Model for First Conception under the Influence of Pre-Marital Sexuality

C M Pandey / Uttam Singh
Sanjay Gandhi Postgraduate Institute of Medical Sciences, Dept. of Biostatistics
Raebareli Road
Lucknow, India
cmpandey@sgpgi.ac.in / uttam@sgpgi.ac.in

V K Singh
Banaras Hindu University, Dept. of Statistics
University Campus
Varanasi, India
vksingh@banaras.ernet.in

1. Background
The interval between marriage and first conception leading to a live birth is unique in the sense that, it is free from random amenorrhoea period, the women may not like to use contraceptives to postpone the first birth and there is a little chance of recall lapse in its reporting. It is reported that fertility of a woman is age dependent and could be assumed constant only for short span of reproductive life (Bhattacharya et al. 1988). Most of the models available in literature for waiting time of first conception assume that all females are susceptible to conception at the time of marriage (Mode 1985). This assumption holds only if there are no premarital coitions. It has been observed that a proportion of females starts their sexual life and conceives before marriage (de Sarno Prignano A 1985). Under the influence of behavioral and cultural transition, the assumption of first exposure to risk of pregnancy only after marriage is not warranted and calls for modification in this approach.

2. Objective
The aim of this study is to develop a stochastic model for describing waiting time of first conception incorporating prenuptial pregnancies and assuming that the risk of first conception (RFC) depends on females age and age at marriage. It is also proposed to obtain maximum likelihood estimate (MLE) of parameters in the model.

3. The model
Let $T$ be the period from marriage to the first live birth-conception and assume that:
(a) $1 - p$ be the probability that a female is pregnant at the time of marriage
(b) Conception is a chance variable.
(c) Risk of first conception for a woman of age $y$ and married at age $y_0$ is given by
$$R(y/y_0) = C_0(y - m_0) (m_0 + r - y)^2$$
Where $m_0$ is the age at which woman becomes able to conceive; $r$ is the age of the female measured from $m_0$ at which RFC becomes zero and $C_0$ is age constant depending on $y_0$

Under prevalent assumptions a woman begins the reproductive cycle after marriage in a fecundable and non-pregnant state. The distribution of $T$ under assumption (b) and (c) is derived as:
$$F_0 (t) = 1-\exp\{-\phi(t)\} \text{ at the age of marriage } y_0$$
(1)
and the density function is given as

\[ f_0(t) = C_0 (y_0-m_0+t) (m_0+r-y_0-t)^2 \exp{-\phi(t)} \quad ; t > 0 \]  

(2)

Where, \( \phi (p) = C_0 h(y_0, m_0, r, p) \)

and

\[ h(y_0, m_0, r, p) = \left[ p(y_0-m_0) (m_0+r-y_0)^2 + (1/2)p^2 (m_0+r-y_0) (3m_0+r-3y_0) + (1/3)p^3 (3y_0-3m_0-2r)+(1/4)p^4 \right] \]

Let us further assume that all females pregnant at the time of marriage report to have conceived at some time during the interval \((0, t_0)\) where \(0\) refers to time of marriage. Under this condition, the expression (2) becomes inflated in the interval \((0, t_0)\). Accordingly, we get the distribution of \(T\) as

\[ F_T(t_0) = 1- \exp{-\hat{\phi}(t_0)} \]  

(3)

\[ f_T(t) = C_0 (y_0-m_0+t) (m_0+r-y_0-t)^2 \exp{-\phi(t)} \quad ; t > t_0 \]  

(4)

4. Estimation

Data on age at menarche and marriage may be obtained from field studies and these could precisely be estimated. Assuming \(m_0\) and \(y_0\) to be known, let \(f_i\) be the number of females in the interval \((0, t_0)\) and \(N\) be total number of females. The maximum likelihood estimates of \(\hat{\phi}, \hat{C}_0\) and \(r\) may be obtained by solving the following equations

\[ \hat{\phi} = \frac{(N-f_0)}{N \exp{-\hat{\phi}(t_0)}} \]  

(5)

\[ \hat{C}_0 = \frac{(N-f_0)}{\sum h(y_0, m_0, \hat{r}, t_i) - (N-f_0) h( y_0, m_0, \hat{r}, t_0)} \]  

(6)

and

\[ 2 \sum 1/(m_0+\hat{r}-y_0-t_i) = \hat{C}_0 \left[ g(y_0, m_0, \hat{r}, t_i) - (N-f_0) g(y_0, m_0, \hat{r}, t_0) \right] \]  

(7)

Where \(g(y_0, m_0, \hat{r}, t_i) = [2(y_0-m_0) (m_0+\hat{r}-y_0)t_i + (2m_0+\hat{r}-2y_0) t_i^2 - (2/3) t_i^3] \)

and summation is over \(i = f_0+1, f_0+2, \ldots \ldots N \quad ; t_i > t_0\).

5. Conclusion

It is difficult to observe the incidence of premarital conception directly or isolate them from the pool of first conceptions. The proposed model provides a method to estimate the risk of first conception at various ages and the age at which the risk tends to zero. It also provides the estimate of proportion of premarital conception. The third degree polynomial seems to explain the variation in RFC due to adolescent sterility, temporary separations because of social customs etc. during early period of married life.

REFERENCES


de Sarno Prignano A: One aspect of extra-marital reproduction: pre-nuptial conception. Contribution of Italian Scholars to the IUSSP XX General Conference, Rome, Italy 1985: 87-102


RESUME

The quantification of fecundability using indirect approach has a great importance in public health and population studies. Interval between marriage and first conception leading to a live birth is a sensitive tool for fertility studies. This paper suggests a model for the waiting time of first conception incorporating premarital conceptions, which were reported to occur within a short interval. A third degree polynomial has been assumed as the risk function of first conception in order to develop the model. ML estimates of the parameters of the models are obtained.