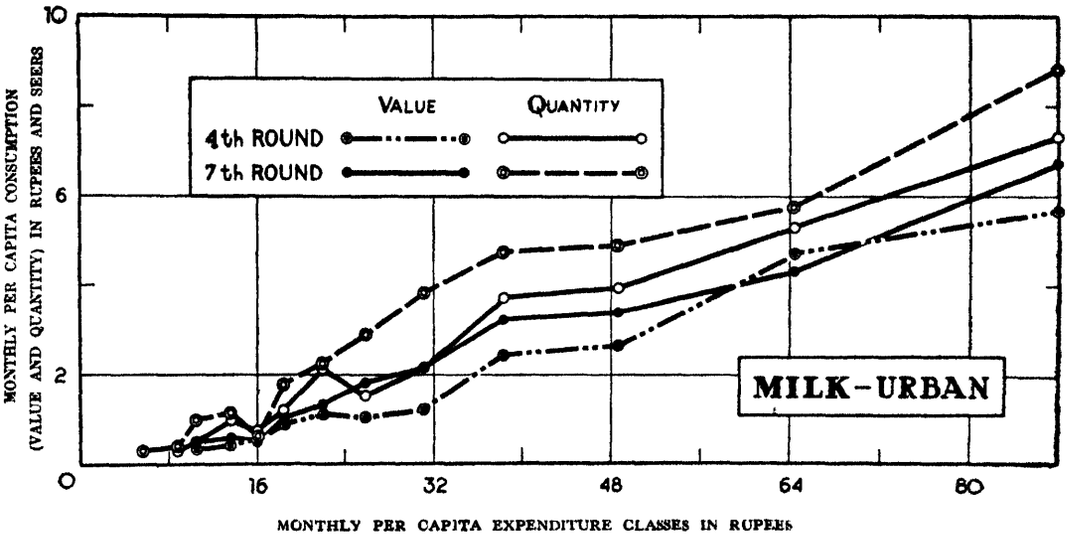

FOOD
URBAN
4th ROUND
7th ROUND
MONTHLY PER CAPITA CONSUMPTION (VALUE) IN RUPEES
0
10
20
30
40
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

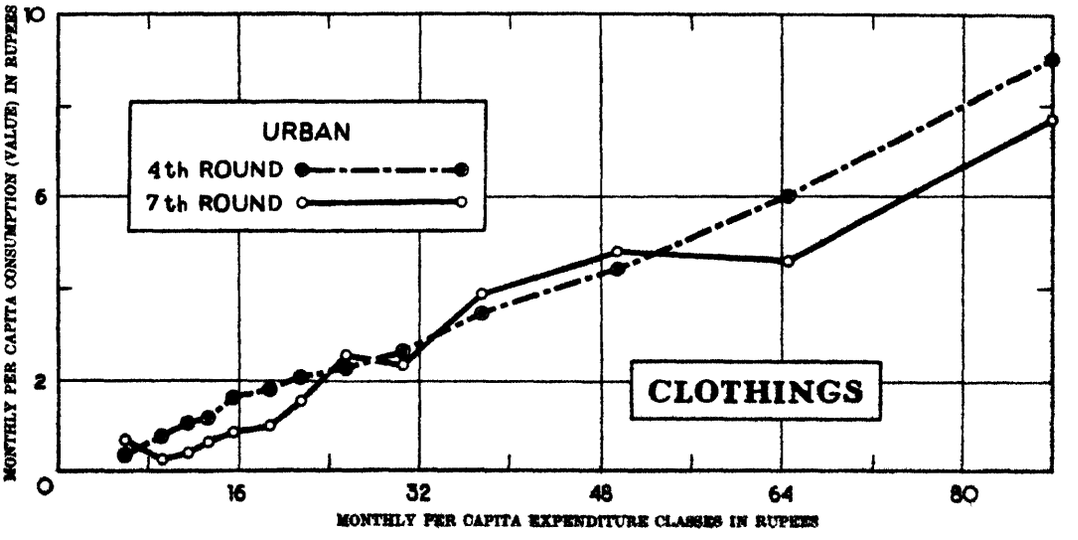

SUGAR-URBAN
VALUE
QUANTITY
4th ROUND
7th ROUND
MONTHLY PER CAPITA CONSUMPTION (VALUE AND QUANTITY) IN RUPEES AND SEERS
0
0·8
1·6
2·4
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

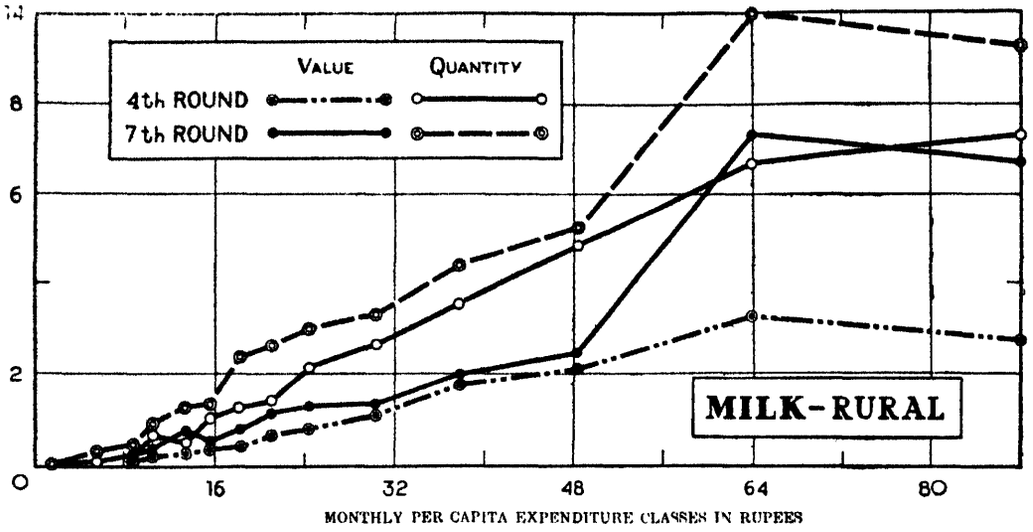

FOOD
RURAL
4th ROUND
7th ROUND
MONTHLY PER CAPITA CONSUMPTION (VALUE) IN RUPEES
0
20
40
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

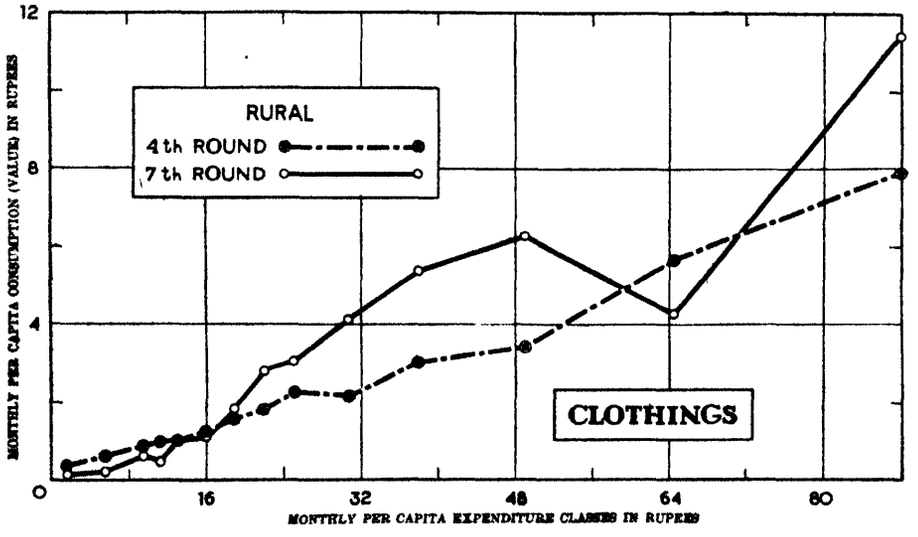
SOME RESULTS IN CONSUMPTION STUDIES



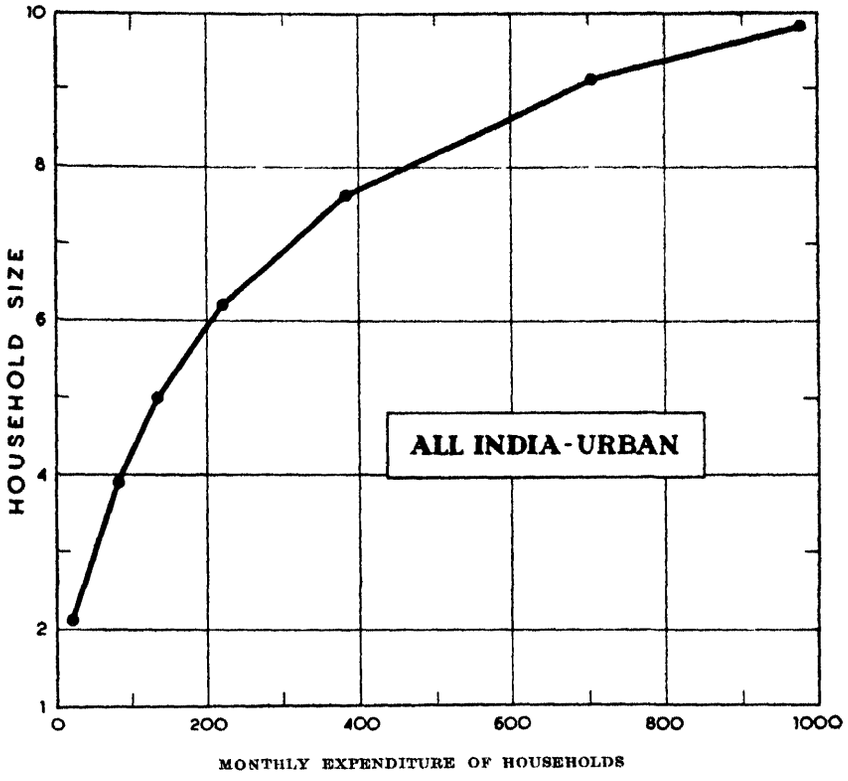





VALUE
QUANTITY
4th ROUND
7th ROUND
MILK-RURAL
8
6
2
O
16
32
48
64
80
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES


RURAL
4th ROUND
7th ROUND
CLOTHINGS
12
8
4
O
16
32
48
64
80
MONTHLY PER CAPITA CONSUMPTION (VALUE) IN RUPEES
MONTHLY PER CAPITA EXPENDITURE CLASSES IN RUPEES

SOME RESULTS IN CONSUMPTION STUDIES



The curves for 'oil seeds' and 'fuel and light' are very nearly linear, indicating that expenditure on these heads increase proportionately to increase in total expenditure. The curves for 'meat and fish', however, reveal a slight convexity downwards, and that for 'milk and milk products' more so. This is to be interpreted as indicating that demand for 'meat and fish' and for 'milk and milk products' rise at a slightly higher rate than the rate of increase of the standard of living.

The levels of the curves for 'fuel and light' are the same for urban and rural consumers enjoying the same level of living. This may be surprising, for one might expect urban consumers to spend more on light : the explanation may be that while rural consumers consume less of these in *quantity*, they have to pay a higher price per unit.

The levels of the other three food items, namely 'meat and fish', 'milk and milk product, and oil seeds are higher for urban consumers than for rural consumers. We have, however, found that rural consumers consume more of food. The explanation of this remarkable difference between total food and these individual items of food becomes clear from graphs of 'food grains'. Food grains cover all the major and minor food grains (rice, wheat, jowar, bajra, barley, etc.). The two demand curves for food grains are extremely interesting. Firstly, we note the really significant difference between the levels of the two curves. A rural consumer having the same standard of living (measured by per capita monthly expenditure) as an urban consumer consumes *very much more* food grains than the latter, the difference increasing with the level of prosperity. The difference is so large that even though the rural consumer consumes less of 'milk and milk products', 'meat and fish', oil, etc., he consumes more (in value) of total food than his urban counterpart.

Secondly, we notice that there is a significant differenee between even the natures of the two curves. The demand curve for urban consumers mark a sharp rise at the lower extremity of the per capita expenditure groups, and then becomes almost *flat*. By the time households belonging to per capita monthly expenditure of Rs. 24/- are reached, the tendency for increasing consumption of food grains as the standard of living rises becomes negligible. The picture is completely different for rural consumers. The curve for them is typical of any other demand curve exhibiting a constantly rising demand with rising level of living. It is true that demand rises proportionately at a slower rate compared to the rise in the standard of living, but the important fact remains that the *curve does not reach an asymptote*, that is consumption of food grains does not reach saturation at any point.

The remarkable difference in the composition of the food budget of rural and urban households is clearly brought out in the graph on page 23 showing the proportion of food expenditure spent on foodgrains for the different household groups.

The difference we have spoken of is of great strategic importance from the planning point of view (vide Appendix III) and therefore, requires further close study. 'Food grains' is a term covering various individual grains, and it is of importance to know more details about these individual items. We have considered the two

most important grains of our country, namely rice and wheat and have discovered yet another very interesting fact, that the consumption habits of urban consumers regarding these two grains show a difference which is crucial from the planning point of view.

The difference will be clearly understood if we compare the graphs in page 24- for rice and wheat separately. Both represent habits of urban consumers, but they are not based on all-India samples. The graph for rice is based on West Bengal, Assam, Bihar, Madras and Bombay—some of the provinces where rice consitutes a major part of the food grains consumption of the average household. The wheat graph is drawn on the basis of Bihar, Punjab and Bombay—some of the provinces where wheat constitute a major part of the food grains consumption. Orissa should have been included in the first list and U.P. in the second. They have been omitted for no other reason than that relevant statistical data were not readily available to us while working.

The two graphs look very different indeed. The rice graph rises sharply and, then reveals a tendency of gradually falling off or at least remianing horizontal. The sharp rise persists only upto the per capita monthly income of Rs. 24/-.

The wheat graph, however, gently slopes upward, the tendency persisting much beyond the point of saturation for rice. In our graph, there is upward rising tendency lingering upto the point of Rs. 64/- per capita monthly total expenditure. The last two points should not be interpreted as definitely indicating a gradual falling off after this point, for it may very well be sampling effect.

Wheat and rice being the main food grains of India, the resultant curve for food grains is, as it is found to be—marked by a sharp rise at the lower and, then more or less flat.

Before passing on, we should make note of the fact that this difference of consumer attitude towards rice and wheat is likely to be more an urban phenomenon than a rural phenomenon. We have not as yet investigated the rural sector systematically with respect to this phenomenon, but this much can be stated that even for rice rural consumers do not reach saturation as early as urban consumers. The graph for rice marked 'Rural' refers to rural West Bengal only and is, therefore, based on a rather small sample. It shows a sharp increase at the bottom, the tendency lingering beyond the point of saturation for urban rice consumers. The last three points at a lower level should not, however, be inerpreted as necessarily indicating a drop in consumption : it may very well be a result of sampling fluctuation; no definite conclusion can, however, be arrived at before basing studies on all-India data.

We now pass on to the second set of graphs. While in the first set, curves for the rural and urban sectors were superposed on each other for the same round, here we superpose on each other curves for the same sector but for two different rounds (the 4th and the 7th). In six out of the twelve graphs we plot both value

and quantity of per capita consumption; in the remaining six, only value. The price changes between the 4th round (extending over March to December 1952) and the 7th round (October 1953 to March 1954) mainly consisted of a slight general rise in wholesale 'food' prices accompanied with a slight fall in the wholesale prices of food grains, textiles and other manufactured articles. In terms of the level of consumption, we find that the change has resulted, as far as urban consumers of all levels are concerned, in an increase in the spending on food and a slight decrease in the spending on textiles. As far as food grains are concerned, there is an increase in the quantity consumed by the lower groups, spending on this item remaining more or less unchanged. The consumption of food items other than cereals (milk, meat, fish, sugar, etc.,) seems to have increased in all groups. Money saved by not increasing consumption of cotton textiles, as its prices fall, seems to have been utilised to purchase more of nutrition giving food items, even though there has been a slight general rise in their prices.

The rural consumers behave in a distinctly different way. The main reason must be that the dominating section of the rural consumers are agriculturists; and agriculturists of the upper group are subsistent producers of food crops whose relation with the market is that of sellers as well as of purchasers.

Thus, fall in wholesale price of food articles does not result in any change in the overall spending on food by any class. Consumption of milk and milk products increase; so also does that of sugar and cotton textile, though not of meat and fish. The demand curve for cereals, however, show a very interesting change. While lower groups increase their consumption of cereals the upper group actually reduce it in quantity, thus spending much less money than before on this particular item. A possible explanation is that the upper agricultural household groups, being mainly sellers of food grains, have to reduce their consumption of cereals and increase its sale to bring in more or less the same amount of monetised income as before. Now, price fall must have meant a fall in the income (calculated by imputing agricultural production) of many of the households, so that many a household belonging to a particular group during the 7th round survey belonged to a higher group during the 4th round survey. This reduction in income has, however, been accompanied by keeping the monetised income fixed. That means that such a household spends more in the market than the average household of the group where he now belongs did during the 4th round survey. That will mean a general rise in the per capita monetised spending of each group during the 7th round period compared to the 4th round period. This explanation fits in with the feature we have already made note of, that consumption of such marketable commodities as clothings and sugar has been increased by lower as well as upper household groups of the rural sector.

Demand elasticities

Demand curves of the type we have worked out are often reasonably well fitted by mathematical curves of the type of $y = ax^b$ where y is the per capita

consumption a particular commodity by a group of households whose per capita income is x. We have tried to fit such a model to our demand curves and found that they give reasonably good fit for most of the commodities. We give in the following Table the values of b for the different commodities. We are interested in b only, as it is b that determines the shape of the curve, and our present purpose is to see how price changes affect the shape of the demand curves. Instead of trying to understand the changes in the shapes by looking at the curves, it is more convenient to consider the values of b. We also compare the values of b between the cases when the ordinate is measured in value and the cases when it is measured in quantity.

The differences in the value and quantity elasticities and their changes are interesting. Value elasticity is usually higher than quantity elasticity, for higher groups not only consume more quantity of any commodity, they also choose better quantity.

