Annals of the Institute of Statistical Mathematics (2020) 72:803–825
https://doi.org/10.1007/s10463-019-00710-w

Semiparametric Bayesian multiple imputation for regression models with missing mixed continuous–discrete covariates

Ryo Kato[1] · **Takahiro Hoshino**[2,3]

Received: 17 July 2018 / Revised: 10 December 2018 / Published online: 11 March 2019

Abstract

Issues regarding missing data are critical in observational and experimental research. Recently, for datasets with mixed continuous–discrete variables, multiple imputation by chained equation (MICE) has been widely used, although MICE may yield severely biased estimates. We propose a new semiparametric Bayes multiple imputation approach that can deal with continuous and discrete variables. This enables us to overcome the shortcomings of MICE; they must satisfy strong conditions (known as compatibility) to guarantee obtained estimators are consistent. Our simulation studies show the coverage probability of 95% interval calculated using MICE can be less than 1%, while the MSE of the proposed can be less than one-fiftieth. We applied our method to the Alzheimer's Disease Neuroimaging Initiative (ADNI) dataset, and the results are consistent with those of the previous works that used panel data other than ADNI database, whereas the existing methods, such as MICE, resulted in inconsistent results.

Keywords Full conditional specification · Missing data · Multiple imputation · Probit stick-breaking process mixture · Semiparametric Bayes model

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10463-019-00710-w) contains supplementary material, which is available to authorized users.

✉ Takahiro Hoshino
bayesian@jasmine.ocn.ne.jp

Ryo Kato
kato.ryo@keio.jp

1 Research Institute for Economics and Business Administration, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe, Japan

2 Department of Economics, Keio University, 2-15-45 Mita, Minato-ku, Tokyo, Japan

3 RIKEN Center for Advanced Intelligence Project, 1-4-1 Nihonbashi, Chuo-ku, Tokyo, Japan