ESTIMATION OF VOLUME IN TIMBER STANDS BY STRIP SAMPLING

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1. Introduction. The present paper is the second of a proposed series, in which it is intended to present a systematic study of the properties of several methods of sampling timber stands and statistical treatments of the samples.

The effects of size, shape, and arrangement of sampling units on the accuracy of sample estimates of timber stand volume were reported in the earlier paper [1] for 5,760 acres of the Blacks Mountain Experimental Forest. With complete inventory data, the nature of stand variation was shown to be such that 2.5-acre plots, the smallest size tested, were more efficient sampling units than larger plots, i.e., for a given intensity of sampling the sampling error was smaller. Long, narrow plots were more efficient than square plots of the same size. Line-plot sampling units consisting of two or more equally spaced plots along lines of fixed length were as efficient as single-plot sampling units and more efficient than strips consisting of plots contiguous end to end. Improvement in the accuracy of estimates was obtained by subdividing the area into rectangular blocks of equal size, and sampling each block to the same intensity. By systematic sampling, whereby the center lines of parallel line-plot or strip sampling units were spaced equidistant, the sample estimates of stand volume were improved over estimates from comparable random samples. Treatment of the volumes on individual plots of systematic samples as random sampling observations, however, as is sometimes done in practice, was shown to give seriously biased estimates of sampling error.

In the present paper we shall be concerned with sample estimates from strip samples taken within blocks of irregular shape, and consequently with sampling units which vary in length within samples. The methods will be equally applicable to line plot samples.

Following the general ideas expressed by Neyman [2] it is felt that: (1) If the formulae of the theory of probability have to be applied at all to the treatment of samples, the theoretical model of sampling must involve some element of randomness. (2) This element of randomness may conveniently be introduced by a random selection of the sample, but may also be assumed present in the distribution of deviations of timber stand volumes in the area sampled from a postulated pattern. (3) Many attempts to treat systematic arrangements statistically are faulty because the treatment consists in applying to systematic arrangements formulae that are deduced under the assumption of randomness. If the arrangement of sampling is a systematic one, and random errors are

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