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A stochastic algorithm for reconstructing tree height growth with stem analysis data

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Keywords: height growth models, mixed-effects models, growth rates, site productivity.

Tree growth is very important for understanding forest dynamics and forest management planning. Among the alternatives for measuring tree growth, stem analysis, a destructive technique that involves cutting trees, yields detailed information on each tree through time, such as diameter, taper, and total height. Several algorithms have been proposed to adjust the section-height-age information from stem analysis to obtain the real time series data of tree height. Here, we present a stochastic algorithm for reconstructing height-age data pairs from stem analysis data. We use stem analysis data from two deciduous broadleaves tree species (*Nothofagus alpina* and *N. obliqua*), an evergreen tree species (*N. dombeyi*) growing in the southern hemisphere, and a conifer (Douglas-fir) growing in the northern hemisphere for our analysis. We reconstruct pairs of height-age data for each species by the widely used Carmean algorithm and the one proposed here. For each species, we fit the Bertalanffy growth model using both data. A mixed-effects model strategy was used for fitting this non-linear model. Comparisons between the models generated from the two types of data consider confidence intervals of the estimated parameters, as well as a regression-based equivalence test within a non-parametric bootstrapping framework. Results showed that fitted height growth models obtained from these two algorithms are equivalent from a statistical point of view. However, the proposed algorithm is simpler than the Carmean one and most likely more accurate as well, and therefore we propose its use.

Simultaneous fit of biomass-component equations: statistical analysis and practical implications

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Keywords: biomass modelling, regression techniques, statistical inference.

Accurate quantification of tree biomass is key for estimating and understanding fiber production and carbon sequestration by trees, however, tree biomass is also influenced by several factors affecting tree growth. Given the highly intensive set of measurements needed for measuring tree biomass (*w*), we are forced to build statistical relationships between *w* and predictor variables that are easily recorded, e.g., tree diameter (*d*). Modelling of tree biomass components (i.e., stem, branches, and