Institutional Effectiveness
2023-2024

Program: Mathematics BS
College and Department: College of Arts and 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. 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 graduates per semester. The BS in Mathematics program did not meet this goal because only 5 students graduated from the program in the 2023-2024 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 for graduates is 8.2.

Number of TTU BS in Mathematics Graduates

Year	Math Majors - Men	Math Majors - Women	Math Majors - Total	Graduates - Men	Graduates - Women	Graduates - Total
Fall 2019	25	10	35	2	2	4
Spring 2020	21	8	29	8	2	10
Summer 2020	11	10	21	1	0	1
Fall 2020	20	8	28	0	0	0

Spring 2021	17	7	24	6	3	9
Summer 2021	16	5	21	0	0	0
Fall 2021	19	4	23	4	1	6
Spring 2022	17	3	20	1	0	0
Summer 2022	21	11	32	0	0	0
Fall 2022	18	8	26	0	0	0
Spring 2023	19	11	30	3	3	6
Summer 2023	19	10	29	1	0	1
Fall 2023	29	13	42	2	0	2
Spring 2024	26	11	37	3	0	3
Summer 2024	31	15	46	0	0	0

Use of Results to Improve Outcomes:

Although the five-year average for the number of graduates is down, the increase in the number of math majors this past year will definitely bring an increase in the number of graduates. Again, it is believed the new concentrations have been helpful. For this coming year, though, there are plans to attend more recruiting events.

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%

Use of Results to Improve Outcomes:

Last year there was a change in financial aid policy across the state in which no courses could be taken that are not part of a student's program of study. As a result, the number of students pursuing a minor, regardless of the major, has dropped across campus. Unfortunately, the Math Department was also affected as can be seen by the significant drop on the number of students pursuing a minor in mathematics. Hence, the goal of 3% in the coming years may not be obtainable but the Department will try to recruit.

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:

The Math faculty definitely use technology in the classroom. Here is this past year's list of computer applications used by them.

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

That is a total of 23 different math or scientific software packages being used in teaching in Math classes.

Use of Results to Improve Outcomes:

Based on this most recent survey of the Math faculty, it is quite apparent a majority of them are using technology both in the classroom and in their research. This survey only represents 21 of the 28 faculty in the Department, though. Therefore, this goal has not been met and further encouragement of the faculty in the use of technology in the classroom will be implemented.

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:
The Math Department has a Math Club, which met four times last year. Also, the Department annually hosts the Tennessee Math Teachers Association high school and middle school math contest. Unfortunately, though, this year's contest was canceled because of the strong possibility of severe weather. Next, six faculty attended Preview Day and the Spring Showcase. At Preview Day, the faculty met with over 25 potential math majors. The Department also has an active Instagram account which is posted to weekly. Next, every spring the Department hosts an Integration Bee where students come and solve integrals as fast as they can. Finally, the Department publishes a monthly newsletter which is sent to all faculty, staff, students, and alumni.

Use of Results to Improve Outcomes:
The Department is working hard to reach more potential students and stay in communication with current and former students. This academic year the Department does plan to attend as many recruiting events as possible. In fact, the Department was represented the CAS Student Success Center this year at the Upper Cumberland College Fair, held August 28th.

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 87rd, 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
2019-20	157.4	9	177	84th	6
2020-21	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

Use of Results to Improve Outcomes:

Although only two of the five graduates scored above the 75th percentile, one scored at the 73rd percentile which is pretty good. But this result will be shared with the faculty to keep the conversation going.

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.

For the common courses of Math 1530 Elementary Statistics and Math 1910 Calculus I, each semester faculty members teaching these courses will be asked to include common questions on their final exams, as chosen by the individual course committees. The average percentage in each course over all the sections will be reported.

Criteria for Success (Thresholds for Assessment Methods):
The Department will strive for a better than 65% pass rate on the common questions for each course. Currently, the pass rate for calculus I across the country is 35% with elementary statistics being just a little higher. A pass rate of 65% would be almost equivalent to moving a retention rate of 70% to 85%.

Link to 'Tech Tomorrow' Strategic Plan:
1.B General Education Curriculum

Results and Analysis:
Although data was collected on the common questions, it was apparent that this outcome is overshadowed by the new student outcome on DFW rates.

Use of Results to Improve Outcomes:
This outcome has been replaced the new student outcome on DFW rates.

