# INTERFAMILY VARIATION IN WOOD QUALITY OF BLACK SPRUCE IN A NORTHWESTERN ONTARIO PROGENY TRIAL

By

Istvan Balogh

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Dr. Ashley Thomson
Major Advisor

Dr. Mat Leitch
Second Reader

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# MAJOR ADVISOR COMMENTS

# ABSTRACT

Keywords: Black spruce, wood density, wood quality, breeding value.

The right trees for replanting must be selected to ensure optimal future forest conditions. Based on desired future outcomes, various progenies can be selected to suit these needs. In Canada, black spruce (*Picea mariana*), plays a crucial role in the forest economy. This is due to the large range the species covers as well as the variety of products produced from it, especially pulp. It is hypothesized that various families differ significantly in wood quality. Top growing families (designated with high breeding values) are believed to have the poorest wood quality due to their rapid growth. This paper aims to test that hypothesis and examine the correlation between breeding values and wood quality. Samples tested through models such as regressions and ANOVA analysis concluded that there is low to none statistical significance between wood quality and breeding value. However, this result could possibly be attributed to a low number of samples, as well as lack of control for block effects.

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# ACKNOWLEDGEMENTS

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# INTRODUCTION

In order to determine the appropriate trees to plant for future reforestation efforts, trees that have been grown in past family tests must be analyzed. Depending on the final purpose and use for these trees, different attributes can be selected for. In the majority of cases, industry selects for those trees that are able to be most profitable. In other words, trees that have the best desired quality, either wood properties or growth, in the shortest amount of time.

Selection attributes that would provide the best quality in the shortest amount of time would be density and height. In this instance, density would be a measure of the wood quality. Density of wood is an important measure of quality since this affects quality of both solid wood and fibrous products (Zobel and Jett 1995). There is a clear relationship of density to pulp yield, paper-making properties, as well as clear-wood and lumber strength. Height is one measure that can be used to determine growth over time. It can be hypothesized simply that taller trees grow faster. Furthermore, selection of families with higher wood density results in reduced mortality. Studies suggest that this increase in wood density provides structural benefits such as stem stiffness and strength to be able to withstand a wide variety of hazards in the understory (McMahon 1973). Also, studies confirmed that density has been correlated with growth rate and mortality, such that saplings with higher wood density resist infection by having harder and impenetrable stems (Augspurger 1984).

The value of wood can be determined by its machine stress rating (MSR). MSR measures stiffness of individual lumber pieces to estimate their strength and thus assign them to various categories (Zhang et al 2002). Multiples characteristics such as defects and density affect this MSR.  To improve these characteristics, forest management actions such as spacing and longer rotations can be used. However, choosing to plant families with a genetic advantage would reduce the need for longer rotations and thus increase profits. Wood density in black spruce (*Picea mariana)* is highly heritable (Lenz et al 2017), however optimal trees to be selected are those that also carry traits for fast growth.

The purpose of this paper is to examine the correlation between breeding value and wood density. The hypothesis is that families with a high breeding value will result is less wood density, due to their faster growth. Likewise, those families with low breeding values will result in higher wood density, due to their slower growth. A negative correlation is expected, which would indicate that breeding for increased growth has a negative effect on wood quality.

## LITERATURE REVIEW

### USE OF FAMILY TESTS AND PROVENANCE TRIALS

Family tests and provenance trials aid foresters in making the right choice as to what trees to plant for the following rotation (Nikolaeva 2014). Family tests and provenance trials provide a great deal of information in order to select the optimal trees for the desired site and purpose. Foremost, provenance trials are conducted, and provenance is defined as “the original geographic are from which seeds or other propagules were obtained" (Zobel and Jett1995). Due to wide natural ranges of plants, such as black spruce, trees develop certain characteristics as a result of adaptation to their specific environment. These characteristics may include stem form, resistance to pests, and growth rate.

For black spruce, there is a large amount of clinal variation in growth and survival particularly (Morgenstern and Mullin, 1990). Best growth can be found in provenances with more degree days, and best survival in those with fewer degree days, ultimately showing that faster growing provenances do not have best survival (Boyle 1985; Morgenstern and Mullin, 1990). Due to the significant trade-off between these traits, and the equal importance they carry, breeding values are assigned to the families and individuals. Various traits that the trees possess, such as growth and form, as well as their performance are compiled to determine these breeding values to aid in future selection.

The goal of family testing, specifically that of the Lake Nipigon West Black Spruce Family Tests Breeding Zone, is to calculate both family and individual breeding values (Fu 2000). The use of this data will assist is selecting individuals for a second-generation seed orchard and also for rouging the associated Nikulasson seed orchard. The benefits of this is to promote and use those individuals and families that meet objectives (have a high breeding value), and to eliminate those that are not desired. By attaching breeding values to families and individuals, this is what helps foresters determine what trees are best suited for the area.

## IMPORTANCE OF WOOD DENSITY

Wood density is the most important property in wood, not only in solid products but also in fibrous products (Zobel and Jett 1995). Besides its importance in wood products, wood density is an important aspect in survival also. Trees must at least have stems strong enough to support their own weight, in order to prevent them from bending or breaking (McMahon 1973; King 1981). Thus, trees with higher density are not only able to support their own weight, but also resist environmental factors. Some environmental factors that trees may face can include severe winds, snow, as well as other falling trees and/or branches. In addition, wood density also affects survival in terms of resistance. Saplings which have higher wood density are more resistant to insects and pathogens, since their stems are less penetrable (Auspurger 1984). By having this increase in wood density, trees are less likely to suffer damages or defects from these environmental conditions and grow properly.

Furthermore, wood density is often the determining factor for the end use product of a species (Zhang 2003). High density is associated with lumber strength, stiffness and high pulp yield, however, some end products (OSB) require low density wood. Since wood density plays a significant role in determining end use, it is important to manage for the desired wood density to achieve the desired objectives. Managing for wood density is also important since it affects MSR (Machine Stress Rated) yield (Zhang et al 2002). Management through appropriate silviculture and forestry practices, such as spacing, rotation age and pruning, can improve wood quality and result in an increase in the MSR yield.

## IMPORTANCE OF BLACK SPRUCE

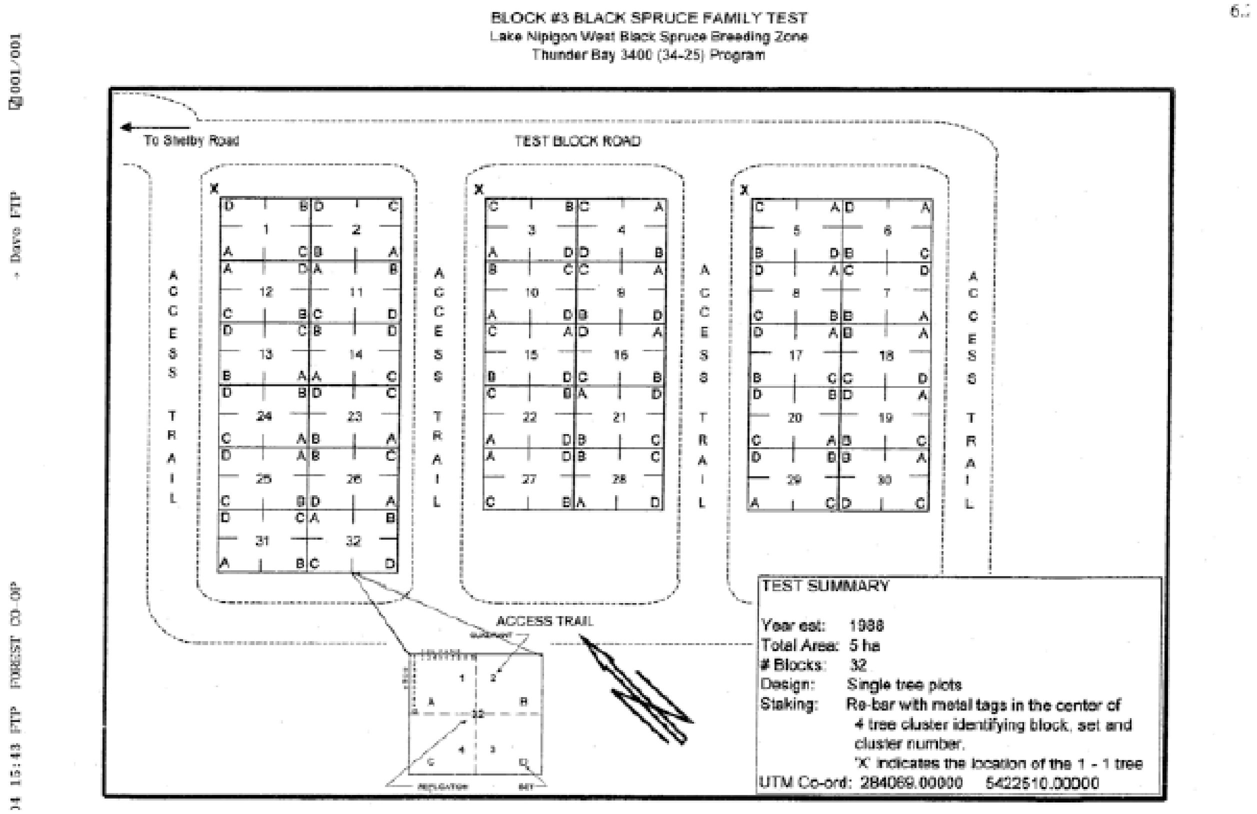
Black spruce is important for the forest industry in Canada as well as portions of the United States. This is partially due to the large range that the species covers. Black spruce can be found from coast to coast, including the Lake States of the United States, Alaska, and as far north as 68ºN in latitude which is above the treeline in the Arctic Circle (Heinselman, 1957). Commercially, black spruce is used for a variety of products such as framing material, millwork, crating and other lumber products (Alden 1997). However, in Canada it is the most important pulpwood species (Viereck and Johnston 1990). Black spruce is selected over other species due to its structural qualities. Black spruce wood contains long tracheids, which is important in the pulp industry, as well as high relative density, in addition to being resistant to insects and diseases.