Not all the fits are of equal quality; hence we have remarked below each figure the quality of the fit. There is only one case when the fit is really bad. That is for sugar in value for urban consumers. Here, we find that no single curve of the type $y = ax^b$ fits the data well, but two curves of the same type fitted separately to the lower and the upper parts of the curve fit the data quite well.

TABLE (2) · VALUES OF THE COEFFICIENT OF THE MODEL $Y = ax^b$ FITTED TO SOME OF THE DEMAND CURVES ACCOMPANIED WITH COMMENTS AS TO THE GOODNESS OF THE FITS

commodity	round	urban		rural	
		quantity	value	quantity	value
(2) food grains	6		.35 (good)	—	.62 (very good)
(3) cereals	4	.23 (good)	.50 (fairly good)	.59 (good)	.73 (good)
	7	10 (good)	37 (fairly good)	.38 (fairly good)	.55 (good)
(5) milk	4	1 45 (fairly good)	1.68 (good)	1.86 (fairly good)	1.73 (good)
	7	1.45 (fairly good)	1.63 (good)	1.53 (fairly good)	1 77 (very good)
(8) clothings	4		1.14 (good)		1.12 (good)
	7		1.71 (very good)		1 45 (good)
(6) sugar	4	† 1.56 (l) .87 (u)	.95 (good)	1 18 (good)	1.32 (good)
	7	† 1.76 (l) .96 (u)	1.20 (good)	1.13 (good)	1.11 (good)
(1) all food	4		.84 (very good)		.83 (very good)
	7		.87 (very good)		.81 (very good)
(7) meat and fish	4		1.03 (good)		1.30 (fairly good)
	7		1.62 (good)		1.25 (fairly good)
(9) fuel and ligh.	6		.80 (good)		.80 (good)

† l : lower part
u : upper part

STUDIES ON CONSUMER BEHAVIOUR

Demand prediction

Planned development presupposes that as far as consumer goods are concerned the balance of demand and supply are not to be left to the operations of the market but the two are to be planned simultaneously so as to be balanced. If this has to be done, the planner has to arrange supply so as to equal the demand created by his own planned steps. This is possible only if he has, at his disposal, statistical tools to enable him to make 'Demand Predictions'.

Prediction, however, is not possible. Prediction is not possible in economics any more than in any other branch of science. True, in the physical sciences the 'natural laws' are supposed to be made use of in making predictions. But the physical laws are also statistical in character, and exact predictions are not possible even there. The basic nature of any prediction in any science is the same and is as follows : certain regular features have been observed to hold true in the past under a set of conditions; an assumption is now made which is referred to as the assumption of the 'uniformity of the world'. Under this assumption, the scientist permits himself to believe that if the same set of conditions are brought together in the future, the regular features observed in the past will also repeat themselves.

It is under the same assumption that predictions are made in economics. The act of prediction is, however, made much more complicated and usually much less accurate by the fact that it is difficult to get hold of a set of conditions that might be assumed to remain constant and identify the features that reveal regularity under these conditions.

Demand Prediction has necessarily to be related to a new set of prices, a new level of national income and a new pattern of income distribution. This combination of fixed variables might not have been observed often before and therefore, strictly speaking, it is not possible to say what the total demand for a given commodity will be under this set of conditions.

Statistical Demand Predictions are very often carried out by using some very simple formulae. Assuming prices to remain constant for the time being, a simple formula often used to predict demand is to assume the following law connecting the national income Y and the national demand for a given commodity, D.

$$D = AY^B \qquad \ldots \quad (1)$$

(See H. Wold's Demand Analysis, Page 2)

A and B are supposed to be constants. B is called the coefficient of income elasticity of demand. If this model holds, prediction becomes simple indeed. For, supposing national income goes up by α percent by how much does demand for the given commodities go up ? By approximately αB percent. For, if the new demand be D',

$$D' = D\left(\frac{Y'}{Y}\right)^B = D(1+\alpha)^B \qquad \ldots \quad (2)$$

But what justifies the assumption that D is indeed connected with y as in (1)? The only way of scientific verification is by checking with empirical evidence. But empirical evidence is difficult to obtain, as prices always change and in a country like India estimates of neither Y nor D are available over a reasonably long period of time in the past.

An indirect justification that is sometimes given is in terms of family budget studies. Let there be n individuals in a community. Let y_i and d_i stand for the income and consumption of a given commodity by the i'th individual during a specified period of time. By plotting d_i against y_i it is often found that a function of the type $d_i = ay_i^b$ fits the empirical data reasonably well. This evidence does not, however, say anything about the relations between Y and D.

As a matter of fact, if we assume that the relation between income and consumption of the n individuals remains unchanged, we can write,

$$D = \sum_{i=1}^{n} d_i = \sum_{i=1}^{n} ay_i^b \qquad \ldots \quad (3)$$

This, however, is in immediate contradiction with the model

$$D = AY^B \qquad \ldots \quad (4)$$

for $D = \sum_{i=1}^{n} d_i$ and $Y = \sum_{i=1}^{n} y_i$

so that by (2)

$$\sum_{i=1}^{n} d_i' = D' = D\left(\frac{Y'}{Y}\right)^B = D\left(\frac{\sum_{i=1}^{n} y_i'}{\sum_{i=1}^{n} y_i}\right)^B \qquad \ldots \quad (5)$$

which is not usually equal to

$$\sum_{i=1} d_i \left(\frac{y_i'}{y_i}\right)^b \qquad \ldots \quad (6)$$

There are, however, two situations when D' can be predicted in terms of D by using (2) even though the model (1) is not holding, provided that the model (3) may be assumed to hold between individual demands and individual income.

The first situation is when $B = 1$
Under this condition

$$D' = D\frac{Y'}{Y} = D(1+\alpha) \qquad \ldots \quad (7)$$

and $$\sum_{i=1}^{n} d_i' = \sum_{i=1}^{n} ay_i' = ay' = ay(1+\alpha) = D(1+\alpha) = (1+\alpha)\sum_{i=1}^{n} d_i \qquad (7a)$$

when α is the percentage increase in the total income of the community.

The second situation is when the income of each individual changes by the same constant percentage, say α; thus,

$$\sum_{i=1}^{n} d_i' = \sum_{i=1}^{n} d_i \left(\frac{y}{y}\right)^b = (1+\alpha)^b \sum_{i=1}^{n} d_i \qquad \ldots \quad (8)$$

It is, however, important to bear in mind that this result holds true under an important assumption, namely that the empirically observed relation $d_i = ay_i^b$ between d_i's and y_i's holds true independent of time.

This really means that if the i th individual having now an income $y_i(t)$ at t, have income $y_i(t')$ at t', his consumption habit changes over to those of individuals j who are already at t having income $y_j(t)$ equal to $y_i(t')$. This may not be true if the time points t and t' are not close together.

Let us consider the problem generally. Instead of considering individuals, in statistical analysis one considers groups, especially when the number of the individuals is large. Thus, let the number n be divided into k groups 1, 2. ..., k so that the groups contain n_1^t, n_2^t, ..., n_k^t members respectively at t. Let the per capita consumption of a given commodity by these different groups at time t be c_1^t, c_2^t, ..., c_k^t. Then obviously the total consumption of the commodity in question, by the community is

$$C(t) = c_1^t + c_2^t + \ldots, c_k^t \qquad \ldots \quad (9)$$

Supposing the groups are so constituted that c_1^t, c_2^t, ... are independent of t. This means that, though over time, the membership n_i^t of the group i changes to $n_i^{t'}$ the newcomers get adapted to the consmuption habits of the already existing members of the group, in such a way that the average per capita consumption of the commodity in question remains the same as before, that is c_i^t. We can then omit t and write $c_i^t = c_i$ ($i = 1, 2, \ldots, k$). The total consumption of the commodity at time t', then will be given by $C(t') = \sum_{i=1}^{k} n_i' c_i$. $C(t')$ can then be estimated with the help of $c_1, c_2, \ldots$, etc., if we know the new income distribution, n_1', n_2' etc., of consumers.

The new distribution can hardly ever be known, and one has to proceed by making hypotheses about it. In making hypothesis, however, it is simpler to assume continuous instead of discrete demand curves and continuous instead of discrete frequency distributions. Let us suppose that the k groups are obtained on the basis of per capita income of households. Thus group 1 represents households having per capita income between 0 and a; group 2, having the same between a and $2a$; and so on. It is possible to fit 'curves' to the frequency distribution n_1^t, n_2^t,..., n_k^t and the demand functions $c_1, c_2 \ldots, c_k$, i.e., a curve $f_t(x)$ such that the number of consumers at time t having per capita income between x and $x+\Delta x$ is roughly equal to $f_t(x)\Delta x$, and the per capita demand for the commodity in question by members of this group is roughly equal to $c(x)$. $f_t(x)$ and $c(x)$ may be regarded as univalued functions defined for all values of x between 0 and ∞.

The present consumption $C(t)$ then can be expressed as

$$C(t) = \int_0^\infty f_t(x)c(x)dx \qquad \cdots \quad (10)$$

and $C(t')$ as

$$C(t') = \int_0^\infty f_{t'}(x)c(x)dx \qquad \cdots \quad (11)$$

We shall consider three special situations.

1. $C(x) = bx$, the distributions $f_t(x)$ and $f_{t'}(x)$ unknown and arbitrary.

$$C(t) = b\int_0^\infty xf_t(x)dx = bY(t) \qquad \cdots \quad (12)$$

$$C(t') = b\int_0^\infty xf_{t'}(x)dx = bY(t') \qquad \cdots \quad (13)$$

where $Y(t)$ and $Y(t')$ are income at time t and t' respectively. If the total increase in the income of the community is α percent, the increase in the consumption is $b\alpha$ percent. Thus, change in demand can be predicted in terms of change in income only, irrespective of the change in income distribution.

2. $c(x) = ax^b$; $f_{t'}(x)\Delta x = f_t\left(\frac{x}{1+\alpha}\right)\frac{\Delta x}{(1+\alpha)}$

Then $C(t') = \int_0^\infty ax^b f_t\left(\frac{x}{1+\alpha}\right)\frac{dx}{1+\alpha} = (1+\alpha)^b C(t)$

This is the situation when every individual's income has changed by a constant proportion α percent.

3. $f_{t'}(x) = f_t(x+\alpha)$; $c(x)$ arbitrary.

$$C(t') = \int_0^\infty c(x)f_{t'}(x) = \int_0^\infty c(x)f_t(x+\alpha)dx$$

No simplification is possible, except that the integration can be numerically evaluated by using suitable formula for numerical integration.

STUDIES ON CONSUMER BEHAVIOUR

INDEX OF GRAPHS

In the graphs marked with*, the solid line curve stands for urban and the broken line curve for rural consumers. In each graph marked with † the solid line curve stands for the 7th round and the broken line curve for the 4th round.

Page—21.

1* Per capita total consumption of food.
2* Per capita total consumption of clothings.
3* Per capita total consumption of oil seeds.

Page—22.

1* Per capita total consumption of milk and milk products.
2* Per capita total consumption of meat and fish.
3* Per capita total consumption of fuel and light.

Page—23.

1* Per capita total consumption of food grains.
2* Ratio of per capita food consumption to per capita total consumption.
3* Ratio of per capita cereal consumption to per capita total food consumption.

Page—24.

1 Per capita consumption of rice in seers (for principal urban rice areas only and for rural West Bengal only).
2 Per capita consumption of wheat in seers (for principal urban wheat areas only).

Page—24-25. (*Urban*) *and Page*—25 (*Rural*)

1* Per capita consumption of cereals (quantity and value) for the 4th and the 7th rounds.
2† Per capita consumption of meat and fish (value) for the 4th and the 7th rounds.

Page—26. (*Urban*) *and Page*—26-27 (*Rural*)

1† Per capita consumption of food (value; all items taken together) for the the 4th and the 7th rounds.
2† Per capita consumption of sugar (quantity and value) for the 4th and the 7th rounds.

Page—27. (*Urban*) *and Page*—28 (*Rural*)

1† Per capita consumption of milk and milk products (quantity and value) for the 4th and the 7th rounds.
2† Per capita consumption of clothings (value) for the 4th and the 7th rounds.

Page—29.

1 Dependence of household size on total monthly expenditure of households.

APPENDIX I

The demand curves we have studied in this paper all refer to "All India" households classified into only two environmental classes, rural and urban. It will be of interest to make detailed study of consumption habits classwise and regionwise. Information regarding different economic classes, (e.g., farmers, agricultural labourers, self-employed workers, urban proletariats, urban salaried workers, etc.,) will be of interest in itself in showing the relationship between consumption habits and production relations. Information regarding regional variation in consumption habits must constitute basic materials for regional planning. Apart from these interests, there is a purely statistical advantage in obtaining information separately about the consumption habits of classes of households defined in terms of production relations. As we have seen in section 3, Demand Prediction is possible for a class of households if, along with a knowledge of the preferences of the class and the increase in its aggregate income, some knowledge is available as to the way the additional income gets distributed among the different income groups within the class. This latter information being usually lacking, one has usually to proceed on the basis of some *statistical assumptions*. Now if one is making Demand Predictions about the whole of India, and if they are based on blanket assumptions about the distribution of an additional income amongst all the households in India, the results are likely to be much worse than if one proceeds regionwise, classifying the population of each region into several classes (defined in terms of production relations) such that the additional income going into each class as well as its consumption habits are known and then applying to each such class certain statistical assumptions about the distribution of income within it.

We have also studied a few curves illustrating how the consumption habits may vary regionally. Only three items are considered; total food, milk and clothings. On each graph there are superposed two curves, one for U.P., the other for West Bengal (excluding Calcutta). As one might expect, the food curves are almost identical : the differences between the two are of a purely random character. There is, however, systematic difference between the two curves in the other two cases. The U.P. curve for milk is definitely above the West Bengal one while the U.P. curve for clothings is above the W. Bengal only for the higher prosperity groups. These curves have not been reproduced in the paper.

APPENDIX II

Note on the choice of index of standard of living.

We have all through this paper classified households in terms of the per capita total monthly expenditure of households for studying the variation consumption habits between the classes as originating from differences in the prosperity of the households. As total monthly expenditure (alternatively, total monthly income) is also a measure that has often been used to obtain the same classification, we think it necessary to make a few observations to justify our choice.

We are of the opinion that in any consumption study with respect to Indian households, household income or total expenditure should never be used for classificatory purposes, for it cannot be treated as an index of the standard of living of households. The reason for this is that the variation in household sizes within each income group is quite high in India and the average household size is very strongly correlated with household income. As a result of the first, the real standard of living enjoyed by the different households belonging to the same group differ widely amongst themselves; which means that averages based on such a group do not carry much meaning and if curves based on total expenditure as classifying factor are unsatisfactory from the point of view of revealing the nature of dependence of consumption of specific items on the level of prosperity of a household, they might be positively misleading if used for the purpose of Demand Prediction. The statistical assumption involved in Demand Prediction would have that when a household moves away from one total expenditure class to another total expenditure class, it will adopt the consumption habits of the new class. This, however, is quite impossible, if Prediction is to be made for the near future. For, the average household belonging to the class say Rs. 95–Rs. 105 contains only 4 members; when it gets promoted to the class Rs. 145–Rs. 155, its size does not increase; the average size of a household in this class at present is, however, 5. The newcomer household, having an income between Rs. 145–Rs. 155 but only 4 members cannot possibly have the same consumption pattern as the households belonging to the group before, having income between Rs. 145–Rs. 155 but containing 5 members per family.

No difficulty of this type is involved when per capita expenditure groups are used.

APPENDIX III

Consumption studies and planning strategy.

Apart from helping in predicting demands for specific consumer items, can consumption study of the type we have undertaken be of any help to the planner? The answer is 'yes'; such studies can be of great strategic importance in the formulation of planning policies; e.g., a study of the regional variation in consumption patterns and geographical distribution of crop areas have necessarily to be the starting point in making a long term plan for the gradual changeover from the existing crop pattern in India to a more rational one. Our own studies lead, in our opinion, to some basic conclusions regarding planning for the near future in India. We discuss them briefly here.

One of the commonest bottlenecks in an industrialisation plan is the short supply of foodgrains and other food products. Provided that import of food is not considered in any significant scale, there are three ways in which excess food products can be obtained out of the producers and carried to the non-food producing workers. These three ways which are not mutually exclusive, are :

1) Increase in the production;
2) Increase in the pace of 'migration' of population from the rural to the urban sector;
3) Introduction of gradual changes in the consumption habits of the urban and rural consumers.

Increasing the production of food products constitutes a problem which everybody is aware of, so that it does not require many comments. It is common knowledge, and it is verified by our graphs, that as income rises, demand increases much more sharply for protein and fat containing food items like meat, fish, eggs, milk, etc., than for cereals. Increase in the cereals demand arise mainly from increased purchasing power among the lower income groups, but those for the other items arise from all the income groups. The importance of cereals lies, however, in the fact that even a small proportionate increase means a large absolute volume of increase. All these points seem to have been kept in mind in formulating the agricultural plan of the 2nd Five Year Plan; for, quite correctly, a lot of emphasis is laid on dairy and poultry and animal husbandry. What, however, does not receive any mention in this agricultural plan is that within the cereals group itself, there has to be careful crop-planning. While income rise may not induce a very large increase in demand for cereals, it will certainly induce a large volume of substitution of inferior grains by superior grains; also, we have already noticed that among urban consumers, rice-demand reaches saturation much before wheat-demand. This means, that a very different attitude is necessary towards these two chief grains. Demand for rice will not rise indefinitely as national income rises; after a certain point demand will rise only in proportion to the growth of the number of mouths. The demand for wheat will, however, grow. Unless this basic fact is kept in mind by the planner right now and agricultural planning carried out accordingly, there is bound to be serious imbalance in the grain market in the future.

