Institutional Effectiveness
2024-2025

Program: Mathematics BS
College and Department: College of Arts & Sciences, Mathematics
Contact: Michael Allen
Mission:
In alignment with Tennessee Tech's Vision and Mission statements, the Department of Mathematics will foster students' tenacity and analytical abilities through the offering of a wide variety of math courses, innovative teaching and research, and service, both public and institutional. As a central part of a STEM-infused comprehensive institution, the Department of Mathematics will create successful learners of mathematics in the university community and in the region. Learning opportunities will be provided to students of all disciplines to advance their understanding of mathematical concepts through effective use of analytical practices and critical thinking. More specifically, the Department will provide its majors with a thorough foundation in mathematics and the flexibility to prepare for a variety of careers through the opportunity to study multiple areas of mathematics.

Attach Curriculum Map (Educational Programs Only):
The attached table is a curriculum map showing how the required mathematics courses relate to learning goals for mathematics majors. The mathematics majors take at least 3 additional courses that reinforce these goals.
Attached File: See Appendix 1

Program Goal 1: Ideal Number of Majors

Define Outcome:
The Mathematics program will grow and continue to recruit and retain an "optimal" number of students who major in Math. To be more precise, the average number of math majors in universities across the country has been 1% of the total enrollment of the institution. The Department would like to be at or above this average.

Assessment Methods:
The Department will track the number of Math majors admitted and the number of Math graduates per year as given by Admissions and the Graduation office.

Criteria for Success (Thresholds for Assessment Methods):
The Math Department Undergraduate degree program will average at least 12 graduates per year with a fall-to-spring retention rate of 95% or greater and a fall-to-fall retention rate of 85% or greater. These thresholds are based on past records with an average of 10 or less graduates per year, an average fall-to-spring retention rate of 93% and an average fall-to-fall retention rate of 83% for the last three years. In the years previous to the last three the Department was at these thresholds.

Link to 'Tech Tomorrow' Strategic Plan:
2.A Technology Infused Programs,2.B Research, Scholar, Intellect, and Creativity,4.C Network of Scholars

Results and Analysis:
The table below shows the number of math majors and graduates per semester. The values in parentheses are the number of double majors who have math as their second major. Last year 6 students graduated from the Department with math chosen as their first major. This year there were 8 graduates from the program. Based on the enrollment patterns, the Department should see an increase in the number of graduates.

Number of TTU BS in Mathematics Graduates

Year	Math Majors - Men	Math Majors - Women	Math Majors - Total	Graduates - Men	Graduates - Women	Graduates - Total
Spring 2021	15(2)	7(0)	22(2)	6	3	9
Fall 2021	17(2)	4(0)	21(2)	4	1	6
Spring 2022	15(2)	3(0)	18(2)	1	0	0
Fall 2022	16(2)	8(0)	24(2)	0	0	0
Spring 2023	18(1)	12(0)	30(1)	3	3	6
Fall 2023	24(5)	8(5)	32(10)	3	0	3
Spring 2024	25(1)	8(3)	33(4)	3	0	3
Fall 2024	24(7)	12(8)	36(15)	2	2	4
Spring 2025	22(9)	11(5)	33(14)	4	0	4

Use of Results to Improve Outcomes:

Recruitment and retention are top priority with the Math Department. With the introduction of the new concentrations, the Math Department has seen a modest but significant increase in the number of majors. When faculty attend recruiting events these concentrations and the jobs the students could obtain are the main topics of discussion. The Math Department has looked at other universities, like Appalachian State and Kennesaw State, and seen the benefit of creating concentrations like these. Although the number of graduates from the Math Department has been low recently, the expectation is an increase through continued University and Departmental recruiting efforts.

Program Goal 2: Ideal Number of Minors

Define Outcome:
The Mathematics program will continue to recruit and retain an "optimal" number of students who minor in Math. Just like in program goal 1, this optimal number can be subjective. Hence, based on past data, the Math Department would like to see a growth of the number of Math minors to be at least 3% of the enrollment of the institution.

Assessment Methods:
The Department will track the number of undergraduates who pursue a minor in Mathematics per semester. This data will be collected from Banner and/or Tech Connect.

