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MCA Scores and Student Success

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Executive Summary:

The Minnesota Comprehensive Assessment (MCA) is a test taken by all Minnesota students in high school. There are three sections on the MCA Test: Math, Reading, and Science. MCA scores are used primarily for ranking Minnesota high schools. Schools are then able to tell where they rank in the state of Minnesota. The Reading and Science section are taken in 10th grade, with scores ranging from 1000-1099. Math assessments are given in 11th grade, with ranges 1100-1199. The Minnesota State Colleges and Universities (MNSCU) used MCA scores to detect students who they believed would not be career ready. Numerous studies have been done by MNSCU regarding MCA benchmarks. MNSCU is now currently replaced by Minnesota State; however their research regarding MCA scores and student success is still valuable. A benchmark is a score cut-off that MNSCU believed a student must meet to succeed in college level courses. St. Cloud State University (SCSU) uses similar benchmarks to gain access to their math courses. Using SCSU math MCA cut-scores and the MNSCU reading cut-scores, this analysis will analyze the success of students in regards to their MCA scores. The Math cut-score that MNSCU created was a score of 1157, while the reading cut-score was a score of 1016. According to MNSCU, if a student scores 1157 on their math MCA they would be predicted to have a 50% chance of receiving a 'B' or better in their first-term math course. They also would be predicted to have a 75% chance of receiving a 'C' or better in their first-term math course. Similarly, students scoring a 1016 on their reading MCA would be predicted to have a 50% chance of receiving a 'B' or better in their first-term English course. Also, a 75% chance of receiving a 'C' or better in their first-term English course. The math cut-score was specifically designed for a college algebra course, which at SCSU is Math 112. The reading cut-score was designed for an entry

level writing course, which at SCSU is English 190 and 191. Princeton school district is interested in how MCA scores affect college readiness, while seeing the effect of the MCA score on their first-year grades.

This analysis examines students' grades in their first year, along with analyzing the percentages of students meeting the benchmarks. Further analysis examines the MCA scores and their effectiveness in predicting incoming first-year students' grades at SCSU. Using this analysis, the Princeton school district can better prepare their students. Students can gain insight on college readiness based on their MCA exam scores.

Data and Demographics:

There were two main data sets used in this analysis. The first data set was the Minnesota Statewide Longitudinal Education Data System (SLEDS) data. SLEDS data is information that was available on Minnesota high school students. Information such as MCA and ACT scores were available in the SLEDS data. The SCSU data was data pulled on former first-year students at SCSU. This data set included grades first-year students received in their term one, and term two classes. These two data sets were based on eight cohort years of data, which ranged from the years 2008 to 2016. The SCSU data also included ACT scores and high school name, which were used for the merging process (Appendix). These two data sets were merged together to form one data set that included students' grades and MCA scores. This data set was 8881 observations, which were used for this analysis. Table 1 and Table 2 reference the most common classes students were taking from the data set, while also listing the counts in that class number.

Table 1: Available Math Classes in the Data Set

Course	Term 1	Term 2	Total
Math 112	546	308	854
Math 115	376	98	474
Math 193	342	509	851
Math 221	313	12	325

Table 2: Available English Classes in the Data Set

Course	Term 1	Term 2	Total
Eng 190	327	244	571
Eng 191	2341	1078	3419

The main variables used for this analysis dealt with categorizing the grades. Indicator variables were created to indicate if a student received a 'B' or better. There were also indicator variables for students receiving a 'C' or better. These variables were coded as '1' for students who did receive the letter grade or better. The students who did not receive the letter grade or higher were coded as '0'. These variables were created for term 1 and term 2 and by class section (Math, English). Using these indicator variables, averages of students receiving those grades scores were analyzed.

Research Problems:

The Princeton school district asked for insight on how MCA scores effect college readiness.

