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A Probability Model of Matured and Prematured Live Birth

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Abstract: During the past 6 decades, theory of probability and human reproductive process expanding in various field. In general a random variable plays an important role in human reproductive processes and construction of the probability distribution. In this aspect an attempt has been made to analyse the parity of mothers using some probability model.

Key words: Binomial distribution, parity, matured, prematured, live birth, probability

INTRODUCTION

The period of pregnancy is considered as a variable, which may result in either a live birth (sometime multiple births, especially twin births) or an abortion. Explicit distributions can be derived to describe the variation in the duration of intervals between pregnancies or births under varying assumptions about the bio-cultural aspects of human reproduction in a population. The biological considerations of the present model for human reproduction. The probability of a non-pregnant married woman to get pregnant during the infecundable period may depend on number of factors.

A suitable probability distribution model in human reproductive process provides an insight into biological, social, cultural, economic and demographic factors and their quantitative effects on the human reproductive process. The pioneer research in this direction was initiated by Italian statistician Gini (1924) and was followed by Dandekar (1955), Brass (1958), Perrin and Sheps (1964), Biswas (1973), Pathak (1999), Pathak and Pandey (1981), Biswas (1993), Dunson and Colombo (2003), Dunson *et al*. (2005) and others.

DESCRIPTION OF THE MODEL

The formulation of models for the study of human fertility has been found in the study. The development of probability distribution models, relating to the human reproductive process, perhaps had its foundation with the research of Dandekar (1955). The following assumptions are made:

- Probability of a live birth (vis-a-vis a birth, assuming a one-to-one correspondence between conception and birth) is p in every trial (every trial is assumed to be the number of parity).
- Given that there is a success (a matured live birth), the probability of further success in another δ number of trials (δ is an integer) inclusive of the trial in which a success took place, is zero.

Notations:

- X is a random variable represents the number of success (live births).
- n is the number of trials(Parity).
- p is the probability of success(matured live birth) in a trial; $q = 1 - p$.
- $P(x; n)$ is the probability of exactly x successes in n trials.
- $F(x, n) = P[X \le x \mid n]$, the probability of not more than x successes in n trials.

Let us consider a sequence of n trials. If there is no success in $(n\text{-}x\delta)$ number of trials, obviously in the remaining $n\text{-}(n\text{-}x\delta) = x\delta$ number of trials at most x number of successes can occur. Probability of more than x successes in the remaining $x\delta$ number of trails, given that no successes occurred upto the first $(n\text{-}x\delta)$ number of trials is zero. In other words, given that the $(n\text{-}x\delta)$ leads to failures the probability of at most x number of successes in the remaining $x\delta$ number of trials is one.

Again when the first success occurs after s number of consecutive failure $(s < n - x\delta - 1)$, a case distinct from the earlier one where in the remaining $(n\text{-}\delta\text{-}s)$

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effective trials at most (x-1) successes occur with probability F(x - 1; n - δ - s).
Thus

$$F(x;n) = F(0;n - x\delta) + \sum_{S=0}^{n-x\delta-1} pq^S F(x-1;n-\delta-s)$$

Where x and δ are integers.
Obviously F(0; n) = P(0, n) = q^n
Similarly

$$F(1;n) = F(0;n-\delta) + \sum_{s=0}^{n-\delta-1} pq^s F(0;n-\delta-s)$$

$$\text{ie,}\quad F(1,n) = q^{n-\delta}[1 + (n-\delta)p]$$

When δ = 0, it gives Binomial distribution.
Putting x = 2 , we get that

$$F(2,n) = F(0,n-2\delta) + \sum_{S=0}^{n-2\delta+1} q^s pF(1,n-\delta-s)$$

$$= q^{n-2\delta}\left[1 + (n-2\delta)p + \frac{(n-2\delta)(n-2\delta+1)}{2}.p^2\right]$$

Proceeding in this way,

$$F(3,n) = q^{n-3\delta}\left[1 + (n-3\delta)p + \frac{(n-3\delta)(n-3\delta+1)}{2}p^2 + \frac{(n-3\delta)(n-3\delta+1)(n-3\delta+2)}{1.2.3}p^3\right]$$

$$\text{In general } F(x,n) = q^{n-x\pi}\left[1 + p(n-x\pi) + \frac{(n-x\pi)(n-x\pi+1)}{2!}p^2 + \cdots + \frac{(n-x\pi)(n-x\pi+1)\ldots(n-x\pi+x-1)}{x!}p^x\right]$$

= the first (x+1) terms in the expansion of

$$q^{n-x\delta}(1-p)^{-(n-x\delta)}$$

The above relation is true for all integral values of x for which

n - xδ ≥ 0
i.e., n / δ ≥ x.

For large values of x, n - xδ < 0 and hence in this case F(x; n) = 1

From this, the required probability P(x, n) is given by

P(x; n) = F(x; n) – F(x - 1; n)

Table 1: Study variables

Parity	No. of births (matured and prematured)
0	340
1	70
2	50
3	40

The value of p = 0, 758 q = .242

Table 2: Expected frequency of the study variable

S.No	Observed frequency	Expected frequency
1	340	22.9
2	70	101
3	50	211
4	40	165.1
Total	500	500

DATA BASE

The data for the present study, were collected from Government general hospital, Nagercoil in the state of Tamilnadu. It is the southernmost part of India. The hospital is well equipped with maternity wards consisting of 250 beds. The hospital maintains records with the data about various bio-demographic characteristics of pregnant women, who come for treatment. Data from newborn and mothers were collected from the hospital during January 2006 to December 2006. The number of matured birth was 379 and the number of premature birth was 121. For each of 500 mothers and babies the data on the selected variables were collected from the hospital case records (Table 1).

Using the observed and expected values the computed chi-square value is 4615.2. It reveals that there is no significant difference between the orders of parity (Table 2).

CONCLUSION

Birth (or parity) order refers to the numerical order of the live birth or foetal death, recorded in relation to all previous issue of the mother, irrespective of whether the issue is a live birth or foetal death or whether pregnancies were nuptial or extra nuptial. A comparison of observed and theoretical means shows that this model is a better approximation to the situation under consideration. From the above results contained that parity is one of the vital roles in matured and premature live birth. Mothers take regular checkup, appropriate nutrition, iron intake and check the hemoglobin status is to avoid the premature live birth.

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