

Incorporating Relative Value in Plot Allocation for Stratified Sampling

By: Derrick Gallagher

MS Student

Warnell School of Forestry, UGA

Introduction

- **Timber Inventory Essential in Estimating Tract Value**
- **Importance of Stratified Sampling**
 - **Separate Strata in Homogeneous Units**
 - **Reduce Variation Across Strata**
 - **Improve Inventory Estimates**

Proportional Allocation

- **Proportion of Stratum Acres to Total Tract Acres**

$$n_h = \left(\frac{N_h}{N} \right) \times n$$

- **Pro- Easy to Calculate**
- **Con- Does Not Account For Variability**

Neyman Allocation

- **Includes Stratum Size and Variability**

$$n_h = \left(\frac{N_h \times S_{y_h}}{\sum N_h \times S_{y_h}} \right) \times n$$

- **Pro- Less Plots Needed Than Proportional Allocation**
- **Con- Does Not Account For Stratum Value (If Objective is Total Tract Value)**

Relative Value Calculation

Strata	\$/ton	Formula	Relative Value
Pulpwood	\$10	$\frac{\text{Pulpwood } \$/\text{ton}}{\text{Pulpwood } \$/\text{ton}}$	1
CNS	\$15	$\frac{\text{CNS } \$/\text{ton}}{\text{Pulpwood } \$/\text{ton}}$	1.5
Sawtimber	\$30	$\frac{\text{Sawtimber } \$/\text{ton}}{\text{Pulpwood } \$/\text{ton}}$	3

Relative Value Allocation

- **Includes Stratum Size, Variability, and Value**

$$n_h = \left(\frac{N_h \times S_{y_h} \times RV_h}{\sum N_h \times S_{y_h} \times RV_h} \right) \times n$$

- **Pro-Allocates More Plots to Higher Value Strata**
- **Con- Trade Off in Confidence Interval Precision Between Strata**

Weighting SD by Product Class

Standard Deviation (tons/acre)	% of Observations			Weighted SD (tons/acre)		
	Pulpwood	CNS	Sawtimber	Pulpwood	CNS	Sawtimber
18.9	100%	32%	9%	18.9	6.2	1.8
32.55	0%	60%	57%	0	19.4	18.3
49.1	0%	8%	34%	0	3.8	16.9
Total	100%	100%	100%	18.9	29.4	37.0

Stratum Attributes for Plot Allocation

Strata	Acres	Variability tons/acre	RV	Stratum Value
Pulpwood	40	18.9	1	\$11,625
CNS	110	29.4	1.5	\$145,195
Sawtimber	60	37.0	3	\$159,085
Total	210			\$315,905

Percentage of Plot Allocation by Method

Strata	Proportional	Neyman	RV
Pulpwood	19%	12%	6%
CNS	52%	52%	40%
Sawtimber	29%	36%	54%
Total % of Plots	100%	100%	100%

Conclusion

- **Allocate More Plots Into Higher Value Strata**
- **Better Value Estimation of Strata Reaching Financial Maturity**
- **Possibilities**
 - Improve Confidence Interval Precision of Tract Value**
 - Reduce Number of Plots Needed to Achieve Desired Confidence Interval**

Question?