2017-2018 Program Review

IPFW Department of Mathematical Sciences

http://users.pfw.edu/coffmana/PR2017/2018ProgReviewMath.pdf

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2017-2018 Program Review **1-page Summary**

IPFW Department of Mathematical Sciences

- **The IPFW Department of Mathematical Sciences (DMS) has provided excellent education in mathematics and statistics at the undergraduate and graduate levels for over 50 years, with steady enrollments in BS and MS programs over the past 20 years.**

- **The BS programs are undergoing a significant reorganization:**
    - **A highlight is the recent launch of a new BS in Actuarial Science, with the strong support of the NE Indiana community.**
    - **The new BS in Data Science and Applied Statistics is planned for launch in Fall 2018, subject to adequate staffing levels.**
    - **The Mathematics Teaching program is being redeveloped after a campus-wide drop in secondary teaching program enrollments.**

- **The MS program is being reorganized with a more applied focus.**

- **The Math Assistance Learning Lab (MALL) is already reporting positive results in student success for calculus-and-above math classes.**

- **Fewer students are in the pre-college and pre-calculus sequences; enrollments are steady in general education courses MA 140 and STAT 125.**

- **There has been a significant increase in dual-credit enrollment off-campus, with a corresponding decrease in on-campus credits taught by LTLs. There are new rules from HLC on qualifications for LTLs and dual-credit teachers.**

- **The Department is maintaining its international reputation for research and is attracting competitive national research funding.**

- **The new Center for Applied Math and Statistics (CAMS) brings faculty expertise to the metropolitan area and generates revenue that is reinvested into the educational mission.**

- **To maintain the quality of instruction and research into and beyond the transition to PFW, there must be an adequate number of PhD qualified faculty to replace recent and planned retirements. To support the launch of new programs, new faculty lines are needed.**

0. Framework for Program Review

The IPFW Framework for Program Review (OAA Memo 16-3)[1] suggests general topics for reporting. This Report addresses all the topics, in the following way:

- *Program Context* and *Departmental Profile*
  Section 1 reports on the Department in general; Section 2 considers each degree program (undergraduate majors and minors, graduate programs) one at a time; Section 3 covers service and dual credit courses. Some Sections have Subsections on **Accreditation** and **Enrollment Trends**. Appendices C and D give supporting data and supplemental reporting.
- *Strategic Direction*
  For a large part of the time period covered by this review, Departmental goals and needs were reported, and received feedback, within the *University Strategic Alignment Process*. So, there are Subsections labeled **USAP** within each program's Section, which discuss DMS strategic goals and how this Process impacted the Department. Appendix A.1 has Departmental Annual Reports as part of USAP, and Appendix A.2 has documentation for USAP as it pertained to the College and University. Appendix E has further information on campus strategic planning. Annual Department Reports from before and after USAP (2013 and 2017) appear in Appendix D.
- *Student Learning*
  This topic, including lists of learning outcomes, is addressed in each program's Section in a Subsection labeled **Assessment**. Also, Section 4 describes a specific DMS initiative (the **MALL**). Appendix B contains the DMS Annual Assessment Reports, the DMS Assessment Plan, and data.
- *Faculty, Students and Alumni, and Other comments*
  Section 5, and supplemental reporting in Appendix D.
- *5 year improvement plan*
  Section 6 states some short-term plans and long-term goals and recommendations. Subsection 6.f. reports on progress already made in 2018 on the plans made in 2017.

Useful Acronyms:

- **BS** = Bachelor of Science**, MS**= Master of Science, **MAT** = Master of Arts in Teaching
- **CAMS** = Center for Applied Mathematics and Statistics
- **CASA** = Centers for Academic and Student Achievement
- **CL** = Continuing Lecturer, **LTL** = Limited Term Lecturer, **TT** = Tenure track
- **COAS** = College of Arts and Sciences, **CEPP** = College of Education and Public Policy
- **DMS** = Department of Mathematical Sciences
- **ETCS** = College of Engineering, Technology, and Computer Science
- **MA** = course code for mathematics classes, **STAT** = course code for statistics classes
- **MALL** = Math Assistance Learning Lab
- **TAP** = Transformational Allocation Program – 2014 funding for the MALL (Section 4)
- **UCAP** = Universities and Colleges with Actuarial Programs
- **USAP** = University Strategic Alignment Process
- **VCAA** = Vice Chancellor for Academic Affairs

[1] https://www.pfw.edu/offices/oaa/2016-about-academic-affairs/memoranda/16_3%20OAA_Memo_ProgramReviewApril2017.pdf

1. Department Overview and Program Context

a. History

The teaching of college-level and graduate-level mathematics in Fort Wayne predates the 1964 merger that formed IPFW. Purdue University at Fort Wayne was included in a Sputnik-era, NSF-funded program for teachers to earn Master's degrees. Since then, IPFW has continued to offer a Master of Science (MS) in mathematics and, during some intervals of history, a Master of Arts in Teaching (MAT). DMS has never offered a PhD degree, although some faculty have occasionally worked with and advised graduate students at other universities with doctoral programs.

