Computation of FIA Plot Expansion Factors

Expansion factors can be thought of as the number of acres that a given plot represents. Thus, the plot value can be expressed on a per-acre basis (eqs. 4.1 or 4.8), and then multiplied by the expansion factor to compute the plot's contribution to the attribute total for the estimation unit (target population). Expansion factors depend on three variables: the total area (A_T), the stratum weight, and the number of plots in the stratum (n_h).

Rather than applying the equations supplied in Chapter 4, users often prefer to apply expansion factors to plot estimates in order to compute totals. While this approach is simple to understand and apply in database management systems, it does have drawbacks. First, variances cannot be computed using this approach. Users should avoid making any inference about an estimate without knowing its variability. Second, the expansion factors are not always the same for a given plot – they are dynamic. For example, the table of area estimates based on all plots, regardless of whether or not they were accessed, results in a different set of expansion factors than the table based on only accessed plots (n_h can differ). The expansion factors can also change for estimates of the components of change (4.3.6), because during the first cycle of annual inventory not all plots are remeasures (both n_h and the stratum weights can differ). Third, the expansion factors stored in the FIADB are based on the estimation units used by FIA. If the user is interested in different estimation units, such as ecoregions or a cutting unit, then more efficient estimates can be obtained by using just the Phase 1 data for the area of interest. For these reasons, the use of expansion factors is discouraged. As long as the user understands these limitations, expansion factors can be helpful for quick tabulations for exploratory purposes.

As noted above, expansion factors depend on three variables: the total area, the stratum weight, and the number of plots in the stratum. In the stratified estimation (and the simple random sampling) case, where strata sizes are known, the expansion factor is:

$$F = A_T W_h / n_h \quad (4B.1)$$

and in the double sampling for stratification case:

$$F = A_T \frac{n'_h}{n' n_h} \quad (4B.2)$$

Multiple values for F are supplied in FIA's online database, FIADB. Because the sample size can differ when making tables that exclude plots that could not be accessed, two sets of expansion factors were needed. Also, since some new plots were installed during the first cycle of the annual inventory, not all plots can be used to estimate the components of change, thus a third expansion factor must be used for those estimates. If the number of remeasured plots is small enough, then the number of strata may also need to be reduced, thus also affecting the expansion factor. The user needs to make sure that the number of plots used to create a table matches with the number of plots used to compute the expansion factor.

As noted above, if interest is in an estimation unit other than that used by FIA, such as cutting unit, then two approaches can be used. The common one is to use the expansion factors for all the plots within the cutting circle and apply them to the plot attributes. The preferred method is to recompute the area, A_T, the stratum weights, and the sample sizes based on the cutting circle alone. Currently, the FIA web tools do not have this capability, but they are being developed. However, the FIA units have the capability to do this as a special request.