Students scoring the benchmarks set by MNSCU are expected to have a 50% chance of receiving a 'B' or better and a 75% chance of receiving a 'C' or better. The main questions addressed in this report are as follows:

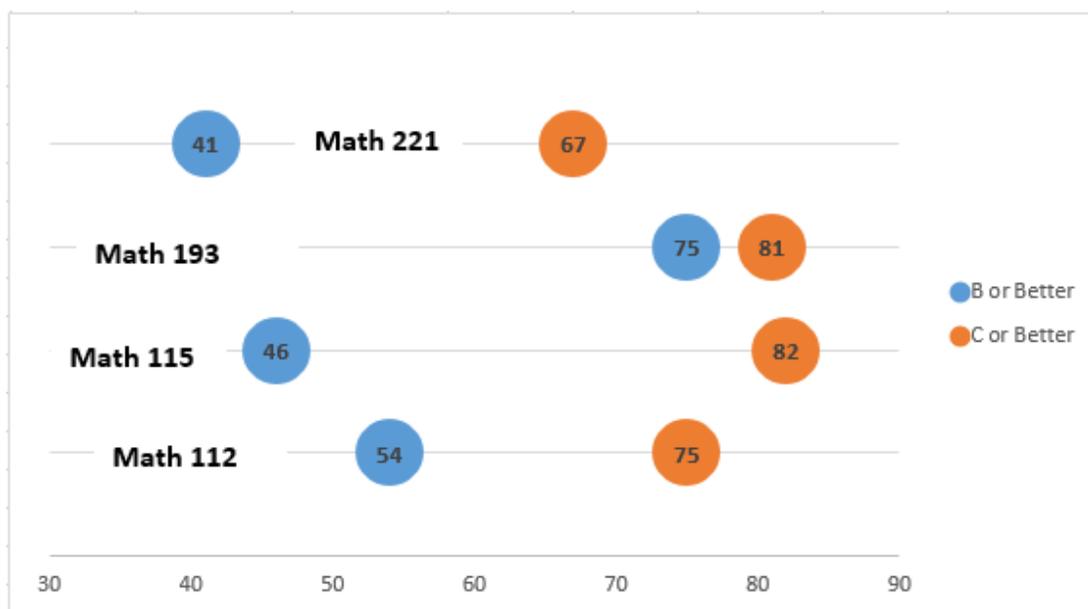
1. What were the average MCA scores for the first-year students attending SCSU? Are these averages above the MCA benchmarks?
2. Of the students that are scoring the benchmark, are 50% of those students receiving a 'B' or better in their classes? Are 75% receiving a 'C' or better?
3. Do the MCA tests predict college readiness?

Findings:**Table 3:** *MCA Levels of Proficiency with SCSU Average MCA Scores*

Math MCA		Reading MCA
1140	Partially Meets	1040
1150	Meets	1050
1164	Exceeds	1064
1157	Cut-Score	1016
1151	SCSU Average	1060

MNSCU releases MCA scores that measure a student's proficiency. The standards are labeled as 'Partially Meets', 'Meets', and 'Exceeds'. Generally, students should be scoring the 'Partially Meets' score or above, otherwise they are flagged as not being proficient. It is important to notice that the SCSU average math MCA score is not above the cut-score. This means that less than 50% of SCSU students would be expected to receive a B or better in their first-term math course. English however shows a result of being well above the cut-score.

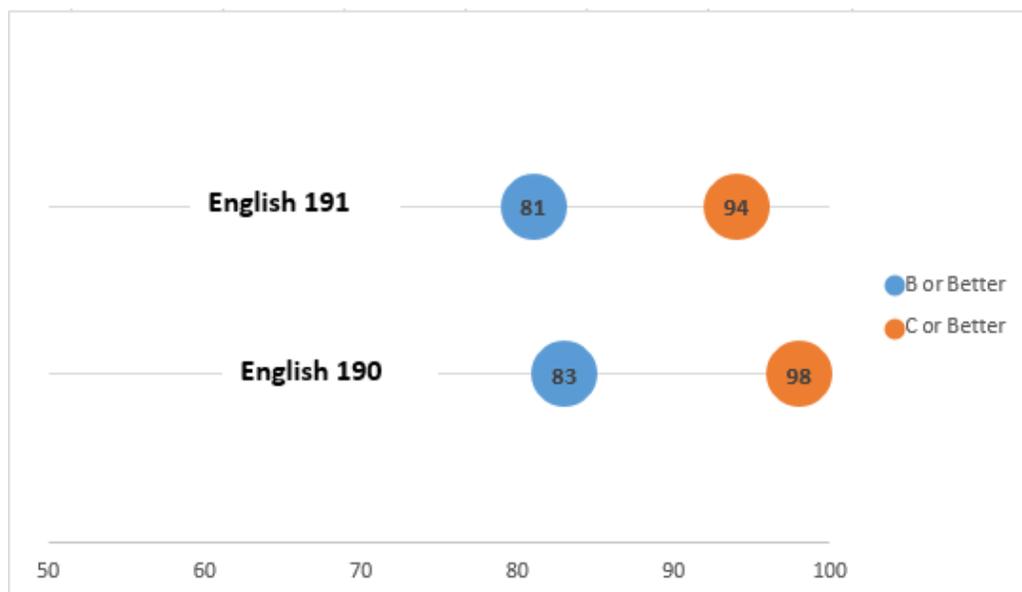
Figure 1: Term 1 Math Course Grades Percentage