## MATERIALS AND METHODS

For the analysis conducted in this thesis, a specific subset of trees was sampled from the Lake Nipigon West Black Spruce Breeding Program Block 3 Test Site. Of the Black Spruce, (*Picea mariana*), at the site, the 5 best and 5 worst preforming families (Table 1.0), in terms of breeding value, of the 230 first generation families carried forward to the second generation of the breeding program were selected. Samples from 5 individuals of each family were collected. The test site was established in 1988 in a single tree plot design with 32 blocks covering an area of 5 hectares (Figure 1). The test site is located at UTM coordinates 284069.00000 5422510.00000, which is off Shelby Rd, between Shabaqua Corners and Upsala (Figure 2).

Table 1.0: Top five best and worst performing families sampled.

| Top 5 Best Families | Top 5 Worst Families |
|---|---|
| 48 | 185 |
| 31 | 275 |
| 285 | 81 |
| 393 | 205 |
| 21 | 62 |



TEST SUMMARY

Year est: 1988
Total Area: 5 ha
# Blocks: 32
Design: Single tree plots
Staking: Re-bar with metal tags in the center of 4 tree cluster identifying block, set and cluster number.
'X' indicates the location of the 1 - 1 tree
UTM Co-ord: 284069.00000 5422510.00000

Figure 1: Lake Nipigon West Black Spruce Breeding Zone Block #3 Family Test Map.

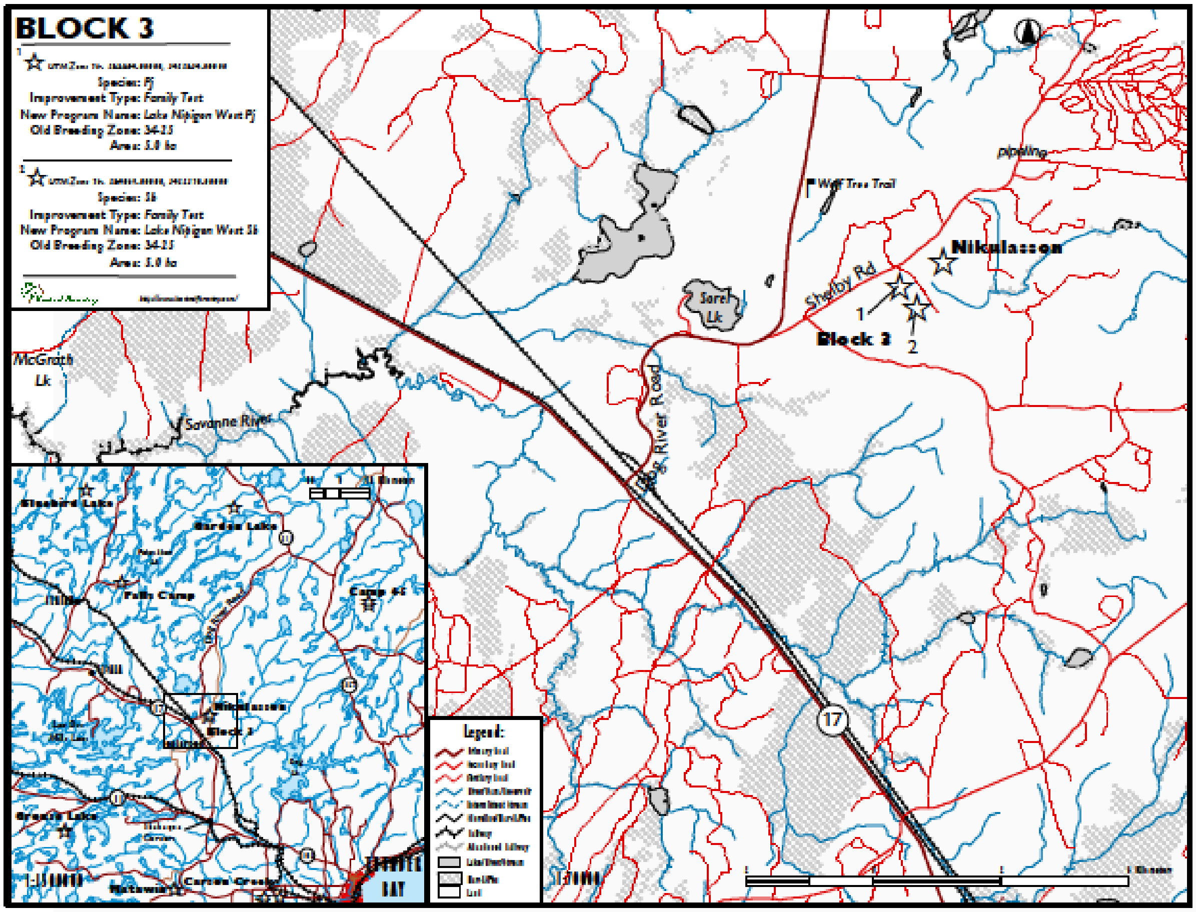


Figure 2: Block #3 Test Site Road Map.

The samples that were collected were 12mm core samples. Collection was done by the use of an increment borer and all samples were collected from the North facing side of the tree. Upon boring samples were placed in protective tubes and labeled with the block, quadrant, row, column and family number. Samples were mounted onto wooden throughs (Figure 3), after which they were cut in half longitudinally. These halves of the sampled cores that were not mounted were then sectioned (Figure 4) and density measured. Five rings starting from the pith and five rings staring from the bark were measured for volume using the water displacement technique (Figure 5) and weight using a 4-point scale. The water displacement technique uses the amount of water displaced when immersed in the water in grams and due to the weight of water being 1000 kg/ $m^3$ the weight of displaced water in grams also equals the volume of the sample in cm3. Therefore, with the weight of the sample and the volume, density can be calculated by mass divided by volume resulting in a g/$cm^3$ value which can be converted to kg/$m^3$ by multiplying by 1000. This will provided data used to calculate both juvenile and mature wood density.

Figure 3: Collected sampled mounted to wooden trough and labeled.

Figure 4: Sample sectioned in 5 ring increment from pith.

