An Approximate Point-based Alternative for the Estimation of Variance under Big BAF Sampling

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Abstract

Background

A new variance estimator is derived and tested for big BAF (Basal Area Factor) sampling which is a forest inventory system that utilizes two BAF sizes, a small BAF for tree counts and a larger BAF on which tree measurements are made usually including dbh s and heights needed for volume estimation.

Methods

The new estimator is derived using the $\bar{D}_m$ from an existing formulation of the big BAF estimator as consisting of three sample means. The new formula is compared to existing big BAF estimators including a popular estimator based on Bruce's formula.

Results

Several computer simulation studies were conducted comparing the new variance estimator to all known variance estimators for big BAF currently in the forest inventory literature. In simulations the new estimator performed well and comparably to existing variance formulas.

Conclusions

A possible advantage of the new estimator is that it does not require the assumption of negligible correlation between basal area counts on the small BAF factor and volume-basal area ratios based on the large BAF factor selection trees, an assumption required by all previous big BAF variance estimation formulas. Although this correlation was negligible on the simulation stands used in this study, it is conceivable that the correlation could be significant in some forest types, such as those in which the dbh-height relationship can be affected substantially by density perhaps through competition. We also mathematically derived expressions for bias in the big BAF estimator that can be used to show the bias approaches zero in large samples on the order of $1/n$ where n is the number of sample points.

Full Text

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Figures

Figure 1

Approximate bias in the big BAF estimator for the northern hardwoods and white pine populations with $BAFv = 30$ (dotted, ●), $BAFv = 20$ (dash, Δ) and $BAFv = 10$ (solid, +).

Figure 2

The northern hardwood Monte Carlo standard error simulation results as the average over 1; 000 replications for each BAF pair and sample size with the Delta Method (dashed, $\diamond$), Goodman's (dot-dashed, $+$), the point-based Delta method (dotted, Δ) and the simplified point-based Delta method (long-dash, $\times$). The reference line (solid, $\bullet$) is the average Monte Carlo standard error for the BAFc HPS results.

Figure 3

The white pine Monte Carlo standard error simulation results as the average over 1; 000 replications for each BAF pair and sample size with the Delta Method (dashed, $\diamond$), Goodman's (dot-dashed, $+$), the point-based Delta method (dotted, Δ) and the simplified point-based Delta method (long-dash, $\times$). The reference line (solid, $\bullet$) is the average Monte Carlo standard error for the BAFc HPS results.

Figure 4

The northern hardwoods Monte Carlo simulation results for condence interval capture rates as the average over 1; 000 replications for each BAF pair and sample size with the Delta Method (dashed, $\diamond$), Goodman's (dot-dashed, +), the point-based Delta method (dotted, Δ) and the simplified point-based Delta method (long-dash, $\times$). The reference line (solid, $\bullet$) is the average Monte Carlo standard error for the BAFc HPS results.

Figure 5

The white pine Monte Carlo simulation results for condence interval capture rates as the average over 1; 000 replications for each BAF pair and sample size with the Delta Method (dashed, $\diamond$), Goodman's (dot-dashed, $+$), the point-based Delta method (dotted, Δ) and the simplified point-based Delta method (long-dash, $\times$). The reference line (solid, $\bullet$) is the average Monte Carlo standard error for the BAF_c HPS results.

Supplementary Files

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