FIG WORKING WEEK 2025
AND Locate25 THE NATIONAL GEOSPATIAL CONFERENCE
Collaboration, Innovation and Resilience: Championing a Digital Generation
FIG Geospatial Council of Australia
Brisbane, Australia 6–10 April

Predictive modelling of eucalyptus tree metrics using stump measurements

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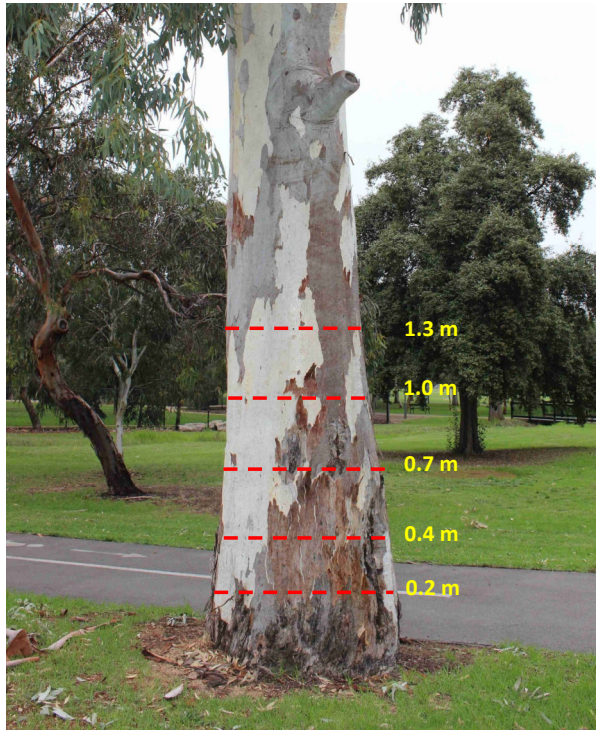
Motivation

Estimating diameter at breast height (DBH) from stump measurements can be used for predicting tree metrics (i.e. height volume and weight). Stump data can be used for reconstructing pre-harvest stand conditions, particularly in cases of unplanned or illegal tree removals.

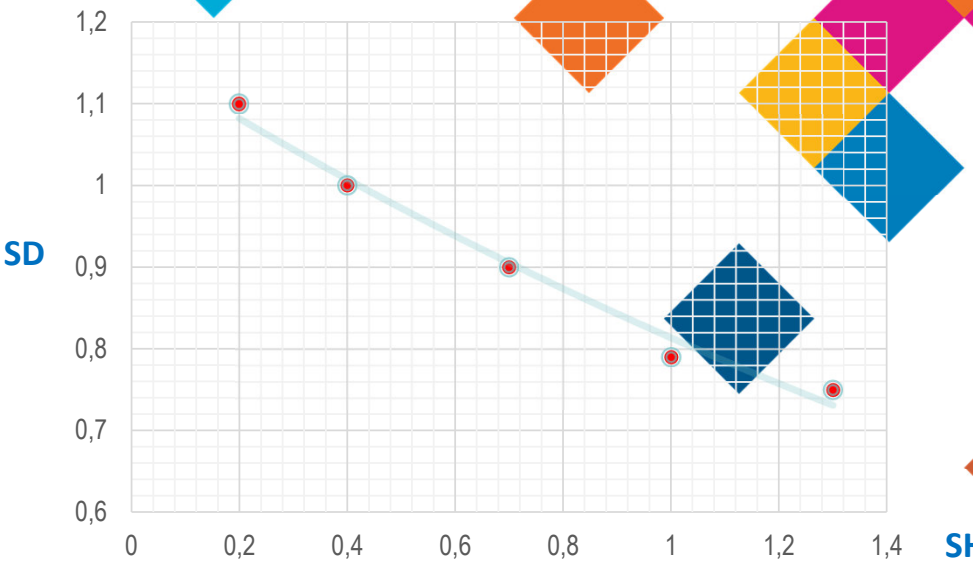
Illegal logging : money does grow on trees

Natural disasters

DBH from stump measurements



This exponential model was selected in view of the slight curvature of the trunk sections of interest