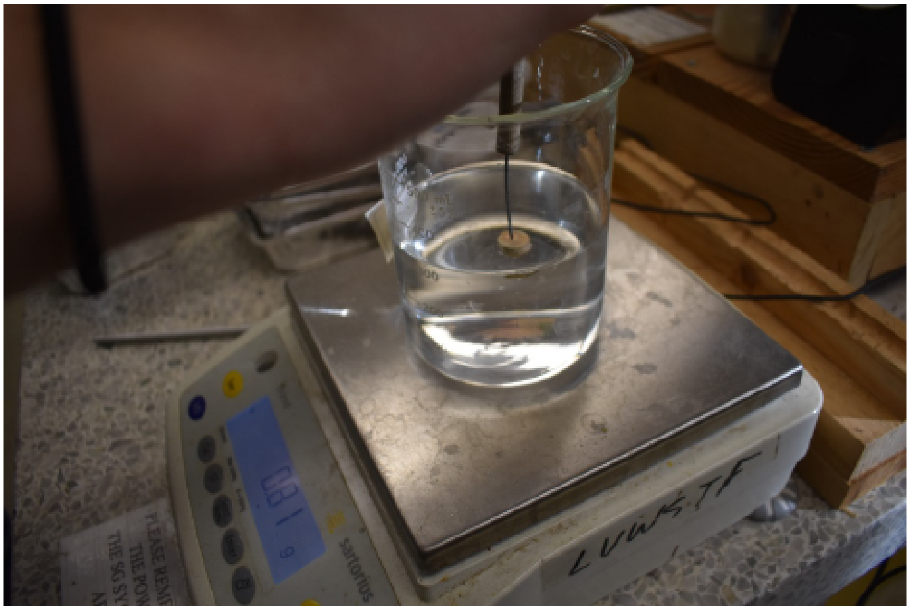


Figure 5: Volume of sectioned sample measured using water displacement technique.

ANOVA was used to examine the occurrence of significant differences in juvenile and mature wood density between families. For the statistical analysis, SPSS software was used. Average juvenile and mature wood quality for each family was calculated and used to examine the relationship between breeding values and wood quality using a simple linear regression. A negative correlation is expected, which would indicate that breeding for increased growth has a negative effect on wood quality.

## RESULTS

### DESCRIPTIVE STATISTICS

Table 2: Average juvenile and mature wood density per family.

| Family | Average Juvenile Density | Average Mature Density | Breeding Value |
|---|---|---|---|
| 48 | 0.5772 | 0.6143 | 2 |
| 31 | 0.6119 | 0.6745 | 4 |
| 285 | 0.5619 | 0.5943 | 10 |
| 393 | 0.5493 | 0.5787 | 9 |
| 21 | 0.5953 | 0.6200 | 3 |
| 185 | 0.5579 | 0.6084 | 246 |
| 275 | 0.6572 | 0.6932 | 235 |
| 81 | 0.5871 | 0.6890 | 227 |
| 205 | 0.5980 | 0.6414 | 239 |
| 62 | 0.5522 | 0.6187 | 228 |

### ANOVA RESULTS

In addition to the two regressions run, two additional ANOVA tests were conducted in SPSS. Both ANOVA use a $\alpha = 0.05$ value and are one-way ANOVA's. The null hypothesis for both cases is there is no significant statistical relationship between the variables. In the first case, the independent variable was family, and the dependant variable being wood density. As can be seen in table 3.0, the significance value under the juvenile density category is 0.041. Since this is below the α value of 0.05, there is significant statistical significance. On the contrary, under the mature density category of table 3.0 the significance value is 0.211. Since this is higher than the α value of 0.05, there is no statistical significance. Additionally, a Bonferroni post hoc test was conducted as can be seen in appendix 1.

Table 3.0: ANOVA for families related to wood density.

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Juvenile Density | Between Groups | 0.044 | 9 | 0.005 | 2.238 | 0.041 |
| | Within Groups | 0.084 | 38 | 0.002 | | |
| | Total | 0.128 | 47 | | | |
| Mature Density | Between Groups | 0.064 | 9 | 0.007 | 1.429 | 0.211 |
| | Within Groups | 0.189 | 38 | 0.005 | | |
| | Total | 0.252 | 47 | | | |

Next, the second ANOVA test conducted used wood density as the dependant variable, and category as the independent variable. In this situation, a category was assigned to each family, as either "Top" performing families or "Bottom" performing families. In SPSS, a value of "1" was designated for "Top" families and a value of "2" designated for "Bottom" performing families. Under the significance value column for both juvenile and mature density in table 3.1, the values are 0.665 and 0.194, respectively. Since both these values are higher than the α value of 0.05, it can be concluded that there is no statistical significance between the two variables. Therefore, for the first ANOVA the null hypothesis was partially rejected, since the relationship between juvenile wood density and family proved to be significant be remaining below the α value. However, the null hypothesis was accepted since the significance values proved there is no statistical significance between the variables.

Table 3.1: ANOVA for category related to wood densities.

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Juvenile Density | Between Groups | 0.001 | 1 | 0.001 | 0.190 | 0.665 |
| | Within Groups | 0.127 | 46 | 0.003 | | |
| | Total | 0.128 | 47 | | | |
| Mature Density | Between Groups | 0.009 | 1 | 0.009 | 1.740 | 0.194 |
| | Within Groups | 0.243 | 46 | 0.005 | | |
| | Total | 0.252 | 47 | | | |

## CORRELATION OF BREEDING VALUE TO WOOD QUALITY

As mentioned previously, the measure of wood quality used was wood density, both for mature and juvenile wood. The regression model (Figure 6) for mature wood density against breeding value resulted in an $R^2$ value of 0.032 (Table 4.0). This result indicates that only 3.2% of the variance in mature wood density can be explained by the assigned breeding value. Furthermore, the regression model (Figure 6.1) for juvenile wood density against breeding value yielded even more surprising results. The $R^2$ value for juvenile wood against breeding value is 0.003 (Table 4.1). This indicated that only 0.3% of the variance in juvenile wood quality can be explained by the assigned breeding value. Overall, the regression results indicate that the correlation between the wood quality and the assigned breeding value is low.

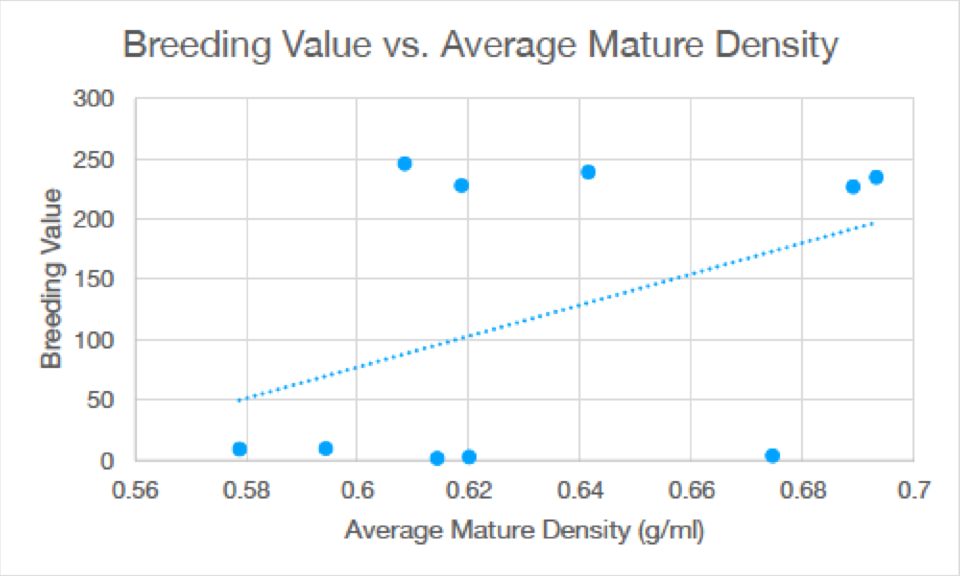


Figure 6.0: Regression of Breeding Value vs. Average Mature Wood Density.