Criteria for Success (Thresholds for Assessment Methods):
The Department will strive to have at least 2% of the enrollment at Tech to minor in Mathematics with the hope of increasing it to 3% in the coming years.

Link to 'Tech Tomorrow' Strategic Plan:
2.A Technology Infused Programs,2.B Research, Scholar, Intellect, and Creativity,2.C Adult Learners,4.C Network of Scholars

Results and Analysis:
Here is a table of the numbers of Math minors for the last five semesters and their percentage of total enrollment.

Semester	Number	Total Enrollment	%
Fall 2021	303	8394	3.6%
Spring 2022	319	7762	4.1%
Fall 2022	291	8537	3.4%
Spring 2023	285	7584	3.75%
Fall 2023	180	8838	2%

Spring 2024	180	7878	2.2%
Fall 2024	209	9187	2.3%
Spring 2025	209	8334	2.5%

Use of Results to Improve Outcomes:

From Fall 2023 to Fall 2024 and from Spring 2024 to Spring 2025 there was a slight increase in the percentage of students obtaining a math minor. The goal for the Department is 3%, so this small increase is promising. The Department will continue reminding students about our minor.

Program Goal 3: Use of Technology to Enhance Teaching in Math Classes

Define Outcome:
The Departmental Faculty will increase the use of technology in mathematics classes to illustrate concepts and to apply taught algorithms.

Assessment Methods:
The percent of faculty using said technology will be tracked. A survey will be sent early in the spring semester in order to determine this percentage and on what technology. Of course, a target of 100% of the faculty using technology in every class would be a lofty goal, having 100% of the faculty using some type of technology in at least one course is obtainable.

Criteria for Success (Thresholds for Assessment Methods):
The Department will strive for having 100% of the faculty using some type of technology in at least one course.

Link to 'Tech Tomorrow' Strategic Plan:
2.A Technology Infused Programs

Results and Analysis:
After taking a survey of the faculty to learn of the computer applications they use to teach, the following list was created.

MS WORD - to write on screen

MS EXCEL - for calculations and graphs

MS PowerPoint - for presenting

MS OneNote - for presenting

MS TEAMS - for presenting and recording lectures

ZOOM - for presenting and recording lectures

YUJA - for recording lectures

Adobe Acrobat - for PDF editing

PDF Annotator - for presenting

Xournal++ - for presenting

Geogebra - for calculations, curve sketching, and graphs

LaTex - to create course note

Overleaf - to create course notes

Python - for coding and computations

MATLAB - for coding and computations

R and R Studio - for coding and computations

SAS - for coding and computations

Mathematica - for coding and computations

Magma - for coding and computations

Maxima - for coding and computations

Octave - for coding and computations

GitHub - for collaborative coding

Poll Everywhere - for polling, formative assessments, attendance, etc.

Use of Results to Improve Outcomes:
There were more applications and websites to list but the list above is more than sufficient. The faculty in the Department of Mathematics uses, daily, multiple computer applications and websites in their teaching. This program goal has been met.

Program Goal 4: Outreach and Recruitment

Define Outcome:
The Math faculty and the Department will be more involved in outreach and recruitment of new Math majors.

Assessment Methods:
The Department will track the number of outreach and recruiting events attended and the number of students engaged in conversation.

Criteria for Success (Thresholds for Assessment Methods):
The Department will have a goal of at least two recruiting events per year and at least 25% of the faculty participating in some sort of outreach. As for the number of students engaged in conversation, a conservative goal of engaging at least 100 students per year is set for now.

Link to 'Tech Tomorrow' Strategic Plan:
1.D High Impact Practices,4.C Network of Scholars

Results and Analysis:
Either the chair and/or multiple faculty attended the following recruiting events this past year: Fall Preview Day (5 faculty members), Tech to You (chair and one faculty member), Race to Tech (chair and one faculty member), and Spring Showcase (chair and three faculty members). Over 30 different students from all the events met with the Math Department and considered majoring in one of our concentrations.

