AGR9014-2324: Research Methods (LIAT)

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Task 1:

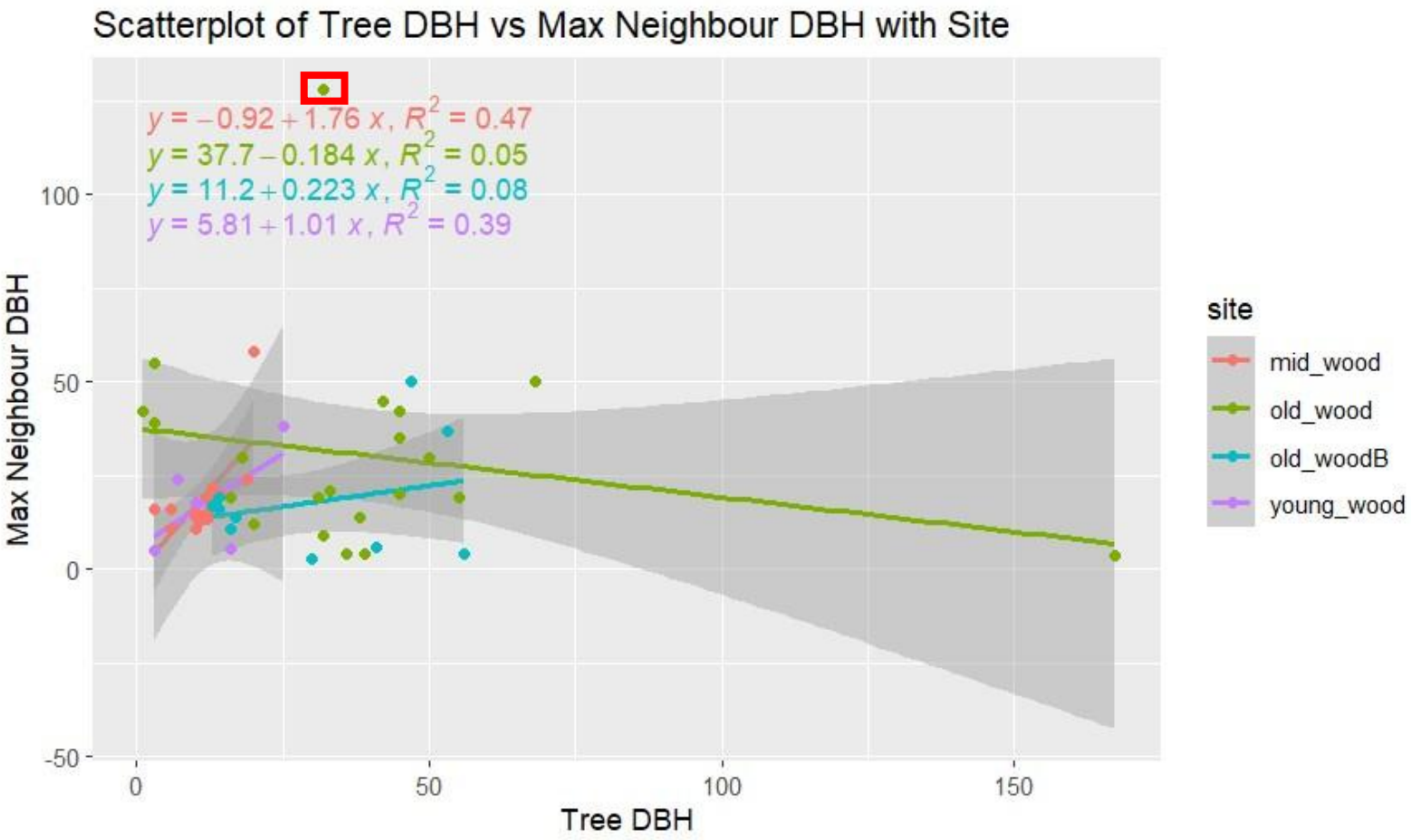

Figure: Describing the relationship between the Diameter at Breast Height (DBH) of individual trees and the maximum DBH of their neighbouring trees between distinct sites. While each of the 4 various colours points in the graph represents a different site, the lines of the same colours show the slope of the relationship.

The aim of the test is to ascertain whether the Diameter at Breast Height (DBH) of trees influences the growth of their neighbours. The key result indicate that the findings suggest that DBH of selected trees have minimal impact on the growth of their neighbouring tree’s DBH.

