Small Area Estimation for Doctor Visits

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1. Introduction

We applied a hierarchical Bayes model to estimate small areas with nonresponse. For this problem, Stasny (1991) used a hierarchical Bayesian model to study victimization in the National Crime Survey. She estimated the hyper-parameters by maximum likelihood methods and assumes them as known. But in this study the parameter for nonresponses is different from that of respondents and estimate hyper-parameters by random priors. This method was applied to the National Family Income and Expenditure Survey Data.

2. National Family Income and Expenditure Survey

The National Family Income and Expenditure Survey (NFIES) has been conducted every five year since 1991 by National Statistical Office to measure an aspect of income and expenditure structure of Korean household. One of the variables of interest in the NFIES is doctor visits of households. In this survey the average response rate was about 80%. The nonresponses of sample households were imputed assuming the distribution of the respondents and nonrespondents are the same within the same imputation class. However this imputation method may be unreliable, thus there is a need to consider the adjustment by a method other than random imputation. The Bayesian method is discussed as a possible alternative to impute the NFIES nonresponses.

3. A Bayesian Model .

Here we describe the hierarchical Bayes model for nonresponse. Define x_{ij} =1 if household j in area i visited doctor at least once and x_{ij} =0 otherwise, and y_{ij} =1 if household j in area i is respondent and y_{ij} =1 if household j in area i is not respondent.

For the ignorable model, $x_{ij} \mid p_i$: Bernoulli (p_i), $y_{ij} \mid \boldsymbol{p}_i$: Bernoulli ($\boldsymbol{p}_i$),

$$p_i \mid m_{11}, \boldsymbol{t}_{11} : beta(m_{11}\boldsymbol{t}_{11},(1-m_{11})\boldsymbol{t}_{11}), \quad \boldsymbol{p}_i \mid m_{12}, \boldsymbol{t}_{12} : beta(m_{12}\boldsymbol{t}_{12},(1-m_{12})\boldsymbol{t}_{12}) \quad \text{-----------------(1)}$$

For the nonignorable model, $x_{ij} \mid p_i \sim$ Bernoulli (p_i), $y_{ij} \mid x_{ij}$ =s,$\pi_i \sim$ Bernoulli (π_{is}),

$p_i \mid \mu_{21}, \tau_{21} \sim beta(\mu_{21}\tau_{21}, (1-\mu_{21})\tau_{21})$, $\pi_{is} \mid \mu_{2,s+1}, \tau_{2,s+1} \sim beta(\mu_{2,s+1}\tau_{2,s+1}, (1-\mu_{2,s+1})\tau_{2,s+1})$,s=1,2

---(2)

Assumption 1 and 2 express similarity among the areas which gave a borrowing strength.

By applying Metropolis-Hastings Algorithms for ignorable and nonignorable models, we estimated proportions

	Ignorable model		Nonignorable model		
area	p_i	π_i	p_i	π_{i1}	π_{i2}
1	.552(.011)	.749(.008)	.539(.010)	.746(.013)	.781(.011)
2	.555(.011)	.794(.008)	.543(.010)	.787(.013)	.820(.011)
3	.550(.013)	.841(.009)	.542(.012)	.834(.014)	.858(.012)
4	.582(.012)	.785(.009)	.563(.011)	.767(.015)	.821(.012)
5	.543(.013)	.909(.007)	.539(.012)	.904(.011)	.917(.010)
6	.583(.014)	.780(.011)	.564(.012)	.762(.017)	.816(.013)
7	.588(.013)	.801(.010)	.569(.011)	.781(.015)	.835(.012)
8	.604(.018)	.800(.014)	.581(.016)	.772(.023)	.838(.017)
9	.560(.017)	.933(.010)	.553(.016)	.925(.015)	.938(.012)
10	.540(.022)	.914(.014)	.535(.020)	.908(.021)	.916(.018)

Note : Standard deviation estimates are shown in parentheses

4. Concluding Remarks

We have studied Bayesian models with nonresponses for the small area proportion estimation . This works well for both ignorable and nonignorable nonresponse models as we applied for the NFIES data.

REFERENCE

Stasny, E. A. (1991). Hierarchical Models for the Probabilities of a Survey Classification and Nonresponse: An Example from the National Crime Survey . Journal of the American Statistical Association 86, 296-303.

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