The two other suggestions for increasing the supply of foodgrains have not received any mention in the 2nd Five Year Plan. In our opinion, there are great possibilities in these directions deserving of careful investigations. By 'migration' from the rural to the urban sector, we mean changeover from agricultural occupations or occupations dependent on agricultural activities to industrial occupations or occupations depedent on industrial activities. It does not necessarily mean physical changeover from one region to the other, though it is not precluded either. It means mainly urbanisation of areas which are at present rural. This has to be done by so spacing the new industrial production units as to draw as much as possible of the labour force needed to run them from the underdeveloped rural population. We are assuming that there is a scope for choice in the regional allocation of the new production units as regards the hinterland of labour supply—and we are suggesting that the choice be made so as to draw upon as much as possible from the reservoir of underdeveloped labour force in the rural sector. It is quite conceivable to so organise matters that the labour required for these new units is almost entirely drawn from the reser-

voir of underemployed labour force in the existing urban sector, without making significant urban inroads into the existing rural sector; and as a matter of fact it may cost less to do so in terms of socio-economic overheads, for our suggested alternative will mean building new townships around new industrial enterprises in places where townships do not exist, instead of locating the units of production in the outskirts of existing cities and towns. Against this additional cost in terms of socio-economic overheads has, however, to be placed the advantage that this migration permits of a greater marketable surplus of food products and therefore, permits of a greater investment plan. So long as the additional investment allowed by the additional supply of food as a result of this choice of location of the unit of production is not less than the additional investment in construction necessary to build up the township, it is of advantage to adopt this location from the point of view of the industrial development of the country.

The fact that greater migration allows of greater investment follows thus. Removal of one consumer from the rural to the urban sector will not affect the production of agricultural (or non-agricultural) consumer goods in the rural sector, as we are working under the assumption that migration is taking place from a pool of underemployed labour force.* The removal will then mean two things. There will be one less mouth to feed; hence total consumption of food commodities in the rural sector will fall. But, as a result of the same removal, the per capita total income of the remaining population will increase. That will mean an increased consumption per consumer of food (as well as non-food) commodities. The net result of these two opposing forces will most probably be an increased surplus for the market, as far as food grains are concerned, owing to the inelasticity of the demand for food grains. The total demand by the rural population of some other food commodities may, however, rise but the urban supply of many of these commodities (say milk) does not depend on the surplus over the rural consumption as much as food grains (the urban supply being often obtained from the neighbourhoods and suburbs of towns). While the increased supply to the urban market as result of urbanisation may be conceded, it may be contested that this will necessarily allow of a greater investment on the alleged ground that the demand curve of rural consumers for foodgrains is, as has been already seen, altogether above that of urban consumers, so that an urban worker freshly recruited from the rural sector will consume more of foodgrains than his fellow worker from the town slum earning the same amount of money. This may be true, but the consumption habits of the freshly recruited worker is bound to change and merge with that of his counterpart from the slum as time passes and he ceases to be fresh. It is the long term prospect that has to be taken into account in deciding upon the location of new units of production. There can, however, be many more objections and no definite conclusions can be drawn before some practical experience is gathered in this line.

* The situation is of course made very much more complicated by the existence of the peak load problem of agricultural labour.

The third suggestion is to increase the supply of food grains for the urban market by changing the consumption habits of the rural consumers against foodgrains and in favour of non-food articles of consumption. We have already seen that the demand curve for food for urban consumers is below that for rural consumers. The difference as revealed in the graph may be an underestimate of the real difference; for the per capita demand is expressed in value in this graph, and the prices of food articles are generally lower in the rural than in the urban sector. Compared to urban consumption pattern, the rural pattern is marked by this feature that given the same level of living (in terms of per capita total expenditure), a rural consumer consumes very much more of food grains, and somewhat less of other nutritive food than his urban counterpart. This of course means that he consumes less of non-food items, especially such items as are industrially manufactured in the urban sector. This is illustrated by the graph on clothings. The difference between the urban and rural consumption of textile must be even more marked in physical terms than in value terms as revealed by the graph, as prices of manufactured articles are higher in the rural sector than in the urban sector. This difference in consumption pattern is due to a great extent to the difference in the environmental conditions. The type of work one has to do probably necessitates a greater intake of cereals. There are, however, also economic factors, e.g., the fact that the rural population being predominantly agricultural produces a big part of the food it consumes; and the fact that, by the very nature of things, the relative prices of agricultural and manufactured articles are biased in favour of agricultural commodities in the rural sector.

In so far as food grains can be substituted by manufactured articles in the family budget of the rural households, there exists a potential source of supply of food grains to the urban sector. Assuming that this substitution can be effected, there cannot be any objection to taking steps to achieve it. The only objection could be on the grounds of the physical wellbeing of the rural consumers. Now, we have seen that the demand curve for foodgrains for the rural sector is everywhere above that for the urban sector by a significant amount. A part of this surplus consumption per consumer above urban consumption person may be regarded as essential to the rural consumers' physical wellbeing, but certainly not the whole amount. How to effect the substitution is another matter—and a more difficult one. Our suggestion is a suitable price policy : on the one hand raising of the procurement (or harvest) prices of foodgrains and on the other a planned reduction in the prices of manufactured articles in the rural markets and a planned increased supply of the same. The justification of this approach is that we consider the organised industries very much more easily and directly controllable than agriculture, allowing investment to be carried more according to the planners' wishes and results obtained in a shorter interval of time. Implementation of a price policy as described above may be difficult as a matter of practice. It would necessitate state intervention on a large scale in the wholesale trade in foodgrains and also influencing the retail trading in the countryside. A partial takeover of these trades by the State would also bring to the State Exchequer a large sum by way of planned profit which may be used for purposes of

investment. This will of course mean progressive elimination as a class of a large part of the wholesale traders between the urban and rural markets. It, however, seems to be unavoidable that in a period of planned and rapid industrialisation, certain unproductive classes will suffer.

All the three suggestions given above are, however, little more than idle talk if not put in an institutional context. And if the context be the present socio-economic set up in the agrarian sector, it can be safely said that neither the above nor any other suggestion that may be advanced about increasing the urban supply of foodgrains can be relied upon in launching upon a bold plan for industrialisation. As long as the property and ownership relations in agriculture remain as at present, the urban supply of foodgrain is bound to remain subject to factors beyond the control of the planner.

A NOTE BY PROF. P. CHAKRABARTTY

With reference to the discussion of the effects of an increase in the pace of migration from the rural to the urban sector, I would refer to pages 38-40 in "Problems of Capital Formation in Underdeveloped Countries" by Ragnar Nurkse. Prof. Nurkse points out that the degree of mobilisation possible will depend on the amount of complementary saving available and on the relative size of the leakage. The leakage referred to here arises mainly through increased consumption by the non-migrant agricultural population and by the migrant workers after their taking up new jobs and receiving higher incomes.

In the present paper this problem is considered in connection with the increased agricultural production envisaged in future plans. Analytically, however, the problem of migration is not necessarily linked with the possibility of increased agricultural production, and, as such, should be considered separately. Even under a completely thorough-going state control of the economic system, at least in the earlier phases of planning, when the problem is the most acute, I think past experience in the USSR does not warrant the conclusion that migration by itself increases the movement of the theoretical surplus to the required extent. In the case of a partially controlled system, the assumption that food may be expected to follow the migration of surplus labour has very little justification.

EXPENDITURE CONSUMPTION CURVES FOR SOME SELECTED CONSUMER ITEMS

By DEB KUMAR BOSE

Consumption function, showing the relationship between the consumption expenditure and income of an individual, holds an important position both in applied and theoretical economics. National Sample Survey (NSS) has been collecting data on consumer expenditure for a fairly long period but no comparable data on income are available at the moment. The survey results, however, offer excellent data on total consumer expenditure which can be taken as close substitute for income of an individual. The kind of data available would permit a search for some relationship of general nature between consumer expenditure on particular items and total consumer expenditure.

It is with such intent that data for per capita consumer expenditure on some of the items—cereals and salt being two of the commonest and most essential commodities and milk from among the less common items—have been selected. The data have been plotted against per capita total consumer expenditure classes in the graphs presented. The curves are generally known as Expenditure Consumption Curves. Simple curve types were chosen from visual check of the data. Second degree curves were fitted to data for cereals and straight lines were fitted to those for salt and milk items. The households were classified into 14 groups of per capita total expenditure classes. In actual fitting of the curves, data for the highest expenditure class were not included. The sample size for this class came to be too small and showed wide variations. They have, nonetheless, been plotted in their respective positions on the graph for observation. Besides, the sactter of observed points have also been plotted on the graph for comparison with the curves fitted.

The materials for three rounds—4th, 5th and 7th—have been used in this study. All these three rounds had one month as their period of reference. Data relate to all India averages for rural and urban sectors separately. Table (1) shows the distribution of the sample households by monthly per capita expenditure classes for the three rounds.

A few mathematical expressions which have been used are explained here:

y = per capita monthly expenditure on particular commodity

x = per capita monthly total consumer expenditure on all commodities.

From the equation for second degree curves, $y = a+bx+cx^2$, we obtain

$$dy/dx = b+2cx \qquad \ldots \quad (1)$$

which expresses the marginal increment in consumption per unit increase in per capita total expenditure, and

$$\eta = (dy/dx)(x/y) = (b+2cx)x/(a+bx+cx^2) \qquad \ldots \quad (2)$$

indicates the elasticity of expenditure for the particular commodity under investigation.

TABLE (1): DISTRIBUTION OF SAMPLE HOUSEHOLDS BY MONTHLY PER CAPITA EXPENDITURE CLASSES

All-India

monthly per capita expenditure classes in Rs.	number of sample households					
	4th round April–Sept. '52		5th round Dec. '52–Mar. '58		7th round Oct. '53–Mar. '54	
	rural	urban	rural	urban	rural	urban
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0 – 4	41	—	36	5	49	5
5 – 7	161	29	94	21	140	24
8 – 10	251	67	171	41	236	50
11 – 12	201	67	116	37	132	38
13 – 14	190	71	125	40	141	41
15 – 17	330	103	186	64	171	58
18 – 20	246	83	155	53	132	54
21 – 23	190	89	98	46	103	44
24 – 27	205	83	113	45	83	48
28 – 33	197	131	104	74	93	44
34 – 42	184	121	84	65	64	60
43 – 54	96	98	46	40	35	37
55 – 74	58	61	20	41	23	25
75 and above	38	71	18	46	11	30
all classes	2388	1074	1361	618	1413	558

The elasticity of expenditure for linear equations of the form $y = a+bx$ would be

$$\eta = b(x/y) = b(x/a+bx) \quad \ldots \quad (3)$$

The expressions (1)—(3) are functions of the level of total per capita expenditure x. They are all in ratio form and are independent of the monetary units in which expenses are measured.

Figures (1) and (2) show the second degree curves fitted to data on consumer expenditure on cereals. Table (2) shows the parameters of the curves for the three rounds and the two sectors respectively.

TABLE (2): PARAMETERS FOR CEREALS

rounds	rural			urban		
	a	b	c	a	b	c
(0)	(1)	(2)	(3)	(4)	(5)	(6)
4th	0.1403	0.5389	-0.0051	2.7719	0.1823	-0.0016
5th	1.0260	0.4364	-0.0045	1.9730	0.2411	-0.0023
7th	2.3688	0.3181	-0.0028	3.0131	0.2039	-0.0019

EXPENDITURE CONSUMPTION CURVES

In the rural sector expenditure on cereals shows a steep rise with the rise in expenditure level nearly all the way. Only in the highest expenditure levels there is a tendency for per capita consumption to decrease. The slopes of the curves for the rural sector, described by $dy/dx = (b+2cx)$ are considerably higher than those for the urban sector.

An obvious advantage in the use of the simple formulae has been that the elasticity values can be derived for different ranges of expenditure levels by putting the mean values for the expenditure in the equations (2) and (3).

The expenditure elasticity of consumption of cereals are computed at the mean level and at three grouped levels of expenditure for the different rounds and are given in Table (3).

TABLE (3): EXPENDITURE ELASTICITY OF CEREALS CONSUMPTION

monthly per capita expenditure classes in Rs.	rural			urban		
	4th round	5th round	7th round	4th round	5th round	7th round
(0)	(1)	(2)	(3)	(4)	(5)	(6)
0 — 20	0.85	0.70	0.54	0.37	0.50	0.39
21 — 42	0.64	0.57	0.49	0.42	0.42	0.32
43 — 74	-0.45	-0.69	-0.36	-0.35	-0.12	-0.49
all classes	0.74	0.65	0.54	0.34	0.41	0.35

The elasticity values for all classes lie between .5 and .7 in the rural sector and between .3 and .4 in the urban sector. In the absence of estimates of standard errors for the data for different rounds, it is difficult to attempt any explanation for the roundwise variations observed in the values for elasticity. Fluctuation in prices of consumer items also affects the comparability of the expenditure elasticity values. Price data at hand did not, however, permit analysis at the desired level.

Table (4) shows the expenditure on cereals as percentages of total consumer expenditure for different classes. The percentages are of high order, round about 50 per cent, in the lower expenditure classes and considerably small in the higher expenditure classes. This is in conformity with Engel's law that expenditure on necessity is initially high and is a decreasing function of total expenditure. In the lower expenditure levels the large percentage of increment of total expenditure is spent on cereals items in both the sectors. Proportions are relatively higher in the rural areas. In urban sector the expenditure rises much slowly. The actual level of cereal consumption for the highest expenditure class in the urban sector remains much below the corresponding level for the rural sector. Declining consumption of cereals at high levels in both the sectors suggests a point of satiety near the high levels beyond which the preference shifts to other items of consumption. Due to small sample size for

higher expenditure groups, however, it is difficult to ascertain the level of per capita expenditure at which cereal consumption appears to reach its satiety.

TABLE (4): PERCENTAGE OF EXPENDITURE ON CEREALS TO TOTAL EXPENDITURE BY MONTHLY PER CAPITA EXPENDITURE CLASSES

monthly per capita expenditure classes in Rs.	rural			urban		
	4th round	5th round	7th round	4th round	5th round	7th round
(0)	(1)	(2)	(3)	(4)	(5)	(6)
0 — 4	54.52	49.02	59.80	—	49.56	66.47
5 — 7	50.07	52.06	60.71	48.82	46.75	59.74
8 — 10	49.85	50.79	52.33	47.66	41.71	47.25
11 — 12	49.66	46.62	54.03	40.87	42.37	43.98
13 — 14	47.13	43.24	41.14	34.68	37.70	42.82
15 — 17	46.56	47.50	46.76	31.99	34.30	41.92
18 — 20	46.41	41.95	41.91	29.78	36.29	36.54
21 — 23	44.21	40.26	39.94	29.36	27.36	32.32
24 — 27	40.02	38.16	32.03	24.85	24.71	26.18
28 — 33	39.29	34.65	28.05	24.34	22.14	26.94
34 — 42	36.05	27.67	24.34	17.78	19.45	16.88
43 — 54	27.46	24.84	23.86	14.71	15.44	15.11
55 — 74	22.67	17.89	18.22	12.77	13.67	14.48
75 and above	14.16	12.36	7.89	7.31	8.49	6.91
all classes	39.23	36.69	39.19	21.49	21.61	26.46

Differences in the consumption pattern of cereals between the two sectors, rural and urban, deserve important consideration in view of the rapid industrialisation envisaged in the plan. With 70 per cent of the population still living in the rural areas, the nature of cereal consumption for the country as a whole is expected to be close to the rural pattern shown here, but with the progress of urbanisation the Expenditure Consumption Curve is likely to approach the urban curve in form. The rate of change of increment of consumption diminishes sharply in the urban sector. This is evident from the expression $d^2y/dx^2 = 2c$. Values of parameter 'c' are considerably lower in the urban area.

Expenditure on salt generally shows increase at a very small but uniform rate for all the expenditure classes, excepting the last one. The data were fitted to straight line, ignoring the figures for the last expenditure class (figs. 3-4). The slopes of the lines indicated by values of 'b' (Table 5) are very small for both the sectors. Per capita consumption of salt does not appear to be affected much by change in the expenditure levels.

EXPENDITURE CONSUMPTION CURVES

TABLE (5): PARAMETERS FOR SALT

rounds	rural		urban	
	a	b	a	b
(0)	(1)	(2)	() 3	(4)
4th	0.0419	0.0009	0.0232	0.0009
5th	0.0422	0.0006	0.0232	0.0009
7th	0.0395	0.0006	0.0290	0.0005

TABLE (6): PERCENTAGE OF EXPENDITURE ON SALT TO TOTAL EXPENDITURE BY MONTHLY PER CAPITA EXPENDITURE CLASSES

monthly per capita expenditure classes in Rs.	rural			urban		
	4th round	5th round	7th round	4th round	5th round	7th round
(0)	(1)	(2)	(3)	(4)	(5)	(6)
0 — 4	1.00	0.79	0.93	—	0.47	0.47
5 — 7	0.70	0.62	0.54	0.43	0.44	0.44
8 — 10	0.52	0.54	0.52	0.31	0.32	0.43
11 — 12	0.49	0.44	0.34	0.33	0.34	0.34
13 — 14	0.43	0.38	0.36	0.28	0.28	0.29
15 — 17	0.36	0.31	0.31	0.24	0.24	0.25
18 — 20	0.31	0.32	0.26	0.21	0.20	0.16
21 — 23	0.26	0.27	0.27	0.18	0.18	0.22
24 — 27	0.23	0.24	0.19	0.19	0.15	0.16
28 — 33	0.20	0.23	0.23	0.13	0.19	0.16
34 — 42	0.18	0.14	0.16	0.13	0.13	0.13
43 — 54	0.21	0.20	0.16	0.10	0.12	0.10
55 — 74	0.14	0.11	0.11	0.14	0.14	0.09
75 and above	0.08	0.10	0.07	0.05	0.05	0.08
all classes	.028	0.30	0.29	0.14	0.17	0.17

The percentage of expenditure on salt also continues to decrease at a slow rate with the increase in total consumer expenditure Table (6). The elasticity of expenditure on salt given by $b\frac{x}{y}$ comes to lie between .3 and .2 in the rural sector and between .6 and .3 in the urban sector as shown in Table (7).

The fitted line for the rural sector is, however, on a higher level than that for the urban sector, as shown by the larger value of '*a*'. This is possibly explained by the fact that in rural areas more cereals are consumed at lower expenditure levels, and salt bears a complementary relationship with consumption of cereals.