This scatterplot reveals a weak relationship for all site between tree DBH and the maximum DBH of neighbouring trees, based on R-squared results which are %47, %5, %8 and %39 respectively. When analysing the directions for each site through slope examination, we observe a positive slope indicating an upward trajectory for middle wood, old wood B, and young wood. However, old wood exhibits a negative slope, indicating a descending trajectory. In addition, we can conclude that all our sites exhibit a non-linear form, as none of their points follow a straight line. Regarding the study's objective, there appears to be no discernible correlation between tree DBH and neighbour DBH, to establish a correlation, we would typically expect to see a corresponding increase or decrease in neighbouring DBH values with changes in tree DBH values. However, this is not observed in the plot under consideration. Eventually, while outlier observations are evident across all sites except Young Wood, the most notable finding is the value identified in Old Wood, highlighted by a red square.

This research is important in many ways, because for the sustainable management of forest resources at various geographical levels, forest inventories offer crucial information and the diameter at breast height (DBH), which is connected with numerous other tree properties, is a crucial forest trait (Räty et al., 2021). An important aspect that increases the interest in this study is that Chen and Bowman (2022) contributed to the finding that there is no direct positive relationship between the Mean Diameter at Chest Height (DBH) of the nearest neighbouring trees and the distance, with the conclusion that neighbours do not affect each other's DBH.

Task 2:

Introduction:

The growth and development of forest trees is influenced by numerous natural and human influences. The species, size, and proximity to nearby trees all affect how much of a competitive influence they have on the growth of the target tree (Canham et al., 2004), which support one of the natural factors affecting tree growth is the effects of neighbouring trees on each other. The assessment's goal is to determine whether or not a tree's DBH (Diameter at Breast Height) affects its neighbour's DBH on the University of Lincoln's Riseholme campus. In particular, I aim to ascertain whether the DBH of a focus tree and the DBH of its largest neighbour tree within 5m exhibit a strong linear association. Similar to this study, a previous work was carried out by Chamagne et al., (2016) investigating the effects of neighbouring trees on each other were investigated and concluded that there was no interaction. My hypothesis also concluded that neighbouring trees do not influence each other.

The null hypothesis; **H0** = The relationship between tree DBH and max neighbour DBH is not statistically significant.

Alternative hypothesis; **H1** = The relationship between tree DBH and max neighbour DBH is statistically significant

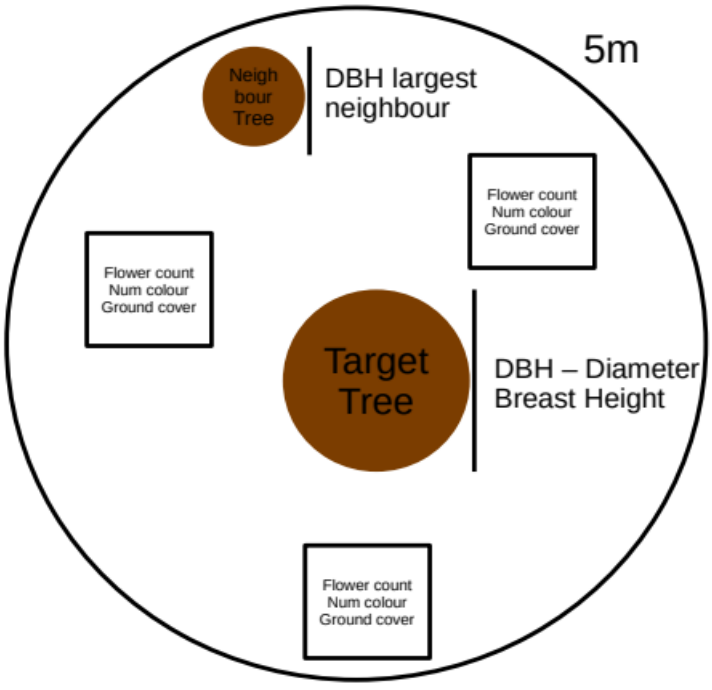

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Figure 1: The DBH of the target tree and its closest neighbour were measured at each target tree.

Methods:

Four distinct forest areas were used for the study: young wood, ancient wood, old woodB, and mid wood using and the study was carried out on 54 samples selected from forests. After all, the DBH of the target tree as well as the closest tree which had maximum DBH were carried out at randomly selected locations within a 30 to 30 cm range.

