

Guidelines for Evaluating Decisions of Sample-Based Area Estimation (SBAE)

Steve Stehman

State University of New York

Syracuse, New York, United States

Decision Criteria

- Statistical
 - Bias
 - Variance (precision)
- Practical
 - Cost
 - Simplicity
 - Flexibility / adaptability
 - Consistency (over time and among projects)

Components of SBAE

- Sampling design – selection of units to observe or measure
- Response design – protocol to assign reference class to sample unit
 - Deforestation
 - Degradation
 - Driver(s)
- Reference class - best available determination of condition of sample unit
- Ensemble classification could be used in sampling design (e.g., strata) or response design

Statistical Features of SBAE

- Estimate area
 - From sample units selected by the sampling design
 - Using the reference class assigned by the response design
 - Estimate uncertainty of area estimate (standard error, confidence interval)
- Statistical properties of area estimator
 - Bias
 - Variance (precision)
 - Mean square error = Variance + Bias²

Bias

- Potential sources of bias
 - Sampling design – estimators unbiased or small bias (from sampling theory)
 - Response design - errors in the reference class, “measurement” bias
- Assess measurement bias from subsample using
 - Superior quality imagery or ground data
 - “Super” expert interpreter(s) or consensus review
 - Accuracy assessment of reference data

Sources of Variance

- Sampling variance
 - Different sample would yield different area estimate
 - Reduce by increasing sample size, stratification, model-assisted estimation
- Response variance
 - Different iteration of response design yields different reference class
 - Reduce by interpreter training and coordination, quality control protocols

Assessing Variance

- Total variance = Sampling variance + Response variance
- Sampling variance – conventional estimators from sampling theory
- Response variance – generally not incorporated in practice
 - Requires repeating response design protocol on subsample of units
 - Human interpreters – 2 or more independent interpreters
 - Automated classifier – how to define repeat classification?

Summary

- SBAE decisions can be evaluated using statistical and practical criteria

Statistical

Bias

Variance

Practical

Cost

Simplicity

Flexibility

Consistency

- Sampling design and estimator decisions are usually variance criterion
- Response design decisions are usually bias criterion (variance only recently becoming a concern)
- Find good (not perfect) solution recognizing trade-offs of choices