Table 4.0: Regression for mature density against breeding value.

| R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|
| 0.180 | 0.032 | 0.011 | 0.0729 |

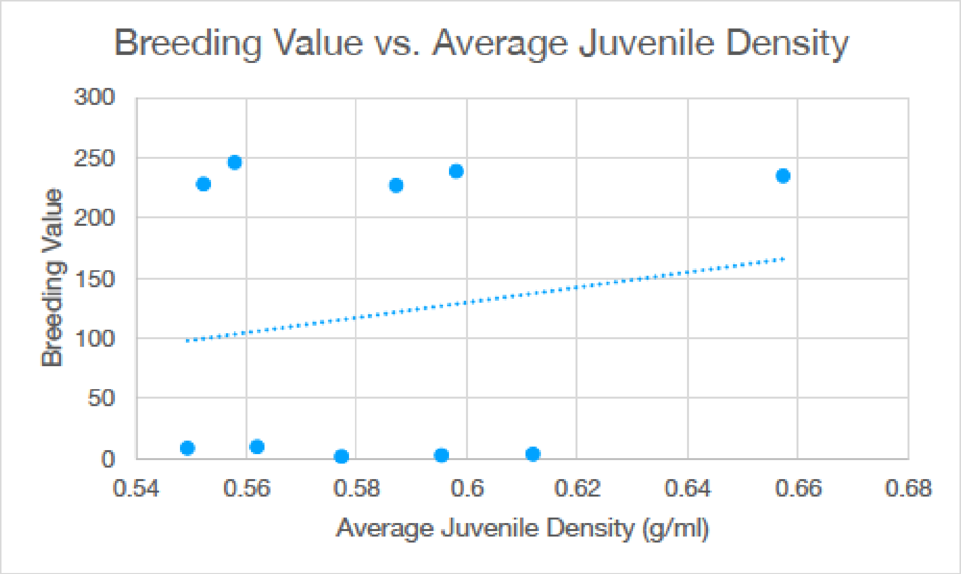


Figure 6.1: Regression of Breeding Value vs. Average Juvenile Wood Density.

Table 4.1: Regression for juvenile density against breeding value.

| R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|
| 0.058 | 0.003 | -0.018 | 0.0526 |

## DISCUSSION

Results from the analysis conducted proved to be much different than originally expected. To explain this unexpected results, multiple factors can be examined. First of all, site conditions throughout the test could have variation. Some trees could have been planted in site conditions that are unfavorable for growth. Some such conditions could include soil moisture, as this can account for a large variability in growth (Hamel 2004).

If this study were to be conducted again, more control over variation would yield different results. In this study, block effects were not controlled for, by including block effects as a predictor in the ANOVA, this could partially explain the non-significant differences in mature wood density between families. For future studies to yield better results, dividing the block into various areas on a scale from favorable growing conditions to less favorable conditions may elucidate some variation. To properly categorize these block segments, factors such as soils, nutrient availability, topography, and moisture would have to be considered. Also, improving accuracy of assessing average wood quality for families would be a benefit. To do so, an increase in the number of trees sampled would be required.

Furthermore, fundamental aspects that the analysis was based upon are possibly flawed. For this analysis, the previously assigned breeding value was based on height growth. In order for the breeding value to be an accurate representation of the family's progeny, multiple factors should be considered. First of all, mortality is one factor. Some families had higher mortality in the test block than other, which also limited the number of samples that were able to be collected since replicates were dead. Secondly, form is another important characteristic that determines the quality and also the value of the tree (Castle 2018). In the test site, and among the samples, multiple trees had multiple co-dominant stems or tops. Other trees also had poor form such as splits, bows, leans or one-sided canopies. These factors, such as form and diameter, would affect the trees wood quality, and in turn its commercial value (Castle 2018). Overall, for better representation of progeny, and therefore possibly more accurate results, reassessing breeding value to include multiple factors such as height, diameter, mortality and form would be an asset to future analysis.

In other studies, such as one regarding Sitka spruce (*Picea sitchensis)* in British Columbia, it was concluded that wood density was strongly heritable (Kennedy 2013). It was also concluded that wood stiffness and strength have a stronger genetic correlation with density than microfibril angle (Kennedy 2013). Based on these conclusions, selecting for wood stiffness or strength will result in an increase in wood density also. Other heritable factors have been found to be strongly correlated, such as acoustic velocity and stiffness in radiata pine (*Pinus radiata*) (Lindstrom et al 2002), while slightly less correlated in Scots pine (*Pinus sylvestris*) (Auty and Achim 2008). Selecting for acoustic velocity would also result in increased stiffness, and thus wood density, since stiffness is highly correlated to density. Therefore, many of the components of wood quality, such as stiffness, strength and acoustic velocity, are correlated to wood density in conifers. These traits also possess high heritability. Albeit some traits contain higher correlation to wood density than other, such as microfibril angle, selection based on these traits would evidently result in increased wood density.

## CONCLUSION

Based on the results of this study, there is minimal difference in wood quality between families previously designated with high breeding values and those with low breeding values. Since the trial is becoming of maturity, assigned breeding values could be reassessed in order to conduct tests to determine a relationship between breeding value and wood quality. For optimal future forest conditions, to meet both environmental and industry related goals, regeneration efforts are critical. The first step in optimal regeneration is the selection of the most appropriate progeny that would fulfill those goals. Ultimately, tests such as this are important in that they allow the forester to know the future outcome of the forest, based on their choice of planted tree families. In conclusion, based on the results gathered from this analysis, selecting families for regeneration based on breeding value would have a minimal impact of wood quality harvest in the future.

# LITERATURE CITED

Alden, H.A. 1997. Softwoods of North America. USDA FS For. Prod. Lab. Gen. Tech. Rep. FPL-GTR-102, 151 pp

Augspurger CK. 1984. Light requirements of neotropical tree seedlings a comparative study of growth and survival. Journal of Ecology 72: 777–796.

Auty, D., Achim, A. 2008. The relationship between standing tree acoustic assessment and timber quality in Scots pine and the practical implications for assessing timber quality from naturally regenerated stands. Forestry. 81(4). pp 475-487.

Boyle, T.J.B. 1985. Range wide provenance tests of black spruce in Ontario. Canadian Forest Service Petawawa National Forest Institute Info Rep. PI-X-57, 36 pp.

Castle, Mark., Weiskittel, Aaron., Wagner, Robert., Ducey, Mark., Frank, Jereme., Pelletier, Gaetan. 2018. Evaluating the influence of stem form and damage on individual-tree diameter increment and survival in the Acadian Region: implications for predicting future value of northern commercial hardwood stands. Canadian Journal of Forest Research. Vol 48(9). pp 1007-1019.

Fu, Yong-Bi. 2000. Lake Nipigon West Breeding Zone Black Spruce Family Tests: 1998 assessment and calculation of family and individual breeding values. Prepared for: Ontario Tree Improvement Board. 137pp.

Hamel, Benoit., Belanger, Nicolas., Pare, David. 2004. Productivity of black spruce and Jack pine stands in Quebec as related to climate, site biological features and soil properties. Forest Ecology and Management. 191(1-3): 239-251.

Heinselman, M.L. 1957. Silvical characteristics of black spruce. USDA For. Serv. Lake States For. Exp. Stat. Paper 45, 30 pp.

Lindstrom, H., Harris, P., Nakada, P. 2002. Methods of measuring stiffness of young trees. Holz als Roh-und Werkstoff. Vol 60. pp 165-174.

Kennedy, S.G., Cameron, A.D., Lee, S.J. 2013. Genetic Relationships between wood quality traits and diameter growth of juvenile core wood in Sitka spruce. Canadian Journal of Forest Research. 43(1). pp 1-6.

King, D.A. (1981) Tree dimensions: maximizing the rate of height growth in dense stands. Oecologia 51: 351–356.

Lenz, Patrick R.N., Beaulieu, Jean., Mansfield, Shawn D., Clement, Sebastien., Desponts, Mireille., Bousquet, Jean. 2017. Factors affecting the accuracy of genomic selection for growth and wood quality traits in an advanced breeding population of black spruce (Picea Mariana). BMC Genomics. Vol 18(1) pp 1-17.

McMahon, T.A. (1973) Size and shape in biology. Science 179: 1201–1204.

Morgenstern, E.K., and T.J. Mullin. 1990. Growth and survival of black spruce in the range-wide provenance study. Can. J. For. Res. 20: 130-143.

Nikolaeva, Marina A., Faizulin, Danial Kh., Potokin, Alexander Ph., Jamaleev, Oleg A. 2014. Comparative evaluation of preservation and growth of spruce climatypes based on long term provenance trials in Russia. Folia Forestalia Polonica: Series

A – Forestry. 56(1), pp 56-67.

