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Generalized coherent calibration using small area estimates

Topic 2 – Learning more from what we already know

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Introduction

Within the European Statistics Code of Practice, a set of 15 principles is defined that shall foster providing high quality statistics in Europe. Additionally to accuracy and reliability, coherence is one of the principles to be considered. Since most surveys are multi-purpose, also in terms of the aggregation level of interest, different estimation methods may be applied to gain reliable estimates.

Design-based methods are preferably applied, if sample sizes allow high accurate estimates. Estimates on highly disaggregated level may then suffer from small, even unplanned sample sizes which fosters applications of model-based methods, such as small area estimation (Rao and Molina, 2015). Especially in this context, when different types of estimates are used on different aggregation levels, coherence plays an important role.

Methods / Problem statement

One alternative of integrating coherence is to apply benchmarking in small area estimation (Rao and Molina, 2015). Another alternative is to use small area estimates as additional calibration constraints in a design-based methodology. However, since the small area estimates are subject to sampling errors, one may relax the constraints and introduce penalties depending on the aggregation level.

Results / Proposed solution

The paper presents an approach of generalized calibration using boundary constraints with different penalties for areas and variables. The algorithm for solving the problem allows inspecting the impact of different kinds of penalties on variables, areas, and domains using Lagrange arguments. In contrast to classical calibration methods, a semi-smooth Newton method is applied that does not suffer from the non-differentiability of hard constraints. The methodology is programmed such that applications also to large data sets are feasible.

Applications to the German register-assisted census, in terms of a one-number census, as well as to integrated household surveys are presented.

Conclusions

The generalized calibration routine presents a computationally feasible calibration method, that allows using a huge vast amount of constraints with individually different penalties. Additionally to the final weight vector, information on the impact of the penalties on the routine is provided that allows the user to understand the problematic and unproblematic constraints.