

Abstract:

Over the last several years and within the framework of the Sustainable Development Goals, there has been a need to improve the measurement and understanding of local geographic patterns to support more decentralized decision-making and more efficient program implementation. This requires more disaggregated data that are not currently available in a nationally representative household survey. The spatial modeling techniques that leverage existing survey data, spatial relationships between survey clusters, and relationships with geospatial covariates have become increasingly popular for mapping key development indicators at high spatial resolution. This study explores the potential of model-based geostatistics methodology to model DHS survey indicators.

We implement a stacked ensemble modeling approach that combines multiple model algorithmic methods to increase predictive validity relative to a single modeling. Three submodels are fitted to DHS indicator survey data using the geospatial covariates as exploratory predictors. The model prediction surfaces generated from the submodels are used as covariates in the final Bayesian geostatistical model, which is implemented through a stochastic partial differential equation approach in the integrated nested Laplace approximations. To explore the ability of our modeling approach to estimate indicators below the first subnational level, pixel-level estimates generated from the Bayesian model were aggregated to the second subnational level by using the population-weighted average within the administrative boundary.

Results of the individual submodels vary spatially, which is explained by the uncertainties in the individual model algorithm. The use of an ensemble model approach seems more adequate than relying on predictions from any single modeling method. We demonstrate the predictive ability of the model at the second administrative level using cross-validation.

This approach can help to inform the allocation of resources and program implementation in areas that need more attention. Countries can use this approach to model other DHS survey indicators at much smaller spatial scales.

Keywords:

Geospatial, Bayesian model, DHS Indicators, Subnational Admin 2.