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A Probabilistic Approach in Rural Out-Migration System

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(ABSTRACT)

This paper presents a probability model for the rural out-migration system at a micro-level. The parameters involved in the model are estimated by the method of moments. The application of the model is discussed and it is fitted to observed data.

Key Words: out-migration, probability model, household moment method of estimation.

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農村外移體系的機率模型之探討

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（中文摘要）

本文乃針對微視的農村外移系統提出一機率模型，採用「動差方法」（the method of moments）推估模型中的參數值，除了以模型檢測資料的適合情形，並討論該模型的應用。

關鍵字：外移，機率模型，家戶動差方法之推估

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1. INTRODUCTION

Population movement and its impact on other social, economic and demographic characteristics have been increasing attention of social scientists and demographers in recent years and a large number of studies on migration have been conducted. A variety of approaches, depending upon the conceptualization of migration process and scale of investigations, have been used in the past to analyse data on aggregate levels (Lee, 1966; Greenwood, 1971). They have used mostly macro-level approach by operating on highly aggregate data for countries, districts, states and the nation as a whole. Since the explanation offered by such studies are based on net or gross migration flow, derived from aggregate census data, these are relevant only at the macro -levels. Macro-level studies might not provide the adequate explanation for the tremendous regional and heterogenity planning that prevails in the spectral economy; while movement patterns largely ignored the decision making process of migrating individuals. In recent years the study of a migration system at the micro-level has been proved useful and it is governed by "human grouping" based on probabilistic and stochastic approach. The most important human grouping that may be of concern in a population study in general and migration system in particular, is a household; because it is well that the characteristics of the household play a very important role in the decision of an individual to move or not to move from the household(Yadava, 1977). The number of migrants per household is essentially a random variable and thus requires probabilistic approach for its study. In this connection Yadava and Singh(1983), Ojha and Pandey(1991)and Pandey(1994)proposed various models under certain limitations.

The main objective of this paper is to develop a probability model for the rural out-migration system at a micro-level. It estimates the parameters involved in the proposed model and tests the suitability of the present model through observed data.

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The data for this study are taken from the three years' prospective survey entitled "Rural Development and Population Growth: A Sample Survey 1978, B.H.U.".

1.1. MIGRATION SYSTEM

Human grouping is a vital event in the study of mechanism of out-migration system at the micro-level. The most common unit of human grouping is a household. The characteristics of a household are bound to play an active role in the decision of an individual to move or not move from a household. Considering the rural out-migration pattern, the household can be categorized into two main groups:

(i) an adult male aged fifteen years and above alone migrates from the village leaving behind his family.

(ii) an individual (male) migrates with his family.

These two groups of migrants have different social, economic and cultural characteristics. Present work includes both (i) and (ii) types of migration pattern.

2. THE PROBABILITY MODEL FOR OUT MIGRATION SYSTEM

2.1. ASSUMPTIONS:

The probability model for the rural out-migration system may be obtained under the following assumptions:

(I) Let α be the probability that a household is exposed to the risk of migration at the survey point and (1- α) the probability that household is not exposed to the risk of migration.

(II) There are two types of households which are exposed to the risk of migration at the survey point. In the first type, only males aged fifteen years and above migrate and in another type of household males migrate with their family members. Let W and 1-W be the respective proportions of the two types of households exposed to the risk of migration.

(III) The survey data indicate that the probability of K single males (aged fifteen years and above) migrating from a house-hold is greater than the probability of (K+1) males migrating (K=1,2,....). Thus the probability is a decreasing function of K and therefore it creates a situation where the number of migrants from the W-proportion of households (that is from (i) types of migrants) follows a displaced geometric distribution:

$$P[A=K]=pq^{k-1},\ k=1,2,\ldots\ldots\ldots\ldots(1)$$
$$\text{and } p=1-q$$

(IV) In the (1-W)-proportion (that is in (ii) type of the migration pattern), the migrants move with their family members; indicating that they move in groups (form a cluster). In this situation the risk of occurring a cluster may vary from household to household and they follow displaced poisson distribution:

$$P[B=K]=\frac{e^{-m}m^{k-1}}{\lfloor k-1},\ k=1,2,\ldots\ldots\ldots\ldots\ldots(2)$$
$$\text{and } m>o$$

2.2. THE MODEL:

From the above assumption (I) to (IV) through probability law (Johnson & Kotz, 1969) the probability model for the number of total out-migrant, x, from a household becomes:

$$P[X=0]=1-\alpha,\ K=0$$
$$P[X=1]=\alpha WP,\ K=1$$
$$\text{and } P[X=K]=\alpha\left[Wpq^{k-1}+(1-W)\frac{e^{-m}\ m^{k-2}}{\lfloor K-2}\right],\ K=2.\ 3,\ldots.$$