As of Spring 2017, the DMS undergraduate programs included a BS in Mathematics and a BS in Mathematics Teaching. The degree requirements for the mathematics major allowed a student to pick an "option" to follow one of several curriculum tracks. This structure is being replaced by a new list of BS degrees, as described in detail in Section 2, although current students may continue to graduate under the old requirements during a teach-out period.

At the undergraduate level, DMS also offers a minor in mathematics and a research certificate. At the graduate level, there is a Certificate in Applied Statistics.

In the past, DMS also offered an Associate of Arts Degree (AA) in Mathematics but, following a campus-wide trend, the AA degree no longer appears in the Bulletin, and no such degrees were granted in 2014 or later.

In 1988, some DMS faculty left to form a separate Department of Computer Science, now in the College of ETCS. DMS continued to administer a BA in Computer Science, but this also no longer appears in the Bulletin and no such degrees have been awarded by DMS recently.

In May 2017, the Indiana Commission on Higher Education (ICHE) approved two new BS programs, after a proposal process initiated by DMS in 2015 (Section 2). The BS in Actuarial Science became available to students starting Fall 2017, and the BS in Data Science and Applied Statistics is scheduled for launch in Fall 2018, subject to adequate staffing levels as described in the program proposals (Appendix D.2, Documents 13,14.).

This Program Review report was prepared in Fall 2017 and early 2018. In Summer 2018, there were some editorial modifications based on feedback from the COAS Associate Dean, some web site address updates, and a new Subsection 6.f. with updates on progress already made on short-term plans.

b. Overview of Program Demand / Niche

DMS offers courses in mathematics (IPFW Bulletin code MA, course numbers of the form MA 123, or equivalently MA 12300) and statistics (code STAT).

i. **General Education.** The IPFW General Education requirements include 3 credits (at least) in a Quantitative Reasoning category. Students can satisfy this by completing one course from a list, which includes MA 153 (Algebra and Trigonometry), 159 (Precalculus), MA 101 (Mathematics for Elementary Teachers), MA 140 (Practical Quantitative Reasoning, formerly MA 168), and STAT 125 (Communicating with Statistics). The first-year calculus courses (MA 165, 166, 227, 229) also satisfy this Gen. Ed. requirement. A trend since our last Program Review in 2008 is that more IPFW students are taking MA 140 or STAT 125 as a terminal math course, while fewer are taking MA 153, which is part of a pre-calculus sequence (See Section 3).

ii. **Service Courses.** Many IPFW undergraduate programs have requirements for math or statistics beyond the general education list. In particular, many majors in ETCS or COAS science programs have five or more semesters of math requirements and electives. Graduate programs in other departments, especially ETCS, allow or require graduate students to take upper-level MA or STAT courses (see Chart 3.e.).

iii. **Community Needs.** Mathematics has been an integral part of higher education since Plato's Academy, and includes (at least) three of the seven Liberal Arts subjects in the classic Trivium + Quadrivium curriculum. The benefits of an education including mathematics, which make public (state) funding worthwhile, are many:

- Basic numeracy: handling money, time, maps, technology.
- Educated citizenship: understanding enough about data, graphs, probability, and quantitative language to participate in a democracy[2,3].
- Critical thinking: how conclusions follow from assumptions, valid vs. invalid arguments, problem solving, precision in language.
- Scientific method: mathematical modeling, making predictions based on theory, designing experiments, collecting data, analyzing data to support or refute hypotheses.
- Culture: appreciation of the role of mathematics in a high-tech civilization, including progress in science, engineering, communication, and art.

