

**Institutional Effectiveness
2022-2023**

Program: Mathematics BS

College and Department: College of Arts & Sciences, Department of 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):

Attached Files: 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.

Assessment Methods:

The Department will track the number of Math majors admitted and the number of Math graduates per year.

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 90% or greater and a fall-to-fall retention rate of 81% or greater.

Results and Analysis:

The table below shows the number of math graduates per semester. The BS in Mathematics program did not meet this goal because only 5 students graduated from the program in the 2022-2023 academic year, but the number of math majors has increased. It is believed it is because of the new concentrations. The five-year moving average is 9.4.

Number of TTU BS in Mathematics Graduates

Year	Math Majors - Men	Math Majors - Women	Math Majors - Total	Graduates - Men	Graduates - Women	Graduates - Total
Fall 2018	18	9	27	0	3	3
Spring 2019	20	5	25	7	2	9
Fall 2019	25	10	35	2	2	4
Spring 2020	21	8	29	8	2	10
Fall 2020	20	8	28	0	0	0
Spring 2021	17	7	24	6	3	9
Fall 2021	19	4	23	4	1	6
Spring 2022	17	3	20	1	0	0
Fall 2022	18	8	26	0	0	0
Spring 2023	19	11	30	3	3	6

Use of Results to Improve Outcomes:

Enrollment is growing and it is hoped we can achieve this goal in the next five years.

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.

Assessment Methods:

The Department will track the number of undergraduates who pursuit a minor in Mathematics per semester.

Criteria for Success (Thresholds for Assessment Methods):

The Department will strive to have more than 100 minors in Mathematics per semester.

Results and Analysis:

Here is a table of the numbers of Math minors for the last five semesters.

Semester	Number
Fall 2021	303
Spring 2022	319
Fall 2022	291
Spring 2023	285

Use of Results to Improve Outcomes:

Although the Department has a good number of minors, there is a definite downward trend to the data. It is perceived that the recent state audit regarding programs of study and financial aid has and will continue to affect the number of Math minors. The Math Department will continue, though, to offer and encourage students to minor in Mathematics.

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 percentage of faculty using said technology will be tracked.

Criteria for Success (Thresholds for Assessment Methods):

The Department will strive for 100%.

Results and Analysis:

Most of the faculty in the Math Department use a large assortment of computer applications. Here is the latest list.

Maple, MatLab, R, EXCEL, SAS, Python, Anaconda, Tensor Flow, Keras, PyTorch, Wolfram Alpha, Geogebra, Desmos, Maxima, Octave, Mathematica, TI-Connect and CODAP

That is a total of 18 different software packages being introduced and taught to our students in our Math classes.

Use of Results to Improve Outcomes:

Based on this year's survey, it is apparent the Math Department faculty continue to stay relevant with the use of technology both in the classroom and in their research. The Department will continue to monitor the number of uses of technology by the faculty but believe this goal will probably be removed in the near future because of it being constantly met.

PROGRAM GOAL 4: PROPER PLACEMENT OF INCOMING STUDENTS

Define Outcome:

The Department will continue to search for and implement a math placement algorithm that maximizes students' success.

Assessment Methods:

The Department will track the DFW rate of students placed into our general education and service Math courses.

Criteria for Success (Thresholds for Assessment Methods):

The Department will work towards a goal of an average DFW rate below 40%.

Results and Analysis:

Last Fall the Math Department worked with the College of Engineering on their RAMP (Reinforce Advanced Math Placement) program. Simply put, faculty from the Department prepped incoming freshmen for Math 1710, 1720, 1730, and 1910. After a week of classroom time, the students took the ACCUPLACER to see what courses they are ready for.

Of the 83 students, 13 dropped down a class after going through the program, 26 stayed at the same level, and 43 took a class higher than what they were first advised to take before the program.

Of the 13, 6 got a D, F, or W.

Of the 26, 15 got a D, F, or W.

Of the 43, 21 got a D, F, or W.

Overall, of the total 83, 42 got a D, F, or W.

In summary, the ACCUPLACER appears to have a coefficient of determination of around 50%.

Use of Results to Improve Outcomes:

The Department continues to work with the College of Engineering to find a proper placement algorithm. Next year the Department will also have a secondary assessment tool to present the results from. Hopefully, an assessment tool or tools can be found which predict future success in Calculus at better than 50%.

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 on the ETS Major Field Test in Mathematics.