**** Note: This only includes students who scored the cut-score of 1157**

MNSCU predicts that a student scoring the math benchmark of 1157 would have a 50% chance of receiving a 'B' or better and a 75% chance of a 'C' or better. Since this includes students scoring over 1157 also, it would be expected that there would be a higher percentage scoring both of these grades. MNSCU specifically designed this cut-score for a college algebra course, which is Math 112 at SCSU. The percentages are relatively close to what MNSCU would predict. It is also interesting to note that students taking Math 221 (Calculus) are showing lower grades than any other course.

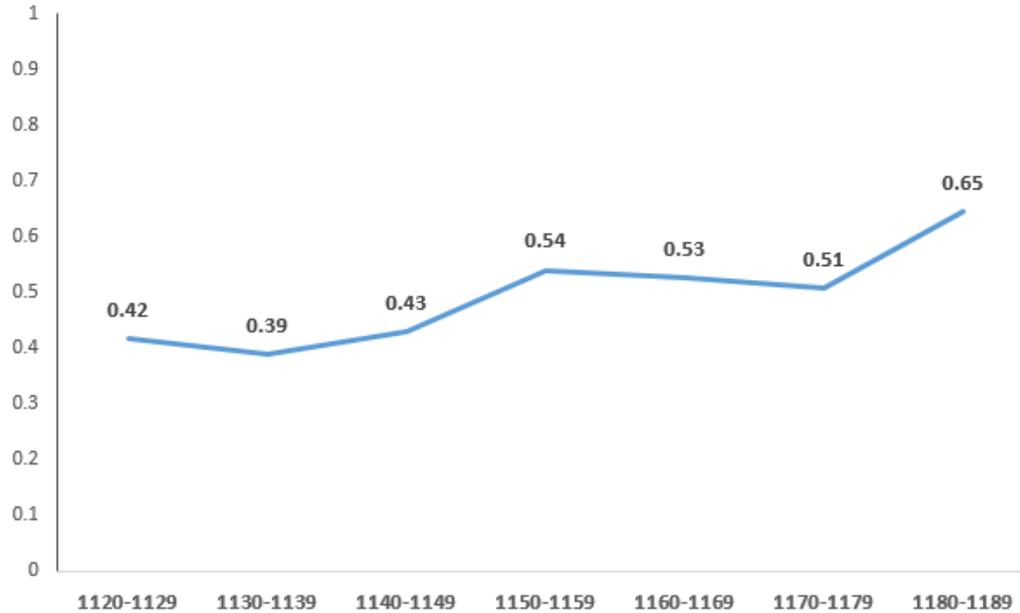
Figure 2: Term 1 English Course Grades Percentage