Student Learning Outcome 3: 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 this freshmen 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

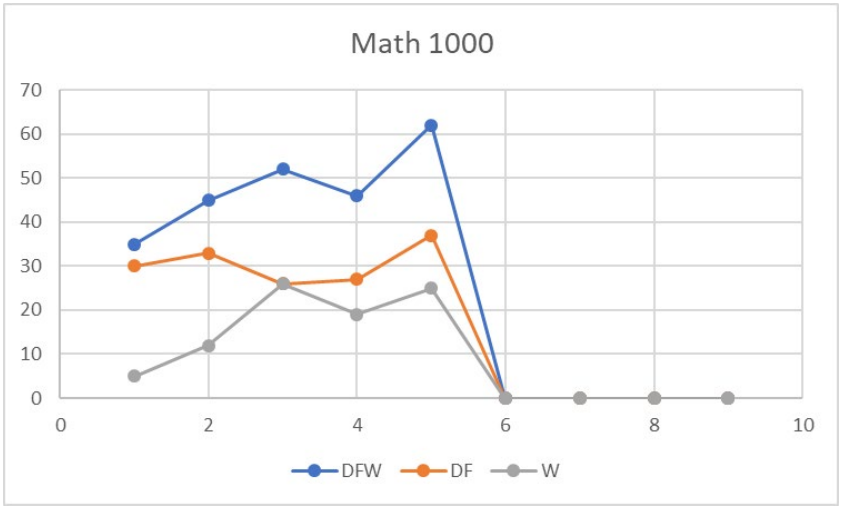
Results and Analysis:

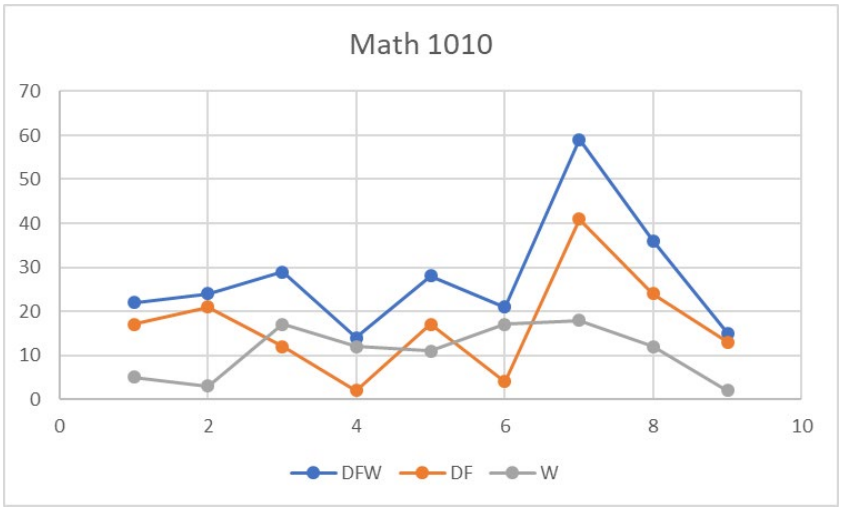
The following table has the DFW and DF rates and course enrollment for Math 1000, 1010, 1130, 1530, 1710, 1720, 1730, 1830, 1904, 1906, 1910, and 1920 per semester starting Spring 2020. The DFW and DF rates are percentages while the enrollments are not. Also, the W rate can be determined by taking the difference between the DFW and DF percentage rates. Note, Math 1000 and 1130 end Spring 2022. Math 1000 was created as a remedial course and was removed because of the new policy from THEC allowing only community colleges to teach remedial courses. Math 1130 was removed because the University was routinely giving Math 1710 credit for Math 1130. Also, the two courses were quite similar, so they were combined. Math 1904 and 1906 were created to be a one-year version of Math 1910 and started in Fall 2023. Finally, Math 1830 is now only required by one department in the College of Business, so the course is now offered only once per year.

