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A PROBABILITY MODEL FOR AGE AT MARRIAGE

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ABSTRACT

Female age at marriage is of a great importance due to its direct relationship with the level of fertility in the developing countries where the contraceptive use rate is low. Study of age at marriage in any population is of immense importance due to its strong association with social, economic and demographic changes in the population. In most societies, family building occurs mainly after marriage and fertility is strongly related to the length of exposure within the state of reproductive period as married life. Age at marriage is also an important indicator of female's status, because of its role in determining the fertility level, improving females and its child health, and enhancing female's status by enhancing her educational level. In the present study, a probability model for age at marriage has been discussed. The data set for the study has been taken from a primary survey of flood prone area of north eastern Bihar. Results show that Negative binomial distribution explains the variability of age at marriage of the area satisfactorily well.

KEYWORDS: Age at Marriage, Moment Estimation, Negative Binomial Distribution, Probability Model

INTRODUCTION

Female age at marriage is of a great importance due to its direct relationship with the level of fertility in the developing countries like India, where the contraceptive use rate is low. Marriage usually puts the foundation of family formation and, as such, is an important determinant of fertility associated with the duration of exposure for the risk of childbearing [1]. For example, late age at marriage leads to the lower fertility, lengthens the interval between generations, plummeting population growth and ultimately a little proportion of grand-mothers in the population [2]. A number of studies have been done on differentials and determinants of age at marriage [3] and its relationship with fertility [4].

A study of female age at marriage in any population is of immense importance due to its strong association with social, economic and demographic changes in the population. In fact, marriages result in the formation of new nuclear families. In most societies, family building occurs mainly after marriage and fertility and is strongly related to the length of exposure within the state of reproductive period as married life. Among others, proportions marrying and age at first marriage especially for females are the two dominant factors, which play a prominent role in deciding the potential of fertility. It has been seen that an increase in age at marriage beyond a certain minimum, results in cutting down the level of fertility and also advances the mean age of child-bearing and hence result in a slowing down of population growth. In the context of India, which are in grip of high rate of population growth, the idea of using age at marriage as an instrument to curtail fertility level and thereby to slow down the rate of population growth is thus of special significance.

In India, marriages are not only universal but also take place at early ages [5]. In most of the cases parents married off their daughters once they reach menarche and also they settle for more dowry if a girl is married late and so on. Since traditional marriage systems are usually organized to protect women's sexuality and maximize their reproductive value,

parental and social interest are best served by marrying daughters close to puberty. Additionally, in the absence of alternative opportunities such as schooling and employment, marriage may be the only socially legitimate option for an adult woman [6].Though there are legislations to check the practice of early marriage in India, lot of marriages do take place below the marriageable ages [7]. Thus the problem of early age at marriage in India is very complex in nature.

In societies where child bearing prior to the marriage is not socially acceptable, delay in marriage contributes significantly towards reduction in the levels of fertility by shortening the total reproductive span of a female. This in turn reduces the number of children and has inverse impact on the population growth rate of the country. The age at marriage vary by religion/caste, geographical location, urban-rural residence, type of family and income level. In India, the marriage is a signal to start the family building process so that the two important factors in deciding the tempo and quantum of fertility are the proportion of married persons and the age at marriage. Thus, age at marriage is an interesting area for the demographers, who are interested in the projecting fertility rates and population growth rate. Age at marriage is also an important indicator of female's status, because of its role in determining the fertility level, improving females and its child health, and enhancing female's status by enhancing her educational level. Studies on differentials and determinants of age at marriage have been done by Agarwal [8] and Malaker [9]. Besides these studies on age at marriage, some theoretical studies have also been done. A number of probability models have been used to describe the distribution of females according to their age at marriage. Nydell [10] used the lognormal distribution to describe the age at marriage after that Hyrenius et al. [11] proposed the use of logistic curve to graduate the number of single female at different ages.

In any society, partners are not selected from country level marriage market. There exists a smaller circle of mates with homogeneous characteristics. Verma and Pathak [12] have developed a model, which is used for estimating the adolescent sterility among married females by Pathak and Prasad [13]. The suitability of model was checked on NFHS-1 India data by taking a cohort of females aged 35-45 years at the time of survey. They have considered only the females whose age at marriage was 15 years and above. The model gave poor fit particularly for higher ages. The age heaping in the data is observed at even digits i.e. 16, 18, 20, 22 and 30 years. This may be due to the fact that a large number of females do not know their exact age. This age misreporting and digit preference complicates research on age at marriage. To resolve the problem of digit preference and age misreporting, two consecutive ages has been grouped as one. After giving the index 0,1,2..., a displaced negative binomial distribution proposed by Singh et al. [14]. In our study we did not find digit preference so we have taken the data of age at marriage in original form and then displaced it by 12.