TABLE (7): EXPENDITURE ELASTICITY OF SALT CONSUMPTION

monthly per capita expenditure classes in Rs.	rural			urban		
	4th round	5th round	7th round	4th round	5th round	7th round
(0)	(1)	(2)	(3)	(4)	(5)	(6)
0 — 20	0.21	0.15	0.15	0.34	0.34	0.18
21 — 42	0.37	0.28	0.30	0.52	0.53	0.33
43 — 74	0.57	0.47	0.50	0.73	0.75	0.54
all classes	0.32	0.22	0.21	0.64	0.53	0.29

The data for milk were also fitted to a straight line ignoring the last expenditure class (figs 5-6). The values of '*b*' for the lines, indicating the slope, are considerably higher than those for salt (Table 8). The values of parameters '*a*' in the equations are all negative. Allen and Bowley would classify commodities with negative 'a' as luxury items. But very low values of '*a*' in this instance would rank it low in any ordering of luxury items.

TABLE (8): PARAMETERS FOR MILK

rounds	rural		urban	
	a	b	a	b
(0)	(1)	(2)	(3)	(4)
4th	-0.4375	0.0556	-0.4614	0.0661
5th	-0.3657	0.0625	-0.5241	0.0775
7th	-1.0196	0.1008	-0.4573	0.0801

Table (9) shows the increase in the proportions of expenditure devoted to milk with the increase in the expenditure levels. The percentages range from 1.00 or less in the lowest expenditure classes to 4.66 or more in the higher expenditure classes in the rural areas. Parallel figures for urban areas are 2.01 or less for the lower expenditure classes (in two of the rounds there were no returns for the lowest expenditures class) and 4.76 or more for the higher expenditure classes. It is interesting to observe that the percentages for the highest expenditure class, which is excluded from the computatin of the fitted line, falls to a lower level for all the three rounds.

EXPENDITURE CONSUMPTION CURVES

TABLE (9): PERCENTAGE OF MILK TO TOTAL EXPENDITURE BY MONTHLY PER CAPITA EXPENDITURE CLASSES

monthly per capita expenditure classes in Rs.	rural			urban		
	4th round	5th round	7th round	4th round	5th round	7th round
(0)	(1)	(2)	(3)	(4)	(5)	(6)
0 — 4	1.00	0.03	0.15	—	0.38	—
5 — 7	1.26	1.26	1.23	0.32	0.79	2.01
8 — 10	1.69	1.58	1.52	1.71	2.00	2.12
11 — 12	1.95	2.12	2.86	2.02	2.98	4.21
13 — 14	1.69	2.61	3.62	3.13	4.23	4.34
15 — 17	2.49	3.32	2.98	3.11	4.68	3.21
18 — 20	2.55	3.83	4.63	4.49	4.15	5.52
21 — 23	2.94	4.39	5.17	5.00	5.68	6.01
24 — 27	3.52	3.91	4.72	4.21	5.49	6.14
28 — 33	3.83	4.67	4.72	5.04	4.44	7.02
34 — 42	4.42	6.78	5 39	6.77	7.29	8.54
43 — 54	4.48	7.12	5.04	5.38	6.89	6.93
55 — 74	5.24	4.66	11.46	5.71	6 92	6.80
75 and above	2.28	2.24	5.59	4.76	6.04	6.34
all classes	3 18	3.95	4.13	4.78	5.54	5.93

The values for elasticity of expenditure on milk items range between 1.4 to 2.4 in the rural areas and round about 1.3 in the urban areaes (Table 10). Expenditure elasticity of milk decreases with the rise in expenditure levels. The data refers to milk consumed in liquid form. Data on milk and milk products, available in NSS reports, would suggest that the tendency is counteracted by increasing expenses on milk products with rising expenditure levels.

TABLE (10): EXPENDITURE ELASTICITY OF MILK CONSUMPTION

monthly per capita expenditure classes in Rs.	rural			urban		
	4th round	5th round	7th round	4th round	5th round	7th round
(0)	(1)	(2)	(3)	(4)	(5)	(6)
0 — 20	2.72	1.84	6.60	2.15	2.01	1.77
21 — 42	1.40	1.27	1.57	1.33	1.30	1.24
43 — 74	1.14	1.10	1.18	1.11	1.09	1.09
all classes	1.57	1.42	2.42	1.32	1.31	1.31

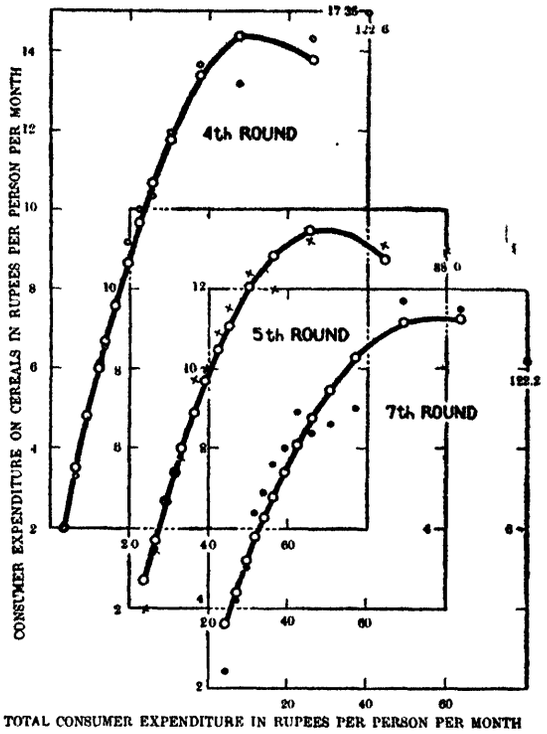
We have discussed in this paper how the relative weights of consumers expenditure differ between the food items themselves with the rise in the expenditure levels with the help of a few items. It is evident that the preference shifts to better types of food with the rise in the expenditure levels, the relative importanee of cereals and other food items diminish and more of substantial and proteinous foods are consumed. The results presented here are of tentative nature and a more comprehensive study covering the major items of consumption is under way.

ACKNOWLEDGEMENT

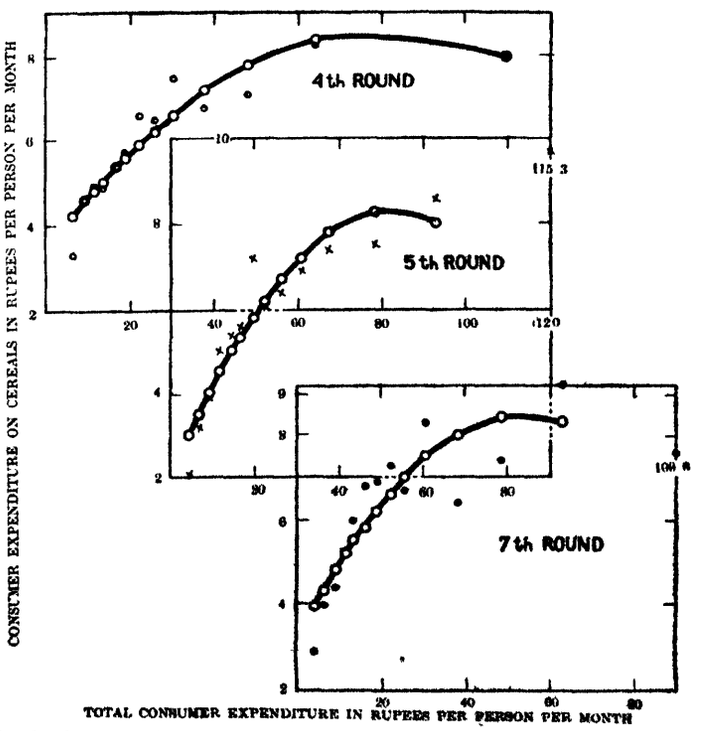
The author is grateful to Shri Ashoke Gupta who was mainly responsible for the mass of computation work involved in the study.

EXPENDITURE CONSUMPTION CURVES

NATIONAL SAMPLE SURVEY
All India (Rural)
Figure 1

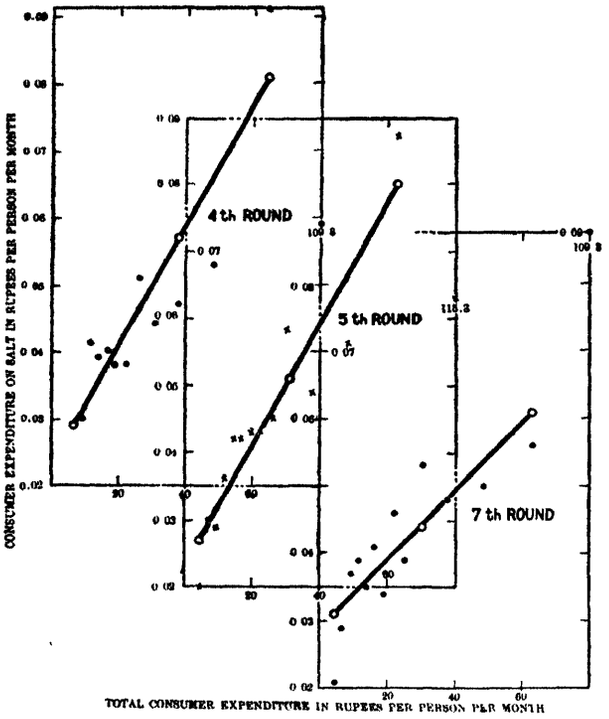


NATIONAL SAMPLE SURVEY
All India (Urban)
Figure 2

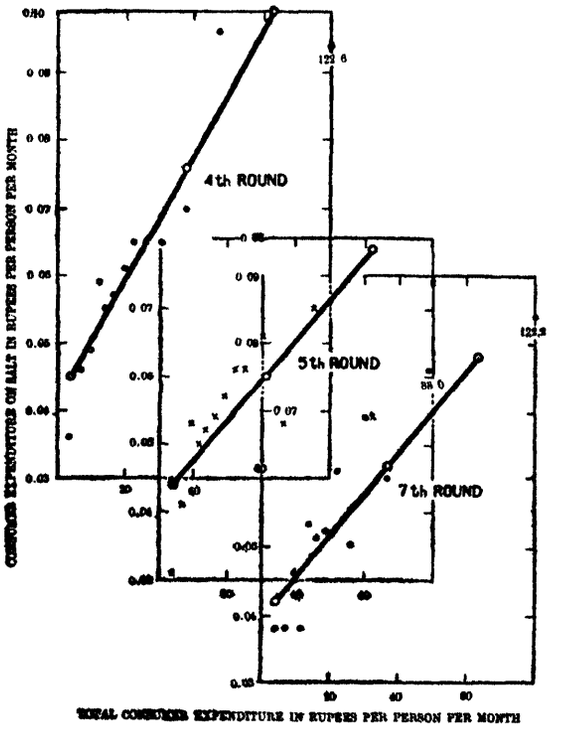


4th Round : April-September 1953; 5th Round : December 1952—March 1953; 7th Round : October 1953—March 1954.

NATIONAL SAMPLE SURVEY
All India (Rural)
Figure 3



NATIONAL SAMPLE SURVEY
All India (Urban)
Figure 4



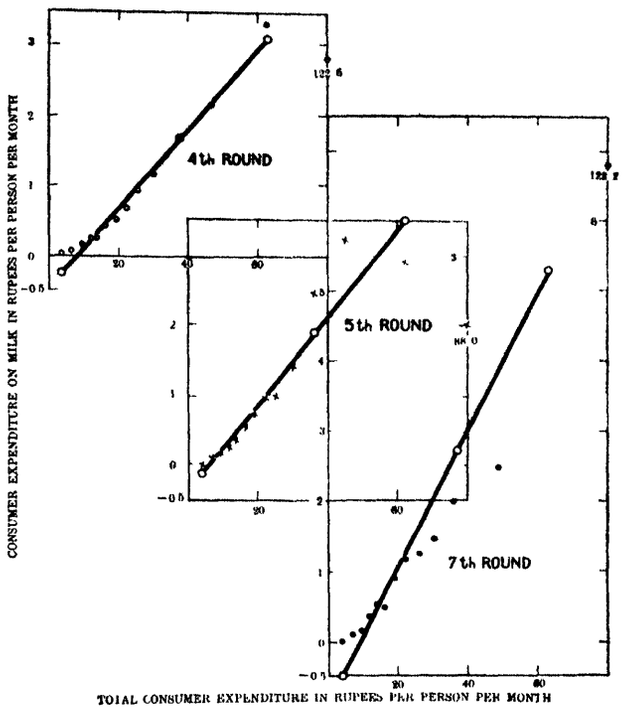
4th Round : April-September 1953; 5th Round : December 1952—March 1953; 7th Round : October 1953—March 1954.

EXPENDITURE CONSUMPTION CURVES

NATIONAL SAMPLE SURVEY

All India (Rural)

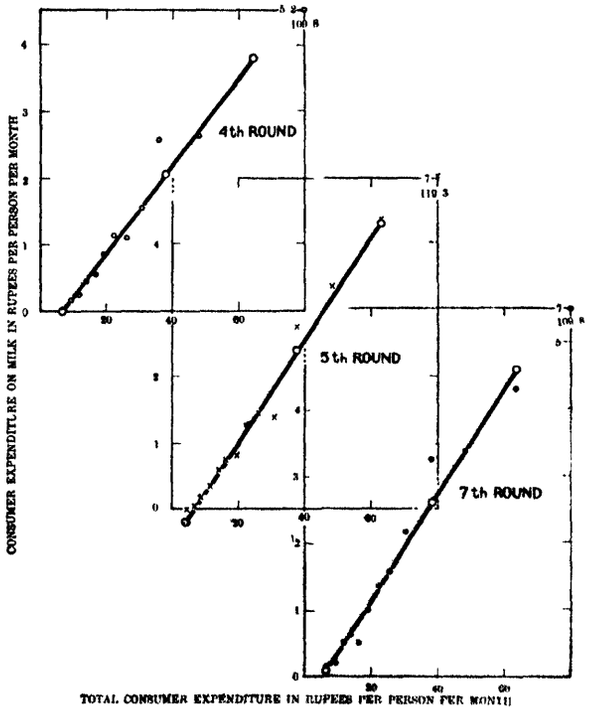
Figure 5



NATIONAL SAMPLE SURVEY

All India (Urban)

Figure 6



4th Round : April-September 1953; 5th Round : December 1952—March 1953; 7th Round: October 1953—March 1954.

A STUDY ON THE PATTERN OF CONSUMER EXPENDITURE IN RURAL AND URBAN INDIA

By J. ROY AND S. K. DHAR

The importance of studying the pattern of consumer expenditure in connection with the formulation of plans for national development has been emphasised by Professor Mahalanobis (1955). Under a planned programme of governmental investment, the real income of individuals is expected to rise. This, in turn, will increase consumer demand for different commodities, and unless provision is made for meeting, at least partially, this increased demand, prices may rise and cause serious difficulties. Estimates of expected increase in expenditure on different items are, therefore, very useful in planning. If the pattern of expenditure by households at different levels of income is known and the assumption is made that when a household moves on to a higher level, its pattern of expenditure tends to be the same on an average as that of a household which is at present in that higher level, it is then possible to estimate the expected increase in demand for any given change in the distribution of income.

The material on consumer expenditure collected by the National Sample Survey (NSS) in India has been utilised by Roy and Laha (see pp. 9—16) to estimate the pattern of expenditure in rural and urban India. This paper is, in a sense, a follow-up of their work.

In this paper, a study is made of the distribution of household expenditure in rural and urban India and these are found to be approximately of the log-Normal type. A regression relationship is sought between the expenditure on a particular item and the total household expenditure per person. Constant elasticity curves and Törnqwist's hyperbolic forms are tried and it is found that though Törnqvist's forms generally give better fit, the constant elasticity curve is good enough for all practical purposes. An investigation is made of the notion of 'adult-equivalent' and 'consumption unit' by studying the difference in the expenditures made by households of different composition.

The data

The data for this study are taken mostly from the NSS Report No. 19: Pattern of consumer expenditure. The NSS is a repetitive fact-finding survey, carrying out about two rounds of survey in a year. The collection of the data by personal interview is carried out by an independent field organisation set up by the Government of India whereas the design, analysis and overall technical supervision are undertaken by the Indian Statistical Institute. For a detailed account of the NSS, the reader should see the occasional reports issued by the NSS. Since this study is based on material collected during the 7th round of the survey, a brief account of this round is given here for ready reference.

PATTERN OF CONSUMER EXPENDITURE

The period of the 7th round of the survey was from October 1953 to March 1954. The entire geographical area of the Indian Union excluding Jammu and Kashmir, Andaman and Nicober islands and Sikkim was covered.

A stratified multistage sampling plan was used in the survey. Sampling in the first two stages was with replacement and probabilities proportional to area or population of the units and in the third or final stage a systematic sample was taken. In the rural sector, after extensive stratification, a tehsil (a revenue division of an average area of 500 square miles) formed the first stage unit, villages within a tehsil the second stage unit and households in a village the third stage unit. In the urban sector, the towns (excluding the four big cities Bombay, Calcutta, Delhi and Madras) formed the first stage units. The four big cities were all included because of their special importance. Blocks within a town formed the second stage units and households in a block the ultimate third stage units. In all 1413 households in 954 villages in the rural sector and 558 households in 441 blocks were surveyed. The survey was split up into independent interpenetrating subsamples thus providing two independent estimates of each characteristic. For the purpose of this study overall estimates obtained by combining the two independent estimates are taken.

Table (1) which gives the basic material in this study shows the pattern of household expenditure in rural and urban India separately. This is extracted from Table (1.60.9) and Table (2.60.8) of NSS Report No. 19. This Table gives the expenditure per person for a period of thirty days on twelve groups of items for each of twleve different groups of households. The households are grouped in ascending order of magnitude of the total monthly household expenditure per person, the class-limits being fixed such that approximately equal number of sample households are included in each class.