2.3. ESTIMATION PROCEDURE

The model (3) involves four parameters α, W, p and m. These parameters are estimated by equating the 'proportion of zeroth cell', 'proportion of first cell', 'sample mean' and sample variance to their corresponding theoretical values which are represented by following equations:

$$\frac{N_o}{N}=1-\alpha \qquad (4)$$

$$\frac{N_1}{N}=\alpha WP \qquad (5)$$

$$\mu_1=\alpha\left[W/P+(1-W)(m+2)\right] \qquad (6)$$
$$\mu_2=\alpha\left[W(p/q^2)+(1-W)m\right] \qquad (7)$$

Where N_0, N_1 and N denote the number of observations in zeroth cell, first cell and the sample as a whole respectively, μ_1 and μ_2 denote the observed mean and variance respectively. The estimated value of the parameters are obtained by solving equation (4) to (7) simultaneously. During estimation the form of p results in $ap^3 + bp^2 + cp + d = 0$; the real roots of this equation are found by Newton-Raphson method. Once the estimate of α, W, p and m are obtained, the expected frequencies can be easi -ly calculated.

Sample moments and sample proportions are the consistent and unbiased estimator of the population moments and population proportion respectively (Sukhatme et al. 1976). Thus in the present estimation procedure, the estimator $\hat{\alpha}$, $\hat{W}$, $\hat{p}$ and $\hat{m}$ are consistent and unbiased.

3. APPLICATION OF THE MODEL TO SURVEY DATA:

3.1 DATA AND METHODOLOGY:

The basic data used in the present work has been taken from the sixth and seventh round resurvey during the period March-October 1978 from rural areas of Varanasi and its neighbouring districts Azamgarh of Eastern Uttar Pradegh, India, under auspices of the Centre of Population Studies, B.H.U., India. The main objective of the survey was to study the existing levels of fertility, mortality and migration in three types of villages representing different levels of socio-economic development. The three groups of villages have been termed 'semi-urban', 'remote' and 'growth centre' villages. The semi-urban villages are situated nearby villages of Varanasi city, while remote villages are situated at a comparatively larger distance from the city. The growth centre villages are those where recently new household and other industries have been established. A random selection of 8, 6, and 5 villages was made from these three types of villages respectively. The information on about 3497 household were enumerated from these 19 sampled villages, following a stratified clustered sampling method to make a comparative study of villages representing three phases of development.

Information on household structure, household facilities, migration, fertility, mortality and morbidity was obtained for each household through a personal interview method. Detailed information relating to a number of migrants from each household

was noted by adopting a "modified definition" of a household. A household has been defined as a group of persons who normally live together and take food from a common kitchen, inclusive of the persons who usually live outside the village but claim the household to be their own. Such persons are generally migrated persons who usually go away to earn their livelihood but have all contacts with the household and visit the household in regular intervals of time. These persons have also been included in the household as they are closely linked together with the other members of the household and participate in the economic and social activities of the household.

3.2 CONCLUSIONS:

Table-1 gives the distribution of observed and expected number of households according to the total number of out-migrants in three types of villages. The risk of migration in a household, α, is highest ($\hat{\alpha}$ = 0.2319) in Remote villages and lowest ($\hat{\alpha}$ = 0.1111) in semi-urban villages. The estimated values of w according to three types of villages are found to be 0.7301, 0.8439 and 0.8061 respectively. This shows that in Semi -urban villages, the proportion of households exposed to the risk of migration for male aged fifteen years and above is less than in Remote and in Growth Centre type villages, but proportion of migrants belonging to group (or cluster) with their wife, children, other dependent members etc. are high in comparison to Remote and Growth Centre villages. This may be due to more facilities, higher education, kinship relation prevailing in all Semi-urban villages. α [w/p + (1-w)(m+2)] gives the average number of migrants per household which is highest (0.5547) in Remote villages than in Growth Centre (0.4229) and in Semi-urban (0.3264).

For applying a X^2-test, the last two cells have to be grouped. From table 1, the calculated X^2 in significant at 5 percent level of significance in three types of villages. This suggests that the proposed model under consideration is a better approximation to observed distribution of rural out migrants at the micro-level. Thus it may be a useful tool in calculating the various probabilities connected with the out-migration system from the household and also for predictions in specified populations.

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Table-1: Distribution of Observed and Expected Number of Households According to the Total Number of Migrants from a Household in Three Types of Villages.

Number of migrants	Types of Villages					
	Semi Urban		Remote		Growth Centre	
	Obser-ved	Expec-ted	Obser-ved	Expec-ted	Obser-ved	Expec-ted
0	1032	1032.00	871	871.00	972	972.00
1	58	58.00	139	139.00	124	124.00
2	23	22.66	52	52.31	32	41.59
3	06	10.30	15	21.18	25	19.01
4	10	07.22	14	11.41	12	09.83
5	08	07.16	11	09.21	10	09.29
6	07	07.11	10	08.64	05	07.06
7	01	16.55	06	21.25	05	19.22
8	16		16		17	
Total	1161	1161.00	1134	1134.00	1202	1202.00
α	0.1111		0.2319		0.1913	
W	0.7301		0.8439		0.8061	
R	0.6159		0.6263		0.6690	
M	4.4931		4.6916		4.3918	
χ^2	2.8865		2.9814		5.6352	
d. f.	3		3		3	