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学位論文題目 A Bayesian Binary Regression Cohort Model for
Analyzing the Determinants of Family Planning in
Bangladesh With Special Focus on Unmet
Contraceptive Need

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論文内容の要旨

On Proposed Method

The main focus of this thesis is to perform the cohort analysis of unmet contraceptive need data of several surveys in Bangladesh. Most of traditional studies on unmet contraceptive need have been done by employing classical methods, such as logistic regression analysis. Our objective of the analysis is not only to see the effects of age, period and cohort separately but also to observe the age, period and cohort components of effects of important covariate, which was impossible with any existing cohort analysis methods.

We proposed a new Bayesian binary regression cohort model. Ours is the first model which incorporated the effects of explanatory variables (covariates) on the response variable. It is also true that our model is the first cohort analysis model which can handle the survey data in the form of binary response variable. Our model not only helps to examine the effects of age, period and cohort but also to explore the influence of the covariates on the response variable as well. Our model is applicable for not equally spaced survey data, because of the use of *B*-spline functions. The fit of models are evaluated by Akaike Bayesian Information Criterion (ABIC). The model which has the minimum ABIC value among the models fitted to the data is chosen as the best model.

Traditional statistical methods help to examine the instantaneous influence of the covariates, but our method helps to see the age-by-covariate, period-by-covariate and cohort-by-covariate effects on the response as well as to see the instantaneous influence of the covariates. The performance of our Bayesian method have been checked by two simulation studies. The first set of simulation data is generated assuming no covariate effect, while in the second simulation, the covariate effects on the response variable is also envisaged as well as age, period and cohort effects. It is shown that our method can detect the true model in both cases. The reliability of the estimated parameters have also been inspected visually by attached confidence interval. A new way of inspection is devised to take into consideration the identification problem.

Utilizing Information Criterion ABIC we can check whether two sets of data can be explained by the same model or not. It is realized by comparing the sum of ABIC values of the best models of separate analyses and ABIC value of the best model for combined data. An example was Section 5.3.3. There, it is concluded that mothers in rural areas are behaving differently from the mothers in urban areas.

The present study considered only 'bi-variate' effects of covariates. But it is not difficult to modify our method to take into consideration the strength of covariates. This quantitative aspect of covariates will be included into our model in future.

On Revealed Facts

Combined surveys data on unmet contraceptive need and current contraceptive use are taken from a series of surveys such as CPSs 1983, 1985, 1989, 1991, and DHSs 1993-94, 1996-97 of Bangladesh (according to survey reports title). These surveys were not conducted with equally spaced of interval. But the application of our Bayesian binary regression cohort model to this type of data is straightforward. We apply our method to these survey data by utilizing *B*-spline function.

Our model revealed interesting facts about contraceptive behavior of Bangladeshi women. Two response variables, UCN and contraceptive use, are analyzed by our proposed methodology. We revealed that:

1. Women in the younger cohorts are more conscious about the number of living children compared older cohorts.
2. The field workers visit is increasing its efficiency.
3. Unmet contraceptive need increases among the mother who at most two children indicates that their tendency to stop child birth increases in time to time but not so much increases their practice of contraception.
4. In rural areas religion effect on UCN is lower in younger cohorts. Therefore it can be concluded that younger generation of Muslim women in rural areas are changing their attitude towards “stop child birth” by adopting contraception (This observation is obtained from the separate analysis of rural and urban data). There are no cross effects between covariates and age, period or cohort effects on UCN of urban women.
5. Interaction effect of age by fieldworker's visit (i.e., the cross effect of women's age on the fieldworker's visit) on contraceptive use is clearly observed. While the cross effect of women's age on the fieldworker's visit is little.
6. It is an impressive findings that the use rate increases time to time also in rural areas. Muslim women also change their attitude toward contraception.

As for the contraceptive use, our results are harmonious with our prior expectation and the published literature on this subject. Contraceptive use varies by age. Users are higher in the middle ages of child bearing years. It can be said that women are likely to use contraceptive when they are in their middle ages. Lower use in the older ages may reflect the women's declining fecundity while lower use in the younger ages probably is due to want more child to reach their desired family size.

Results of our analysis are encouraging in the sense that it is proving the effectiveness of female field force on the reduction of UCN. UCN could be reduced not necessarily interfering the personal intention about desirable size of the family. Of course, the reduction of the ‘average’ of desired family size is an important issue but it is out of scope of the present study.

Family planning fieldworkers visit is an important covariate to reduce the unmet need not only by motivating women but also supplying the contraceptive methods to them. Some other studies have demonstrated that services of fieldworkers may be central to the success of the family planning. Bongaarts and Bruce (1995) mentioned that the best example of family planning performance under adverse condition is that of Bangladesh. In the invigorated national family planning program, an active cadre of female family planning health visitors reach into the community and home environments of women; the visitors make themselves available on a regular and predictable basis.

Our method also pointed out that the women having unmet need are more concentrated in their middle ages. Field worker should encourage such women to accept the family planning method by explaining the advantage of small family. Also the percentage of women desiring additional children in future should be reduced, desired family size is one of the factor found to have an

effect on contraceptive use in Bangladesh. Our model revealed that education reduces UCN in rural areas also. At this point it can be said that an improvement in the status of women should be helpful in reducing the UCN. Though “religion prohibit” is one of the important causes of UCN and which is normally not considered easily amenable to intervention. Our model provided that Muslim women in rural areas are gradually changing their attitude towards adoption of contraception to control family size over the period and this attitude is stronger in younger cohorts.

The family planning program should be made more explicit and purposeful in their efforts to reduce/close the gap between women's intention of child birth and contraceptive use. Program should extend it's activity specially in rural areas to reduce the areal variation between rural and urban areas of the country.

論文の審査結果の要旨

出願者の学位申請論文は、主としてバングラデシュの再生産年齢にある女性の避妊の必要と避妊法の実行との間にあるギャップ（UCN）がどのような要因に影響されているかを明らかにするために、年齢・時代・世代効果の他に個人レベルでの共変量の効果を取り入れることを可能にするベイズ型2値回帰コウホートモデルを提案し、バングラデシュにおける全国規模の避妊普及調査（1984, 1986, 1989, 1991）および人口保健調査（1994, 1997）の時系列データを分析したものである。

この論文で提案されたベイズ型2値回帰コウホートモデルは、個人レベルでの共変量の主効果および年齢・時代・世代効果との交互作用効果を分析するためのものであり、共変量との交互作用効果を取り入れた点、また増大する計算量に対処する工夫を行い複数時点の個票調査データ全体の（同時）分析を可能にした点で、方法論上著しい貢献が認められる。この方法は、本特定データにとどまらず、広範な複数時点の個票調査データに対して適用できるという汎用性をもつにいたっている。さらに、UCNに対する指導普及員訪問の効果が近年強まってきている等、人口学的にも、また、政策提言上も意義深い知見を得ている。

出願者は平成13年9月末日で本学博士課程を退学しているが、在学期間中の授業科目の単位取得状況、研究指導を受けた状況等すべて順調であり、本研究科の規定を満たしている。提出論文に基づいて投稿した学会誌論文1編も出版された。

以上により数物科学研究科の課程博士の学位を授与するに十分であると判断した。