In this Table, foodgrains include husked grains of rice, wheat, jowar, bajra, Bengal-gram, barley, small millets, ragi and other foodgrains such as tapioca, pea, etc. Milk and milk products include milk, ghee, butter, dahi, ghol (lassi), khoa, chhana and other milk product. Edible oil includes mustard oil, coconut oil, gingelly oil (til oil) groundnut oil, vanashpati oil seeds and others. Salt includes common salt, sea salt, rock salt and other salts. Sugar includes cane sugar, gur (unrefined sugar) and sugar candy. Other food items include pulses and products, vegetables fruits and nuts, spices and beverages and refreshments, Among the non-food items, clothing, fuel and light rent, taxes are given separately and the rest are treated as miscellaneous. Clothing includes cotton (millmade, handloom, khadi) silk, wool and bedding and upholstery. Fuel and light include coal, fire-wood, electricity, gas kerosine, candle, matches and other lighting agents. Rents cover rents on residential houses, residential land and other goods. Taxes include road cess, chowkidari tax, municipal rates, consumer licenses fees, etc. The miscellaneous items cover pan, tobacoo and products, drugs and intoxicants, amusement and sports, education, medicine, toilets, sundry goods, furniture, services, conveyance, ceremonials, etc.

TABLE (1): PATTERN OF HOUSEHOLD EXPENDITURE IN RURAL AND URBAN INDIA—SHOWING THE MONTHLY EXPENDITURE ON DIFFERENT ITEMS IN RUPEES PER MONTH PER PERSON FOR HOUSEHOLDS AT DIFERENT LEVELS OF EXPENDITURE.

Source : NSS : 7th round, October 1953—March 1954 Report No. 19.

All India : RURAL

per capita monthly expenditure	percentage distribution of persons	per capita monthly expenditure in Rs. on												
		food grains	milk and milk products	edible oil	meat, egg and fish	sugar	salt	other food items	clothing	fuel and light	rent	taxes	miscellaneous	all items
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
— 7	15.47	3.88	0.10	0.12	0.10	0.08	0.04	0.65	0.20	0.59	0.00	0.01	0.43	6.20
8 — 10	17.80	5.24	0.27	0.22	0.23	0.16	0.05	1.10	0.78	0.84	0.01	0.01	0.72	9.63
11 — 12	12.04	6.60	0.60	0.26	0.28	0.28	0.04	1.43	0.51	0.80	0.00	0.01	1.11	11.92
13 — 14	10.31	7.08	0.79	0.42	0.36	0.39	0.05	1.48	1.10	0.91	0.05	0.01	1.32	13.96
15 — 17	10.83	7.82	0.90	0.44	0.37	0.41	0.05	1.87	1.28	1.15	0.00	0.03	1.89	16.21
18 — 20	8.75	8.14	1.45	0.55	0.49	0.58	0.05	2.19	1.84	1.30	0.06	0.01	2.40	19.06
21 — 23	6.94	9.05	1.99	0.53	0.47	0.59	0.06	2.37	2.84	1.42	0.03	0.02	2.89	22.26
24 — 27	5.77	8.58	2.25	0.62	0.49	1.11	0.05	3.44	3.04	2.18	0.00	0.03	4.27	26.06
28 — 33	4.82	8.98	2.79	0.77	1.08	1.13	0.07	3.38	4.28	1.85	0.06	0.10	6.04	30.53
34 — 42	3.73	9.43	3.67	0.92	1.27	1.22	0 06	3.86	5.30	1.71	0.84	0.07	8.54	30.89
43 — 54	1.97	12.70	5.67	1.34	1.48	1.76	0.08	5.02	6.09	2.05	0.11	0.06	12.62	48.98
55 —	1.57	11.15	13.67	3.58	0.81	2.82	0.08	6 95	7.64	3.44	0.30	0.43	38.18	89.06
all classes	100.00	6.96	1.31	0.45	0.41	0.49	0.05	1.90	1.66	1.14	0.06	0.03	2.78	17.24

All India : URBAN

per capita monthly expenditure	percentage distribution of persons	per capita monthly expenditure in Rs. on												
		food grains	milk and milk products	edible oil	meat, egg and fish	sugar	salt	other food items	clothing	fuel and light	rent	taxes	miscellaneous	all items
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
— 7	7.52	3.78	0.14	0.16	0.09	0.06	0.03	0.89	0.06	0.54	0.03	0.00	0.46	6.24
8 — 10	12.09	4.45	0.28	0.43	0.26	0.20	0.04	1.47	0.35	0.78	0.06	0.00	1.04	9.36
11 — 12	8.56	5.25	0.65	0.46	0.36	0.28	0.04	1.64	0.47	1.00	0.31	0.04	1.42	11.92
13 — 14	9.29	6.00	0.84	0.49	0.44	0.36	0.04	2.09	0.79	1.16	0.06	0.04	1.70	14.01
15 — 17	11.36	6.83	0.88	0.56	0 49	0.33	0.04	2.58	0.82	1.23	0.15	0.02	2.34	16.27
18 — 20	10.44	6.94	1.38	0.58	0.51	0.48	0.03	2.57	0 96	1.31	0.35	0.40	3.47	18.98
21 — 23	7.79	7.40	2.00	0.99	0.58	0.76	0.05	3.12	1.59	1.48	0.49	0.44	3.69	22.59
24 — 27	8.32	6.71	2.98	0.87	0.92	0.72	0.04	4.15	2.23	1.59	0.88	0.04	4.51	25.64
28 — 33	5.41	8.27	3.62	1.07	1.34	0.82	0.05	4.70	2.31	2.16	1.35	0.15	4.83	30.67
34 — 42	7.85	6.44	5.32	1.30	1.69	1.14	0.05	5.27	3.72	1.87	1.32	0.56	9.47	38.15
43 — 54	4.86	7.36	6.79	1.41	1.33	1.35	0.05	6.39	4.80	2.85	2.55	0.77	13.05	48.70
55 — above	6.51	8.60	8.77	2.07	3.60	1.58	0.07	10.21	5.71	3.77	5.66	0.60	29.69	80.33
all classes	160.00	6.33	2.34	0.79	0.84	0.59	0.04	3.37	1.68	1.50	0.88	0.22	5.30	23.88

STUDIES ON CONSUMER BEHAVIOUR

THE FREQUENCY DISTRIBUTION OF MONTHLY EXPENDITURE PER PERSON IN INDIA

The form of the distribution of income has been the subject of many theoretical and empirical economic investigations since Pareto (1897) formulated his famous law that the number of persons with income greater than x is proportional to $x^{-\nu}$ where ν is a constant approximately 1.5 in value. Pareto's law itself has raised some controversy, one school of thought (see Davis (1941)) regarding this as a special form of a more general law of the distribution of special abilities, and a different school (Pigou (1932) Dalton (1929)) denying any universal validity of Pareto's law. Yardi (1951) examined the empirical evidence regarding Pareto's law and found it to be unsatisfactory. The point, however, is not whether deviations from Pareto's law are statistically significant, but whether the law gives a *reasonably good* fit to the data.

Theoretical models of generation of income distributions have been constructed by various authors. Champernowne (1953) considers a subdivision of income into successive ranges in geometric progression and denotes by P_{ij}^t the probability that a person in the income ranges i at time t will lie in the income range j at time $t+1$. On the assumption that P_{ij}^t is a function of t and $j-i$ only, he shows that the equilibrium distribution tends to Pareto's form. On the other hand, if the mode of generation of incomes is such that the probability that a person with income in the interval (x_t, x_t+dx_t) at time t will have income in the interval $(x_{t+1}, x_{t+1}+dx_{t+1})$ at time $t+1$ depends only on t and on the ratio x_{t+1}/x_t and therefore, can be denoted by $dH_t(X_{t+1}/X_t)$ then $F_t(x_t)$ the distribution function of income at time t satisfies the recurrence relation

$$dF_{t+1}(x_{t+1}) = \int_0^\infty dH_t(x_{t+1}/x_t)dF_t(x_t)$$

This is the same as the equation derived by Kolmogorov (1941) for a breakage process. Consequently, the ultimate distribution of incomes should follow the log-Normal distribution. A detailed discussion of this model is given by Aitchison and Brown (1957).

In India, specially in the rural sector, savings per persons form a very negligible fraction of the expenditure per person. The distribution of expenditure per person is thus likely to follow the same pattern as that of income. Moreover statistics of income are usually very unreliable. In this section, an empirical study is made of the form of the distribution of expenditure per person in rural and urban India separately.

Let us denote by $Q(X)$ the proportion of persons in households with a monthly expenditure of Rs. X per person or more. Then, if the distribution of monthly expenditure per person is of Pareto's type, we must have

$$\log\ Q(X) = \mu+\theta \log X$$

so that the graph of log Q against log X should be linear. On the other hand, if the distribution is log-Normal, we must have

$$Q(X) = \phi\left(\frac{\log X - \theta}{\lambda}\right)$$

where ϕ is the Normal probability integral

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

and θ and λ are respectively the mean and the standard deviation of the distribution of the logarithm of the monthly expenditure per person. Consequently, if η, the probit of Q defined by

$$Q(X) = \phi(\eta)$$

is plotted against log X, the graph should be a straight line :

$$\eta = A + B \log x$$

where

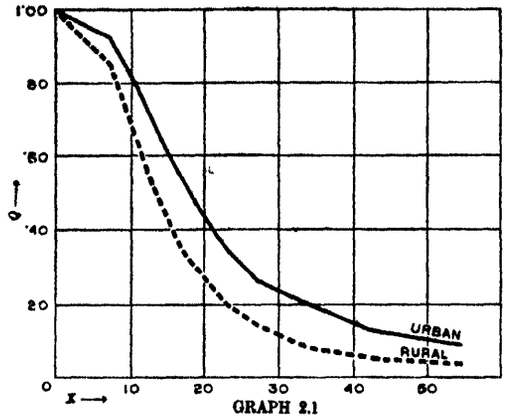
$$A = -\theta/\lambda$$

and

$$B = 1/\lambda$$

These graphs are plotted seperately for rural and urban India using the distribution of monthly expenditure per person as obtained from NSS : 7th round and presented in report No. 19. Graph 2.1 gives the cumulative distribution in the original scale, graph 2.2 in the double log scale and graph 2.3 in the log-probit scale. It appears from these graphs that while the graph 2.2 is considerably curved, the graph 2.3 is approximately linear and parallel for the rural and urban sectors. This indicates that over the whole range of monthly expenditure per person, the distribution is not of Parete's type but may be regarded as approximately of the log-Normal type. The parallelism of the lines for the rural and urban sectors indicates that the coefficient of variation of the distribution of monthly expenditure per person is approximately the same for the two sectors. It is also evident from the graph that the log-Normal fit is better for the rural sector than for the urban sector.

The log-Normal distribution involves two parameters θ and λ, the mean and the standard deviation of the distribution of the logarithm of the variate. Though the mean of the distribution of the monthly expenditure per person has been estimated by the NSS, estimates of the mean and the variance of its logarithm are, however, not available. These could have been estimated from the frequency distribution given in



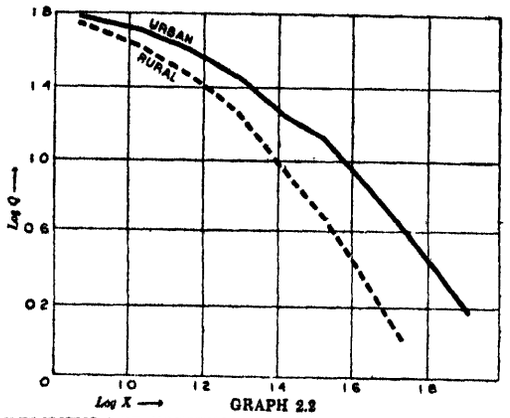
GRAPH 2.1

DISTRIBUTION OF HOUSEHOLD EXPENDITURE PER PERSON PER MONTH IN RURAL AND URBAN INDIA

NSS 7th ROUND (OCTOBER 1953—MARCH 1954)

Q-PROPORTION OF PERSONS IN HOUEHOLDS WITH A MONTHLY EXPENDITURE OF RUPEES X PER PERSON OR MORE

X-EXPENTITURE IN RUPEES PER PERSON PER MONTH



GRAPH 2.2

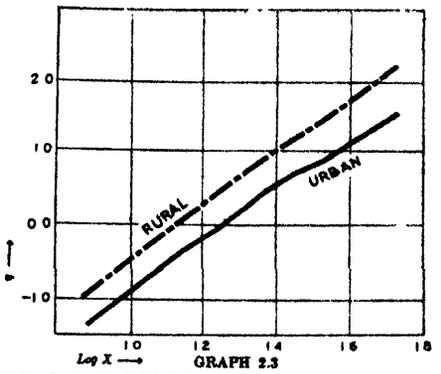
DISTRIBUTION OF HOUSEHOLD EXPENDITURE PER PERSON PER MONTH IN RURAL AND URBAN INDIA

DOUBLE LOG SCALE

NSS 7th ROUND (OCTOBER 1953—MARCH 1954)

Q-PROPORTION OF PERSONS IN HOUEHOLDS WITH A MONTHLY EXPENDITURE OF RUPEES X PER PERSON OR MORE

X-EXPENTITURE IN RUPEES PER PERSON PER MONTH



GRAPH 2.3

DISTRIBUTION OF HOUSEHOLD EXPENDITURE PER PERSON PER MONTH IN RURAL AND URBAN INDIA
LOG—PROBIT SCALE
NSS 7th ROUND (OCTOBER 1953—MARCH 1954)

X-EXPENDITURE IN RUPEES PER PERSON PER MONTH

$$Q = \int_{\eta}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}\, dx$$

Table (1) but the grouping is rather coarse and two classes are indefinite. Estimates of θ and λ were obtained by fitting straight lines to graph 2.3 by the method of least squares. The estimates of θ and λ, the observed and theoretical frequencies are presented in Table (2).

TABLE (2): LOG-NORMAL DISTRIBUTION FITTED TO THE DISTRIBUTION OF MONTHLY EXPENDITURE PER PERSON IN RURAL AND URBAN INDIA

Source: NSS: 7th round (October 1953—March 1954)

monthly expenditure in Rs. per person	percentage of persons			
	rural		urban	
	observed	theoretical*	observed	theoretical*
(1)	(2)	(3)	(4)	(5)
— 7	15.47	17.14	7.52	9.15
8 — 10	17.80	16.93	12.09	11.14
11 — 12	12.04	10.69	8.56	8.07
13 — 14	10.31	9.46	9.29	7.91
15 — 17	10.83	11.56	11.36	10.87
18 — 20	8.75	8.75	10.44	9.37
21 — 23	6.94	6.48	7.79	7.81
24 — 27	5.77	6.05	8.32	8.28
28 — 33	4.82	5.51	5.41	8.84
34 — 42	3.73	4.03	7.85	7.97
43 — 54	1.97	2.08	4.86	5.32
55 —	1.57	1.31	6.51	5.29
all classes	100.00		100.00	

* Computed on the basis that the logarithm (Base 10) of monthly expenditure per person is distributed normally with the following means and standard deviations:

	Rural	Urban
mean	1.13265	1.26401
standard deviation	0.27146	0.29200

CONSTANT ELASTICITY CURVE

If the elasticity of expenditure on a particular item is constant at all levels of total expenditure, the average expenditure on the item (Y) in households with a total expenditure of X is given by:

$$\log Y = \alpha + \beta \log X \qquad \ldots \quad (3.1)$$

both X and Y being expressed in rupees per person per month to correct for the variation in size of household. The graph of Y against X in double logarithmic scale should then be linear. This was plotted for all the items separately for the rural and urban sectors in graphs; over the whole range of expenditure, graphs for certain items (food total, milk and milk products, edible oils, fuel and light, miscellaneous items) appear to be approximately linear, whereas the graph for other items generally rise less rapidly at higher levels of expenditure. The graphs indicate that a constant elasticity curve defined by (3.1) may not give too bad a fit to the observed data for most of the items. Further advantages of this curve are that the parameters can be estimated easily and algebraic manipulations are simpler than with most other forms. The curve (3.1) was, therefore, fitted for all the different items of expenditure by the method of weighted least squares, the weights being the proportion of persons in each group. The values of the parameters as estimated are presented in Table (3). It will be seen that the constant elasticity curve generally overestimates the expenditure on an item at higher levels of expenditure.

TABLE (3): PARAMETERS OF CONSTANT ELASTICITY ENGEL CURVE

$\log_{10} Y = \alpha + \beta \log_{10} X$

where Y = expenditure on item and X = total expenditure in rupees per month per person

items	values of the parameters			
	rural		urban	
	α	β	α	β
(1)	(2)	(3)	(4)	(5)
food grains	0.226	0.516	0.403	0.303
milk and milk products	-2.470	1.989	-2.182	1.786
edible oil	-2.149	1.181	-1.355	0.916
meat, egg and fish	-1.805	1.138	-1.941	1.328
sugar	-2.277	1.554	-1.950	1.245
salt	-1.598	0.254	-1.707	0.256
all food items	0.179	0.808	0.131	0.758
clothing	-1.900	1.661	-2.207	1.719
fuel and light	-0.780	0.690	-0.810	0.729

If the distribution of total expenditure is log-Normal and the relationship between the expenditure on a particular item and the total expenditure can be described by a constant elasticity curve, the average expenditure on the item can be readily computed using formula (A. 12) given in the appendix. In order to examine

what difference it makes on different items the average expenditure on different items expected under the assumption of log-Normality and constant elasticity were computed. These are presented together with the observed figures in Table (4).

TABLE (4) : COMPARISON OF OBSERVED AND EXPECTED* VALUES OF MONTHLY EXPENDITURE ON DIFFERENT ITEMS PER PERSON

items	expenditure on the item per person per month in Rs.			
	rural		urban	
	observed	expected*	observed	expected*
(1)	(2)	(3)	(4)	(5)
food grains	6.96	6.80	6.33	5.77
milk and milk products	1.31	1.32	2.34	3.69
edible oil	0.35	0.43	0.79	0.95
meat, egg and fish	0.41	0.39	0.84	1.10
sugar	0.49	0.49	0.59	0.80
salt	0.05	0.05	0.04	0.45
all food items	11.57	14.11	14.30	16.65
clothing	1.66	1.65	1.68	2.68
fuel and light	1.14	1.10	1.50	1.73

* Computed on the basis that elasticity is constant and the distribution of expenditure in Rs./person/month is log-Normal.