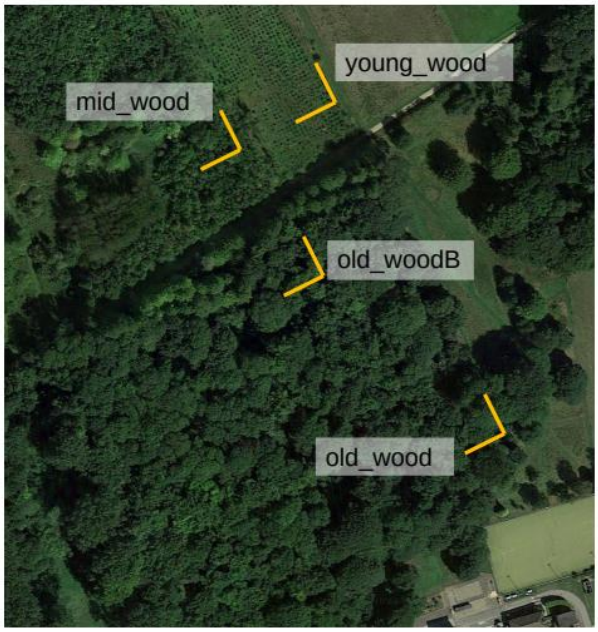

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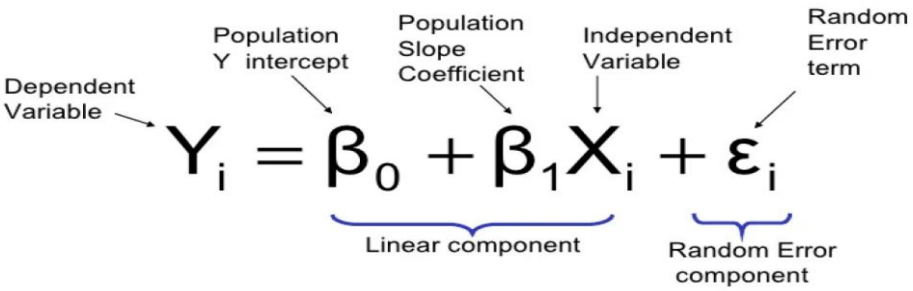
Figure 2: Name and location of the four sample locations

According to the Kasza and Wolfe (2013) when a continuous outcome variable needs to be understood in relation to a single explanatory variable, simple linear regression is employed by the researcher. As the purpose of the research is to find whether there exists linear association between tree DBH and max neighbour DBH, simple linear regression model is used in the study, the Mathematical form of which is illustrated with figure 3. If we use the variables of the study in the formula, dependent variable for the model will be tree DBH and the Independent variable will be maximum neighbour DBH.



Assumptions of Linear Regression - Linearity, Outliers, Multicollinearity, (nucleusbox.com)

Figure 3: Mathematical form of linear model

Results:

Before diving into the statistical analysis, given that scatterplots exhibiting more correlation will often have smaller average distances between their points and the regression line (Strain et al., 2023). While mid wood demonstrates a stronger correlation compared to other sites, the scatter plot visualization fails to exhibit a discernible correlation in my data overall between the DBH of tree and the maximum neighbouring DBH, as demonstrated in Figure 4.

