The primary goal of this study is to determine if a certain course track in high school mathematics leads a student to be more or less likely to be retained in the North Dakota University System, and ultimately, complete their degree.

First off, is retention positively associated with retention in the North Dakota University system? To determine this, a data set consisting of students graduating from North Dakota public high schools in either 2008 or 2009 and enrolling the following fall in a North Dakota University System institution was collected. A total of 6,471 students were found meeting these criteria, 2,389 who enrolled in a Community College, and 4,082 who enrolled in either a Regional or Research NDUS institution.

Institution Type	Degree Rate	Degree Rate if retained
Community	50.9%	69.8%
Regional/Research	57.1%	66.8%

Table 1: Degree Completion Rates by NDUS Institution Type and Retention

For the purposes of this study, retention was defined as a student remaining enrolled in *any* NDUS institution during the fall semester one year following their initial enrollment (the beginning of their sophomore year). Students, for the purposes of this study, were considered to have completed their degree if they obtained either an Associate or Bachelors degree within 5 years of initial enrollment in the system. As table 1 shows, both students in Community and Regional/Research universities were more likely to complete their degree within 5 years if they began a second year in the university system.

Now that it has been illustrated that student retention is positively associated with degree completion, which math courses and/or math course sequences tend to be positively associated with student retention (and ultimately degree completion)? To determine this, high school math sequences were tracked for students graduating on-time from North Dakota public high schools in 2011, 2012, or 2013. Students were only under consideration if they enrolled in an NDUS institution in the fall semester immediately following their high school graduation. After tracking the math courses, a student was identified as retained if they were enrolled in an NDUS institution the fall semester in the year following their initial enrollment (the fall of their sophomore year).

9th Grade	10th Grade	11th Grade	12th Grade	NDUS Retention	n
Algebra I	Geometry	Algebra II	Prob./Statistics	85.5%	69
Algebra I	Geometry	Algebra II	Pre-Calculus	83.7%	141
Algebra I	Geometry	Algebra II	None	67.3%	425

Table 2: Community College Retention Rates by High School Mathematics Courses

9th Grade	10th Grade	11th Grade	12th Grade	NDUS Retention	n
Geometry	Algebra II	Pre-Calculus	AP Calculus AB	97.1%	138
Algebra I	Geometry	Algebra II	College Algebra	95.4%	65
Geometry	Algebra II	Pre-Calculus	None	90.6%	85
Algebra I	Geometry	Algebra II	Pre-Calculus	89.5%	380
Algebra I	Geometry	Algebra II	Prob./Statistics	87.7%	163
Pre-Algebra	Algebra I	Geometry	Algebra II	70.8%	65
Algebra I	Geometry	Algebra II	None	69.7%	366

Table 3: Regional and Research University Retention Rates by High School Mathematics Courses

Tables 2 and 3 appear to show certain mathematics course tracks have a higher retention rate than others. However, this does not take into account the underlying academic differences between the students in each group. For example, when looking at the average ACT composite score and average high school GPA for students enrolling in community colleges, distinct differences arise in the groups.

9th Grade	10th Grade	11th Grade	12th Grade	NDUS Retention	n	ACT	GPA
Algebra I	Geometry	Algebra II	Prob./Statistics	85.5%	69	20.4	3.18
Algebra I	Geometry	Algebra II	Pre-Calculus	83.7%	141	21.4	3.38
Algebra I	Geometry	Algebra II	None	67.3%	425	19.3	2.95

Table 4: Community College Retention Rates by High School Mathematics Courses

As table 4 shows, students taking either Pre-Calculus or Probability/Statistics in their senior year had a noticeably higher retention rate than students who did not take a math course in their senior year. However, the groups containing students who took a math course in their senior year also had a higher average GPA and higher average ACT Composite than the group of students who did not take a math course. So while certain math course tracks may be associated with an increase in NDUS retention, it may only be due to the fact that more academically inclined students *choose* to take these tracks, leading to higher retention rates. The specific course track may not be a large factor contributing to retention, but the student themselves.

