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The Presence of Birth Parents and Students' Mathematics Achievement: A Case Study

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### **Abstract**

This paper discusses the relationship between the presence of birth parents in a student's home life and their grade last semester in mathematics. Our<sup>1</sup> study consisted of two sets of rosters from two different urban high schools in a large metropolitan district. The 238 students involved are currently enrolled in either AP Calculus AB, Pre-calculus, Applied Statistics, Algebra II, Honors Geometry, or Geometry. The research showed that 30.8% of students who live with only their birth mother received an A or a B for the semester while 17.5% percent failed their mathematics course. In contrast, 58.4% percent of students who live with both of their birth parents earned an A or a B and only 10.1% of them failed their mathematics course for the semester. I was able to conclude at a 1 percent significance level that students living with both of their birth parents are more likely to earn an A or a B in their mathematics course than students living with just one of their birth parents. Furthermore, at a 10 percent significance level, there is sufficient evidence to draw the conclusion that it is less likely for a student who lives with both of their birth parents to fail their mathematics course than it is for a student who lives with just their birth mother. Therefore, the data seems to imply a definite correlation between the presence of birth parents in the homes of students and the students' grades.

### **Introduction**

In this study, I sought to determine whether there exists a relationship between the achieved mathematics grades of students and the presence of their birth parents in their home. Specifically, I will analyze the grades of students who live with only their birth mother, only their birth father, both of their birth parents, or with some other form of guardian (aunts, uncles, grandparents, foster families, etc.) in two different urban high schools in a large metropolitan

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<sup>1</sup> This study was completed with one other person, Cailyn Rowan.

school district. This paper will explore if a relationship exists between the students' grades and their living situation.

Prior studies on this topic suggest we could expect to find that students who live with both of their parents will be more likely to achieve an A or a B in their mathematics courses, and also that they will be less likely to fail their mathematics courses than students who live with just one of their birth parents or with one of the guardianships I classified as "other". The research points to this result because it is expected that students with a more stable home environment will be more likely to perform better in their mathematics courses than students with a less stable living situation. According to Alike and Edosa (2012), "such abnormal conditions of the home, are likely to have a detrimental effect on school performance of the child" (p. 257). This result, I believe, will be due to lack of stability and/or the trauma experienced by the loss of one or both parents (whether from divorce, death, loss of custody, or some other case). Additionally, in her book on revolutionizing mathematics education, Boaler (2016) mentions that it is considered discriminatory to use homework as a significant marker of success in the mathematics classroom since oftentimes students who are living with a single parent or in one of the "other" types of guardianships have more responsibilities at home than their peers who live with both parents (p. 207-209). With these additional responsibilities, the students do not have as much time to spend on homework or studying outside of school, which puts them at a disadvantage. Thus, I not only think that students who live with both parents will demonstrate an increased likelihood to pass the class they are in, but I also believe that I will find an increased likelihood for them to achieve As and Bs in their mathematics course.

## Research

In order to assess the validity of my hypotheses, I conducted research on 238 students in two different large urban high schools in a large midwestern metropolitan school district who were currently taking mathematics courses. Each teacher had demographic information available to them regarding several criteria about each student including who they lived with and their grades from previous semesters. This data was collected and transcribed without names to preserve the anonymity of the students. Specifically, I looked at if the students lived with their birth mother, their birth father, both their birth parents, or another type of guardian as well as their first semester grade for the class they were taking at that time. The students included were either currently enrolled in AP Calculus AB, Pre-calculus, Applied Statistics, Algebra II, Honors Geometry, or Geometry.

My findings are shown in the figures below. Figure 1 shows the living arrangements and semester grades of all 238 students that I surveyed. Figure 2a represents the percentage of students that live with their birth mother that passed/failed their mathematics course last semester, while Figure 2b represents the percentage of students that live with both of their parents that passed/failed their mathematics course last semester.<sup>2</sup> In order to further compare the grades achieved, Figure 3a and 3b separate the results of the research by students enrolled in required general education mathematics courses (Geometry and Algebra II) and students enrolled in higher level mathematics courses (Applied Statistics, Pre-calculus, AP Calculus, Honors Geometry), respectively.

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<sup>2</sup> I chose to compare the students that lived with both their parents to students that lived with just their birth mother because the majority of the students fell within these two categories. Very few students fell in the categories of living with just their birth father or living with another guardianship and therefore, it wouldn't be statistically significant to compare them to the students living with both of their birth parents.