TORNQVIST'S FORMS

Törnqvist (1941) suggested three different hyperbolic forms for Engel curves :

$$\text{(a)} : Y = \alpha \frac{X}{X+\beta}$$

$$\text{(b)} : Y = \begin{cases} \alpha \dfrac{(X-\gamma)}{X+\beta} & \text{for } X \geqq \gamma \\ 0 & \text{for } X < \gamma \end{cases}$$

$$\text{(c)} : Y = \begin{cases} \alpha \dfrac{(X-\gamma)^2}{X+\beta} & \text{for } X \geqq \gamma \\ 0 & \text{for } X < \gamma \end{cases}$$

where Y stands for the expenditure on a particular item and X for the income of a household. Another hyperbolic form used by Prais and Houthakker (1955) is

$$\text{(d)} : Y = \alpha + \frac{\beta}{X}$$

Forms (a) and (d) have been suggested for items which may be regarded as 'necessities' (b) for 'semi-luxuries' and (c) for 'luxuries'. A detailed description of Törnqvist's functions is given by Wold and Jureen (1953).

In this study, attempt was made to fit hyperbolic functions of types (a), (b), (c) and (d) to the data for Table (1) taking Y as the monthly expenditure on a particular item and X as the total monthly expenditure both expressed in terms of rupees per person. For functions of types (b) and (c) involving three parameters, the value of

γ was taken as $\gamma = 5$. The two parameters α and β were estimated by fitting straight lines by the method of weighted least squares using the following transformations :

$$\text{(a)}: \quad X/Y = (1/\alpha)X + (\beta/\alpha)$$

$$\text{(b)}: \quad (X-\gamma)/Y = (1/\alpha)X + (\beta/\alpha)$$

$$\text{(c)}: \quad X(X-\gamma)/Y = (1/\alpha)X + (\beta/\alpha)$$

The percentage of persons in a group was taken as the weight. All the four types were fitted for every item and the goodness of fit was measured in terms of the weighted average squared deviation δ^2 of the observed values from the function fitted:

$$\delta^2 = \Sigma w(Y - Y_e)^2 / \Sigma w$$

where w is the weight, Y the observed and Y_e the fitted value. The type for which the value of δ^2 is smallest was finally chosen. The following Table (Table 5) gives the functions finally fitted. In Table (6) the values of δ^2 for the fitted Törnqvist's functions are shown against the corresponding values of δ^2 for the fitted constant elasticity curves. Though the values of δ^2 are smaller for Törnqvist's curves, the complicated nature of the curves stands in the way of using them.

It will be seen that the elasticity coefficient

$$\eta = \frac{X}{Y}\frac{dY}{dX}$$

for these curves vary from point to point and are given by

$$\eta_a = \frac{\beta}{X+\beta}$$

$$\eta_b = \frac{X(\beta+\gamma)}{(X-\gamma)(X+\beta)}$$

$$\eta_c = \frac{X(X+2\beta)-\beta\gamma}{(X-\gamma)(X+\beta)}$$

$$\eta_d = -\frac{\beta}{\beta+\alpha X}$$

for the types (a), (b) (c) and (d) respectively. The values of the elasticity coefficients at the average level of expenditure per person computed on the basis of the Törnqvist's function fitted are shown in Table (7). These can be compared with the values β obtained from the constant elasticity curve given in Table (3).

TABLE (5): TÖRNQVIST'S FUNCTION FITTED TO DESCRIBE EXPENDITURE PATTERN IN RURAL AND URBAN INDIA

Y = expenditure on item

X = total expenditure (in rupees per person per month)

item	fitted function	
	rural	urban
food grains	$Y = \frac{18.686\,X}{X + 13.993}$	$Y = \frac{9.091\,X}{X + 8.069}$
milk and milk products	$Y = \frac{0.168(X-5)X}{X + 13.142}$	$Y = \frac{0.140(X-5)X}{X + 5.771}$
edible oils	$Y = \frac{-18.853\,X}{X - 881.141}$	$Y = \frac{7.529\,X}{X + 197.783}$
meat, egg and fish	$Y = \frac{6\ 220\,X}{X + 265.739}$	$Y = \frac{0.004(X-5)X}{X - 0.024}$
sugar	$Y = \frac{10.695\,(X-5)}{X + 239.956}$	$Y = \frac{3.312\,(X-5)}{X + 70.137}$
salt	$Y = \frac{0.083\,X}{X + 9.352}$	$Y = \frac{0.074\,X}{X + 14.520}$
food total	$Y = \frac{71.697\,X}{X + 83.151}$	$Y = \frac{68.204\,X}{X + 80.414}$
clothing	$Y = \frac{119.263(X-5)}{X + 903\ 933}$	$Y = \frac{-16.261(X-5)}{X - 230.328}$
fuel and light	$Y = \frac{4.721\,X}{X + 49.368}$	$Y = \frac{6.845}{X + 76.008}$

TABLE (6): VALUES OF δ^2 (WEIGHTED AVERAGE SQUARED DEVIATION OF OBSERVED EXPENDITURE FROM FITTED FUNCTION) FOR DIFFERENT ITEMS

items	rural		urban	
	constant elasticity	Törnqvist	constant elasticity	Törnqvist
(1)	(2)	(3)	(4)	(5)
food grains	0.935	0.226	0.578	0.338
milk and milk products	2.345	0.041	4.385	0.352
edible oil	0.030	0.029	0.018	0.008
meat, egg and fish	0.061	0.034	0.039	0.033
sugar	0.138	0.007	0.083	0.003
salt	0.254×10^{-4}	0.274×10^{-4}	0.331×10^{-4}	0.453×10^{-4}
all food items	3.252	0.319	0.787	0.241
clothing	3.291	0.272	2.510	0.534
fuel and light	0.032	0.031	0.017	0.025

TABLE (7): ELASTICITY COEFFICIENTS AT MEAN EXPENDITURE OBTAINED FROM TÖRNQVIST'S FORMS

items	elasticity at mean expenditure	
	rural	urban
food grains	0.448	0.253
milk	1.841	1.459
edible oil	1.022	0.892
meat, egg and fish	0 939	1.264
sugar	1.341	1.355
salt	0.352	0.378
food total	0.828	0 771
clothing	1.390	1.380
fuel and light	0.741	0.761

Effect of composition of household

In order to make a preliminary study of the difference in consumption by households of differing composition, a special Table (Table 8) was compiled. The basic material for this Table was collected in the 7th round of the NSS and relates to the rural sector of the state Uttar Pradesh. For households classified by the number of adults and children (age less than twelve), the Table gives the average monthly consumption in seers per household of a number of different items. Six major types of households were only included.

On the assumption that the standards of living of households of differing composition are not much different, we sought to explain the variation in the consumption in terms of the difference in the numbers of adult and child members of the households. Denoting by n_1 the number of adult members, and by n_2 the number of child members and by α the consumption per adult and by β the consumption per child, the expected consumption C by a household is given by

$$C = \alpha n_1 + \beta n_2$$

The parameters α and β have been estimated from the data in Table (8) by the method of weighted least squares (the weights being the size of sample) and are presented below in Table (9). The item sugar and gur has been excluded because a negative estimate of β comes out.

It will be seen that the ratio β/α varies from 0.29 to 0.36. This implies that the consumption by a child is approximately 1/3 that by an adult for all the four groups of items considered.

PATTERNS OF CONSUMER EXPENDITURE

If we regard an adult as a 'consumption-unit', a child may then be regarded as 1/3 'consumption unit' approximately. A household of 2 adults and 3 children thus consists of 3 'consumption units'. We present in Table (10), for the six types of households considered, the monthly consumption of different items both in terms of seers per person and seers per 'consumption unit'. The last row gives the variance of the consumption amongst the six types of households. It is found that the variation can to a large extent be explained by the assumption that the adult-equivalence ratio is 1/3.

TABLE (8): MONTHLY CONSUMPTION OF DIFFERENT ITEMS IN SEERS PER HOUSEHOLD OF DIFFERING COMPOSITION IN RURAL UTTAR PRADESH (NSS: 7th round)

number of persons in household		number of sample household	total monthly expenditure per household in rupees	monthly consumption in seers per household of				
adults	children			cereals	milk and milk products	pulses and products	oil and products	sugar and gur
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	0	51	29.40	26.24	2.40	3.66	0.43	1.06
2	0	34	58 43	56.27	8.60	6.03	0.74	5.41
2	1	52	49.47	67.71	11.90	6.90	0.69	3.81
2	2	67	64.32	75.25	12.89	6.79	0.81	4.09
2	3	45	72.79	82.61	13.52	8.74	1.03	4.43
3	2	48	79.32	90.00	25.20	7.64	1.02	8.15

TABLE (9): CONSUMPTION PER ADULT AND CHILD

item	monthly consumption in seers per		adult equivalent β/α
	adult (α)	child (β)	
(1)	(2)	(3)	(4)
cereals	26.56	9.48	0.36
milk and milk products	5.53	1.58	0.29
pulses and products	2.66	0.77	0.29
oil and oil products	0.32	0.11	0.33

TABLE (10): MONTHLY CONSUMPTION OF DIFFERENT ITEMS (A) PER PERSON AND (B) PER CONSUMPTION UNIT BY HOUSEHOLDS OF DIFFERENT COMPOSITION, NSS: 7TH ROUND UTTAR PRADESH (RURAL).

no. of persons in household		household size	consumption unit	monthly consumption in seers per person of					monthly consumption in seers per consumption unit with				
adults	children			cereals	milk and milk products	pulses and products	oil and products	sugar and gur	cereals	milk and milk products	pulses and products	oil and products	sugar and gur
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	0	1	1.00	26.24	2.40	3.66	0.43	1.06	26.24	2.40	3.66	0.43	1.06
2	0	2	2.00	28.14	4.30	3.02	0.37	2.70	28.14	4.30	3.02	0.37	2.70
2	1	3	2.33	22.57	3.97	2.30	0.23	1.27	29.06	5.11	2.96	0.30	1.64
2	2	4	2.67	18.81	3.22	1.70	0.20	1.02	28.18	4.82	2.54	0.30	1.53
2	3	5	3.00	16.52	2.70	1.75	0.20	0.89	27.54	4.51	2.91	0.34	1.48
3	2	5	3.67	18.00	5.04	1.53	0.20	1.63	24.52	6.87	2.08	6.28	2.22
variance				18.6200	0.8491	0.6031	0.0086	0.3792	2.2475	1.7287	0.2314	0.0026	0.2883

APPENDIX

A.1. *Univariate log-Normal distribution*

A random variable X is said to follow the log-Normal distribution if $Z = \log_e X$ is distributed Normally. If the mean and the standard deviation of Z are denoted respectively by $E(Z) = \theta$ and $V(Z) = \lambda^2$, we have the t-th moment about origin of X given by

$$E(X^t) = \exp.(\theta t + \tfrac{1}{2}\ \lambda^2 t^2) \qquad \ldots \quad (A.1)$$

and, in particular,

$$E(X) = \exp(\theta + \tfrac{1}{2}\lambda^2) = \mu(\text{say}) \qquad \ldots \quad (A.2)$$

$$V(X) = \mu^2(e^{\lambda^2} - 1) = \sigma^2\ (\text{say}) \qquad \ldots \quad (A.3)$$

Thus

$$\theta = \log_e \mu - \tfrac{1}{2}\lambda^2 \qquad \ldots \quad (A.4)$$

and

$$\lambda^2 = \log_e\ (v^2 + 1) \qquad \ldots \quad (A.5)$$

where the coefficient of variation of X is denoted by

$$v = \sigma/\mu \qquad \ldots \quad (A.6)$$

A.2. *Bivariate log-Normal distribution*

Similarly, two random variables X and Y are said to follow the bivariate log-Normal distribution, if $Z = \log_e X$ and $W = \log_e Y$ follow a bivariate Normal distribution. Denote the parameters of the conditional distribution of W for fixed Z by

$$E(W/Z) = \alpha' + \beta Z \qquad \ldots \quad (A.7)$$

$$V(W/Z) = \lambda_o^2 \qquad \ldots \quad (A.8)$$

Then

$$E(Y/X) = AX^{\beta} \qquad \ldots \quad (A.9)$$

where

$$A = e^{\alpha} \qquad \ldots \quad (A.10)$$

and

$$\alpha = \alpha' + \tfrac{1}{2}\ \lambda_o^2 \qquad \ldots \quad (A.11)$$

If the parameters of the marginal distribution of X are denoted by $E\ (\log X) = \theta$ and $V(\log X) = \lambda^2$, it follows that

$$E(Y) = \exp(\alpha + \theta\beta + \tfrac{1}{2}\ \lambda^2\beta^2) \qquad \ldots \quad (A.12)$$

A.3. *Application of the log-Normal distribution in projection of consumption*

Let Y denote the per capita expenditure on a certain item and X the overall per capita expenditure. Suppose that the joint distribution of X and Y is bivariate log-Normal with parameters α, β θ, λ as defined in section A.2. Then the average per capita expenditure on the item is given by formula (A.12). Suppose now that the marginal distribution of overall expenditure X is altered in such a way that the form of the distribution remains log-Normal but the values of the parameters θ, λ change to θ', λ'. On the assumption that the pattern of per capita expenditure on different items for fixed overall per capita expenditure (indicated by formulae (A.7) and (A.8) remains invariant, the expected per capita expenditure on the item would then be given by (A.12) with θ and λ replaced by θ' and λ'. For small changes $\Delta\theta$ and $\Delta\lambda$ in θ and λ respectively, the change $\Delta\phi$ in $\phi = E(Y)$, the average expenditure on the item, is given approximately by

$$\frac{\Delta\phi}{\phi} = \beta\theta \cdot \left(\frac{\Delta\theta}{\theta}\right) + \beta^2\lambda^2 \cdot \left(\frac{\Delta\lambda}{\lambda}\right) \qquad \ldots \quad (A.13)$$

Empirical justification of the use of the log-Normal distribution, estimates of the parameters θ, λ of the distribution of overall monthly expenditure per capita and of the parameters α, β for a number of items have been obtained from material collected in the 7th round of the NSS and are presented in the body of the paper.

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A STUDY OF CONCENTRATION CURVES AS DESCRIPTION OF CONSUMPTION PATTERN

By J. ROY, I. M. CHAKRAVARTI AND R. G. LAHA

INTRODUCTION

The pattern of consumption of different commodities at different levels of overall expenditure is a basic datum in all programmes of planning for a better standard of living. Professor Mahalanobis has made use of concentration curves to describe and compare the consumption pattern for different commodities based on the material collected by the National Sample Survey (NSS).

Mahalanobis's concentration curve is similar, in principle, to the Lorenz Curve. The Lorenz Curve shows the percentage $100q_0$ of the total income enjoyed by the poorest 100p percent of the population—and is generally used by economists to derive a measure of concentration of the distribution of income in the population. The concentration curve for a commodity C gives the percentage 100q of the total consumption of the commodity C consumed by the poorest 100p percent of the population. So the curve itself is absolutely independent of units of money or of quantity and is readily comparable with concentration curves for different commodities in different localities or at different points of time.

The similarity ends there, however. The Lorenz Curve is only a special case of the concentration curves used by Professor Mahalanobis; it is the concentration curve for income. Concentration curves for different commodities together with the Lorenz Curve describe in a very convenient way a very important economic aspect—the pattern of consumption in the country as a whole.

It is easy to show that if Engel elasticity is constant over the whole range of income and if the distribution of income is Paretoan, the concentration curve is characterised by a single parameter. But Professor Mahalanobis found from NSS material that the assumption of constant elasticity is not tenable for the entire range of income except for a few essential commodities. This led him to formulate the principle of characterisation of the concentration curves by two parameters—the "luxury" coefficient and the "necessity" coefficient. If a commodity C lies below the concentration curve of income for the poorest 100p percent of the population and thereafter lies above it, the commodity C may be regarded as a luxury for the poorest 100p and a necessity for the remainder of the population.

STUDIES ON CONSUMER BEHAVIOUR

In the following report only some aspects of the above formulation by Professor Mahalanobis have been studied by three members of the research unit on consumption studies. This is presented in an incomplete stage in the hope that results already obtained may prove useful in problems of planning.

CONCENTRATION CURVE, LORENZ CURVE AND RELATIVE CONCENTRATION CURVE

For each individual person in the population, two values are recorded—one, the per capita expenditure of the household to which he belongs and the other, the per capita consumption (in the household) of a commodity under study. We may think of all the persons being arranged in ascending order of the per capita expenditure and cumulate from the bottom till we get a specified percentage of the population. The total consumption by this section of the population may be expressed as a percentage of the total consumption by the whole population. When this percentage of total consumption is plotted against the percentage of the population which accounts for the consumption, we get the *concentration curve* for the commodity.

We should note that in this formulation, we have essentially two items, one the classifying item—in this case the per capita expenditure and the other the reference item, —the commodity under study. The population is classified by means of the classifying item, and the pattern of consumption of the commodity in the different classes of the population is the subject of investigation.

On the other hand, in the Lorenz Curve, we have got only one item and the Lorenz Curve may be looked up as the concentration curve of the classifying item itself. Here as before, the population is arranged in ascending order of per capita expenditure and for a specified percentage of the population counted from the bottom, the total expenditure for the class is expressed as a percentage of the total expenditure of the whole population.

The essential difference between the Lorenz Curve and the concentration curve of a commodity is, therefore, that while the former describes only one aspect—the distribution of expenditure per capita in the population, the other is a description of the inter-relation between per capita expenditure and per capita consumption of a particular commodity.

We may, however, think of another representation. As before let the population be arranged in ascending order of per capita expenditure, and let us cumulate from the bottom till we get, not a specified percentage of the population, but a specified percentage of total expenditure accounted for. The total consumption of the reference commodity by these persons may be expressed as a percentage of the total consumption of the commodity by all persons. When the percentage of consumption is plotted against the percentage of total expenditure, we get, what may be called the *relative concentration curve* of the commodity.