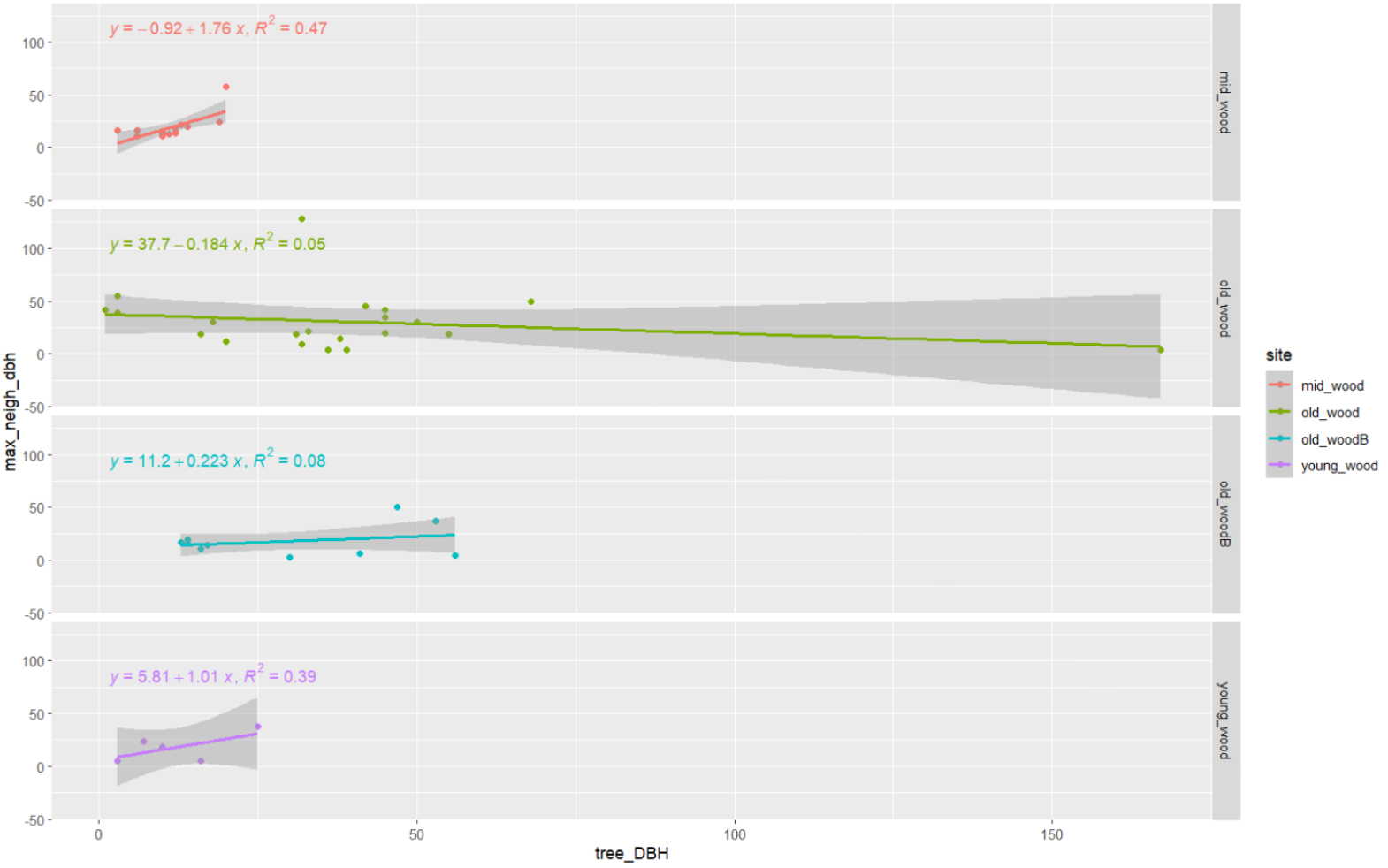


Figure 4: Describing the relationship between the Diameter at Breast Height (DBH) of individual trees and the maximum DBH of their neighbouring trees between distinct sites.

When the statistical findings shown in Figure 5 are examined, it reveals that the coefficient value for tree DBH stands at 0.01462, accompanied by a standard error of 0.10878. As Lunt (2013) mentioned ‘we are interested in testing whether particular β coefficients have a value of 0: or in other words, whether particular variables have no association with Y, the outcome variable.’ Therefore, any changes in the tree's (DBH) are expected to result in a rate of 0.01462 change in the maximum neighbour DBH. You determine the null hypothesis if you put the level of significance at the conventional 0.05 and researchers

would choose the alternative hypothesis (results are "statistically significant") if the P-value was lower (Ross, 2011). In line with this approach, if we look at the p value obtained from the study, it will be seen that it is 0.8936 which is higher than 0.05. In this case, as a result of the research, the H0 hypothesis cannot be rejected which indicated that there is no significant relationship between tree DBH and max neighbour DBH.

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Call:
lm(formula = max_neigh_dbh ~ tree_DBH, data = riseholme)

Residuals:
    Min      1Q  Median      3Q     Max
-21.462 -10.531  -5.189   5.405 105.011

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 22.52112    3.94212   5.713 5.45e-07 ***
tree_DBH     0.01462    0.10878   0.134    0.894
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 20.35 on 52 degrees of freedom
Multiple R-squared:  0.0003471, Adjusted R-squared:  -0.01888
F-statistic: 0.01805 on 1 and 52 DF,  p-value: 0.8936
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Figure 5: Statistical results of the modelling

Discussion:

The aim of this study was to test whether there is any relationship between tree DBH and max neighbour tree DBH. The key result shows that based on the statistical data (p-value and coefficients) obtained, there is no significant relationship between these two values. Even though the previous research executed by Chamagne et al., (2016) was about target tree's growth based on the neighbour diversity likewise mentioned equivalent outcome which is neighbours have no influence on each other's growth. The research took place in city of Brno in the Czech Republic with four different species which were Norway spruce (Picea abies), European larch (Larix decidua), Sessile oak (Quercus petraea) and European beech (Fagus sylvatica) (henceforth referred to by their generic names) with total of 8919 trees of which 576 were target trees collected in 2011. In 2011, they evaluated density as well as diversity, focusing solely on live trees to produce measurements that were accurate for the previous five years. They then computed the density and diversity seen in 2006 by adding the stumps that were removed during the preceding five years. Their accurate estimations of diversity and density over the previous ten years came from averaging these two figures. They came to the conclusion that the focus tree's identification and the variety of its surroundings had no bearing on the tree's growth.

References:

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