

Regression methods for multiple outcomes

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Abstract

In research problems, particularly in Health research, it is common to have multiple outcomes of interest in the same study. The usual approach is to analyse each outcome separately ignoring the correlation between the outcomes. However this approach does not consider the multidimensional structure of the data and may lead to inefficient estimators.

In seemingly unrelated linear regressions (SUR) context, Zellner (1962) showed that if outcomes are associated with the same set of covariates, then the maximum likelihood estimator for the regression parameters is the ordinary least squares (OLS). That is, if the outcomes are modeled with the same covariates, the multivariate linear regression and univariate regressions for the different outcomes produce exactly the same estimators. However, if the outcomes are associated with different covariates, this end result no longer applies. Namely, ignoring the correlation and fitting separate regressions originates inefficient estimates.

In this work, we study a mix setting where the outcomes share some covariates but are also associated with specific covariates. We demonstrate that for the coefficients associated with shared covariates there are efficiency gains, while for the outcome-specific covariates the efficiency gains depend on the correlation between the outcomes. Additionally, we use Monte Carlo simulations to evaluate the performance of both approaches and provide a real data example.

Keywords

Statistics, Multivariate analysis, Data analysis, Applications to biology and medical sciences.

References

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