Let age at marriage *X* is a random variable and follow a negative binomial distribution with parameters *m* and *k* defined as

$$P(Y = y; k, m) = \binom{y + k - 1}{k - 1} m^k (1 - m)^y \tag{1}$$

where *y* =(*X-a*), *a* is a constant taken as 12 and *X* =12, 13, 14, 15,……..

The moment estimates of the parameters *m* and *k* of the negative binomial distribution can be obtained as follows:

$$E(X) = \frac{k(1 - m)}{m} \tag{2}$$

$$E(X^2) = \frac{k(1-m)(1-k+mk)}{m^2} \tag{3}$$

Let μ_1' and μ_2' denotes the first two raw moments about zero for data in hand. Replacing $E(X)$ and $E(X^2)$ by μ_1' and μ_2' in above equations we get two equations with two unknowns α and p as given below:

$$\mu_1' = \frac{k(1-m)}{m} = Mean \tag{4}$$

and $\qquad \mu_2' = \frac{k(1-m)(1-k+mk)}{m^2} \tag{5}$

Using these two above moments we can compute variance as follows

$$Variance = \mu_2' - \mu_1'^2 = \frac{k(1-m)}{m^2} \tag{6}$$

Thus from equation (v) and (vi) we have

$$\hat{m} = \frac{Mean}{Variance} = \frac{\mu_1'}{\mu_2' - \mu_1'^2} \tag{7}$$

Substituting the value of $\hat{m}$ from the equation (vii) in equation (v) we may easily get the estimate of k hence

$$\hat{k} = \frac{\mu_1' \hat{m}}{1 - \hat{m}}.$$

Alternative Method of Estimation

In the above mentioned method we need two moments to estimate the parameters. Thus we suggest an alternative method. In this method probability of first cell and the first moment about zero are used. So there is no need of second moment. Thus this method is easier and quicker than the previous method of estimation. We know that the first cell probability is

$$p(0) = m^k = \frac{n_0}{N} \tag{8}$$

Thus $k \log m = \log n_0 - \log N \Rightarrow k = \dfrac{\log n_0 - \log N}{\log m} \tag{9}$

and $\mu_1' = \dfrac{k(1-m)}{m} \Rightarrow k = \dfrac{\mu_1' m}{1-m} \tag{10}$

Therefore from equation (ix) and (x) we have

$$\frac{\log n_0 - \log N}{\log m} - \frac{\mu_1' m}{1-m} = 0 \tag{11}$$

$$(1-m)(\log n_0 - \log N) - \mu_1' m \log m = 0 \tag{12}$$

Using iteration process we can get the estimate of *m* and then using this estimate and equation (x), *k* can be estimated easily.

Although method of maximum likelihood is considered to be best but it is complicated and needs more mathematical expertise than the alternative method.

Application

A real data set from a survey, entitled "Migration and Related Characteristics-a Case Study of North-Eastern Bihar" conducted during October 2008 to March 2009, has been used to check the suitability of this simple model rather than the complicated models discussed above. The females, whose current age is more than 29 years, are not considered in the analysis. The females with the age at marriage 12 years and above up to 29 years are taken into account because after age 29 years females are rarely get married in the study area. Since the mean age at menarche is about 12 years thus age 12 has been taken as the minimum age at marriage in the present analysis. However, some females get her marriage before menarche but they are not considered here.

First we have displaced the data by 12 years and then considered it as discrete data. Using the first cell probability, mean and variance of the data the parameters have been estimated and then the expected frequencies by both the estimation procedures are calculated by applying the said distribution. The observed and expected number of females according to their age at marriage is shown in Table 1. The Chi-square value supports that the distribution fits the data satisfactorily well.

This study focused on probability modelling of age at marriage among females of North Eastern Bihar aged 12 to 29 years. The study has implications for policies and programs that seek to promote the status of women in the flood prone and economically backward region of the country. Since age at marriage is directly related with fertility and other issues like child health, maternal mortality, so policies for increasing age at marriage should be promoted. Education and women empowerment are other important issues related with mean age at marriage. Thus special programs and policies should be launched in this area to continue improving girl child and women access to education so as to enhance their empowerment and active participation in economy.