**Results**

Figure 1.

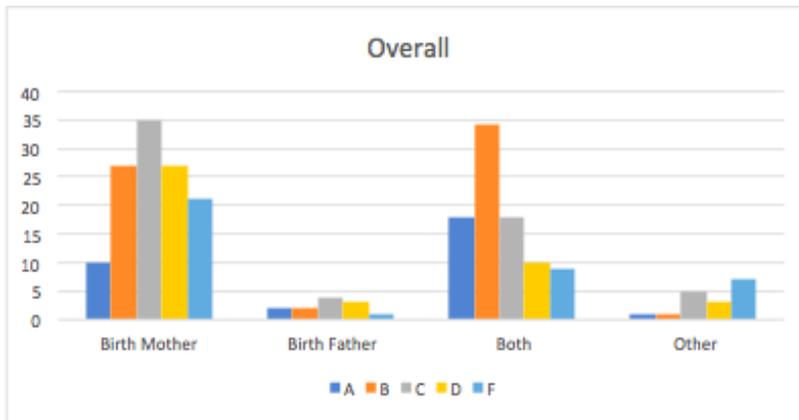


Figure 2a.

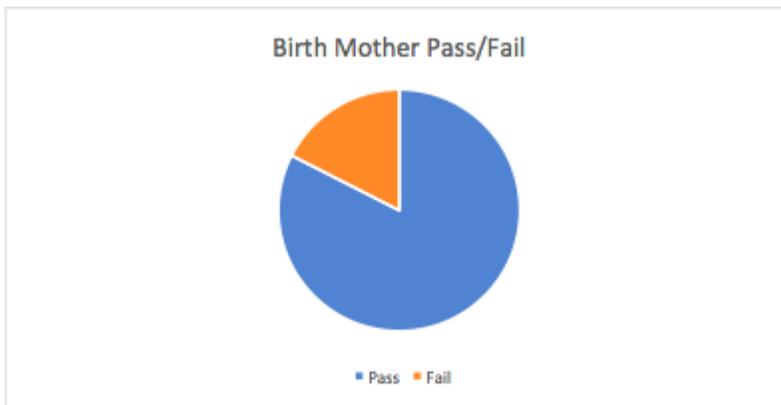


Figure 2b.

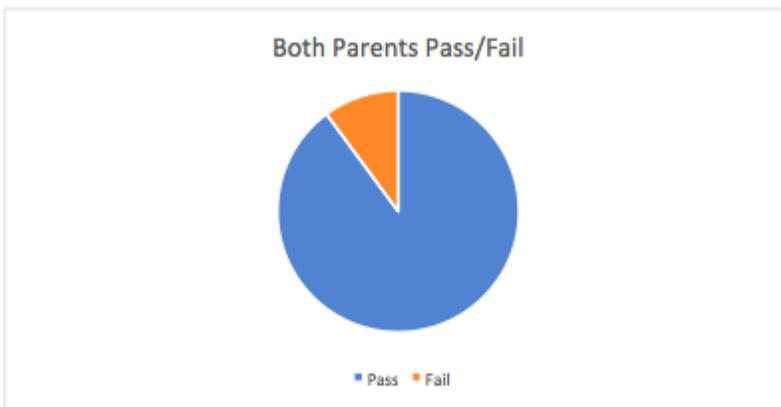


Figure 3a.