For outreach, the Math Club met monthly throughout the year and sponsored our annual Integration Bee in April. Also, the Department hosted the Tennessee Math Teachers Association high and middle school math contest. This year nine scholarships were awarded to the top three in calculus, pre-calculus, and statistics with the caveat they become math majors at Tech. The Department also has an active Instagram account which is posted to weekly and publishes a monthly newsletter which is sent to all faculty, staff, students, and alumni. Scholarships were also offered to winners of the regional science fair in mathematics. Again, the caveat was the recipient must attend Tech as a math major. One final note, six faculty worked for the College of Engineering last August to prep students wishing to take the Accuplacer exam to try to get into the next higher class.

Individual faculty have also offered tutoring to students taking the HESI and PRAXIS exams, work at Windows on the World, graduate school showcase, fourth grade enrichment program,

moderated for the WCTE High School Academic Bowl, judged at the regional science fair, acted as data analyst for the Cookeville High School Track and Field team, and monitored the Putnam exam.

Use of Results to Improve Outcomes:

As can be seen, the Math Department is recruiting heavily and is highly involved in the community. It can reasonably be said this program goal has been reached but it will be continued one more year.

Student Learning Outcome 1: Mathematics Graduate Knowledge of Discipline

Define Outcome:
Students graduating in mathematics will demonstrate a general understanding of pure and applied mathematics.

Assessment Methods:
The Department will track the scores by our Math majors on the ETS Major Field Test in Mathematics given each semester to graduating seniors. A report will be obtained from ETS after the results are in from across the country. Another assessment that could be used here is the score a graduate makes on the Graduate Records Exam. Since the GRE is only taken by graduates wishing to go to graduate school, using the GRE as an assessment would be quite limited.

Criteria for Success (Thresholds for Assessment Methods):
Students graduating in mathematics will demonstrate an understanding of mathematics by having at least 50% of graduates score at or above the 75th percentile on the ETS Major Field Test in Mathematics.

Link to 'Tech Tomorrow' Strategic Plan:
1.D High Impact Practices,2.B Research, Scholar, Intellect, and Creativity,2.C Adult Learners,4.C Network of Scholars

Results and Analysis:
Of the six students who took the ETS Major Field Test in Mathematics in 2022-23, their percentiles scores were 87th, 79th, 71st, 53rd, 53rd, and 24th. The learning outcome goal of having at least 50% of our students score at the 75th percentile or higher was not met again this year.

The table below displays the average scores of TTU students who took the Major Field Test in Mathematics in recent academic years.

	National Average	**Number of TTU Math Students Taking the Test**	**TTU Average**	**Percentile of TTU Average**	**Number of students at 75th percentile or above**
2019-2020	157.4	9	177	84th	6
2020-2021	157.5	7	158.6	56th	3
2021-2022	157.5	6	163	68th	2
2022-2023	157.5	6	162	58th	2
2023-2024	157	5	172.8	83rd	2
2024-2025	157	9	164	61st	2

Use of Results to Improve Outcomes:

Two of the 9 scored above the 75th percentile, which does not meet the goal for the Department. But there were two other students who scored at the 53rd percentile, so the results have improved slightly. This outcome and the results of the ETS test will be shared with the faculty. After looking more closely at the content of the test, it is obvious our curriculum is not covering some of the material. This will be addressed.

Student Learning Outcome 2: Reduction of the DFW rates in Math 1710 and Math 1910

Define Outcome:

Math 1710 and Math 1910 are taken by almost 60% of new freshmen every fall and almost 40% in the spring. Unfortunately, the Department experiences an average DFW rate of 40% to 50% in these freshman-level courses. Although not an outcome for the Math Departments undergraduate program, acting also as a service department, such DFW rates need to be addressed and corrected if possible.

Assessment Methods:

The Department will track the DFW rate of students placed into our general education and service Math courses and, more specifically, Math 1710 and Math 1910.

Criteria for Success (Thresholds for Assessment Methods):

The Department will work towards a goal of an average DFW rate below 40% for the first year, and then below 30% thereafter for Math 1710 and Math 1910. The Department will also monitor the DFW rates for all other general education and freshmen level service courses which already have an average DFW rate of 30%.