Viereck, L.A., and W.F. Johnston. 1990. Picea mariana (Mill.) B.S.P. Black spruce. Pp 227-237 in R.M. Burns and B.H. Honkala (eds.), Silvics of North America Vol. 1, Conifers. USDA For. Serv. Agric. Handbook 654, 675 pp.

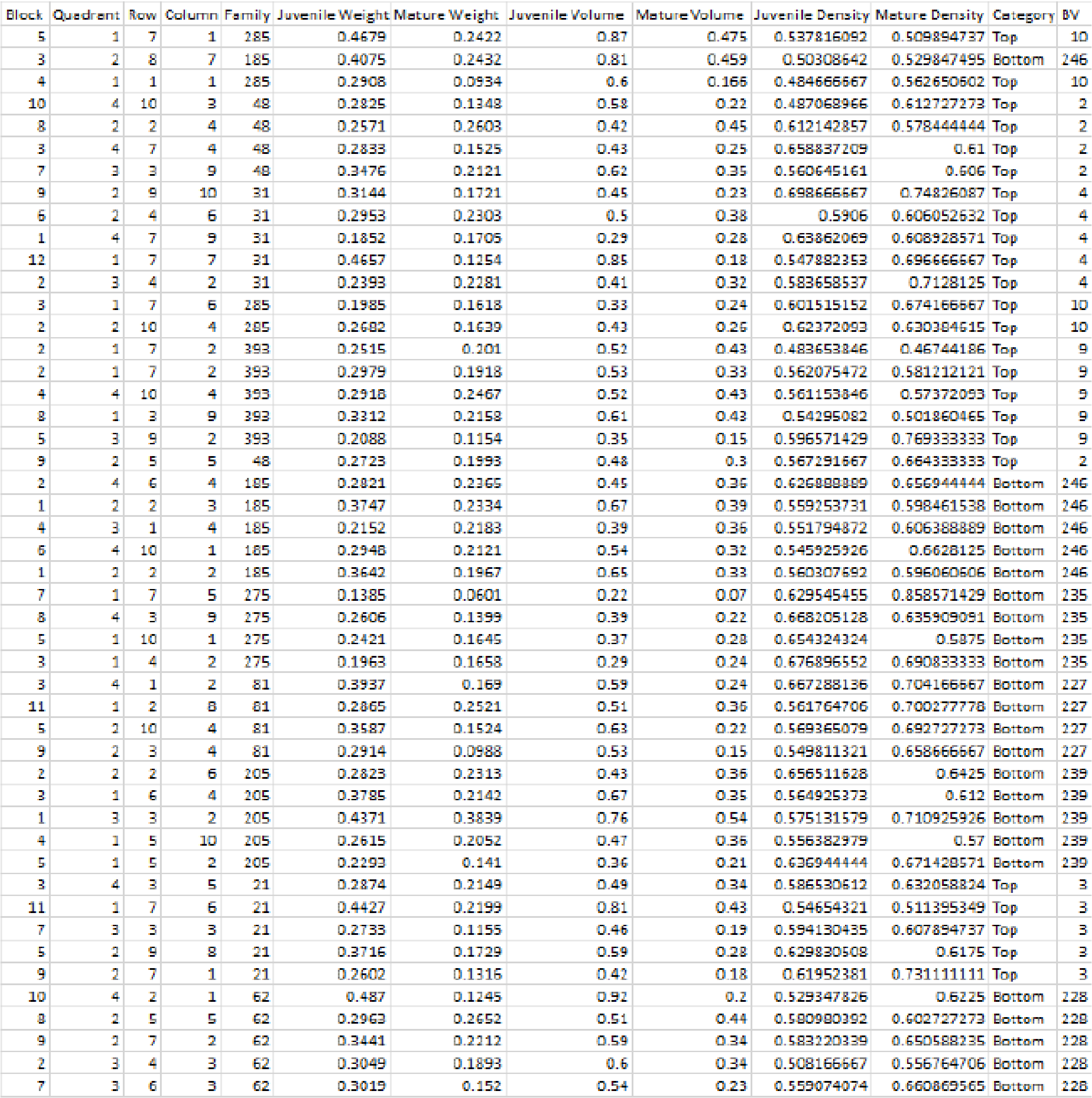
Zhang, S.Y.; Chauret, G.; Ren, H.Q.; and Desjardins, R. 2002. Impact of initial spacing on plantation black spruce lumber grade yield, bending properties, and MSR yield. Wood Fiber Sci. 34(3): 460-475

Zobel B.J., Jett J.B. (1995). The Importance of Wood Density (Specific Gravity) and Its Component Parts. pg 78-97. Genetics of Wood Production. Springer, Berlin, Heidelberg. Pp 337.

Zobel B.J., Jett J.B. (1995). Wood Genetics Related to Provenance and Seed Source. Pg 195-293. Genetics of Wood Production. Springer, Berlin, Heidelberg. Pp 337.