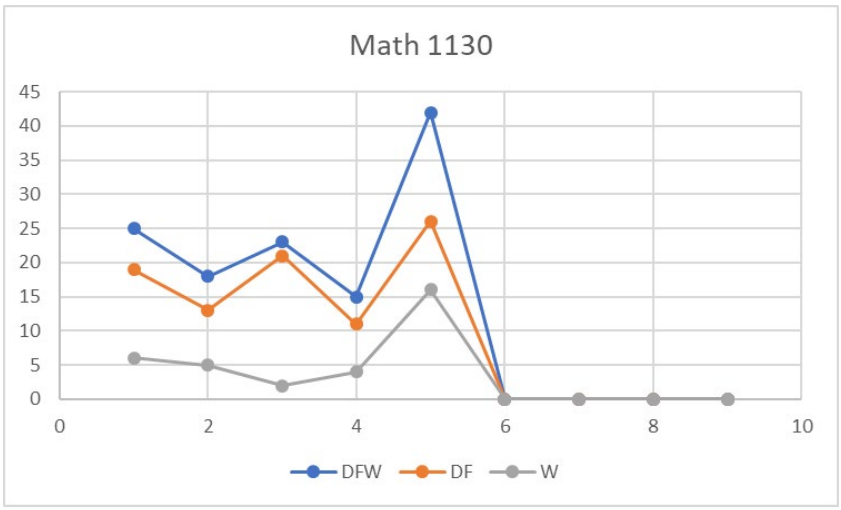
Course\Semester	Sp2020	F2020	Sp2021	F2021	Sp2022	F2022	Sp2023	F2023	Sp2024
Math 1000	35, 30, 54	45, 33, 201	52, 26, 50	46, 27, 245	62, 37, 65				

Math 1010	22, 17, 41	24, 21, 70	29, 12, 34	14, 2, 44	28, 17, 29	21, 4, 28	59, 41, 27	36, 24, 66	15, 13, 39
Math 1130	25, 19, 253	18, 13, 448	23, 21, 173	15, 11, 349	42, 26, 190				
Math 1530	20, 13, 172	37, 28, 237	33, 26, 199	28, 19, 457	31, 26, 328	22, 16, 496	23, 20, 458	24, 18, 659	21, 17, 370
Math 1710	31, 21, 107	30, 21, 174	24, 18, 71	37, 26, 161	44, 37, 117	43, 29, 760	57, 40, 286	41, 25, 720	46, 32, 298
Math 1720	27, 17, 133	32, 24, 190	34, 20, 80	39, 29, 177	36, 23, 149	40, 22, 250	27, 20, 161	43, 23, 244	52, 33, 147
Math 1730	27, 20, 30	47, 32, 62	33, 22, 18	36, 31, 85	50, 31, 16	48, 35, 85	61, 52, 23	67, 36, 66	21, 14, 14
Math 1830	18, 9, 158	33, 21, 118	45, 20, 159	43, 28, 74	33, 20, 30		25, 25, 4		31, 15, 13
Math 1904								45, 24, 51	70, 60, 10
Math 1906									12, 12, 26
Math 1910	23, 15, 281	39, 28, 418	40, 27, 191	28, 20, 397	35, 30, 227	38, 20, 440	42, 30, 300	48, 34, 452	37, 31, 294
Math 1920	28, 18, 277	52, 29, 229	37, 27, 251	39, 25, 216	35, 18, 312	44, 27, 194	39, 23, 272	39, 24, 204	25, 17, 257

To better see the DFW, DF, and W rates, here are graphs plotting said values for each course per semester.