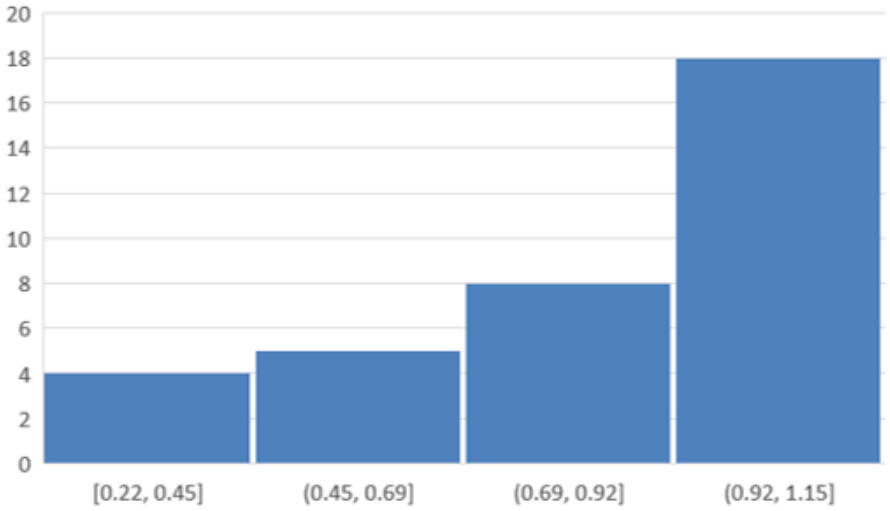
SD: Stump Diameter

SH: Stump Height

$R^2 = 0.98$ $SD = 1.16 * e^{(-0.36*SH)}$

The data

Measurements were obtained from 35 Eucalyptus tereticornis trees. The histogram shows the distribution of DBH (1.3 m) indicating that the majority were mature trees. All measurements were taken outside the bark and within an urban environment.



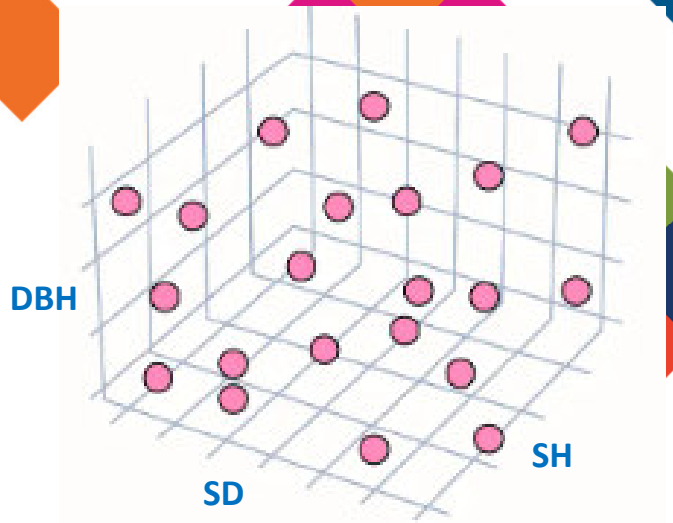
The development of the predictive model

Tree Measurements:
The 35 Eucalyptus trees were measured at 5 stump heights: 0.2 m, 0.4 m, 0.7 m, 1.0 m, 1.3 m. Stump diameter (SD) was recorded at each height up to the DBH.

Equation Development:
Estimating DBH from stump measurements involves fitting a second-degree regression surface model using SH and SD as predictors. The measured SH, SD, and corresponding DBH values are used to determine regression coefficients through least squares regression of the form:

$$DBH = a + b_{1*} SH + b_{2*} SD + b_{3*} SH^2 + b_{4*} SD^2 + b_{5*} (SH * SD)$$

Illustrative only



DBH = F (SH, SD)

Accuracy and conclusions

The model was validated by comparing predicted and field-measured DBH values for 35 trees, yielding an RMSE of ±0.024 m, or 1.71% of the average DBH.

This approach can be extended using neural networks, leveraging the dataset to better capture nonlinear relationships, and for a larger number of trees.

Accurate DBH prediction is vital for forestry, aiding volume, biomass, and growth estimates. When trees are lost due to theft, missing data, or disasters, stump measurements remain a key tool for estimating tree metrics, highlighting the need for reliable DBH prediction from SD and SH.

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