# APPENDICIES

## APPENDICIES I: Table of raw data.



| Block | Quadrant | Row | Column | Family | Juvenile Weight | Mature Weight | Juvenile Volume | Mature Volume | Juvenile Density | Mature Density | Category | BV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 1 | 7 | 1 | 285 | 0.4679 | 0.2422 | 0.87 | 0.475 | 0.537816092 | 0.509894737 | Top | 10 |
| 3 | 2 | 8 | 7 | 185 | 0.4075 | 0.2432 | 0.81 | 0.459 | 0.50308642 | 0.529847495 | Bottom | 246 |
| 4 | 1 | 1 | 1 | 285 | 0.2908 | 0.0934 | 0.6 | 0.166 | 0.484666667 | 0.562650602 | Top | 10 |
| 10 | 4 | 10 | 3 | 48 | 0.2825 | 0.1348 | 0.58 | 0.22 | 0.487068966 | 0.612727273 | Top | 2 |
| 8 | 2 | 2 | 4 | 48 | 0.2571 | 0.2603 | 0.42 | 0.45 | 0.612142857 | 0.578444444 | Top | 2 |
| 3 | 4 | 7 | 4 | 48 | 0.2833 | 0.1525 | 0.43 | 0.25 | 0.658837209 | 0.61 | Top | 2 |
| 7 | 3 | 3 | 9 | 48 | 0.3476 | 0.2121 | 0.62 | 0.35 | 0.560645161 | 0.606 | Top | 2 |
| 9 | 2 | 9 | 10 | 31 | 0.3144 | 0.1721 | 0.45 | 0.23 | 0.698666667 | 0.74826087 | Top | 4 |
| 6 | 2 | 4 | 6 | 31 | 0.2953 | 0.2303 | 0.5 | 0.38 | 0.5906 | 0.606052632 | Top | 4 |
| 1 | 4 | 7 | 9 | 31 | 0.1852 | 0.1705 | 0.29 | 0.28 | 0.63862069 | 0.608928571 | Top | 4 |
| 12 | 1 | 7 | 7 | 31 | 0.4657 | 0.1254 | 0.85 | 0.18 | 0.547882353 | 0.696666667 | Top | 4 |
| 2 | 3 | 4 | 2 | 31 | 0.2393 | 0.2281 | 0.41 | 0.32 | 0.583658537 | 0.7128125 | Top | 4 |
| 3 | 1 | 7 | 6 | 285 | 0.1985 | 0.1618 | 0.33 | 0.24 | 0.601515152 | 0.674166667 | Top | 10 |
| 2 | 2 | 10 | 4 | 285 | 0.2682 | 0.1639 | 0.43 | 0.26 | 0.62372093 | 0.630384615 | Top | 10 |
| 2 | 1 | 7 | 2 | 393 | 0.2515 | 0.201 | 0.52 | 0.43 | 0.483653846 | 0.46744186 | Top | 9 |
| 2 | 1 | 7 | 2 | 393 | 0.2979 | 0.1918 | 0.53 | 0.33 | 0.562075472 | 0.581212121 | Top | 9 |
| 4 | 4 | 10 | 4 | 393 | 0.2918 | 0.2467 | 0.52 | 0.43 | 0.561153846 | 0.57372093 | Top | 9 |
| 8 | 1 | 3 | 9 | 393 | 0.3312 | 0.2158 | 0.61 | 0.43 | 0.54295082 | 0.501860465 | Top | 9 |
| 5 | 3 | 9 | 2 | 393 | 0.2088 | 0.1154 | 0.35 | 0.15 | 0.596571429 | 0.769333333 | Top | 9 |
| 9 | 2 | 5 | 5 | 48 | 0.2723 | 0.1993 | 0.48 | 0.3 | 0.567291667 | 0.664333333 | Top | 2 |
| 2 | 4 | 6 | 4 | 185 | 0.2821 | 0.2365 | 0.45 | 0.36 | 0.626888889 | 0.656944444 | Bottom | 246 |
| 1 | 2 | 2 | 3 | 185 | 0.3747 | 0.2334 | 0.67 | 0.39 | 0.559253731 | 0.598461538 | Bottom | 246 |
| 4 | 3 | 1 | 4 | 185 | 0.2152 | 0.2183 | 0.39 | 0.36 | 0.551794872 | 0.606388889 | Bottom | 246 |
| 6 | 4 | 10 | 1 | 185 | 0.2948 | 0.2121 | 0.54 | 0.32 | 0.545925926 | 0.6628125 | Bottom | 246 |
| 1 | 2 | 2 | 2 | 185 | 0.3642 | 0.1967 | 0.65 | 0.33 | 0.560307692 | 0.596060606 | Bottom | 246 |
| 7 | 1 | 7 | 5 | 275 | 0.1385 | 0.0601 | 0.22 | 0.07 | 0.629545455 | 0.858571429 | Bottom | 235 |
| 8 | 4 | 3 | 9 | 275 | 0.2606 | 0.1399 | 0.39 | 0.22 | 0.668205128 | 0.635909091 | Bottom | 235 |
| 5 | 1 | 10 | 1 | 275 | 0.2421 | 0.1645 | 0.37 | 0.28 | 0.654324324 | 0.5875 | Bottom | 235 |
| 3 | 1 | 4 | 2 | 275 | 0.1963 | 0.1658 | 0.29 | 0.24 | 0.676896552 | 0.690833333 | Bottom | 235 |
| 3 | 4 | 1 | 2 | 81 | 0.3937 | 0.169 | 0.59 | 0.24 | 0.667288136 | 0.704166667 | Bottom | 227 |
| 11 | 1 | 2 | 8 | 81 | 0.2865 | 0.2521 | 0.51 | 0.36 | 0.561764706 | 0.700277778 | Bottom | 227 |
| 5 | 2 | 10 | 4 | 81 | 0.3587 | 0.1524 | 0.63 | 0.22 | 0.569365079 | 0.692727273 | Bottom | 227 |
| 9 | 2 | 3 | 4 | 81 | 0.2914 | 0.0988 | 0.53 | 0.15 | 0.549811321 | 0.658666667 | Bottom | 227 |
| 2 | 2 | 2 | 6 | 205 | 0.2823 | 0.2313 | 0.43 | 0.36 | 0.656511628 | 0.6425 | Bottom | 239 |
| 3 | 1 | 6 | 4 | 205 | 0.3785 | 0.2142 | 0.67 | 0.35 | 0.564925373 | 0.612 | Bottom | 239 |
| 1 | 3 | 3 | 2 | 205 | 0.4371 | 0.3839 | 0.76 | 0.54 | 0.575131579 | 0.710925926 | Bottom | 239 |
| 4 | 1 | 5 | 10 | 205 | 0.2615 | 0.2052 | 0.47 | 0.36 | 0.556382979 | 0.57 | Bottom | 239 |
| 5 | 1 | 5 | 2 | 205 | 0.2293 | 0.141 | 0.36 | 0.21 | 0.636944444 | 0.671428571 | Bottom | 239 |
| 3 | 4 | 3 | 5 | 21 | 0.2874 | 0.2149 | 0.49 | 0.34 | 0.586530612 | 0.632058824 | Top | 3 |
| 11 | 1 | 7 | 6 | 21 | 0.4427 | 0.2199 | 0.81 | 0.43 | 0.54654321 | 0.511395349 | Top | 3 |
| 7 | 3 | 3 | 3 | 21 | 0.2733 | 0.1155 | 0.46 | 0.19 | 0.594130435 | 0.607894737 | Top | 3 |
| 5 | 2 | 9 | 8 | 21 | 0.3716 | 0.1729 | 0.59 | 0.28 | 0.629830508 | 0.6175 | Top | 3 |
| 9 | 2 | 7 | 1 | 21 | 0.2602 | 0.1316 | 0.42 | 0.18 | 0.61952381 | 0.731111111 | Top | 3 |
| 10 | 4 | 2 | 1 | 62 | 0.487 | 0.1245 | 0.92 | 0.2 | 0.529347826 | 0.6225 | Bottom | 228 |
| 8 | 2 | 5 | 5 | 62 | 0.2963 | 0.2652 | 0.51 | 0.44 | 0.580980392 | 0.602727273 | Bottom | 228 |
| 9 | 2 | 7 | 2 | 62 | 0.3441 | 0.2212 | 0.59 | 0.34 | 0.583220339 | 0.650588235 | Bottom | 228 |
| 2 | 3 | 4 | 3 | 62 | 0.3049 | 0.1893 | 0.6 | 0.34 | 0.508166667 | 0.556764706 | Bottom | 228 |
| 7 | 3 | 6 | 3 | 62 | 0.3019 | 0.152 | 0.54 | 0.23 | 0.559074074 | 0.660869565 | Bottom | 228 |

APPENDICIES II: Table of Bonferroni test results.

| Dependent Variable | | | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| Juvenile Density | 21 | 31 | -0.016573934 | 0.02967 | 1 | -0.12127012 | 0.088122 |
| | | 48 | 0.018114543 | 0.02967 | 1 | -0.08658164 | 0.122811 |
| | | 62 | 0.043153855 | 0.02967 | 1 | -0.06154233 | 0.14785 |
| | | 81 | 0.008254405 | 0.03147 | 1 | -0.10279267 | 0.119301 |
| | | 185 | 0.03743546 | 0.028407 | 1 | -0.06280351 | 0.137674 |
| | | 205 | -0.002667486 | 0.02967 | 1 | -0.10736367 | 0.102029 |
| | | 275 | -0.06193115 | 0.03147 | 1 | -0.17297822 | 0.049116 |
| | | 285 | 0.033382005 | 0.03147 | 1 | -0.07766507 | 0.144429 |
| | | 393 | 0.046030633 | 0.02967 | 1 | -0.05866555 | 0.150727 |
| | 31 | 21 | 0.016573934 | 0.02967 | 1 | -0.08812225 | 0.12127 |
| | | 48 | 0.034688477 | 0.02967 | 1 | -0.07000771 | 0.139385 |
| | | 62 | 0.05972779 | 0.02967 | 1 | -0.0449684 | 0.164424 |
| | | 81 | 0.024828339 | 0.03147 | 1 | -0.08621874 | 0.135875 |
| | | 185 | 0.054009394 | 0.028407 | 1 | -0.04622957 | 0.154248 |
| | | 205 | 0.013906449 | 0.02967 | 1 | -0.09078974 | 0.118603 |
| | | 275 | -0.045357216 | 0.03147 | 1 | -0.15640429 | 0.06569 |
| | | 285 | 0.049955939 | 0.03147 | 1 | -0.06109114 | 0.161003 |
| | | 393 | 0.062604567 | 0.02967 | 1 | -0.04209162 | 0.167301 |
| | 48 | 21 | -0.018114543 | 0.02967 | 1 | -0.12281073 | 0.086582 |
| | | 31 | -0.034688477 | 0.02967 | 1 | -0.13938466 | 0.070008 |
| | | 62 | 0.025039312 | 0.02967 | 1 | -0.07965687 | 0.129735 |
| | | 81 | -0.009860138 | 0.03147 | 1 | -0.12090721 | 0.101187 |
| | | 185 | 0.019320917 | 0.028407 | 1 | -0.08091805 | 0.11956 |
| | | 205 | -0.020782029 | 0.02967 | 1 | -0.12547821 | 0.083914 |
| | | 275 | -0.080045693 | 0.03147 | 0.7 | -0.19109277 | 0.031001 |
| | | 285 | 0.015267462 | 0.03147 | 1 | -0.09577961 | 0.126315 |
| | | 393 | 0.02791609 | 0.02967 | 1 | -0.0767801 | 0.132612 |
| | 62 | 21 | -0.043153855 | 0.02967 | 1 | -0.14785004 | 0.061542 |
| | | 31 | -0.05972779 | 0.02967 | 1 | -0.16442398 | 0.044968 |
| | | 48 | -0.025039312 | 0.02967 | 1 | -0.1297355 | 0.079657 |
| | | 81 | -0.034899451 | 0.03147 | 1 | -0.14594653 | 0.076148 |
| | | 185 | -0.005718395 | 0.028407 | 1 | -0.10595736 | 0.094521 |
| | | 205 | -0.045821341 | 0.02967 | 1 | -0.15051753 | 0.058875 |
| | | 275 | -0.105085005 | 0.03147 | 0.1 | -0.21613208 | 0.005962 |
| | | 285 | -0.00977185 | 0.03147 | 1 | -0.12081892 | 0.101275 |
| | | 393 | 0.002876777 | 0.02967 | 1 | -0.10181941 | 0.107573 |
| | 81 | 21 | -0.008254405 | 0.03147 | 1 | -0.11930148 | 0.102793 |