Math 1130
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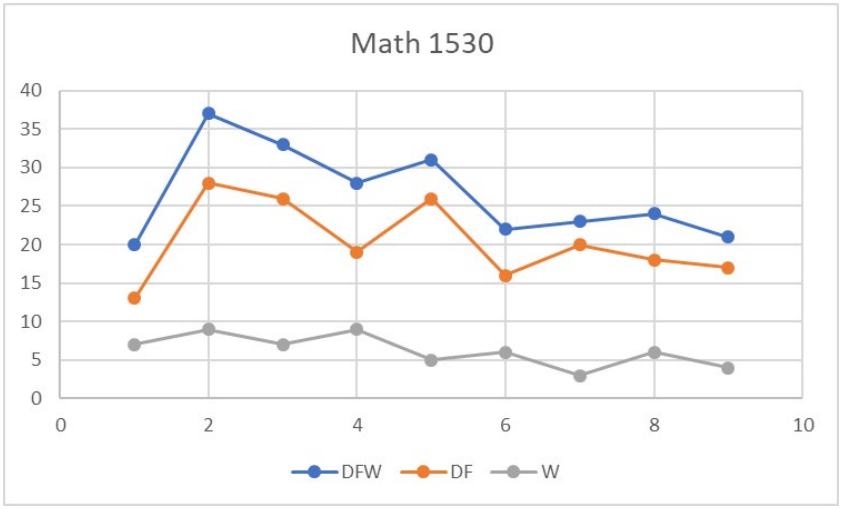
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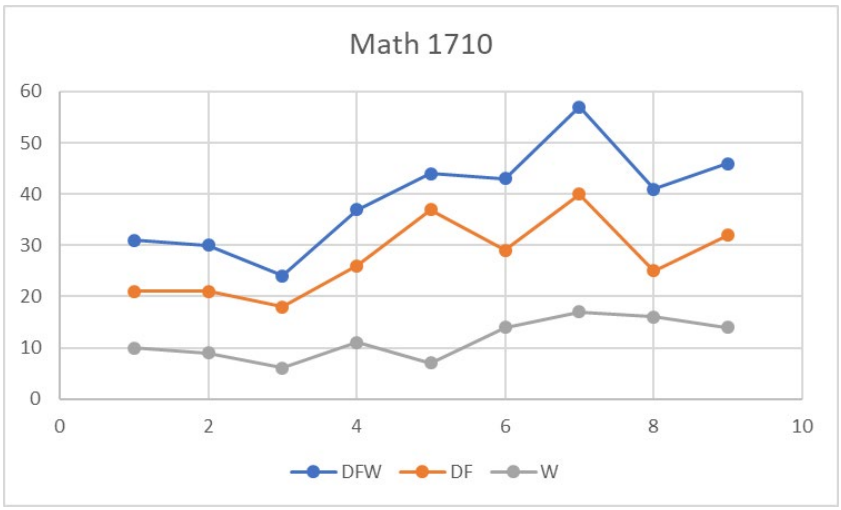
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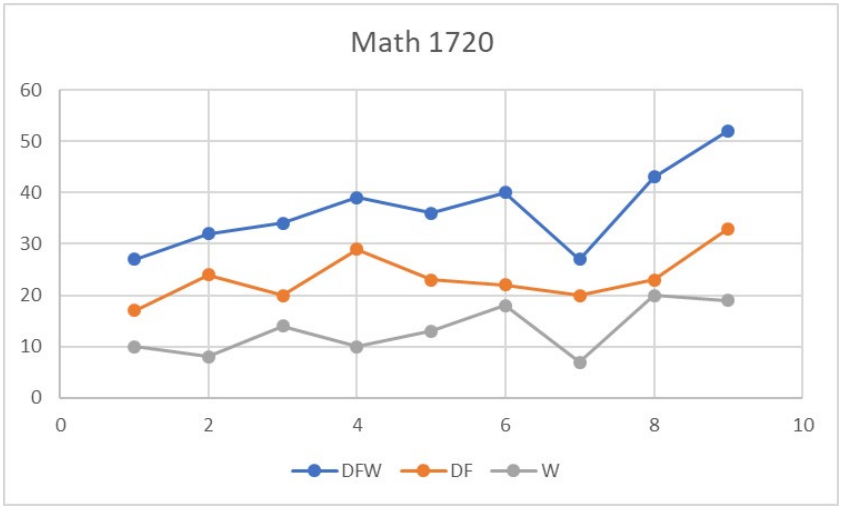
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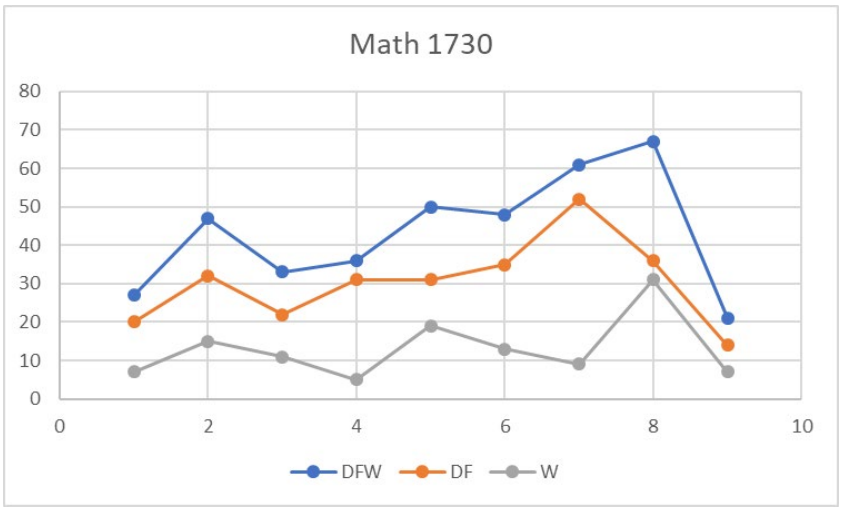
Math 1730