Criteria for Success (Thresholds for Assessment Methods):

Students graduating in mathematics will demonstrate an understanding of mathematics by having 50% of graduates score at or above the 75th percentile on the ETS Major Field Test in Mathematics.

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
2018-19	156.2	12	172.8	83 rd	6
2019-20	157.4	9	177	84 th	6
2020-21	157.5	7	158.6	56 th	3
2021-2022	157.5	6	163	68 th	2
2022-2023	157.5	6	162	58 th	2

Use of Results to Improve Outcomes:

Since 2020 there has been an obvious change in the level of knowledge demonstrated by our students. Regardless of any reasons why this has occurred, these results will be shared with the faculty to discuss means of improvement.

STUDENT LEARNING OUTCOME 2: MATHEMATICAL LITERACY FOR ALL STUDENTS

Define Outcome:

All students in math classes at the University will be "mathematically literate" and able to apply their knowledge from the mathematics courses taken.

Assessment Methods:

The percentage of students who answer correctly common general math education questions posed to them on their final exams.

Criteria for Success (Thresholds for Assessment Methods):

The Department will strive for a better than 65% pass rate on the common questions.

Results and Analysis:

Data from the 2019, 2020 and 2021 National Study of Student Engagement (NSSE) comparing the TTU average to the averages of all Tennessee public universities and our Carnegie peers on a question related to the learning outcome is shown in the table below. Unfortunately, this is the most recent data and hence is simply a repeat from the previous IE report. Freshman and senior students were asked to what extent their experience at college had contributed to their ability to analyze quantitative data.

TTU Student Response Averages on NSSE Questions Related to Ability to handle Quantitative Data

	2019 TTU	2019 Carnegie	2020 TTU	2020 Carnegie	2021 TTU	2021 Carnegie
Freshmen	3.1	2.9	2.1	2.2	2.4	2.4
Seniors	3.3	3.2	2.3	2.2	4.0	2.5

Scale: 1= Very Little; 2= Some; 3= Quite a Bit; 4= Very Much

The Praxis II Mathematics Subject Assessment (2019-2020 and 2020-2021) and the NES Content Knowledge Test (2021-2022 and 2022-2023) data for TTU math education graduates is shown in the table below.

Pass Rate of TTU Students on Praxis II and NES Math Content Knowledge

Academic Year	2019-2020	2020-2021	2021-2022	2022-2023
Number of Test Takers	10	10	24	11
First Attempt Pass Rate	4/10 or 40%	2/10 or 20%		0/11 or 0%

Final Pass Rate for Licensure	4/10 or 40%	9/13 or 69%	10/24 or 42%	3/11 or 27%
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In addition, the success rate of students in two general education classes was recorded. The three questions were given to students in Math 1530 and another set of three questions to those in Math 1910. In 1530, the success rate of n=339 students was 69%. For Math 1910, the success rate of n=110 students was 47%.

Use of Results to Improve Outcomes:

In Math 1530, the success rate is pretty good but could be improved. For Math 1910, there is work to be done. Finally, with regards to the math education majors, the Department has already started working with Curriculum and Instruction to help their students be more successful on the Math Content Knowledge Tests.

Summative Evaluation:

PO1: Enrollment is growing, and it is hoped we can achieve an average of 12 graduates in the next five years.

PO2: Although the Department has a good number of minors, there is a definite downward trend to the data. It is perceived that the recent state audit regarding programs of study and financial aid has and will continue to affect the number of Math minors. The Math Department will continue, though, to offer and encourage students to minor in Mathematics.

PO3: The Department will continue to monitor the number of uses of technology by the faculty but believe this goal will probably be removed in the near future because of it being constantly met.

PO4: The Department continues to work with the College of Engineering to find a proper placement algorithm. Next year the Department will also have a secondary assessment tool to present the results from. Hopefully, an assessment tool or tools can be found which predict future success in Calculus at better than 50%.

SLO1: Since 2020 there is an obvious change in the level of knowledge demonstrated by our students. Regardless of any reasons why this has occurred, these results will be shared with the faculty to discuss means of improvement.

SLO2: With regards to the math education majors, the Department has already started working with Curriculum and Instruction to help their students be more successful on the Math Content Knowledge Tests.

Assessment Plan Changes:

PO4: The Department continues to work with the College of Engineering to find a proper placement algorithm. Next year the Department will also have a secondary assessment tool to present the results from. Hopefully, an assessment tool or tools can be found which predict future success in Calculus at better than 50%.

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