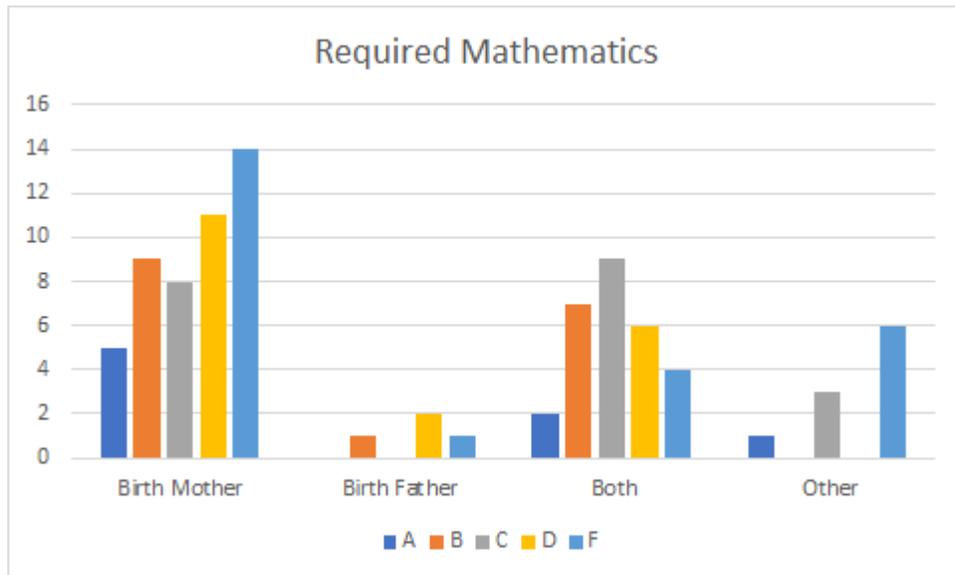


Figure 3b.

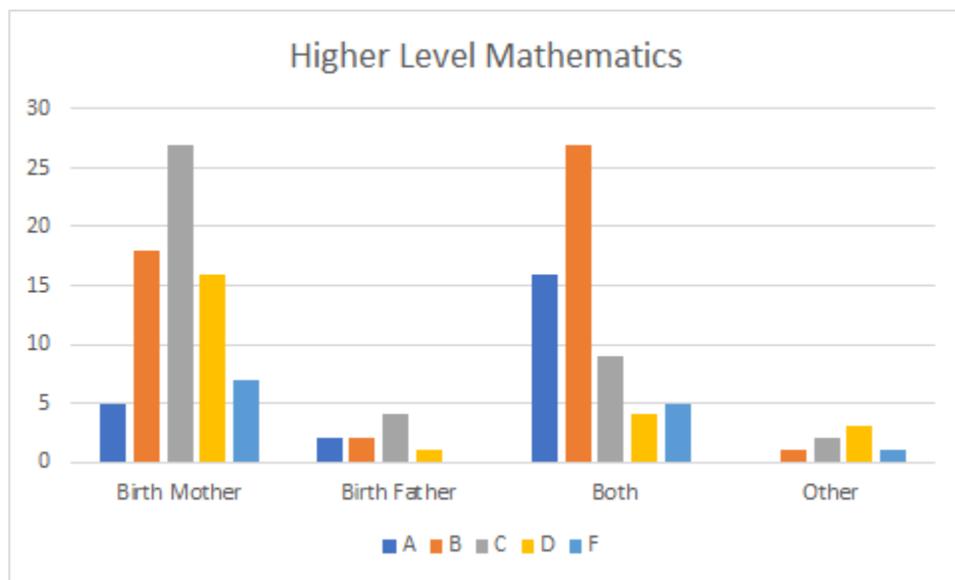


Figure 1 shows the data of all the 238 students in this research and demonstrates many interesting results. First, I see that most of the students live with either their birth mother (120 students) or both of their birth parents (89 students), whereas very few of the surveyed students live with just their birth father (12 students) or other (17 students). Further, Figure 1 demonstrates that there exists some interesting correlations between the living arrangements of

the students and their semester grades. The grades of students that lived with solely their birth mother resemble that of a normal distribution with the exception that the percent of students that earned an F for the semester was nearly double the percent that earned an A (A=8.3%, B=22.5%, C=29.2%, D=22.5%, F=17.5%). An interesting comparison to these statistics are those of the students that live with both of their birth parents. I found that 20.2% of them earned an A, 38.2% a B, 20.2% a C, 11.2% a D, and 10.1% an F. This means that nearly 60% (58.4% exactly) of all students living with both of their parents earned an A or a B, compared with only 30.8% of students who live with just their birth mother. Further, only 10.1% of students living with both of their birth parents earned an F, compared with 17.5% of students who live with their birth mother only.