**** Note: This only includes students who at least scored the cut-score of 1016**

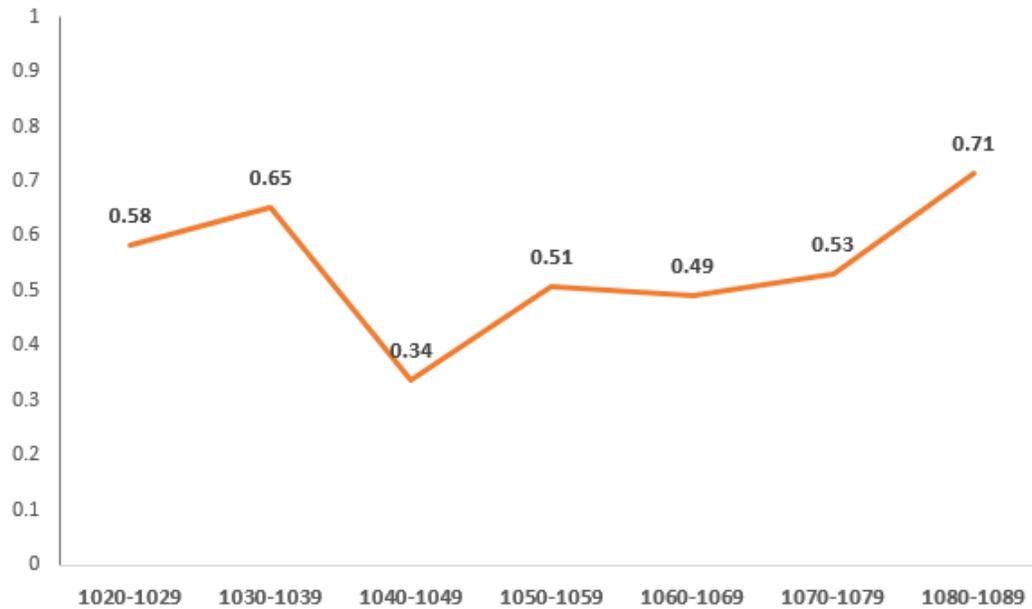
MNSCU predicts that a student scoring the English benchmark of 1016 would have a 50% chance of receiving a 'B' or better and a 75% chance of a 'C' or better. Since this includes students scoring over 1016 it would be expected that there would be a higher percentage scoring both of these grades. MNSCU specifically designed this cut-score for an entry level writing course, which is English 190 and 191 at SCSU. Right away it's apparent that English courses are showing much higher grade percentages than the math courses at SCSU. Students scoring the benchmark or higher are showing a massive 94% receiving a 'C' or better in English 191.

Figure 3: Term 1 Math Percent 'B' or Better by Math MCA Score



Students who are scoring higher on the MCA math assessment are generally showing larger percentages of 'B' or better (Figure 4). The percentages fluctuate between 42% and 65% receiving a B or better. Students who are scoring the highest scores are showing the largest percentages, meaning that students who perform best on the MCA are the ones receiving the better grades. It is important to mention however that the percentage increase is not that large as MCA is increasing.

Figure 4: Term 1 English Percent 'B' or Better by Reading MCA Score



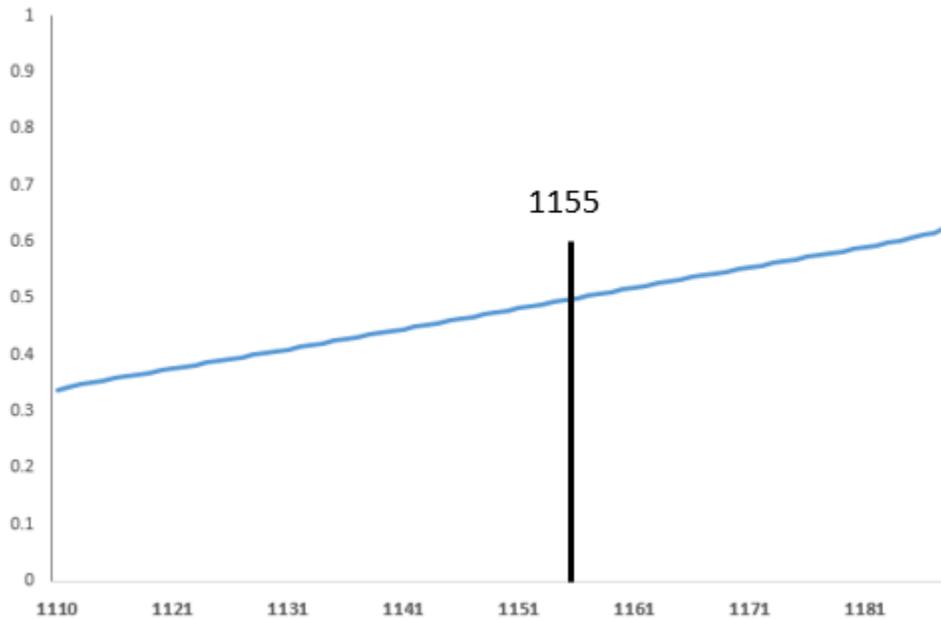
The percentages of students receiving a 'B' or better fluctuate as reading MCA score increases (Figure 5). In comparison to Figure 4, the percentage of students receiving a B or better fluctuates a lot with reading MCA score. It is also important to note that students who are scoring lower reading MCA scores are showing large percentages of 'B' or better, even though they didn't do so well on the reading MCA. This could mean that the English courses at SCSU are easier for students to do well in with little background knowledge.