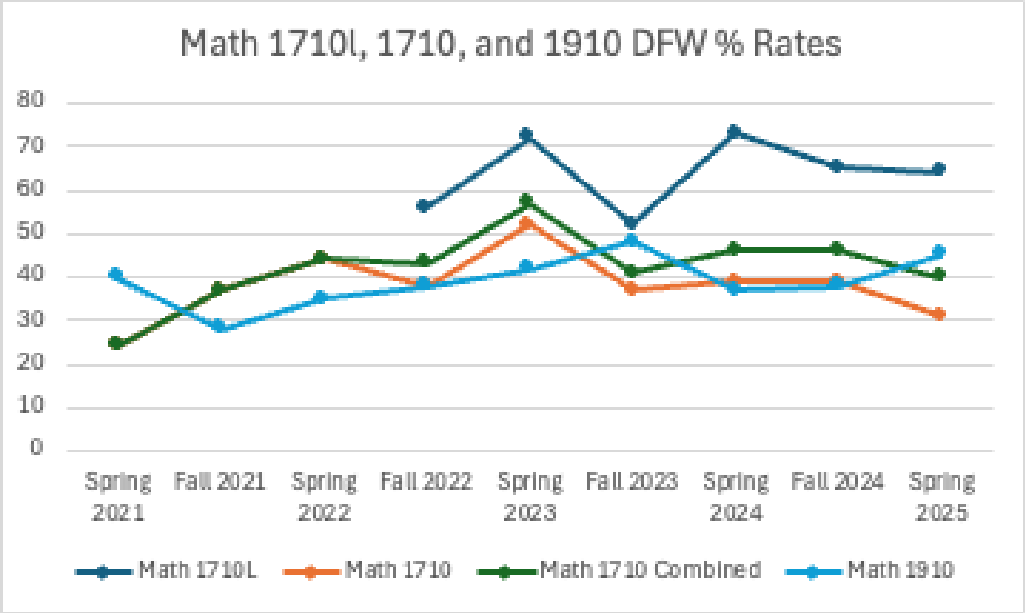
Link to 'Tech Tomorrow' Strategic Plan:

1.B General Education Curriculum,1.D High Impact Practices,3.A Efficiency and Effectiveness

Results and Analysis:

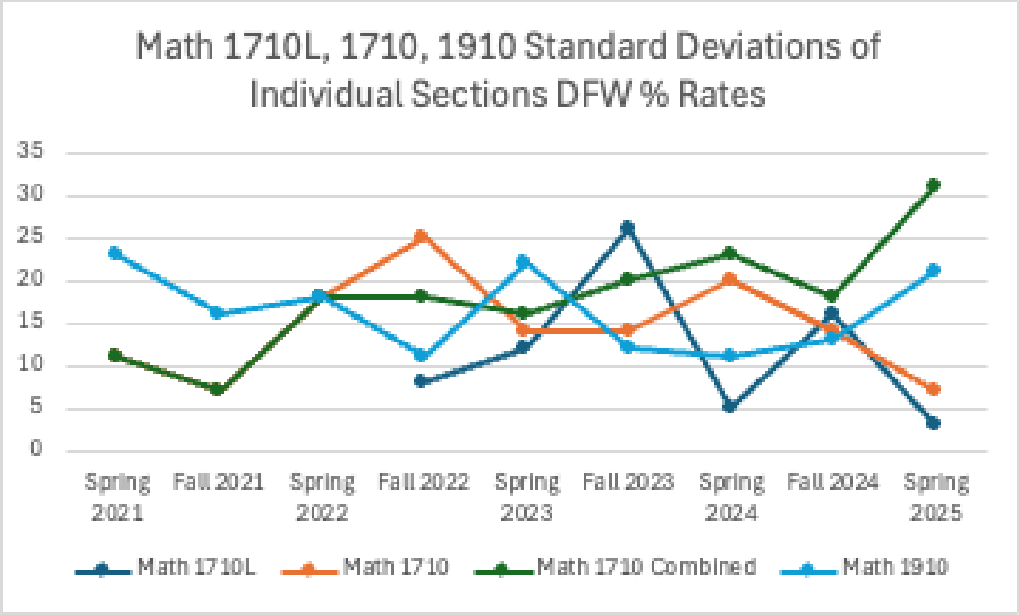
The table from last year has been simplified to only consider Math 1710 and Math 1910. Math 1710 (Math ACT >= 19) and Math 1710L (Math ACT < 19) are listed separately. L sections of courses have extra meeting times to hopefully assist students. The DFW rates those courses are listed below and likewise plotted.