## APPENDICIES II: Table of Bonferroni test results.

| Dependent Variable | | | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| | | 31 | -0.024828339 | 0.03147 | 1 | -0.13587541 | 0.086219 |
| | | 48 | 0.009860138 | 0.03147 | 1 | -0.10118694 | 0.120907 |
| | | 62 | 0.034899451 | 0.03147 | 1 | -0.07614762 | 0.145947 |
| | | 185 | 0.029181055 | 0.030282 | 1 | -0.07767404 | 0.136036 |
| | | 205 | -0.01092189 | 0.03147 | 1 | -0.12196896 | 0.100125 |
| | | 275 | -0.070185554 | 0.033173 | 1 | -0.18723945 | 0.046868 |
| | | 285 | 0.0251276 | 0.033173 | 1 | -0.09192629 | 0.142181 |
| | | 393 | 0.037776228 | 0.03147 | 1 | -0.07327085 | 0.148823 |
| | 185 | 21 | -0.03743546 | 0.028407 | 1 | -0.13767443 | 0.062804 |
| | | 31 | -0.054009394 | 0.028407 | 1 | -0.15424836 | 0.04623 |
| | | 48 | -0.019320917 | 0.028407 | 1 | -0.11955988 | 0.080918 |
| | | 62 | 0.005718395 | 0.028407 | 1 | -0.09452057 | 0.105957 |
| | | 81 | -0.029181055 | 0.030282 | 1 | -0.13603615 | 0.077674 |
| | | 205 | -0.040102946 | 0.028407 | 1 | -0.14034191 | 0.060136 |
| | | 275 | -0.09936661 | 0.030282 | 0.1 | -0.20622171 | 0.007488 |
| | | 285 | -0.004053455 | 0.030282 | 1 | -0.11090855 | 0.102802 |
| | | 393 | 0.008595173 | 0.028407 | 1 | -0.09164379 | 0.108834 |
| | 205 | 21 | 0.002667486 | 0.02967 | 1 | -0.1020287 | 0.107364 |
| | | 31 | -0.013906449 | 0.02967 | 1 | -0.11860263 | 0.09079 |
| | | 48 | 0.020782029 | 0.02967 | 1 | -0.08391416 | 0.125478 |
| | | 62 | 0.045821341 | 0.02967 | 1 | -0.05887484 | 0.150518 |
| | | 81 | 0.01092189 | 0.03147 | 1 | -0.10012518 | 0.121969 |
| | | 185 | 0.040102946 | 0.028407 | 1 | -0.06013602 | 0.140342 |
| | | 275 | -0.059263664 | 0.03147 | 1 | -0.17031074 | 0.051783 |
| | | 285 | 0.036049491 | 0.03147 | 1 | -0.07499758 | 0.147097 |
| | | 393 | 0.048698118 | 0.02967 | 1 | -0.05599807 | 0.153394 |
| | 275 | 21 | 0.06193115 | 0.03147 | 1 | -0.04911592 | 0.172978 |
| | | 31 | 0.045357216 | 0.03147 | 1 | -0.06568986 | 0.156404 |
| | | 48 | 0.080045693 | 0.03147 | 0.7 | -0.03100138 | 0.191093 |
| | | 62 | 0.105085005 | 0.03147 | 0.1 | -0.00596207 | 0.216132 |
| | | 81 | 0.070185554 | 0.033173 | 1 | -0.04686834 | 0.187239 |
| | | 185 | 0.09936661 | 0.030282 | 0.1 | -0.00748849 | 0.206222 |
| | | 205 | 0.059263664 | 0.03147 | 1 | -0.05178341 | 0.170311 |
| | | 285 | 0.095313155 | 0.033173 | 0.3 | -0.02174074 | 0.212367 |
| | | 393 | 0.107961782 | 0.03147 | 0.1 | -0.00308529 | 0.219009 |
| | 285 | 21 | -0.033382005 | 0.03147 | 1 | -0.14442908 | 0.077665 |
| | | 31 | -0.049955939 | 0.03147 | 1 | -0.16100301 | 0.061091 |

APPENDICIES II: Table of Bonferroni test results.

| Dependent Variable | | | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| | | 48 | -0.015267462 | 0.03147 | 1 | -0.12631454 | 0.09578 |
| | | 62 | 0.00977185 | 0.03147 | 1 | -0.10127522 | 0.120819 |
| | | 81 | -0.0251276 | 0.033173 | 1 | -0.14218149 | 0.091926 |
| | | 185 | 0.004053455 | 0.030282 | 1 | -0.10280164 | 0.110909 |
| | | 205 | -0.036049491 | 0.03147 | 1 | -0.14709656 | 0.074998 |
| | | 275 | -0.095313155 | 0.033173 | 0.3 | -0.21236705 | 0.021741 |
| | | 393 | 0.012648628 | 0.03147 | 1 | -0.09839845 | 0.123696 |
| | 393 | 21 | -0.046030633 | 0.02967 | 1 | -0.15072682 | 0.058666 |
| | | 31 | -0.062604567 | 0.02967 | 1 | -0.16730075 | 0.042092 |
| | | 48 | -0.02791609 | 0.02967 | 1 | -0.13261228 | 0.07678 |
| | | 62 | -0.002876777 | 0.02967 | 1 | -0.10757296 | 0.101819 |
| | | 81 | -0.037776228 | 0.03147 | 1 | -0.1488233 | 0.073271 |
| | | 185 | -0.008595173 | 0.028407 | 1 | -0.10883414 | 0.091644 |
| | | 205 | -0.048698118 | 0.02967 | 1 | -0.1533943 | 0.055998 |
| | | 275 | -0.107961782 | 0.03147 | 0.1 | -0.21900886 | 0.003085 |
| | | 285 | -0.012648628 | 0.03147 | 1 | -0.1236957 | 0.098398 |
| Mature Density | 21 | 31 | -0.054552244 | 0.044557 | 1 | -0.21177754 | 0.102673 |
| | | 48 | 0.005690994 | 0.044557 | 1 | -0.1515343 | 0.162916 |
| | | 62 | 0.001302048 | 0.044557 | 1 | -0.15592324 | 0.158527 |
| | | 81 | -0.068967592 | 0.04726 | 1 | -0.2357302 | 0.097795 |
| | | 185 | 0.011572759 | 0.04266 | 1 | -0.138959 | 0.162105 |
| | | 205 | -0.021378895 | 0.044557 | 1 | -0.17860419 | 0.135846 |
| | | 275 | -0.073211459 | 0.04726 | 1 | -0.23997406 | 0.093551 |
| | | 285 | 0.025717849 | 0.04726 | 1 | -0.14104476 | 0.19248 |
| | | 393 | 0.041278262 | 0.044557 | 1 | -0.11594703 | 0.198504 |
| | 31 | 21 | 0.054552244 | 0.044557 | 1 | -0.10267305 | 0.211778 |
| | | 48 | 0.060243238 | 0.044557 | 1 | -0.09698205 | 0.217469 |
| | | 62 | 0.055854292 | 0.044557 | 1 | -0.101371 | 0.21308 |
| | | 81 | -0.014415348 | 0.04726 | 1 | -0.18117795 | 0.152347 |
| | | 185 | 0.066125002 | 0.04266 | 1 | -0.08440675 | 0.216657 |
| | | 205 | 0.033173348 | 0.044557 | 1 | -0.12405194 | 0.190399 |
| | | 275 | -0.018659215 | 0.04726 | 1 | -0.18542182 | 0.148103 |
| | | 285 | 0.080270093 | 0.04726 | 1 | -0.08649251 | 0.247033 |
| | | 393 | 0.095830506 | 0.044557 | 1 | -0.06139479 | 0.253056 |
| | 48 | 21 | -0.005690994 | 0.044557 | 1 | -0.16291629 | 0.151534 |
| | | 31 | -0.060243238 | 0.044557 | 1 | -0.21746853 | 0.096982 |
| | | 62 | -0.004388946 | 0.044557 | 1 | -0.16161424 | 0.152836 |