Table 4: Term 1 Math and English Logistic Model Results

Response Variable	Intercept	Estimate	40% Probability	50% Probability	60% Probability
Term 1 Math Greater than B	-16.88	0.015	1129	1155	1183
Term 1 English Greater than B	-32.24	0.032	1002	1013	1026

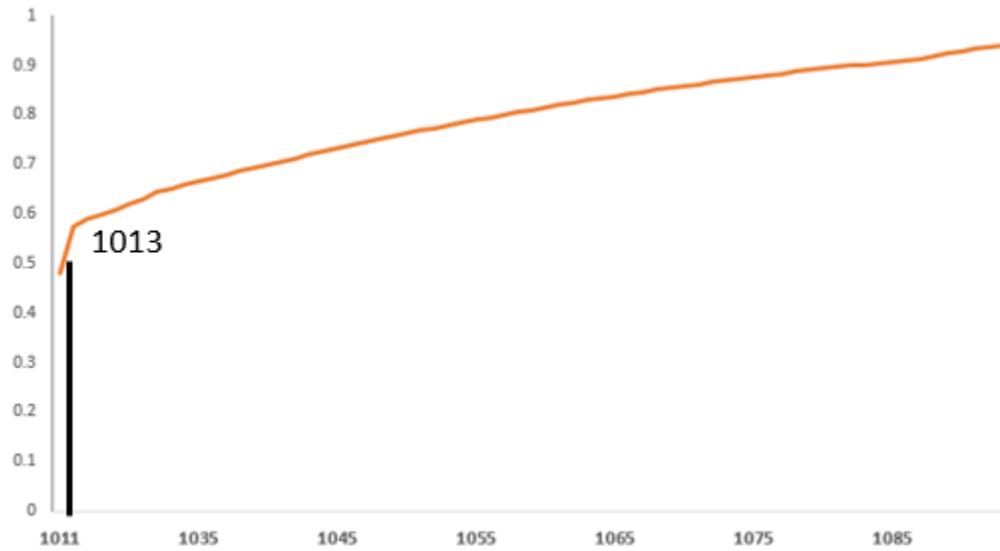
Logistic models were run for term 1 Math and English grades. A logistic model is a model that predicts a binary variable. In this case, the variable was 'Greater than B'. Any student who received a 'B' or better was coded as a '1' whereas anyone lower was coded as a '0'. This model was used to find the 50% cutoff that my logistic model would predict. Probability levels were created to indicate the score needed to have that percentage of receiving a 'B' or better. Students who scored 1155 on the math MCA would be predicted to have a 50% chance of receiving a 'B' or better, which is very close to what MNSCU predicts with their cut-score of 1157. This means that the SCSU data does generally follow that MNSCU predicted. Similarly, the English model showed a 50% probability of 1013 which is only three MCA points off of the MNSCU cut-score. Altogether, students at SCSU are showing results expected by MNSCU.

Figure 5: Term 1 Math Predicted Probability by MCA



The predicted probability is what the logistic model predicts for a certain MCA score by a student (Figure 5). It can be seen that students who score higher on the MCA would be predicted to have a larger probability of receiving a 'B' or better. The cut-score of 1155 that the logistic model predicted is seen in Figure 5, which marks the 50% probability of receiving a 'B' or better. The relationship is linear, which is unusual for a logistic model. This could mean the relationship between MCA score and probability of a 'B' or better is not the strongest.