Certain points of distinction between the concentration curve and the relative concentration curve has to be noted. Let us take a particular commodity, say—sugar. From the concentration curve of sugar, one may find out, for instance, what proportion of the total quantity of sugar consumed in the country is consumed by the poorest 20 percent of the population. Now these 20 percent of the population, being the poorest, will naturally possess not 20 percent but definitely a smaller percentage of the total purchasing power of the population. Consequently, even if the tastes and preferences of all the persons in the population had been identical, the poorest 20 percent of the population would consume much less than 20 percent of the total consumption of sugar, merely because of their limited purchasing power. The concentration curve, therefore, describes the joint effect of the differences in the purchasing power and the differences in tastes, etc., of the different per capita expenditure classes. One way of separating out these two causes is by constructing the relative concentration curve. Here between the groups the purchasing power is equalised, by taking in relatively a larger proportion of the population in the earlier groups. Thus from the relative concentration curve of sugar one can find out what proportion of the total sugar is consumed by the poorest section of the population which enjoys 20 percent of the total purchasing power. If this purchasing power was uniformally utilised to buy all commodities, the relative concentration curves of each would coincide with the egalitarian line. Any difference between the relative concentration curves of different commodities is thus due essentially to the differential preferences for different commodities at different levels of expenditure.

It will be seen immediately that the relative concentration curve may be derived from the concentration curve through the use of the Lorenz Curve. For any percentage of the population, the percentage consumption of the commodity may be read from the concentration curve and the percentage expenditure from the Lorenz Curve. When the percentage consumption is plotted against the percentage expenditure we get the relative concentration curve.

General properties of the concentration curves

The Lorenz Curve can never go above the egalitarian line, and is necessarily convex towards X-axis. The same cannot, however, be said in general about the concentration curves. Intuitively it seems that for inferior goods—that is goods for which quantity consumed falls as expenditure per capita rises—the concentration curve should lie above the egalitarian line while those for superior goods should lie below the egalitarian line. For instance, the poorer section of the population is likely to consume a very large proportion of the total consumption of say very coarse cloth, whereas the reverse should be true for superfine cloth. It seems, therefore, that the concentration curves should have some relation with the elasticities of the commodities. As one moves away from the egalitarian line further and further down the commodities should be more and more elastic. Intuition, however, gives only part of the fact as the following analysis should show.

Concentration curves are never decreasing and therefore, the slope at any point is positive. A very slight increase in the percentage of population to be included will increase the average quantity consumed by the average consumption per person of persons at the particular per capita expenditure level. The increment in the proportion of consumption is, therefore, the ratio of average consumption per person at the particular per capita expenditure level to the average consumption per person for all persons. Consequently, the slope of the concentration curve at any point is proportional to the average consumption per persons at that per capita expenditure level, the constant of proportionality being the reciprocal of the overall average consumption. The relative increase in the average consumption per person for unit relative increase in the per capita expenditure level is known as the coefficient of elasticity of consumption. But the slope at any point of the concentration curve is proportional to the average consumption per person. Consequently, the coefficient of elasticity is equal to the relative increase in the slope of the concentration curve for unit relative increase in the per capita expenditure level. This immediately tells us that the sign of the elasticity at any point is determined by the curvature of the concentration curve at that point. The formula for elasticity comes out as the rate of increase of the logarithm of the slope of the concentration curve with the logarithm of the per capita expenditure level. This may alternatively be written as the product of three factors (i) the ratio of rate of increase of the slope to the slope of the concentration curve (ii) the slope of the cumulative distribution function of the per capita expenditure and (ii) the per capita expenditure level.

If, therefore, at any point, the elasticity of one commodity be greater than that of another, the ratio of the rate of increase of slope to the slope of the concentration curve of the first commodity must be greater than that of the second, at that point. Consequently, the ratio of the slope of the first commodity to that of the second must be increasing at the point.

It is also easy to see that for perfectly elastic commodities, the relative concentration curves should coincide with the equiangular line.

Assumption of constant elasticity and paretoan distribution

Some definite conclusions are arrived at if the number of persons having a given per capita total expenditure or more is assumed to follow Pareto's law, that is if this relationship is linear in the double logarithmic scale and if the expenditure elasticity of quantity consumed is constant, that is, if the average quantity consumed of the commodity for a given per capita expenditure be linearly related with the per capita expenditure in the double logarithmic scale.

Those assumptions, severe though they are, have very often been used in practice. Pareto's law usually gives a good fit for that portion where the per capita expenditure is high, and though the proportion of population where the law applies is small, the proportion of the total consumption accounted for by this section is quite

appreciable. The assumption of constant elasticity may not hold good for the whole range of per capita expenditure level, but over small ranges; this may be quite a satisfactory approximation.

Under those assumptions the whole family of concentration curves for different commodities (of which Lorenz Curve is a special case) is typified by a single parameter. The logarithm of the proportion of the total quantity consumed by persons having per capita expenditure greater than a specified value becomes a constant multiple of the logarithm of the proportion of such persons.

This multiplier δ is necessarily positive and when it is unity the concentration curve coincides with the egalitarian line. The multiplier δ for any commodity is numerically equal to complement of the ratio of the coefficient of elasticity of the commodity to the Pareto constant for the distribution of per capita expenditure. Consequently, the multiplier δ may exceed unity only for commodities with negative elasticities. That is to say, commodities for which consumption per person falls as total expenditure per capita rises will have their concentration curves above the egalitarian line. For commodities with positive coefficient of elasticity consumption per person rises in higher per capita expenditure level and the concentration curves lie below the egalitarian line. Two concentration curves can never intersect , and of the two, the one that lies below represents the more elastic commodity. If the coefficient of elasticity is greater than unity for a rise in the level of expenditure, the proportionate rise in consumption is greater than the proportionate rise in the expenditure level. For such commodities, the concentration curves should be below the concentration curve of the per capita expenditure—the so called Lorenz Curve. The unit square is, therefore, divided by the egalitarian line and the Lorenz Curve into three regions, the one above the egalitarian line being for inferior commodity, the region between the egalitarian line and the Lorenz Curve for necessary goods and the region below the Lorenz Curve being for luxury goods.

MATHEMATICAL APPENDIX

Notations

For each member of a household, let the per capita total expenditure be denoted by x and the quantity consumed of a particular item per capita by y. Let

N = total number of persons. ... (1)

$g(x)$ = marginal probability density function of x ... (2)

$E(y/x)$ the conditional expectation of y for a given value of x ... (3)

Then the proportion of persons having per capita total expenditure less than or equal to x is

$$p(x) = \int_0^x g(x)dx \qquad \ldots (4)$$

and the total quantity of the particular item consumed by these persons is

$$Q(x) = N \int_0^x E(y|x)g(x)dx$$

the total quantity of this item consumed by all persons being

$$Q = N \int_0^\infty E(y|x)g(x)dx$$

Consequently, the proportion of the total consumed quantity of this item consumed by persons having per capita total expenditure x or less is given by

$$\begin{aligned} q(x) &= Q(x)/Q \\ &= \int_0^x E(y/x)g(x)dx \Big/ \int_0^\infty E(y/x)g(x)dx \\ &= K \int_0^x E(y/x)g(x)dx \qquad \ldots \quad (5) \end{aligned}$$

where $$K = 1 \Big/ \int_0^\infty E(y/x)g(x)dx \qquad \ldots \quad (6)$$

is the reciprocal of the average quantity consumed per capita of the particular item.

On the other hand the total expenditure by persons whose per capita expenditure is less than or equal to x is

$$Q_0(x) = N \int_0^x xg(x)dx$$

and the total expenditure by all persons is

$$Q_0 = N \int_0^\infty xg(x)dx$$

and therefore, the proportion of the total expenditure spent by these persons is

$$\begin{aligned} q_0(x) &= Q_0(x)/Q_0 \\ &= \int_0^x xg(x)dx \Big/ \int_0^\infty xg(x)dx \\ &= K_0 \int_0^x xg(x)dx \qquad \ldots \quad (7) \end{aligned}$$

where

$$K_0 = 1/\int_0^\infty xg(x)dx \qquad \ldots \quad (8)$$

is the reciprocal of the average total expenditure per capita. The curve parametrically represented by

$$\{p(x),\ q_0(x)\}$$

will be called the LORENZ CURVE and that represented by

$$\{p(x),\ q(x)\}$$

the CONCENTRATION CURVE for the particular item. The EGALITARIAN LINE is given by $\{p = q\}$

The general nature of concentration curves :

From (4), (5) and (7) we get on differentiation with respect to x :

$$\frac{dp}{dx} = g(x) \qquad \ldots \quad (9)$$

$$\frac{dq}{dx} = K\,E(y/x)\ g(x) \qquad \ldots \quad (10)$$

$$\frac{dq_0}{dx} = K_0 x g(x) \qquad \ldots \quad (11)$$

from which we immediately get

$$\frac{dq}{dp} = K\,E(y/x) \qquad \ldots \quad (12)$$

$$\frac{dq_0}{dp} = K_0 x \qquad \ldots \quad (13)$$

Expenditure elasticity of demand is defined as

$$\eta(x) = \frac{x}{E(y|x)} \cdot \frac{dE(y|x)}{dx}$$

$$= \frac{d \log E(y|x)}{d \log x} \qquad \ldots \quad (14)$$

From (14) and (16) therefore,

$$\eta(x) = \frac{d}{d \log x}\left(\log \frac{dq}{dp} \right) \qquad \ldots \quad (15)$$

which may be put in the alternative from :

$$\eta(x) = \frac{\left(\frac{d^2q}{dp^2}\right)}{\left(\frac{dq}{dp}\right)} \cdot x \frac{dp}{dx} \qquad \ldots \quad (16)$$

Hence, the sign of $\eta(x)$ depends only on the sign of $\frac{d^2q}{dp^2}$ that is, on the curvature of the concentration curve, because x, $\frac{dq}{dp}$ and $\frac{dp}{dx}$ are all positive. Therefore, if $\eta(x) < 0$ for all x, the concentration curve will lie above the egalitarian line, and if $\eta(x) > 0$ for all x the concentration curve will lie below the egalitarian line, The egalitarian line thus separates the inferior goods from the superior ones.

If there are two commodities 1 and 2, and if at a particular point x_0, the elasticity of commodity 1 is greater than that for commodity 2, that is, if

$$\eta_1(x_0) > \eta_2(x_0)$$

$$\text{i.e.} \quad \frac{\left(\frac{d^2q_1}{dp^2}\right)_{x_0}}{\left(\frac{dq_1}{dp}\right)_{x_0}} \; x_0\left(\frac{dp}{dx}\right)_{x_0} > \frac{\left(\frac{d^2q_2}{dp^2}\right)_{x_0}}{\left(\frac{dq_2}{dp}\right)_{x_0}} \; x_0\left(\frac{dp}{dx}\right)_{x_0}$$

$$\text{i.e.,} \qquad (q_1'' q_2' - q_1' q_2'')_{x_0} > 0 \qquad \ldots \quad (17)$$

where primes indicate differentiation with respect to p.
But

$$\frac{d}{dp}\left(\frac{q_1'}{q_2'}\right) = \frac{q_1'' q_2' - q_1' q_2''}{(q_2')^2}$$

Hence

$$\left\{ \frac{d}{dp}\left(\frac{q_1'}{q_2'}\right) \right\}_{x_0} > 0 \qquad \ldots \quad (18)$$

Thus at any point where the elasticity of one commodity is greater than that of another, the ratio of the slope of the concentration curve of the first commodity to that of the second will be increasing with p at the point. Other properties of this general formulation are being studied.

A special formulation

If certain assumptions about the $g(x)$ and $E(y/x)$ functions are made, some definite conclusions can be arrived at.
Assumptions :

1° $E(y/x) = Ax^B$ (Assumption of constant elasticity)

2° $g(x) = 0$ for $x < c$

$= \nu c^{\nu} x^{-(\nu+1)}$ for $x \geqq c$...(Paretoan distribution)

$\nu, c > 0$

3° $B < \nu$ (Assumption of finite total consumption of the particular commodity).
Under these assumptions we immediately derive

$$p(x) = 1-\left(\frac{x}{c}\right)^{-\nu} \quad \ldots \quad (19)$$

$$q(x) = 1-\left(\frac{x}{c}\right)^{B-\nu} \quad \ldots \quad (20)$$

$$q_0(x) = 1-\left(\frac{x}{c}\right)^{1-\nu} \quad \ldots \quad (21)$$

so that we immediately get the following as equations for the concentration curve and the Lorenz Curve :

Concentration Curve : $1-q(x) = \{1-p(x)\}^{\delta}$ ... (22)

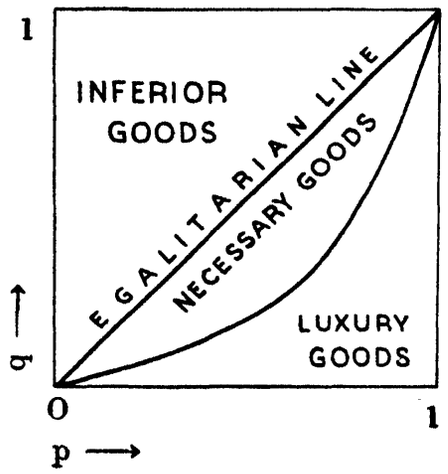
Lorenz Curve : $1-q_0(x) = \{1-p(x)\}^{\delta_0}$ ... (23)

$$\delta = 1-\frac{B}{\nu} \quad \ldots \quad (24)$$

$$\delta_0 = 1-\frac{1}{\nu} \quad \ldots \quad (25)$$

From 3°, we get $\delta > 0$

The coefficient $\frac{1-\delta}{1+\delta}$ will be termed the Index of concentration. For the egalitarian line $\delta = 1$. If $\delta < 1$, the concentration curve is below it, and if $\delta > 1$, the concentration curve is above the egalitarian line. So long as $\delta < 1$, as δ increases the concentration curves move closer and closer to the egalitarian line, but if $\delta > 1$ with increasing δ the concentration curve moves away from the egalitarian line. The concentration curve lies below the egalitarian line and above the Lorenz Curve for δ lying between δ_0 and 1, that is for values of B lying between 0 and 1 (inelastic goods). For elastic goods $B > 1$ and therefore, $\delta < \delta_0$ and the concentration curve lies below the Lorenz Curve. The whole thing may be very neatly represented in a diagram as follows :



ON DISCRIMINATION OF CONSUMER PATTERNS

By A. K. CHAKRAVERTI

INTRODUCTION

In recent times, much importance has been attached to the study of consumer expenditure of families. Large scale sample surveys designed to cover the entire nation promote an understanding of the different consumer habits. These, further, enable one to look into changing picture of consumer patterns with changing prices of consumer goods.

In this study, however, attention is not paid to any of the issues raised above. Consumer economies is being analysed from a different angle to bring out the association between changes in consumer patterns and the total disposable income of consumer households. Instances are not rare, where total disposable income has been equated to the total expenditure, in a certain sense. Consumer patterns are thus somewhat typical of expenditure classes and a family belonging to a particular expenditure level can be expected to behave, to a certain extent, in a fashion typical of that expenditure slab.

The problem can be stated in the following way. Is it possible to label a family belonging to a particular expenditure class, as a "normal" one ? Or, in other words, can we "expect" a family to behave in a particular fashion by virtue of its being a member of a particular expenditure class ?

To answer these questions, one. of course, presupposes the fact that such "normality" and "expectation" can be defined in a statistical sense. To be more specific, one has to assume the existence of a statistical criterion indicative of a particular expenditure pattern.

DISCRIMINANT ANALYSIS

The method of statistical discriminant analysis can be conveniently applied to such problems. Let us choose two expenditure slabs E_1 and E_2. Further, let us consider any m items of expenditure and let the variables $X_1, X_2, \ldots\ldots, X_m$, denote the percentages of expenditure on the different items respectively.

Let there be n households in all, of which first $1, 2, \ldots, n_1$, belong to expenditure class E_1, and the remaining $n_1+1, n_1+2, \ldots\ldots, n_1+n_2$, households belong to E_2. Thus it is possible to find out the average percentage expenditure on the i-th item $\bar{X}_i'$ and $\bar{X}_i''$ in classes E_1 and E_2, based on n_1 and n_2 observarions respectively. For the i-th item, d_i, the difference between the means is given by

$$d_i = \bar{X}_i' - \bar{X}_i'' = \frac{1}{n_1} \sum_{j=1}^{n_1} X_{ij}' - \frac{1}{n_2} \sum_{j=1}^{n_2} X_{ij}''$$

Now let us form a new variable ξ by linearly combining the variables $X_i (i = 1, 2, \ldots m)$, as

$$\xi = l_1X_1+l_2X_2+\ldots+l_mX_m$$

Denoting the difference between the means $\bar{\xi}'$ and $\bar{\xi}''$ for the two classes E_1 and E_2 respectively, by D, we get

$$D = l_1d_1+l_2d_2+\ldots+l_md_m$$

We have the variance of ξ as proportional to

$$V = \sum_{i,j} l_il_jS_{ij}$$

where $$S_{ij} = \sum_{k=1}^{n}(X_{ik}-\bar{X}_i)(X_{jk}-\bar{X}_j), \text{ for } i, j = 1, 2, \ldots, m$$

R. A. Fisher has shown that best discrimination, in a certain sense, between the two classes can be made by maximising D^2 subject to the condition that V remains constant.

This leads to the maximisation of B given by

$$B = D^2-\lambda V$$

where λ is the Lagrange multiplier. We must have,

$$\frac{\partial B}{\partial l_i} = \frac{\partial}{\partial l_i}\ \{\sum_{i,j} l_il_jd_id_j-\lambda\sum_{i,j} l_il_jS_{ij}\}$$

$$= 0$$

or $$d_i(\sum_j l_jd_j) = \lambda\sum_j S_{ij}l_j,$$

or $$\sum_j S_{ij}l_j = \frac{(\sum_j l_jd_j)}{\lambda}\ d_i, \text{ for } i = 1, 2, \ldots\ldots, m$$

Since $\sum_j l_j d_j/\lambda$ is a constant, we can ignore this, and simplify computations by solving out new $l_i's$ from the system

$$S\,\underset{\sim}{l} = \underset{\sim}{d},$$

where S is the matrix of sum of squares and products and l and d are column-vectors $\{l_1, l_2, \ldots, l_m\}$ and $\{d_1, d_2, \ldots, d_m\}$. Thus we arrive at the following solution,

$$\underset{\sim}{l} = S^{-1}\,.\,\underset{\sim}{d}$$

It may be noticed that analysis of variance of the new variable

$$\xi = l_1X_1+l_2X_2+\ldots+l_mX_m,$$

leads to similar optimal solution of l, if one attempts to maximise sum of square (S.S.) between items relative to sum of squares within items.

