DESIGN-BASED AND MODEL-BASED INFERENCE IN FINNISH FOREST INVENTORY

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Abstract

National Forest Inventory (NFI) of Finland was launched in 1921, as a second country after Norway. Currently the NFI is continuous work, with already a 13th round going on. The first NFI was carried out as a line inventory (lines going through the country from south-west to north-east), and from 1960's as a (stratified) cluster sampling.

Due to practical considerations, Finnish NFI, as most NFIs in the world, is based on a systematic sample. This means that only approximate variance estimators are available: the choice is between ignoring the systematic aspect and using design-based estimators and introducing a model and using model-based estimators. In Finnish NFI, mild assumptions on positive autocorrelation and local difference -based estimators have been used for all NFIs, while many other countries apply (conservative) SRS estimators.

During the history of NFI, the need for information to smaller and smaller areas has been increasing. Nowadays, the results are calculated for three regions and 19 counties using purely field plot data. In addition, the results are calculated for 309 municipalities, with a highly variable area. In part of the municipalities, it is possible to calculate useful results with design-based post-stratification with remote sensing material as auxiliary data, but in some cases, there are too few field plots for that. Therefore, we calculate strictly model-based synthetic estimators for all municipalities. However, there is a need for data for even smaller scales, such as single forest stands, for which synthetic estimators are the only possibility. For that purpose, Forestry Centre in Finland carries out a local inventory with a denser plot grid than in NFI. A further complication is that inferences are also needed in pan-European and global scales. Global (model-based) map products are used for policy making in climate change mitigation and biodiversity loss mitigation, to name a few examples. In these maps, the field data used is typically of poor quality and poorly representative leading to high biases.

All in all, complications due to systematic sampling and the multiple scales where information is needed prevent efficiently choosing either design-based or model-based approach, but forces to combine these approaches in many (ad-hoc) ways. Estimators utilizing the best properties of each approach thorough hybrid estimators would be in high demand in forestry.

Keywords: systematic sampling, cluster sampling, hybrid inference.

References

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