The region and state also have cultural and economic needs for university graduates with advanced mathematical education: in the scientific community, the public sector (teaching and government agencies), and the private sector (financial and industrial activity).

iv. **Math Majors.** Students pursuing a mathematical sciences major and earning a Bachelor of Science degree from Purdue University will gain knowledge and skills that will never become obsolete, habits of mind such as critical thinking and clear communication, and a distinguished academic credential, all of which will benefit them in any post-college career path. The student's "first job" after college is only part of such a path, and the mathematical sciences majors are not designed or intended solely as training for any particular industry. Graduates from the College of Arts and Sciences will find many opportunities for employment, and the number of jobs requiring high-level skills in mathematics and statistics has been growing and is expected to continue to grow[4]. For example, Northeast Indiana has a significant concentration of employers in the financial and insurance areas, and IPFW graduates have had success in landing internships and jobs at companies in the region[5] such as Lincoln Financial Group, Medical Protective, Brotherhood Mutual, and Buck Consultants (now Conduent). Students interested in secondary teaching have also had success in finding jobs in the region.

v. **Graduate Program.** The DMS MS program (Section 2.f) is the only post-graduate degree in mathematics offered in northeast Indiana. The MAT program (Section 2.g.) is currently inactive.

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[2] L. Steen, editor, *Mathematics and Democracy: The Case for Quantitative Literacy*, The Woodrow Wilson National Fellowship Foundation, 2001. http://www.maa.org/sites/default/files/pdf/QL/MathAndDemocracy.pdf

[3] Indiana's Math Pathways Recommendations (Appendix C, Document 12.) http://users.pfw.edu/coffmana/PR2017/2015MathPathways.pdf

[4] Regional Employment Outlook/Intel Report, IPFW Community Research Institute, 2015. (Appendix C, Document 9.) http://users.pfw.edu/coffmana/PR2017/RegionIntelReport.pdf

[5] IPFW First Destinations Survey. http://users.pfw.edu/coffmana/PR2017/FDSMath2016.pdf

c. Accreditation & Licensures

i. **Math programs.** As a scientific and liberal arts curriculum, the BS and MS programs in mathematics do not have any accreditation requirements or agency. There is no state licensing of faculty beyond terminal degrees. The Mathematical Association of America is the professional organization for teachers and students of mathematics at the college level, and it occasionally issues curriculum guidelines (Subsection 2.a). DMS programs generally conform to these guidelines.

ii. **Actuarial programs.** The Society of Actuaries is a professional organization for actuaries, and it keeps a list of Universities & Colleges with Actuarial Programs (UCAP) (Subsection 2.c). The DMS actuarial curriculum must meet some criteria to qualify, and IPFW gained that classification in 2015. The SOA also administers a series of professional exams, and some IPFW courses have a matching curriculum that prepares students for specific exams. See Section 2.c.

iii. **Teaching programs.** DMS works with CEPP on coordinating the curriculum for math majors with the requirements for Indiana Teacher Certification, and on CEPP's accreditation. See Section 2.e.

iv. **General Education.** DMS courses in the General Education and Concurrent Enrollment programs meet standards set at the campus, state, and national levels. See Subsection 3.d.

v. **ETCS and DSB programs.** Several programs in the College of Engineering, Technology, and Computer Science and the Doermer School of Business undergo regular accreditation by their respective agencies. Their reviews frequently involve an examination of mathematics requirements, and DMS cooperates with such reviews and participates in site visits. Recommendations from engineering accreditation reports have led to some changes in DMS curriculum and assessment.

vi. **HLC.** The Higher Learning Commission (formerly the North Central Association) is the accreditation organization for the university as a whole. Recently, the HLC introduced new requirements for the qualifications of part-time faculty, which affect the DMS Limited Term Lecturers and the high school teachers in the Dual Credit program. (See Sections 3 and 5, and Appendices D.2 and F.) The DMS Graduate Teaching Assistants (GTA) do meet the qualifications (and would be difficult to replace – Subsection 2.f).

vii. **Articulation agreements.** The 2010 IPFW Self-Study (Appendix F, Document 5.) refers to articulation agreements between IPFW and our neighboring community college, Ivy Tech. At least for the BS programs in mathematical sciences, any such agreements have since expired. Now, with regard to transfer students from other Indiana institutions, IPFW and DMS work with Ivy Tech on committees, including the state committees for the Core Transfer Library (CTL) [6] and the Transfer Single Articulation Pathways (TSAP).[7]

d. Previous Program Reviews and Goals

The most recent DMS Program Review was in 2008 (Appendix D.2, Document 10.).

One major goal of the 2008 report was to establish a resource and tutoring center for student success and retention in calculus-and-above courses. This was accomplished by the MALL --- for a report on this initiative, see Section 4 (and Appendix D.2, Documents 5,6,7,8.).