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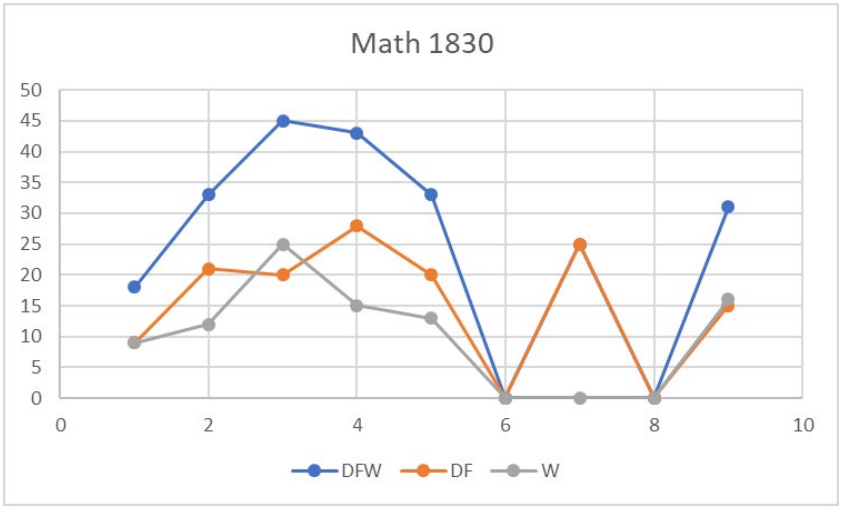
Math 1830
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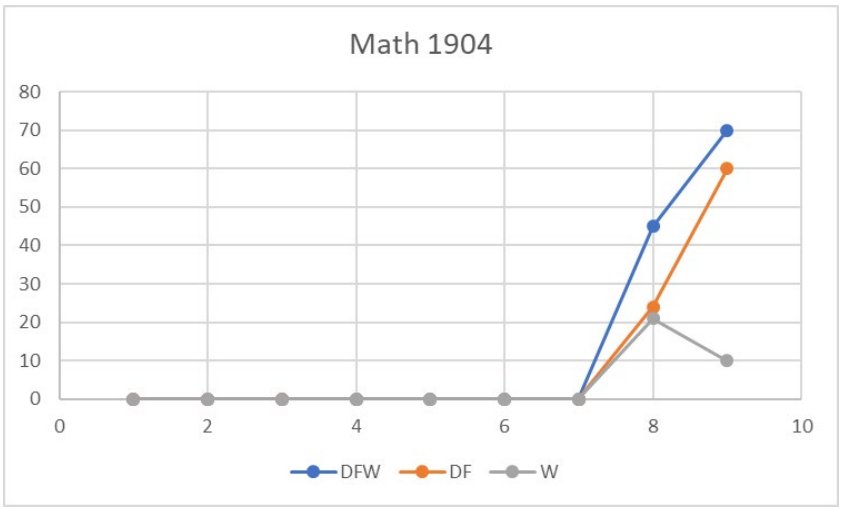
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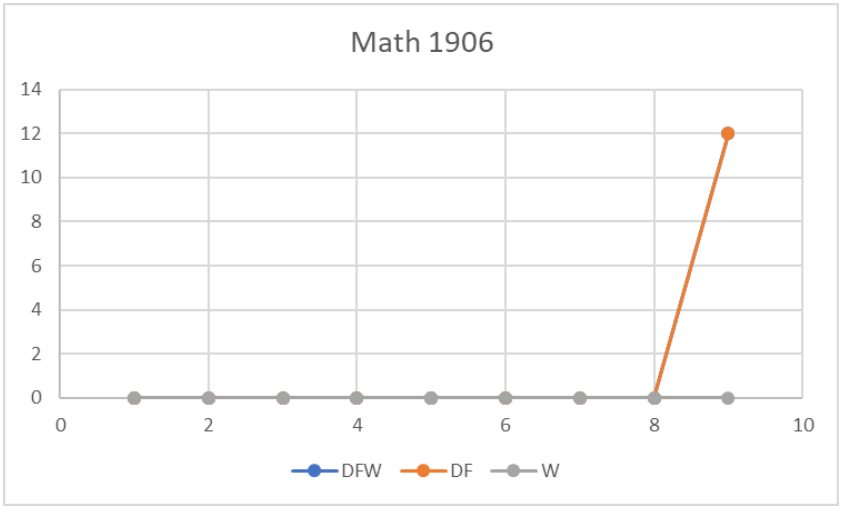
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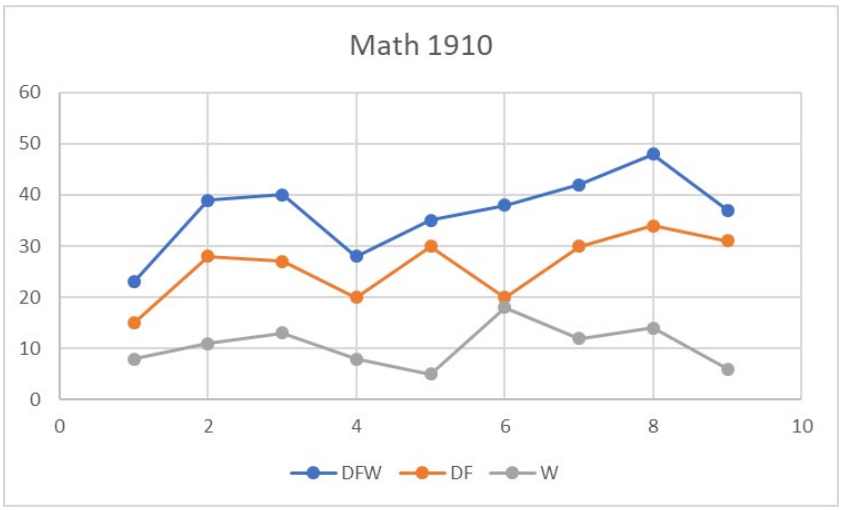