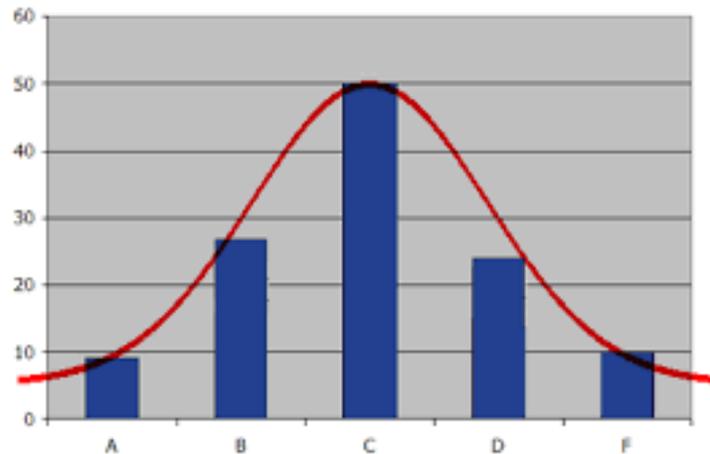
While there were less students in the remaining two groups, the findings are still interesting to analyze. For students living with their birth father, I found that 16.7% earned an A, 16.7% earned a B, 33.3% earned a C, 25% earned a D, and 8.3% earned a F, meaning that only 33.4% of students in this demographic received an A or a B. Finally, the results of the 17 students classified as living with “other” is as follows: 5.9% earned an A, 5.9% earned a B, 29.4% earned a C, 17.6% earned a D, and 41.2% earned an F. This result is of particular interest, as only 11.8% of these students earned an A or a B. Further, this is the only category in which the percent of students that earned an F (41.2%) was higher than the percent of students earning any other grade.

Figures 2a and 2b represent the percentage of students who passed/failed and live with just their birth mother as well as the percentage of students who passed/failed and live with both of their parents, respectively. The study found that 17.5% of the students living with just their

birth mother failed their mathematics course last semester in comparison with 10.1% of students that live with both of their birth parents.

Figures 3a and 3b offered an alternate view by separating the data by students who were enrolled in a required mathematics course and upper level mathematics course. In the regular mathematics courses (Figure 3a), I see that the grades of the 27 students living with both of their parents closely models that of a normal distribution, which one would expect to find in a classroom, (Figure 4 below demonstrates what a normal distribution looks like for grades in a classroom). This means that about the same percent (a low percent) of students achieve an A as achieve an F, the same percent of students (a higher percent) achieve a B or a D, and then the highest percent of students lay in the middle at a C.

Figure 4.



Conversely, the grades of the 47 students living with their birth mother do not model a normal distribution at all as revealed in figure 3a. In fact, the distribution of these students' grades is such that the least number of students in this demographic achieved an A and the highest number of students achieved an F for the semester. This correlation follows for most of the grades of the students in that more students achieved a B than an A, more students achieved a D than a C, and more students achieved an F than a D. The only grade that defies this trend

towards a higher likelihood of students falling into the subsequent, worse grade category is the C in which less students (1 student less to be exact) scored a C than had scored a B. However, the general trend this graph shows is alarming, as it shows that living with just a birth mother skews students away from an A towards an F in a general mathematics course. Otherwise stated, this figure demonstrates that the students in required mathematics classes living with just one of their birth parents are significantly more likely to earn worse grades than good grades. While only 10 students fell into the “other” category, their results were just as alarming. It showed the same skew towards a failing grade with just 1 student achieving an A, 3 students achieving a C, and 6 of the 10 students achieving an F.<sup>3</sup>

Figure 3b, which modeled the data for students in higher level mathematics courses, yielded some curious results. This is the first graph where the grades of students living with their birth mother resembled a normal distribution. In contrast, the students in the higher level mathematics living with both their birth parents enjoyed a very strong skew towards an A or a B. Specifically, 70.5% (43/61) of these students living with both of their birth parents earned an A or a B, in comparison with 30.5% of students who live with just their birth mother receiving an A or a B, which means that students who live with both of their parents are more than twice as likely to have an A or a B in an upper level mathematics course than their peers from single or non-parent households.

### **Interpretation**

In this study, I observed students’ mathematics grades and their living arrangements to see if there was a correlation between them as, due to previous studies conducted, I suspected students living with both their parents would achieve higher grades than students living with one of their birth parents or in a nonparent (other) living situation. It became obvious as I looked at

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<sup>3</sup> Only 4 students belonged to the Birth Father category, which is not statistically significant enough to analyze.

the data that such a correlation exists. The study showed that 58.4% of all students living with both of their parents earned an A or a B in comparison to only 30.8% of students who live with their birth mother, 33.4% of students who live with their birth father, and 11.8% of students who have another living arrangement. This means that nearly twice the percent of students living with their birth parents earn an A or a B as those living with just their birth mother or birth father, and further, over five times the percent of students living with both their birth parents earn an A or a B as those classified as living with “other”. More, nearly double the percent of students living with just their birth mother received an F in their mathematics course (17.5%) compared to the percent of students living with both of their parents receiving an F (10.1%).