Note that $$\xi = \frac{1}{n}\Sigma\, l_i(n_1\bar{X}_i' + n_2\bar{X}_i'')$$

$$= \Sigma\, l_i\bar{X}_i' - \frac{n_2}{n}\Sigma\, l_i d_i$$

Similarly again $$\xi = \Sigma\, l_i\bar{X}_i'' + \frac{n_1}{n}\Sigma\, l_i d_i$$

S.S. between items for ξ, is given by—

$$S_1 = \frac{1}{n_1}\left[\sum_{i=1}^{n_1}(n_1 l_i\bar{X}_i' - \xi)\right]^2 + \frac{1}{n_2}\left[\sum_{i=1}^{n_2}(n_2 l_i\bar{X}_i'' - \xi)\right]^2$$

$$= \frac{n_1 n_2}{n}(\Sigma\, l_i d_i)^2 = \frac{n_1 n_2}{n}\sum_{i,j} l_i l_j d_i d_j$$

Total S.S. for ξ is given by

$$S_2 = \sum_{i,j} l_i l_j S_{ij}$$

We now require to choose l_i in a fashion, which will render S_1/S_2, i.e., the ratio of S.S. between items to total S.S. for ξ, a maximum. This gives,

$$\frac{\partial}{\partial l_i}\left(S_1/S_2\right) = 0$$

or $$S_2 \cdot \frac{\partial S_1}{\partial l_i} = S_1\frac{\partial S_2}{\partial l}$$

or $$(\sum_i l_i d_i)\sum_j S_{ij}\, l_j = d_i(\sum_{i,j} l_i l_j\, S_{ij})$$

Thus we arrive at the system of equations,

$$\sum_j S_{ij} l_j = k.d_i,\ (i = 1,2.....m)$$

where $K = (\sum_{i,j} l_i\, l_j\, S_{ij})/(\sum_i l_i\, d_i)$, is a constant since S_2 is not allowed to vary.

It is obvious, at this stage, that the system essentially boils down to the much simpler system,

$$S.\underset{\sim}{l} = \underset{\sim}{d},$$

derived earlier, where the $l_i's$ are only measured along a different scale.

Work on generalised distance between two populations, known as Mahalanobis' D^2 Statistic, is very closely related to this type of discrimination analysis. P. C. Mahalanobis (1936) first introduced the notion of generalised distance between groups and studied the variation of D^2 with the number of characters used for classification. Mahalanobis, Majumdar and Rao (1949) have also studied the variation of D^2-Statistic with the number of characters for classification between groups. C. R. Rao (1949) also has studied in detail the distribution of D^2-Statistic and has indicated generalised tests of significance for discriminant functions in multivariate analysis.

Now, we are going to indicate a generalised test of significance for ξ used by Harold Hotelling.

The analysis of variance Table for the discriminant variable ξ can be prepared as :

	degrees of freedom	sum of squares	mean square	variance ratio
between items :	m	$S_1 = \frac{n_1 n_2}{n} (\Sigma\, l_i d_i)^2$	S_1/m	$F = \frac{(n-m-1)S_1}{m.S_3}$
within items :	$(n-m-1)$	$S_3 = S_2 - S_1$	$S_3/(n-m-1)$	
total :	$(n-1)$	$S_2 = \sum_{i,j} l_i l_j S_{ij}$		

It is interesting to derive the actual expression for the variance ratio F.

Putting $$\rho = \frac{n_1 n_2}{n} (\Sigma\, l_i d_i)$$

We immediately get

$$S_1 = \rho . (\Sigma\, l_i d_i)$$

Again from the system of equations,

$$S . \underset{\sim}{l} = \underset{\sim}{d}$$

giving the estimates of $l_i's$, it follows that

Hence,
$$S_2 = \sum_{i,j} l_i l_j S_{ij} = \Sigma\, l_i d_i$$

$$S_3 = (1-\rho)\Sigma\; l_i d_i$$

Thus F can be obtained as :

$$F = \frac{(n-m-1)}{m} \cdot \frac{S_1}{S_3} = \frac{(n-m-1)\rho}{m(1-\rho)}$$

It has been shown that if X_i are normally distributed, this F corresponding to the optimum ξ-function is distributed as Snedecor's F with m and $(n-m-1)$ degrees of freedom.

If this F is found significant at a convenient probability level, one can strongly suspect the existence of such a discriminant function (involving the variables under study), that can be used to discriminate the two population classes in the best (defined in a particular sense) possible way.

Illustration

A numerical illustration is appended which will bring out the relevant features of this type of discrimination of consumer behaviours. It should be remembered that the following is purely an illustration and should in no case be considered to furnish estimates typical of any expenditure class. Large scale computation, however, is expected to yield important results, suitable for answering particular questions.

In Table(1) are shown the distributions of percentage expenditures on 3 important items namely food, fuel and clothing for 93 households surveyed in sub-sample-I, under the National Sample Survey project "Chittaranjan Survey", January—March, 1955. The households have been randomly selected from the returns under sub-sample I, and have later been classified under two categories, e.g., those belonging to expenditure class E_1, with a total monthly expenditure not exceeding Rs. 150 and the others belonging to E_2, with a total monthly expenditure exceeding Rs. 150. 48 households are found to belong to class E_1 where as class E_2 includes the remaining 45 households.

In Table (2) below are shown the means of percentage expenditures of the two classes as well as the difference between the two class means for each item.

TABLE (2) : MEAN OF PERCENTAGE EXPENDITURES

item	mean of percentage expenditures			difference between means
	class E_1	class E_2	all households	
1. food	67.96833	51.28267	59.89462	16.68566
2. fuel	5.87250	4 08689	5.00849	1.78561
3. clothing	5.73104	11.83556	8.68483	-6.10452
no. of households	48	45	93	

Table (3) shows the sum of squares and products from their respective means.

TABLE (3) : CORRECTED SUM OF SQUARES AND PRODUCTS

		X_1	X_2	X_3
	food :	13886.56	990.05	-5223.49
S :	fuel :		436.16	-642.67
	clothing :			6158 39

TABLE (1): COMPOSITION OF PERCENTAGE EXPENDITURES FOR 93 HOUSEHOLDS (SOURCE: CHITTARANJAN SURVEY, JANUARY-MARCH, 1955 SUB-SAMPLE 1)

sl. no.	household monthly expenditure (Rs. 0.00)	percentage expenditure on			ξ
		food (X_1)	fuel (X_2)	clothing (X_3)	
(1)	(2)	(3)	(4)	(5)	(6)
		class E_1			
1	41.80	84.62	7.44	—	0.10902
2	34.10	90.65	2.40	—	0.10707
3	27.06	57.06	6.32	9.24	0.07720*
4	50.22	75.95	2.55	—	0.09065
5	38.94	68.03	2.57	—	0.08170
6	41.69	70.86	6.36	9.59	0.09299
7	67.36	68.54	2.51	9.47	0.08362
8	73.21	69.98	7.42	—	0.09237
9	53.12	69.49	4.44	7.06	0.08769
10	75.45	54.79	8.62	5.63	0.07808
11	56.13	79.37	5.68	—	0.09999
12	63.57	67.55	4.72	6.69	0.08592
13	53.61	77.58	13.97	—	0.11242
14	74.75	62.29	3.01	19.81	0.07898
15	72.07	67.71	8.34	—	0.09140
16	73.88	57.91	2.96	13.70	0.07299*
17	79.56	72.96	3.17	9.23	0.08975
18	99.35	70.79	9.21	—	0.09641
19	98.86	60.09	7.75	13.66	0.08381
20	83.68	68.32	5.59	10.41	0.08888
21	92.92	62.30	6.34	14.53	0.08399
22	84.47	60.31	10.67	—	0.08706
23	86.58	71.98	8.08	—	0.09579
24	78.92	87.18	5.07	—	0.10779
25	136.94	64.48	5.52	11.68	0.08460
26	103.38	54.22	7.26	8.46	0.07550*
27	109.18	75.75	5.55	10.53	0.09727
28	150.00	74.67	4.04	7.00	0.09287
29	121.22	56.35	6.15	12.79	0.07664*
30	137.25	60.60	5.82	18.21	0.08172
31	135.34	66.14	4.67	13.39	0.08526
32	105.35	80.38	6.77	1.90	0.10333
33	106.34	58.20	6.94	—	0.07816
34	148.46	72.46	4.11	—	0.08941
35	143.95	77.99	6.06	3.95	0.09969
36	111.51	65.70	7.26	10.99	0.08891
37	110.55	76.97	8.12	—	0.10152
38	147.70	60.94	6.05	7.79	0.08091
39	128.11	63.27	7.27	5.11	0.08527
40	139.38	60.17	5.03	7.35	0.07819
41	119.22	70.81	8.96	—	0.09600
42	105.07	68.80	5.50	—	0.08768
43	148.37	71.64	5.36	—	0.09066
44	142.70	74.81	5.87	—	0.09515
45	137.08	63.74	4.99	7.56	0.08220
46	106.72	54.01	3.92	7.26	0.06925*
47	128.13	56.56	2.80	12.10	0.07093*
48	103.10	57.51	2.67	—	0.06993*

TABLE (1): COMPOSITION OF PERCENTAGE EXPENDITURES FOR 93 HOUSEHOLDS (SOURCE: CHITTARANJAN SURVEY, JANUARY–MARCH, 1955 SUB-SAMPLE 1).—Contd.

sl. no.	household monthly expenditure (Rs. 0.00)	percentage expenditure on			ξ
		food (X_1)	fuel (X_2)	clothing (X_3)	
(1)	(2)	(3)	(4)	(5)	(6)
		class E_2			
49	178.98	49.98	3.76	11.98	0.06512
50	165.99	60.30	4.47	3.61	0.07679
51	176.45	50.06	5.06	10.77	0.06729
52	162.86	59.18	4.37	8.06	0.07602
53	158.19	63.10	6.90	11.54	0.08542*
54	200.42	52.50	3.12	6.74	0.06606
55	191.54	60.46	3.91	17.72	0.07815*
56	167.79	62.72	5.37	8.08	0.08179*
57	162.69	63.50	4.08	3.69	0.07975*
58	163.47	55.39	8.45	12.23	0.07948*
59	183.42	44.80	3.85	15.95	0.06000
60	173.47	46.05	3.21	6.92	0.05892
61	177.02	38.96	2.47	18.50	0.05136
62	190.07	46.99	3.16	—	0.05884
63	230.78	62.82	4.09	18.63	0.08128*
64	227.62	55.44	0.93	18.28	0.06734
65	204.44	52.02	4.41	17.61	0.06943
66	244.12	38.25	4.92	13.72	0.05409
67	245.33	49.16	6.22	14.47	0.06886
68	218.55	62.73	4.91	7.89	0.08097*
69	217.13	59.72	5.41	5.53	0.07806*
70	232.00	29.76	2.52	24.35	0.04190
71	215.93	62.98	5.06	—	0.08031*
72	211.60	52.38	4.23	17.96	0.06958
73	249.87	59.03	3.00	10.21	0.07379
74	243.01	58.84	5.25	9.05	0.07732
75	251.09	46.60	4.12	3.75	0.06065
76	273.40	54.49	5.30	18.80	0.07386
77	255.38	59.43	4.11	5.67	0.07549
78	259.19	57.17	4.58	—	0.07288
79	281.43	47.16	3.69	5.15	0.06075
80	285.53	34.96	3.97	6.13	0.04754
81	356.20	34.48	2.67	37.79	0.04957
82	379.96	53.96	1.88	4.54	0.06522
83	372.91	52.19	3.58	8.29	0.06675
84	331.67	52.54	3.49	15.77	0.06813
85	688.03	40.14	1.37	4.55	0.04864
86	338.28	53.46	3.36	11.08	0.06823
87	316.09	57.92	4.70	13.52	0.07600
88	364.89	59.20	8.34	—	0.08174*
89	696.30	34.68	1.83	44.45	0.04935
90	614.44	45.31	4.57	9.80	0.06090
91	330.46	36.93	4.16	12.01	0.05101
92	369.16	48.55	1.98	30.54	0.06323
93	527.44	41.43	3.08	8.01	0.05362

Taking the discriminant functions as

$$\xi = l_1 X_1 + l_2 X_2 + l_3 X_3$$

we arrive at the following system of equations :

$$\begin{pmatrix} 13886.56 & 990.05 & -5223.49 \\ 990.05 & 436.16 & -642.67 \\ -5223.49 & -642.67 & 6158.39 \end{pmatrix} \cdot \begin{Bmatrix} l_1 \\ l_2 \\ l_3 \end{Bmatrix} = \begin{Bmatrix} 16.68566 \\ 1.78561 \\ -6.10452 \end{Bmatrix}$$

Inverse of the matrix S, at the left hand side, given by

$$S^{-1} = \begin{pmatrix} 0.00011211 & -0.00013515 & 0.00008099 \\ & 0.00287228 & 0.00018511 \\ & & 0.00025039 \end{pmatrix}$$

post-multiplied by the column vector $\{d_1, d_2, d_3\}$ at the right hand side, immediately yields.

$$l_1 = 0.001135, \qquad l_2 = 0.001744, \qquad l_3 = 0.000153$$

as solutions.

The discriminant function, therefore, is given by

$$\xi = 0.001135X_1 + 0.001744X_2 + 0.000153X_3$$

It may be quite interesting to note that in this linear combination more weight has been attached to the item "fuel" than any other characteristics. Next comes "food", and "clothing" last. This behaviour of the ξ —function can be taken to indicate that with reference to the mode of distinction of the expenditure levels as has been adopted here, change in the variable ξ relative to change in X_2 (when X_1 and X_3 are not allowed to change) is the largest in magnitude.

For the expenditure slab E_1, the value of ξ at the mean of E_1 comes out as

$$\bar{\xi}' = 0.08826$$

Similarly, the average value for the expenditure slab E_2, is given by,

$$\bar{\xi}'' = 0.06714$$

At the general mean the value of ξ works out as

$$\bar{\xi} = 0.07804$$

This $\bar{\xi}$ is the most important criterion in distinguishing households in the two different expenditure levels. If ξ_i for any i-th household exceeds $\bar{\xi}$, we conclude that it can be identified as a member in the expenditure class E_1. On the other hand, households with ξ_i s less than $\bar{\xi}$ truly belong to class E_2.

Remembering that for any i-th household having X_{i1}, X_{i2} and X_{i3} as percentage expenditure on "food", "fuel " and "clothing" respectively, ξ_i is given by

$$\xi_i = 0.001135X_{i1} + 0.001744X_{i2} + 0.000153X_{i3},$$

it is possible to test whether the expenditu·e pattern of the household is in conformity with the expenditure pattern of the class to which it actually belongs.

In Table (1), the ξ —measures corresponding to the different households have also been shown. Only 7 exceptions (marked with*) in class E_1 and 10 exceptions (*) in class E_2 can be detected. This indicates that the first 7 households have expenditure pattern in conformity with class E_2 and the other 10 households behave like normal households in class E_1, though all these 17 households have been mis-classified according to their actual expenditures. In testing and labelling households as mis-classified, one very important point is to note the magnitudes of departures of the ξ_i s corresponding to these households from the criteion ξ. This reveals that some are border line cases.

An important extension of this study can be suggested. This involves following up other economic characters, such as principal occupational status, per capita household expenditure, etc., for the 17 discrepant households. Such enquiries are expected to reveal that the households, though inconsistent from the view point of total expenditure, behave homologically with households of the other expenditure class in respect of other economic characters. More concretely, if households are classified by principal household occupation or per capita family expenditure, the particular households would probably be homogeneous with households formerly belonging to the other expenditure class.

In testing the significance of the discriminant function, we calculate

$$\sum_i l_i d_i = 0.02112, \text{ and}$$

$$\rho = \frac{n_1 n_2}{n} \Sigma l_i d_i = 0.49053$$

Thus the variance ratio

$$F = \frac{89(0{\cdot}49053)}{3(1-0{\cdot}49053)} = 28{\cdot}56$$

is distributed with 3 and 89 degrees of freedom.

The analysis of variance for ξ is obtained as shown in Table (4) below.

TABLE (4): ANALYSIS OF VARIANCE FOR ξ

	degrees of freedom	sum of squares	mean square	variance ratio (F)
between items	3	0.0103583	0.0034524	28.56 **
within items	89	0.0107600	0.0001209	
total	92	0.0211183		

The 5 per cent and 1 per cent points of F with 3 and 89 degrees of freedom are 2.71 and 4.01 respectively. Thus $F = 28.56$. is found to be highly significant even at 1 per cent level. Hence such linear combination of the variables is proved to be very effective in distinguishing the two expenditure classes.

An empirical study on discrimination of prices of producers' and consumers' goods based on certain cyclical measurements during the business cycle and some other similar studies made by G. Tintner may be referred to in this connection.

Conclusion

By suitably defining E_1 and E_2, one can conceive of groups as "poor" and "middle class", or "middle class" and "rich". Accordingly, it is possible to arrive at ξ-functions that would best discriminate the two classes under study.

Such attempts when made on the bases of a large number of households, are expected to yield dependable results. Relevant discriminant functions for distinguishing suitable expenditure levels, can be determined. Knowledge of the composition of percentage expenditures of households would then be sufficient to classify them properly under expenditure classes.

Another important observation, which is permitted by such discrimination analysis of consumer patterns, may be noted. If and when the economy undergoes a change it is implied that consumer patterns of households will change. As for example, consumer pattern of a particular household may be observed before and after a five year plan. The relevant ξ-statistic would then reveal whether there is an upgrading of the household from the lower expenditure class to the upper one. Such observations can as well be made at convenient points of time, annually or bi-annually, and the steady change of the ξ-statistic can be noted. This would clearly show how the "consumer expenditure status" of the household in the lower class is improving.

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