Course\Semester	Sp2021	F2021	Sp2022	F2022	Sp2023	F2023	Sp2024	F2024	Sp2025
Math 1710L				56%	72%	52%	73%	65%	64%
Math 1710	24%	37%	44%	38%	52%	37%	39%	39%	31%
Math 1710 Combined	24%	37%	44%	43%	57%	41%	46%	46%	40%
Math 1910	40%	28%	35%	38%	42%	48%	37%	38%	45%



In combination with the DFW rates the variability of DWF rates between sections is presented. The following is a table of the standard deviations, in percentages, for the given courses. A standard deviation below 10% indicates similarities between individual sections' DFW rates and is desired. Below 5% indicates a strong similarity between sections' DFW rates.

Course\Semester	Sp2021	F2021	Sp2022	F2022	Sp2023	F2023	Sp2024	F2024	Sp2025
Math 1710L				8%	12%	26%	5%	16%	3%
Math 1710	11%	7%	18%	25%	14%	14%	20%	14%	7%
Math 1710 Combined	11%	7%	18%	18%	16%	20%	23%	18%	31%
Math 1910	23%	16%	18%	11%	22%	12%	11%	13%	21%



Use of Results to Improve Outcomes:

As can be seen from the results, there has been too much variability between individual section DFW rates. Likewise, course DFW rates vary from semester to semester. A common final was implemented in Math 1710 one year ago. In spring 2025 Math 1910 also started using a common final exam. Using a Six Sigma approach, the Department will reduce the variability between individual sections and will then look at how to reduce the high DFW rates in each course. It is hoped the reduction of the variability of the DFW rates between sections should reduce the overall DFW rates.

Summative Evaluation:

For the first program goal on the ideal number of majors, the goal and assessment methods will not change. Although the results show a modest increase in the number of majors, the Department will make recruiting and retention its top priority by evaluating other universities programs and methods.

As for the second program goal on having an ideal number of minors, there are no plans to change this goal nor its assessment methods. The Department will continue to recruit minors through reminders and its website.

The third program goal on the use of technology in the classroom has been successful and the need for it has diminished. A note about ending it is briefly discussed below.

The fourth program goal on outreach and recruitment has also been successful but it is apparent overlaps with the first two program goals. A note about its removal is presented below.

With regards to the first student learning outcome on math graduates' knowledge of the discipline, the numbers are not where the Department would like them to be. Though no assessment plan changes will be made, the results will be shared with the faculty and curriculum adjustments may be made.

For the second student learning outcome on the DFW rates in Math 1710 and 1910, the outcome and assessment methods will not change but the results will be shared and acted upon. The variability needs to be reduced.

Assessment Plan Changes:

The third program goal on the use of technology in the classroom has been met and will not be continued. It is apparent the use of technology for teaching has saturated the classroom.

Because the fourth program goal on outreach and recruitment overlaps with the first two program goals, the plan is to incorporate it into the first program goal since recruiting is a major part of the assessment process for bringing in new majors. It will be continued one more year.

List of Appendices:

Appendix 1: Curriculum Map

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Provide Students with Conceptual Understanding and Computational, Reasoning and Communication Skills to Begin a Career or Pursue Graduate Education.												
	Required Courses											
	1910	**1920**	**2010**	**2110**	**2120**	**3400**	**3430, 4310, or 4410**	**3810**	**4010**	**4110**	**4470**	**4530**
I. Conceptual Foundation												
a) Students will understand conceptual foundations of calculus, differential equations, and matrix algebra	X	X	X	X	X							
b) Students will understand major concepts in geometry, probability & statistics, abstract algebra, linear algebra, and real & complex analysis							X	X	X	X	X	X
II. Computational Skill												
a) Students will demonstrate algebraic, computational, & algorithmic skills to determine solutions to mathematical problems and interpret the results	X	X	X	X	X			X			X	X
b) Students will utilize technology to solve problems and interpret results												
III. Reasoning & Communication Skills												
a) Students will write sound mathematical proofs						X	X		X	X		X

b) Students will explain orally or in writing the methodology used to solve math or statistical problems	X	X	X	X	X	X	X		X	X	X	X