These findings signify that children not living with both of their birth parents are at a significant disadvantage in their studies. In fact, I am able to conclude at a ten percent significance level that there exists a statistical difference between the percent of students who live with both their birth parents who failed their mathematics course and the percent of those who live with just their birth mother who failed. This means that there is enough evidence to conclude that it is more likely for students living with just their birth mother to fail their mathematics course than it is for students living with both their birth parents. More than just being significantly less likely to fail their course, students living with both of their birth parents are significantly more likely to get an A or a B in their math course compared to those who live with just their birth mother. This finding can be concluded at the one percent significance level.

These results are crucial because they show that the students who do not live in a traditional household with both of their birth parents are much less likely to earn an A or a B and further, are much more likely to fail their mathematics course altogether. It is evident that the demographic of students who live with one of their birth parents or with another type of guardian

is being failed by the current schooling system. With this in mind and also being aware that the “single parent lifestyle is currently largest growing demographic in America,” it is indisputable that this is a study needing attention (Porter, 1981, p. 517).

### **Implications**

The issue of single-parent households and lower student achievement is multifaceted and complex; to deduce any one reason that this correlation exists would be impossible. However, this paper will discuss some of the various possible sources of the discrepancy between the two groups of students’ grades. Some, but certainly not all, of the major obstacles that students of single-parent households face are financial, parental, and social.

When two-parent households become one parent households, one of the biggest struggles is usually financial. This struggle occurs because “after a divorce two households need to be supported instead of only one and thus a lot of household expenses cannot be shared any longer, which is also called a loss of economies of scale” (Amato, 2015, p. 193). According to Amato, Patterson, and Beattie (2015), “Children in single-parent households have a lower standard of living than do children in two-parent households. Family income, in turn, is a good predictor of children’s school grades and test scores” (p. 193). Because single parents must redistribute how they spend their money, and there is less money to use in general, the quality of the child’s education often suffers. McLanahan and Sandefur (1994) state that “the most direct effect of this loss of income on educational performance of children is the fact that the quality of the school they attend generally is lower,” as if parents are more financially secure it is more likely they will live in a neighborhood with a more academically successful school system or that they can choose a more academically successful school to which to send their child (p. 1-11). Moreover, a stable income can support a child’s academic success through “enabling a child to participate in

extracurricular activities, like lessons after school, special trips, or summer camps. Such activities improve children's skills directly, but also indirectly via general intellectual stimulation, which affects subsequent learning" (Lange, 2013, p. 331-332).

Further, after a divorce, children often suffer reduced parental involvement. This decline in involvement generally stems from the fact that "single parents have to divide their time between work and home, and consequently can devote less time to their children compared to a situation in which two parents run a household" (Lange, 2013, p. 331-332). The effect of lowered parental involvement can be detrimental on student academic success in that it decreases "[the time they] spend with their children on reading, helping with their homework, or listening to the stories about their experiences at school, as well as the ability and willingness of parents to monitor and supervise children's social activities outside school, which reduces their opportunities to get in trouble" (Lange, 2013, p. 331-332). Further, single parents are less likely to participate in "activities in relation to schools such as volunteering at school events, attending a parent-teacher organization, or contacting teachers and school officials" (Park, 2010, p. 4).

Further, Amato (2015) describes that "parents are important sources of social capital and provide many resources to children, including emotional support, encouragement, everyday assistance, and help with homework" (p. 193) However, "Children who live with single parents have less access to these social resources, in general, than do children with two parents in the household" (Amato, 2015, p. 193). One reason for this is that single parents often lose personal relationships and community ties as a result of the difficulty to maintain mutual friendships and the likelihood of relocating after a divorce or a financial loss. This leads to a lack of a social support system as well as a lack of knowledge about the community and school system (Lange,

2013, p. 331-332). Finally, children of single-parent households have often experienced the trauma of a divorce of their parents and then will most likely experience other parental transitions during their childhood. In his research, Amato (2015) states that “the cumulative amount of household instability or ‘turbulence’ in children’s lives is associated with a variety of problematic outcomes, including school performance and educational attainment” (p. 193).

