VOLUME EQUATIONS FOR THE MAJOR INDIGENOUS SPECIES IN NEW ZEALAND

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ABSTRACT

Two-way volume formulae for nine indigenous species or crop types have been developed from earlier data on sectionally measured trees.

Volume tables for the major indigenous tree species in New Zealand had, since about 1924 and until recently, been compiled by graphical methods. These tables were cumbersome to use in computer programs so volume formulae have now been developed. These formulae are given in detail in a concurrently published report (Ellis, 1978).

The volume formulae were constructed for two main crop types; mature trees and pole trees. For mature trees, volumes were estimated from d.b.h. (overbark) at 1.4 metres above ground and merchantable height and were usually merchantable volumes above an average stump to a point where heavy branching occurs and no further utilisation is possible. Volumes of poles were derived from d.b.h. and total height and included total volume from ground level to the tip of the tree.

The earlier graphically-derived tables were based on data from trees (approximately 3900) which had been sectionally measured for accurate calculation of volume. So the new formulae were developed from these data in imperial units rather than from new data.

The following nine species or crop types were represented in the basic data:

Mature kauri (*Agathis australis* Salisb.)

Mature beech (*Nothofagus menziesii* (Hook f.)Oerst., *Nothofagus fusca* (Hook f.) Oerst., *Nothofagus truncata* (Col.)Cokn., *Nothofagus solandri* var. *cliffortioides* (Hook f.) Poole).

Mature tawa (*Beilschmiedia tawa* (A. Cunn.) Benth. et Hook f. ex Kirk).

Mature rimu (*Dacrydium cupressinum* Lamb.).

Mature Westland rimu.

Mature native hardwoods in Auckland (*Beilschmiedia tarairi* (A. Cunn.) Benth. et Hook f. ex Kirk, *Dysoxylum spectabile* (Forst. f.) Hook f., *Knightia excelsa* R.Br.).

Pole kauri.

Pole beech (*N. fusca, N. truncata, N. solandri* var. *cliffortioides*).

Pole rimu.

Suitable volume equations were selected from multiple linear regression models

built up using a stepwise multiple regression package on an ICL 1904S computer. Weighted and logarithmic models were tested and for mature rimu a non-linear model was also tried when all of the other models failed. The choice of models was limited by the following constraints. Firstly, that any combination of d.b.h. and height should produce a positive volume and secondly that any increase in d.b.h. and height should give an increased volume. The final choice of a formula for each species and crop type was made by selecting the best scattergram of plotted volume estimates of all sample trees over their actual volumes. Unless a large number of regression terms were used, only the logarithmic and non-linear models were entirely satisfactory throughout the whole range of volumes in each sample.

The nine formulae gave estimated volume in metric units. Results showed that volume estimates for stands (at the 95% probability level) would generally be within 1% (0.6% to 2.0%) and for individual trees within about 10% for pole trees (8.9% to 13%) and about 20% (15% to 26%) for mature trees. The formulae were less accurate for this last crop type due to the unmeasured diameter at the merchantable limit. The principal use of the formulae was for forest inventory, where the volume of a large number of trees was required. Two-way volume tables have been derived from the formulae and are available for each crop and species type. The tables were listed for d.b.h. classes, increasing by 2-cm steps, and height classes by 1-metre steps. The volumes are expressed in either cubic metres or cubic decimetres depending on the sizes of tree involved.

REFERENCE

ELLIS, J. C. 1978: Volume equations for the major indigenous species in New Zealand. **N.Z. For. Serv., For. Res. Inst., Tech. Pap. 67.**