(187)

Mathematical Model for Forecasting Sawn Timber Valuation: A Case Study of Jack Tree in the State Timber Co-orporation, Sri Lanka

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Abstract

Timber is the most valuable commercial commodity taken from most forests. There is growing pressure on the timber industry to increase efficiency and sustainability. The State Timber Corporation (STC) currently functions as the sole authority in harvesting trees from state lands in Sri Lanka. They received permitted logged areas mainly from the forest department in Sri Lanka. STC converts a significant amount of timber to sawn timber that is cut from logs into different shapes and sizes, among their other functions. The output sawn timber volume is estimated by using only the measurable values named length, and girth of the log given in the table (standard) which they have before the sawn timber production by STC. After the sawn timber production, the real sawn timber volume will not reach estimated sawn timber value due to several reasons such as natural inconsistencies, high processing waste, frequent defects, etc. Therefore, this study aims to find a mathematical model to predict the actual sawn timber valuation of a log using the above variables. This study was done based on the Jack tree sample and relevant data for the study was collected from the STC, in Sri Lanka. There were 152 data records. Initially, the sawn timber valuation was estimated by using the multiple linear regression model (MLR) which is a statistical technique. It calculates the linear relationship between independent variables and output variables. But the MLR model is unable to find the nonlinear relationship between inputs and output if there is one. Therefore, accuracy of the MLR model was limited. Then the gradient boosting method (GBM) was applied to the results of the MLR model to increase the accuracy of the model. The learning rate and number of trees were selected as optimal values to avoid overfitting and to balance the accuracy respectively for the GB model based on mean square error. The model accuracy was increased by 70%-90%. The results demonstrated that GBM significantly enhanced prediction accuracy, with its estimates closely aligning with actual production values. I.e. developed mathematical models are better than traditional methods. The actual sawn timber volume, which is received as a final output of the timber processing, is the crucial factor in determining the efficiency and economic variability of the wood processing operation. This model can be applied to any kind of tree and accuracy of the model can be enhanced by incorporating more input variables.

Keywords: *Forecasting, Gradient boosting method, Multiple linear regression, Sawn timber*

Proceedings of the 29th International Forestry and Environment Symposium 2025 of the Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Sri Lanka

134