Resource Inventory Notes

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SOME BASIC CONSIDERATIONS WHEN SAMPLING SMALL WOODLANDS

by

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ABSTRACT: A rough guide to allowable sampling errors for various objectives is presented. Also a table of sampling intensity for various limits of error and expected variation is given. Considerations apply to all resource inventories.

INTRODUCTION

What would you think of a forester who ran a cruise for a pulpwood sale ($3 per cord stumpage) to an accuracy of ±1% with a confidence level of two standard deviations? Conversely, wouldn't you question a forester's reasoning who ran a cruise for a black walnut veneer sale ($2,000 per MBF stumpage) to an accuracy of ±30% with a confidence level of one standard deviation? The former, of course, is wasting time and funds by taking too many samples and the latter is obviously inviting disaster by not taking enough. Now that we have looked at some high and low levels on the accuracy spectrum, let's consider the optimum number of samples needed under various circumstances which will lead to an accuracy befitting the situation.

Before determining the number of samples needed, you must first analyze the situation and establish your objective. This will give you an idea of the accuracy you desire. Following is a rough guide which may or may not parallel your demands:

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OBJECTIVE	ACCURACY (2 standard deviations)
General Management Plan. Basis for establishing future policies and planning procedures.	±30%-40%
To establish cutting policy on sales. Payment to be made by actual sale.	±20%
Lump sum sales -- pulpwood or other low-value product.	±10%
Lump sum sales -- fine hardwoods or other high-value product. Consider 100% inventory for veneer quality trees.	±1%-5%
Real estate appraisals involving high-value timber.	±5%
Court litigations	±5%

With the desired accuracy known, the stand uniformity becomes the next factor for consideration. This is usually a "guestimate". Since a volume estimate is the answer we are usually seeking, we must guess the volume variability among the samples we will be taking. This, as usual, is expressed in percent as the coefficient of variation. Literature published during the last forty years gives a wide range of average figures -- some as high as 115%; some as low as 45%. I have found the average variability in the Midwest hardwood stands to be near 60% and near 30% in pine plantations. Consequently, these figures are used where average stand conditions appear to exist. On the other hand, unusual conditions dictate appropriate adjustments.

Now, with a desired accuracy level (E) and an estimated coefficient of variation (C) available, the number of samples (N) needed can be calculated by using the simple formula: $N=\frac{4C^2}{E^2}$.

The following table lists the number of samples needed for several coefficient of variation and error levels -- such a table can substitute for computations. Even though the table gives some numbers less than 10, it is recommended that 10 samples be the minimum taken.

NUMBER OF SAMPLES
(two standard deviations)

Coefficient of variation (percent)	Limits of Error					
	±5%	±10%	±15%	±20%	±25%	±30%
	Number of Samples Required					
30	144	36	16	9	6	4
40	256	64	29	16	11	8
50	400	100	45	25	16	12
60	576	144	64	36	23	16
70	784	196	88	49	32	22
80	1024	256	114	64	41	29
90	1296	324	144	81	52	36
100	1600	400	178	100	64	45

This table is computed for two standard deviations (19 out of 20 confidence level). Rather than recompute for one standard deviation (2 out 3 confidence level), it is easier to divide the number of samples needed by four. Also, if the accuracy level for one standard deviation is desired, the listed error can be divided by two.

When making a cruise, it is advisable to always tally the volume for each sample separately. You then have the data necessary to compute the actual coefficient of variation, which will condition you to better estimate it for subsequent cruises. In addition, the cruise error can be computed and a comparison made with the original goal.

These unsophisticated procedures are subject to statistical refinement. However, by employing them when performing simple cruises, time and funds can be saved and the forester will become more knowledgeable concerning the reliability of his data.

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