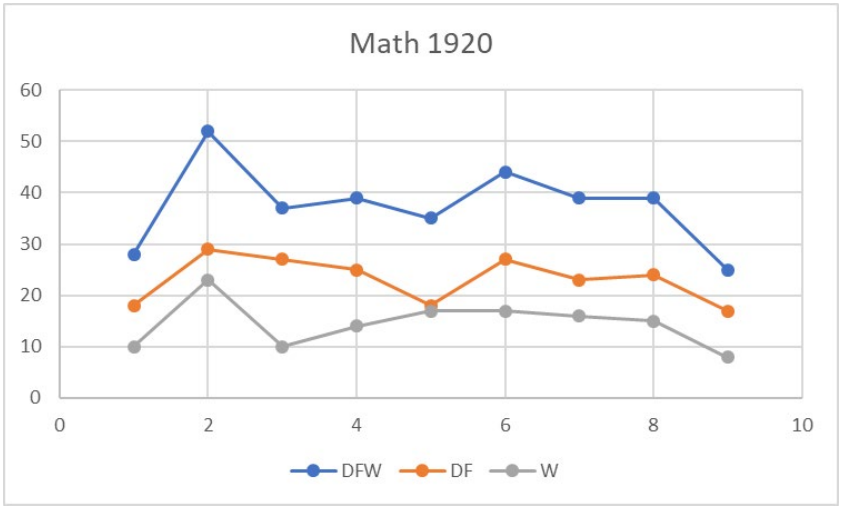

Use of Results to Improve Outcomes:

As can be seen in the graphs, the variability is much too high for every course except Math 1530. The Statistics group has made a concerted effort to have similar questions on their exams. The consequence of which can be seen with an almost steady DFW, DF and W rates starting in Fall 2022. The committees for the other multi-section courses will work more closely together on what material is being taught and how the students are assessed.

Summative Evaluation:

The Department needs to recruit math majors and it needs to align multi-section course to reduce DFW rates. The rest of the program goals and student learning outcomes are on track.

Assessment Plan Changes:

The Student Learning Outcome 2: Mathematical Literacy for all Students will be withdrawn from future reports and replaced with the Student Learning Outcome 3: Reduction of the DFW rates in Math 1710 and Math 1910.

List of Appendices:

Appendix 1: Curriculum Map

Appendix 1: Curriculum Map

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		