Figure 6: Term 1 English Predicted Probability by MCA



English predicted probabilities showed a different trend. In the earlier MCA scores we see a curved relationship; however then it flattens out. Students scoring low MCA scores would already be predicted to have a large chance of a 'B' or better. This could be since students at SCSU are showing high average reading MCA scores, meaning they are prepared for entry-level English courses.

Table 5: Course-Specific Logistic Models

Response Variable	Intercept	Estimate	40% Probability	50% Probability	60% Probability
Term 1 M112 Greater than B	-18.98	0.016	1117	1142	1166
Term 1 E191 Greater than B	-42.76	0.042	1014	1023	1032

Lastly, logistic regression models were run for Math 112 and English 191. The reason for these course-specific models was to predict the courses that MNSCU specifically set these cut-scores for. The 50% probability for Math 112 was 1142, meaning that a student scoring 1142 would be expected to have a 50% chance of receiving a 'B' or better. This is lower than the MNSCU cut-score of 1157. English 191 showed a 50% probability score of 1023. This was 10 points larger than the MNSCU cut-score of 1013.

Future research could involve analyzing all SCSU courses and creating cut-scores. SCSU could use the scores to have an indication of if a student is ready for that course. Larger sample sizes would be needed for this research.

Conclusion:

The MCA tests are used to predict college readiness for students finishing their high school careers. This analysis looked at SCSU first-year students assessment scores to find whether they met MCA benchmarks, along with the grades these students received. The key findings in this analysis are the following:

- First-year students at SCSU on average 'meet' the proficiency expectations from MNSCU in English and math. SCSU students on average are lower than the math cut-score set by MNSCU and higher on average than the cut-score for English.
- Math courses appeared to produce similar results to what MNSCU would predict. For Math 112, students scoring the cut-score or above were showing close to 50% receiving a 'B' or better and 75% receiving a 'C' or better.
- English courses appeared to produce higher grades than expected. Students that met the benchmark for English had far greater than 50% obtaining a 'B' or better. There was also a much higher rate of students obtaining 'C' or better.
- MCA assessments do not appear to be a strong predictor of a students' grades. The relationship was relatively flat.
- Logistic models showed similar predictions to what MNSCU predicted with their cut-scores.

Further research can be done to analyze courses individually to see which courses follow the benchmark. This could be especially useful for the math courses, which many students struggle in.

Appendix:

Data Merge:

There were two different datasets used in this analysis. The first dataset was SCSU data giving students ACT test scores and grades for students who graduated in 2001 to 2017. This dataset consisted of only SCSU first-year students. The second dataset was SLEDS data giving students ACT and MCA test scores for students who graduated in 2008 to 2016. The SLEDS dataset also gave the grades students received in their first two terms of English, Science, and Math courses.

The final dataset used in this analysis was created by merging the two datasets together. The SCSU dataset was merged with the SLEDS dataset to give the MCA scores of only SCSU students. This merge was done by matching students ACT scores as well as demographic information given, including ethnicity, high school, and gender. This merge gave a total of 8881 observations and included students MCA test scores, the English, math, and science courses students took in their first two terms, and the grades they received in those courses.

After the datasets were merged, the MCA test scores were sorted in excel. Some students MCA test scores were below the test score range due to test modifications for some students. These test scores were excluded from the results. Next, variables were created to show student success with a 'B' or better and a 'C' or better in English, math, and science courses. This was used to find if SCSU students met the ACT benchmarks. There were also variables created to show if students met the MCA benchmark for all subjects individually.

Type 1 and Type 2 Errors:

Type 1 and type 2 errors are two very important aspects of statistics. When it comes to p-values, type 1 and type 2 errors must be acknowledged. A type 1 error is the incorrect rejection of the null hypothesis. This is also known as a 'false positive' finding. This is a dangerous error to make, since a statistician making this error is claiming significance when there is none. A type 2 error is wrongly accepting the null hypothesis. This is also known as a 'false negative' finding. This is also a dangerous error to make, since there was significance in which the statistician did not claim. The probability of a type 1 error occurring is the significance level in which you are using. For this report, I used a significance level of .05. This means there is a five percent chance of finding significance any time the null hypothesis is true. This false significance would be a type 1 error. This becomes an issue when the number of tests run increases. If you run tests on 20 variables that actually have no effect, then there is a high chance that a type 1 error occurs. The probability of a type 2 error can only be calculated for specific assumptions about the actual population mean. In this report, my logistic models output p-values for the MCA tests as my predictor variables. In this case, the significance wasn't used.