My findings agree with that of Alike and Edosa (2012), who claimed that a “broken home negatively determine[s] academic achievement of secondary school students which translates to poor academic achievement” (p. 258). While I could only reject the null hypothesis ( $H_0 : p_1 = p_2$ ,  $H_1 : p_1 < p_2$  where  $p_1 =$  percent of students living with both birth parents that failed their mathematics course last semester and  $p_2 =$  percent of students living with their birth mother that failed their mathematics course last semester) at a significance level of 10%, Alike and Edosa (2012) were able to reject their similar null hypothesis at a significance level of 5% (p. 258). This further supports the findings and has led to the conclusion that there is definitely a correlation between the presence of students’ birth parents in their home and their academic achievement in the mathematics.

The results of this paper make it clear that mathematics teachers need to make themselves aware of their students’ home demographic and consider giving their students from single parent and nonparent homes targeted supports to ensure their success in their mathematics classes.

While the implications of this research are profound for student achievement, it is important to acknowledge and take into consideration some of the limitations of this paper. The research completed possessed a relatively small sample size due to the permissions granted to the researchers. Further, it must be considered that the living situations of students are not always

entirely up-to-date in the high schools' databases and the demographic information available to the teachers so some of the students' living situations may not be reflected accurately. Another limitation of this paper is that so few students surveyed fell into the category of living with just their birth father or in an "other" non-parent household that it wasn't always statistically significant to compare the results found in those categories to those found in the birth mother and both birth parents categories. Amato (2015) states that "comparatively little attention has been given to children living with neither parent, presumably because their numbers are relatively small and have not increased much in recent decades. Despite this lack of attention, however, children living without parents have worse educational outcomes, on average, than do children living with one or two parents, not only in the United States but also in other countries" (p. 202). My findings in this study agree wholeheartedly with this sentiment. There were few students in my study classified as living with "other", and on average these students scored very poorly in their mathematics course last semester with 41.2% of them (7/17) failing their mathematics course; this was the highest failure percentage of any category I studied. Finally, and perhaps one of the study's biggest limitations, is that it fails to delve deeply into the family dynamics of the students living with just one of their birth parents (i.e. some of the students that are classified as living with just their birth mother or birth father may also be living with a step mother or step father).

It would be worthwhile to delve deeper into the dynamics of these single birth parent households to determine if there exists a difference in the grades of the students living with just their birth parent (a single-parent household) and the students living with a birth parent and a step-parent (a two-parent household), as in our research all of these students were grouped together. Further, it would be interesting to compare the grades of the students living with both

of their birth parents and students living with one birth parent and a step-parent. These results would be interesting to evaluate as it would provide some clarity as to the exact dynamics that affect students' mathematical achievement. For instance, it would help to determine if it is the lack of two parent figures in a household or specifically, the lack of two *birth* parents in a household that contribute to lower academic achievement.

### **Conclusion**

With the knowledge that the single-parent household demographic is the fastest growing demographic in the United States and the suspicion that students from this demographic are underperforming academically due to financial, parental, and social reasons, I felt it imperative to perform a study to determine if these suspicions were correct. I hypothesized that students from a two-parent household would be more likely to earn As or Bs in their mathematics course, while students from a single-parent household or a non-parent household would be less likely to achieve such a high mark. Further, based on previous studies, I hypothesized that students from a two parent households would be less likely to fail their mathematics course for the semester than their peers from single or non-parent households. I was able to support both of these hypotheses at a 1 percent and 10 percent significance level, respectively.

The research showed that 30.8% of students who live with only their birth mother received an A or a B for the semester while 17.5% percent failed their mathematics course. In contrast, 58.4% percent of students who live with both of their birth parents earned an A or a B for the semester while only 10.1% of them failed their mathematics course. Thus, at the 1 percent significance level, I was able to support the alternative claim that students living with both of their birth parents are far more likely to earn an A or a B in their mathematics course than students from a single-parent household. Furthermore, there is sufficient evidence to draw the

conclusion at a 10 percent significance level that it is less likely for a student who lives with both their birth parents to fail a mathematics course than a student who lives with one of their birth parents.

While I have begun to speculate various potential causes of this gap in academic achievement, my goal with this research is to purely to demonstrate that this correlation exists. In order to begin to address this shortcoming in our education system, we must first discover and acknowledge that the problem exists. It is clear, however, that as the dynamic of the American family continues to change, we as educators will also need to change in order to ensure the success of all students, regardless of with whom they live.

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