STATIS method applied to study diameter growth of eucalyptus stands

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Abstract

Eucalyptus globulus Labill. is one of the most important economic forest species in Portugal, occupying an area of $875,000ha$ of a total forest area of $3,346,000ha$. In order to contribute to a balanced and resourceful management of Eucalyptus stand in Portugal, it is necessary to acquire models that simulate their growth under different environment conditions and treatments.

The objective of the research reported here was to analyse if diameter growth varies in a consistent manner throughout time, according to criteria that describes stand dynamics. A perspective that seemed valid to handle this problem was the STATIS methodology that uses Euclidean distances to compare configurations between statistical units observed in k different circumstances, as a measure of similarity between them. This approach was introduced by (Escoufier and L'Hermier, 1978) and developed by many authors (Lavit et al., 1994), (Areia et al., 2008).

In this method a study consists of a data matrix $X_{i'}$ with a line for objects and a column for variables and two diagonal weight matrices D_p^0 and D_n for variables and objects. To each study the following matrix is associated in order to condense the information, $A_{i'} = X_{i'}^T D_{ni'} X_{i'} D_p^0 \quad i' = 1, ..., k$

The comparison of various studies will be done through the algebraic structure associated to matrices $A_{i'}$, of type $p \times p$, $i' = 1, 2, ..., k$. This structure was developed using Hilbert-Schmidt scalar product in the space of square matrices, ie,

$$S_{i'j'} = A_{i'} | A_{j'} = tr\left(A_{i'} A_{j'}^T\right) = \sum_{v=1}^{p} \sum_{u=1}^{p} a_{v,u}\left(i'\right) a_{v,u}\left(j'\right) \quad i', j' = 1, ..., k$$

The matrix $S = [s_{i',j'}]$ with $i', j' = 1, ...,$ will be symmetric, with eigenvalues $\theta_1, ..., \theta_k$ and mutually orthogonal eigenvectors $\gamma_1, ..., \gamma_k$.

In our case the representation points are near the space spanned by γ_1, γ_2 and the following model is developed: $S = \sum_{i=1}^{2} \lambda_i \alpha_i^k \alpha_i^{k^t} + \overline{E}$ with $\alpha_i^{k^t} \alpha_j^k = \delta_{i,j} \quad i, j = 1, ..., r$, where $\overline{E} = \frac{1}{2}(E + E^t)$ and $vec(E) \sim N(0^{k^2}, \sigma^2 I_k^2)$.

Keywords

F tests, Hilbert-Schmidt product, STATIS method.

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