APPENDICIES II: Table of Bonferroni test results.

| Dependent Variable | | | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| | | 81 | -0.074658586 | 0.04726 | 1 | -0.24142119 | 0.092104 |
| | | 185 | 0.005881765 | 0.04266 | 1 | -0.14464999 | 0.156414 |
| | | 205 | -0.027069889 | 0.044557 | 1 | -0.18429518 | 0.130155 |
| | | 275 | -0.078902453 | 0.04726 | 1 | -0.24566506 | 0.08786 |
| | | 285 | 0.020026855 | 0.04726 | 1 | -0.14673575 | 0.186789 |
| | | 393 | 0.035587268 | 0.044557 | 1 | -0.12163802 | 0.192813 |
| | 62 | 21 | -0.001302048 | 0.044557 | 1 | -0.15852734 | 0.155923 |
| | | 31 | -0.055854292 | 0.044557 | 1 | -0.21307958 | 0.101371 |
| | | 48 | 0.004388946 | 0.044557 | 1 | -0.15283635 | 0.161614 |
| | | 81 | -0.07026964 | 0.04726 | 1 | -0.23703225 | 0.096493 |
| | | 185 | 0.01027071 | 0.04266 | 1 | -0.14026105 | 0.160802 |
| | | 205 | -0.022680944 | 0.044557 | 1 | -0.17990624 | 0.134544 |
| | | 275 | -0.074513507 | 0.04726 | 1 | -0.24127611 | 0.092249 |
| | | 285 | 0.0244158 | 0.04726 | 1 | -0.1423468 | 0.191178 |
| | | 393 | 0.039976214 | 0.044557 | 1 | -0.11724908 | 0.197202 |
| | 81 | 21 | 0.068967592 | 0.04726 | 1 | -0.09779501 | 0.23573 |
| | | 31 | 0.014415348 | 0.04726 | 1 | -0.15234726 | 0.181178 |
| | | 48 | 0.074658586 | 0.04726 | 1 | -0.09210402 | 0.241421 |
| | | 62 | 0.07026964 | 0.04726 | 1 | -0.09649297 | 0.237032 |
| | | 185 | 0.080540351 | 0.045476 | 1 | -0.07992704 | 0.241008 |
| | | 205 | 0.047588696 | 0.04726 | 1 | -0.11917391 | 0.214351 |
| | | 275 | -0.004243867 | 0.049816 | 1 | -0.18002709 | 0.171539 |
| | | 285 | 0.094685441 | 0.049816 | 1 | -0.08109778 | 0.270469 |
| | | 393 | 0.110245854 | 0.04726 | 1 | -0.05651675 | 0.277008 |
| | 185 | 21 | -0.011572759 | 0.04266 | 1 | -0.16210452 | 0.138959 |
| | | 31 | -0.066125002 | 0.04266 | 1 | -0.21665676 | 0.084407 |
| | | 48 | -0.005881765 | 0.04266 | 1 | -0.15641352 | 0.14465 |
| | | 62 | -0.01027071 | 0.04266 | 1 | -0.16080247 | 0.140261 |
| | | 81 | -0.080540351 | 0.045476 | 1 | -0.24100774 | 0.079927 |
| | | 205 | -0.032951654 | 0.04266 | 1 | -0.18348341 | 0.11758 |
| | | 275 | -0.084784218 | 0.045476 | 1 | -0.24525161 | 0.075683 |
| | | 285 | 0.01414509 | 0.045476 | 1 | -0.1463223 | 0.174612 |
| | | 393 | 0.029705503 | 0.04266 | 1 | -0.12082625 | 0.180237 |
| | 205 | 21 | 0.021378895 | 0.044557 | 1 | -0.1358464 | 0.178604 |
| | | 31 | -0.033173348 | 0.044557 | 1 | -0.19039864 | 0.124052 |
| | | 48 | 0.027069889 | 0.044557 | 1 | -0.1301554 | 0.184295 |
| | | 62 | 0.022680944 | 0.044557 | 1 | -0.13454435 | 0.179906 |

## APPENDICIES II: Table of Bonferroni test results.

| Dependent Variable | | | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| | | 81 | -0.047588696 | 0.04726 | 1 | -0.2143513 | 0.119174 |
| | | 185 | 0.032951654 | 0.04266 | 1 | -0.1175801 | 0.183483 |
| | | 275 | -0.051832564 | 0.04726 | 1 | -0.21859517 | 0.11493 |
| | | 285 | 0.047096744 | 0.04726 | 1 | -0.11966586 | 0.213859 |
| | | 393 | 0.062657157 | 0.044557 | 1 | -0.09456813 | 0.219882 |
| | 275 | 21 | 0.073211459 | 0.04726 | 1 | -0.09355115 | 0.239974 |
| | | 31 | 0.018659215 | 0.04726 | 1 | -0.14810339 | 0.185422 |
| | | 48 | 0.078902453 | 0.04726 | 1 | -0.08786015 | 0.245665 |
| | | 62 | 0.074513507 | 0.04726 | 1 | -0.0922491 | 0.241276 |
| | | 81 | 0.004243867 | 0.049816 | 1 | -0.17153935 | 0.180027 |
| | | 185 | 0.084784218 | 0.045476 | 1 | -0.07568317 | 0.245252 |
| | | 205 | 0.051832564 | 0.04726 | 1 | -0.11493004 | 0.218595 |
| | | 285 | 0.098929308 | 0.049816 | 1 | -0.07685391 | 0.274713 |
| | | 393 | 0.114489721 | 0.04726 | 0.9 | -0.05227288 | 0.281252 |
| | 285 | 21 | -0.025717849 | 0.04726 | 1 | -0.19248045 | 0.141045 |
| | | 31 | -0.080270093 | 0.04726 | 1 | -0.2470327 | 0.086493 |
| | | 48 | -0.020026855 | 0.04726 | 1 | -0.18678946 | 0.146736 |
| | | 62 | -0.0244158 | 0.04726 | 1 | -0.19117841 | 0.142347 |
| | | 81 | -0.094685441 | 0.049816 | 1 | -0.27046866 | 0.081098 |
| | | 185 | -0.01414509 | 0.045476 | 1 | -0.17461248 | 0.146322 |
| | | 205 | -0.047096744 | 0.04726 | 1 | -0.21385935 | 0.119666 |
| | | 275 | -0.098929308 | 0.049816 | 1 | -0.27471253 | 0.076854 |
| | | 393 | 0.015560413 | 0.04726 | 1 | -0.15120219 | 0.182323 |
| | 393 | 21 | -0.041278262 | 0.044557 | 1 | -0.19850355 | 0.115947 |
| | | 31 | -0.095830506 | 0.044557 | 1 | -0.2530558 | 0.061395 |
| | | 48 | -0.035587268 | 0.044557 | 1 | -0.19281256 | 0.121638 |
| | | 62 | -0.039976214 | 0.044557 | 1 | -0.19720151 | 0.117249 |
| | | 81 | -0.110245854 | 0.04726 | 1 | -0.27700846 | 0.056517 |
| | | 185 | -0.029705503 | 0.04266 | 1 | -0.18023726 | 0.120826 |
| | | 205 | -0.062657157 | 0.044557 | 1 | -0.21988245 | 0.094568 |
| | | 275 | -0.114489721 | 0.04726 | 0.9 | -0.28125233 | 0.052273 |
| | | 285 | -0.015560413 | 0.04726 | 1 | -0.18232302 | 0.151202 |