To study this further, the groups involving students taking either Probability/Statistics or Pre-Calculus were combined, since they had roughly similar retention rates. After combining those two groups, students were matched one-to-one with a student in the group not taking a course during their senior year of high school. These students were matched based on similar 11th grade ACT Composite scores and GPA in Math courses prior to 12th grade, to more accurately assess the effect of taking a course during the senior year after taking Algebra I, Geometry, and Algebra II.

Senior Math Course	11th Grade ACT Composite	Math GPA prior to Senior Year
Prob./Stat or Pre-Calculus	21.0	2.98
None	19.3	2.32

Table 5: Community College Group Summaries

Table 5 illustrates the differences that exist between the two groups in 11th Grade ACT Composite scores and GPA in Math courses during grades 9, 10, and 11. Propensity score matching students yielded 153 successful matched pairs of students. These matched pairs produced much more similar groups to compare retention rates.

Senior Math Course	11th Grade ACT Composite	Math GPA prior to Senior Year
Prob./Stat or Pre-Calculus	20.6	2.79
None	20.6	2.76

Table 6: Community college group summaries after matching student pairs

After creating matched pairs of students, the two groups have similar underlying academic characteristics, as measured by ACT Composite scores and GPA in math courses prior to the senior year of high school. The students also all took part in the same pre-senior year math track, involving Algebra I, Geometry, and Algebra II. This allows for a much more accurate analysis of the effect (or lack thereof) of taking a math course during the senior year of high school as it relates to post-secondary retention in the North Dakota University System.

		Senior Math Students	
		NDUS Retention	Not Retained
Matched Non-Senior Math Students	NDUS Retention	99	17
	Not Retained	31	6

Table 7: Matched Retention Results on Senior Math Status

Of the matched pairs of students, 85.0% of the students who took part in either Pre-Calculus or Probability and Statistics in their senior year and enrolled in NDUS were retained to their second year of community college. 75.8% of the students who did not take a math course their senior year and enrolled in NDUS were retained to their second year of community college. However, the 95% confidence interval for this difference indicates that taking a math course in the senior year resulted in between a 0.4 and 17.9 percentage point increase in student retention rates among academically similar NDUS Community College enrollees. So, while there is a difference in retention rates, the difference may not be as large as it appears, due primarily to the smaller sample size of students under consideration.

To more broadly study the question, the analysis was opened to all students enrolling in NDUS, not simply the Community Colleges. Along with this, students taking *any* math class in their senior year were allowed to be considered for matching. Similar to the question before, all students took Algebra I during their freshman year of high school, followed by Geometry and Algebra II. 2,505 students were under consideration, 1,726 who did take some math course during their senior year of high school, and 779 who did not. 729 matched pairs of students were created between the two groups. Table 8 below summarizes the group information, both before and after matching.

	Before Matching		After Matching	
Senior Math Course?	ACT Comp.	Math GPA	ACT Comp.	Math GPA
Took Senior Math	21.6	2.97	20.4	2.44
No Senior Math	19.9	2.40	20.0	2.45

Table 8: Group summaries

		Senior Math Students	
		NDUS Retention	Not Retained
Matched Non-Senior Math Students	NDUS Retention	404	96
	Not Retained	176	53

Table 9: Matched Retention Results on Senior Math Status

Of the matched pairs of students across all NDUS institutions, 79.6% of those students who took some form of senior math course were retained, whereas 68.6% of students who did not take a senior math class were retained. The 95% confidence interval for this effect indicates it is likely that students taking a senior math course after taking Algebra I, Geometry, and Algebra II would be 6.8 to 15.8 percentage points more likely to be retained when compared with academically similar students who did not take a senior math class after taking Algebra I, Geometry, and Algebra II.

Does this definitively indicate that taking a senior math class increases a student's likelihood to successfully complete their first year of college, return for their second year, and ultimately graduate? It is possible, but it cannot be said with any degree of certainty. While this study compared students with similar academic ability (as measured by ACT and Math GPA) and the same course tracks leading into their senior years, the major factor that this study cannot control for is a student's drive and ambition. This has the potential to be a contributing factor to leading them to choose to take a math course during their senior year. This drive may also be what leads them to be more successful in college, while the act of taking a senior math course simply occurs as a result of this drive. That being said, the possibility does exist that the act of taking a senior math course may, to some degree, help prepare students for college more than not taking a math course, thus leading to an increased retention rate.