Table 1: Observed and Expected Number of Females According to Age at Marriage

Age	Observed no. of Females	Expected no. of Females	
		MM method	Alternative Method
12	42	40.16	42.02
13	86	98.15	100.03
14	138	140.60	140.88
15	165	154.01	152.75
16	151	142.73	140.87
17	118	117.84	116.21
18	92	89.35	88.34
19	64	63.44	63.05

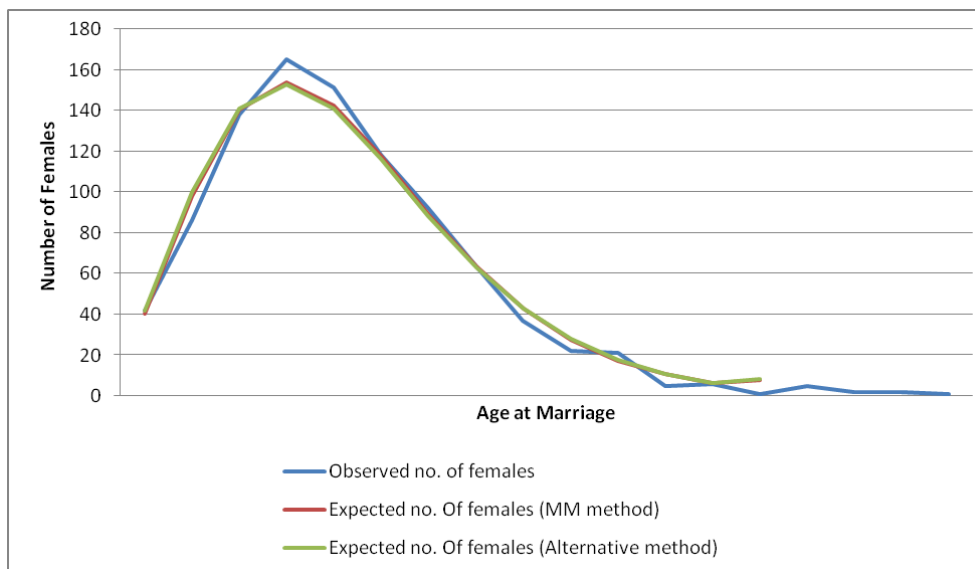|			
20	37	42.75	42.82
21	22	27.61	27.92
22	21	17.21	17.61
23	5	10.41	10.79
24	6	6.14	6.45
25	1		
26	5		
27	2	7.59	8.24
28	2		
29	1		
Total	**958**	**958.00**	**958.00**
Value of parameters		$m= 0.579$ $k= 5.80 \cong 6$	$m= 0.564$ $k= 5.46 \cong 5$
χ^2		10.077	10.694
Degree of freedom		11	11
Mean $(k*(1- m)/ m)$		4.27+12=16.27	
Variance $(k*(1- m)/ m^2)$		7.17	

Figure 1: Observed and Expected Number of Females According to the Age at Marriage

REFERENCES

1. Audinarayana, N. and Senthilnayaki, M. (1990): "Socio economic characteristics influencing age at marriage in a Tamilnadu village", The Journal of Family Welfare, 36(2): 48-55.

2. Durch, J. S. (1980): "Nuptiality patterns in developing countries: Implications for fertility", (Reports on the world fertility survey no. 1). Washington, D. C: Population Reference Bureau.

3. Audinarayana, N. (1993), "Determinants of female age at marriage in rural Andhra Pradesh: Multivariate Analysis", *Demography-India*, Vol. 22 (2), 169-174.

4. Islam, S. M. and Khan, H. T. (1995): "Influences of selected socio-economic and demographic variables on fertility in Bangladesh", *Asia-Pacific Population Journal*, Vol. 10(2), pp. 51-63.

5. Nirupama (1981): Marriages performed in the cradle, Social Welfare, septoct27 (6-7) pp. 14.

6. Caldwell, J. C. (1982): "Theory of fertility decline", Academic Press, London.

7. Pathak, K. B. (1980): "Law and age at marriage for females in India", The Journal of Social Work, 49 (4): 407-416.

8. Agarwal, S. N. (1962): "Age at marriage in India", Kitab Mahal, Allahabad, India.

9. Malakar, C. R. (1985): Modeling of Indian nuptiality. Sankhya, 47B, pp. 118.

10. Nydell, S. (1924): The construction of curves of equal frequency in case of logarithmic a correlation with application to the distribution of ages at first marriage. Skandinavisk Aktuarietidskrift 7.

11. Hyrenius, H., Holmberry, I. and Carlsson, M. (1967): "Demographic methods", DM3, Demographic Institute, University of Goteborg, Sweden.

12. Verma, S. and Pathak, K. B. (2001): "A model for female age at marriage". Paper presented at the National Conference on "Emerging Methodologies of Data Analysis and Related Inferences", Banaras Hindu University, Varanasi, India, and February. 5-7, 2001.

13. Pathak, K. B. and Prasad, C. V. S. (1977): A model for estimating adolescent sterility among married women. Demography, 14, pp. 103.

14. Singh, K. K. and Singh, Brijesh, P. (2004): "On the age pattern of marriage", Statistical

15. Thinking: methods and applications, (Ed. By D. C. Nath & K. K. Das), Capital Publication Company, Guwahati, pp. 104-110.