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Which Tree is Best For Pittsburgh?

1. Introduction:

The city of Pittsburgh maintains a database of every street tree it cares for, including multiple data points for each tree, such as species, height, width, location, and the overall dollar benefits provided. ‘Overall dollar value benefits’ is a grouping of variables, including runoff elimination, air quality benefits, property value benefits, and more. By analyzing the overall dollar benefits of the two most common city trees in Pittsburgh, the Red Maple and the Norway Maple, we hoped to find which species is the best economic choice.

2. Data description and sources

The data came from the Pittsburgh Street Tree Inventory (publicly available on the Western Pennsylvania Regional Data Center). We removed NAN and 0 values and trimmed the data set to the variables we would use. There are no reliability or credibility issues in this data set, as it is maintained by the City of Pittsburgh Department of Public Works Forestry Division; it was last updated December 19, 2022. To create the volume variable, we multiplied height by width to get a rough estimate of the volume of the tree.

Dollar Benefits of Pittsburgh Trees by Size

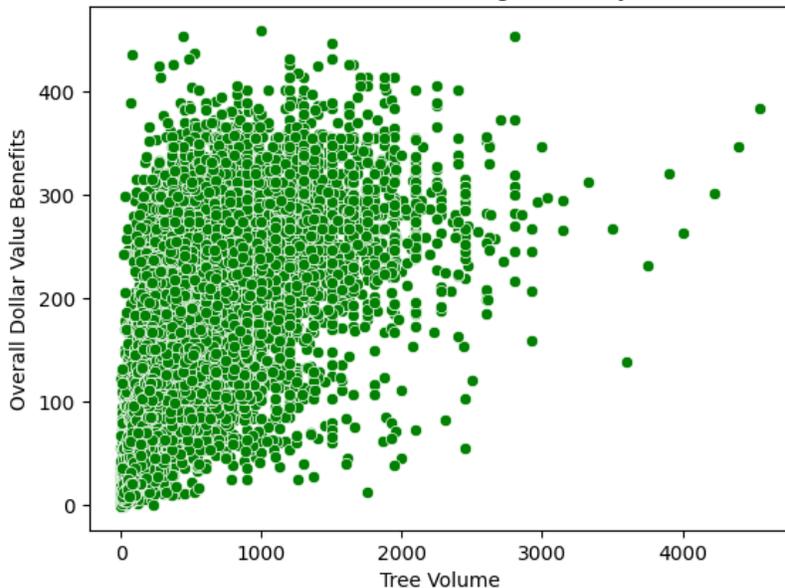


Figure 2. Scatterplot relating tree volume to the overall dollar value of benefits provided

Distribution of Tree Volumes

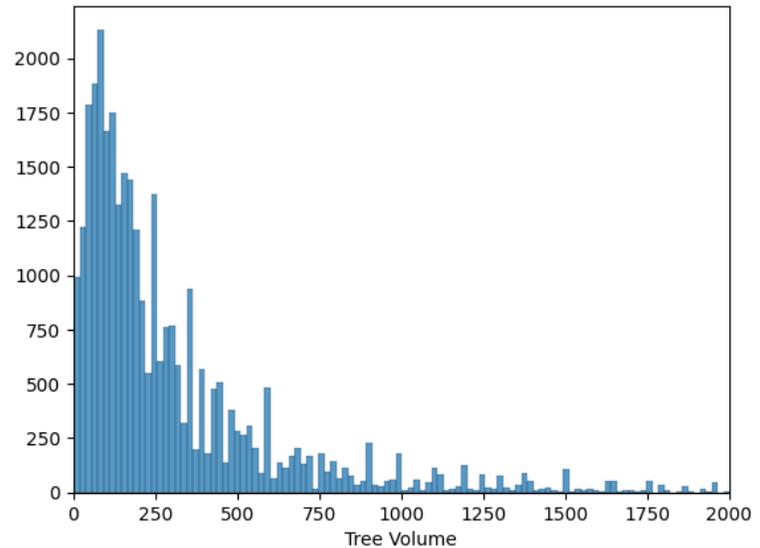


Figure 3. Histogram showing the distribution of tree volume

Figure 2 shows a positive correlation between tree size and the dollar benefits, meaning that accounting for tree size is important in our regression model. Figure 3 shows that the distribution of tree volumes is heavily skewed to the right. Luckily, the data set is very large, so our sampling distribution will be normal.