P-Values:

When you perform a hypothesis test in statistics, a p-value helps you determine the significance of your results. The p-value is a number between 0 and 1 and interpreted in the following way: A small p-value (typically ≤ 0.05) indicates strong evidence against the null hypothesis, so you reject the null hypothesis. In general we define the null hypothesis as (in a statistical test) the hypothesis that there is no significant difference between specified populations, any observed difference being due to sampling or experimental error. In real terms, the p-value represents

the probability that you will mistakenly claim significance. This is very important for any statistical analysis, as the p-value directly is similar to type 1 and type 2 errors. Generally, if a p-value is lower than .05 we reject the null hypothesis. If it greater than .05, we do not reject the null hypothesis as there is not enough evidence to claim significance. Finally, if the p-value is close to .05; it should be reported that the evidence is not clear however it is close to the alpha level. P-values can be very misleading to the public, since statisticians claim significance even if the p-value is borderline. P-values are a powerful statistical tool; however, they should not be relied on as being the only means of a statistical analysis. Looking at the logistic models run, neither of the MCA assessments were significant predictors of 'B' or better. Probability levels were the main focus in this report.

Variable List:

Gender – Male or Female

lpedsEthnicity – Ethnicity

Tech_ID – Students Tech ID

Grad Year – High School Grad Year

HS – High School

ACT_Comp – ACT Composite Score

MCA Math Achievement – MCA Achievement level (D = Does not Meet, P = Partially Meets, M = Meets, E = Exceeds)

MCA Math Score – MCA Math Score

MCA Reading Achievement – MCA Achievement level (D = Does not Meet, P = Partially Meets, M = Meets, E = Exceeds)

MCA Reading Score – MCA Reading Score

MCA Science Achievement - MCA Achievement level (D = Does not Meet, P = Partially Meets, M = Meets, E = Exceeds)

MCA Science Score – MCA Science Score

ACT Math Scale Score – ACT Math Score

ACT Reading Scale Score – ACT Reading Score

ACT English Scale Score – ACT English Score

ACT Science Scale Score – ACT Science Score

Enrolled T3? - Was the student enrolled in the third term? (1 = enrolled, 0 = Not enrolled)

Cumulative GPA T2 – Cumulative GPA in second term

E1_SUBJ – English Subject in Term 1

E1_COU_NBR – Term 1 English Course Number

E1_GRADE – Term 1 English Grade

M1_SUBJ – Term 1 Math Subject

M1_COU_NBR – Term 1 Math Course Number

M1_Grade – Term 1 Math Grade

S1_SUBJ – Term 1 Science Subject

S1_COU_NBR – Term 1 Science Course Number

S1_GRADE – Term 1 Science Grade

E2_SUBJ – Term 2 English Subject

E2_COU_NBR – Term 2 English Course Number

E2_GRADE – Term 2 English Grade

M2_SUBJ – Term 2 Math Subject

M2_COU_NBR – Term 2 Math Course Number

M2_GRADE – Term 2 Math Grade

S2_SUBJ – Term 2 Science Subject

S2_COU_NBR – Term 2 Science Course Number

S2_GRADE – Term 2 Science Grade

Math Success >C T1 – Did the Student get a C or Better in Term 1 Math? (1 = C or Better, 0 = not C or Better)

Math Success >B T1 – Did the Student get a B or Better in Term 1? (1 = B or Better, 0 = not B or Better)

English Success >C T1 – Did the Student get a C or Better in Term 1? (1 = C or Better, 0 = not C or Better)

English Success >B T1 – Did the Student get a B or Better in Term 1? (1 = B or Better, 0 = not B or Better)

Science Success >C T1 – Did the Student get a C or better in Term 1? (1 = C or Better, 0 = not C or Better)

Science Success >B T1 – Did the Student get a B or Better in Term 1? (1 = B or Better, 0 = not B or Better)

English Benchmark – Did the Student Meet the English MCA Benchmark?

Reading Benchmark – Did the Student Meet the Reading ACT Benchmark?

Math Benchmark – Did the Student Meet the Math MCA Benchmark