Methodology:

Overall Dollar Benefits of Red and Norway Maples by Tree Volume

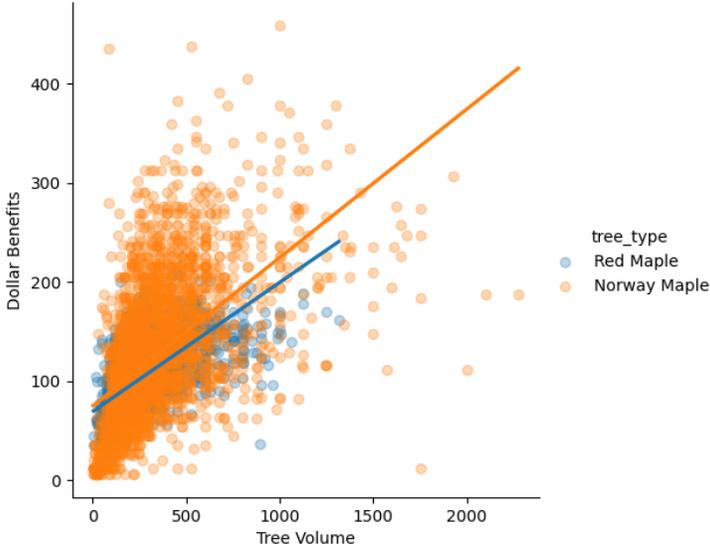


Figure 4. Linear regression plot showing The difference in Dollar benefits provided From Red and Norway Maples at every size

Residual Plot for Observed Minus Predicted values

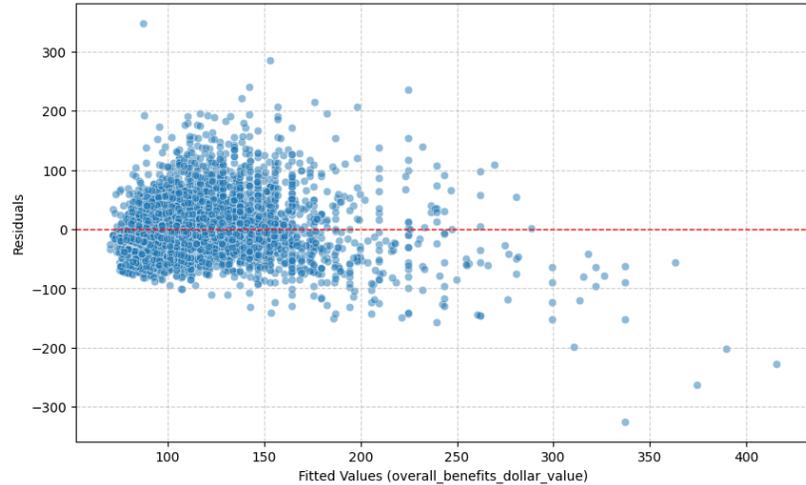


Figure 5. Residual plot showing decreasing accuracy of our model for trees with higher dollar value benefits

	coef	std err	t	P> t	[0.025	0.975]
Intercept	69.0096	1.317	52.417	0.000	66.429	71.591
is_norway	5.4868	1.807	3.037	0.002	1.945	9.028
tree_volume	0.1305	0.005	27.290	0.000	0.121	0.140
tree_volume:is_norway	0.0195	0.006	3.413	0.001	0.008	0.031

$$\text{Benefits} = \beta_0 + \beta_1(\text{s_norway}) + \beta_2(\text{volume}) + \beta_3(\text{volume} \times \text{is_norway})$$

Results and Analysis:

Our model predicts the overall dollar value for Red Maples and Norway Maples of the same size to see if one species provides more dollar benefits than the other. The regression results show that both tree size and species significantly affect dollar benefits. Tree volume has a strong positive effect, meaning for each additional unit of volume Red Maples provide an

additional \$0.13 of benefit, and Norway Maples provide \$0.13 plus an additional \$0.02 of benefit. Norway Maples also provide higher benefits than Red Maples even when both trees are the same size, an average increased benefit of \$5.47 for Norway Maples. The residuals vs. fitted plot (Fig. 5) reveals some heteroscedasticity, the model systematically underpredict the actual dollar value provided for large value trees.

Conclusion:

Norway Maples provide greater economic benefits than Red Maples at every size. Norway Maples provide more dollar benefits on average than Red Maples of the same size and also increase in benefits provided more rapidly as they grow, making them the more economically valuable species overall. Overall, Norway Maples offer higher and faster-growing returns.

References:

Gemini Coding

ChatGPT Coding

[Pittsburgh Tree Data](#)

[Data Analysis](#)

[Data Folder](#)