Another major goal of the 2008 report was to establish an IPFW Center of Excellence in the department, to bring faculty expertise in contact with regional community needs. This was accomplished by the Center

[6] https://transferin.net/

[7] https://www.pfw.edu/offices/sst/transfer-students/transfer-single-articulation-pathway

for Applied Mathematics and Statistics (CAMS). The center's activities are recorded on the web site: https://www.pfw.edu/departments/coas/depts/math/cams/ and a report on revenue generated by CAMS contracts (over $150,000 since 2014) appears in Appendix D.1 (Document 8.).

Some other outcomes from the 2008 DMS Program Review, including the relaunch of the MAT degree (Subsection 2.g.) and the new Graduate Certificate in Applied Statistics (Subsection 2.f.), were included as highlights of the Program Review process in the campus Self-Study and Re-accreditation application (Appendix F, Document 5., page 53).

The 2008 report's "greatest challenge" to DMS was the "ever-diminishing" number of faculty, with "noticeable shortages in math education, statistics, and in the ability to cover calculus classes." These shortages remain chronic – the number of tenured/tenure-track faculty has even **decreased** since then (See Section 5 and the Faculty Profile in Appendix D.1, Document 1.), with no corresponding decrease in the number of students enrolled in courses taught by TT faculty (Table 3.b and Chart 3.c., below). Partial retirements by math, math education, and statistics faculty have already started, with more projected in the near future. Replacing faculty who have retired or are entering partial retirement, and adding new tenure-track faculty to support new programs, are still the most urgent priorities.

2. Degree Programs

a. BS Program Overview

History: DMS has offered an undergraduate degree in mathematics since its founding over 50 years ago. The BS in Mathematics has, for many years, been offered with several "options", allowing students to meet the requirements by completing a common core of math classes and then following a track with different required or elective courses.

The arrangement of math major requirements into "options" appeared in the official IPFW Bulletin, but was handled somewhat informally by DMS academic advisors in the past. The IPFW Registrar used software that gave separate "major" codes for each option; this allowed for collection of data appearing here in Charts 2.d, 2.e., 2.f., and 2.g., although a more appropriate technical designation would have been "concentration" codes augmenting just one "major" code (or two, with another code for the B.S. in Mathematics Teaching). The software codes for the options had little impact on DMS operations or student advising until they started to be used for resource allocation analysis during USAP (see DMS comments from Sept. 2016: Appendix A.2, Document 6.). Starting in 2018, DMS will no longer offer options within a BS major and will instead offer separate BS major programs, each with one set of requirements. For purposes of this Program Review, we will use the terms "option" or "track" or "concentration" interchangeably to refer to the structure as it existed 2010-2016.

There is a "pure math" track, which is the topic of the next Subsection 2.b. The other tracks (Subsections 2.c, 2.d) had an applied and interdisciplinary orientation: actuarial, statistics, computing, and business – often allowing students to complete a "minor" or double major in a related area. This major-with-options format seems to be common nationwide (see the sample of Peer Institutions, Appendix D.1, Document 2.). The IPFW Bulletin has also listed another degree, the BS in Mathematics Teaching, which has been offered for over twenty years (Subsection 2.e).

Starting in Fall 2015, DMS began the process of developing and seeking approval for two new BS degrees, in Actuarial Science, and in Applied Statistics. The motivation was partly in response to student interest (see the enrollment charts below) and regional community interest (see Subsections 2.c and 2.d, and the degree proposal documents, Appendix D.2, Documents 13,14.), and partly to trends in the discipline, with ever-widening opportunities for applications of mathematical sciences, and other universities successfully offering such degrees. The development of the new programs also matched the IPFW Strategic Plan 2020 (Appendix E.1, Documents 1,2,3,4.) Mission statement for the campus to "provide local access to globally recognized baccalaureate and graduate programs that drive the intellectual, social, economic, and cultural advancement of our students and our region" and its Vision statement for IPFW to "be known for […] respected signature programs, and graduates prepared to improve the quality of life in their communities as well as compete locally, regionally, and globally." In particular, the new Actuarial Sciences program was highlighted in the IPFW Chancellor's 2015 Legislative Agenda, Chancellor Carwein's Fall 2016 Convocation address, and a Feb. 2018 announcement by Chancellor Elsenbaumer (Appendix E.1, Documents 6,10,11.).

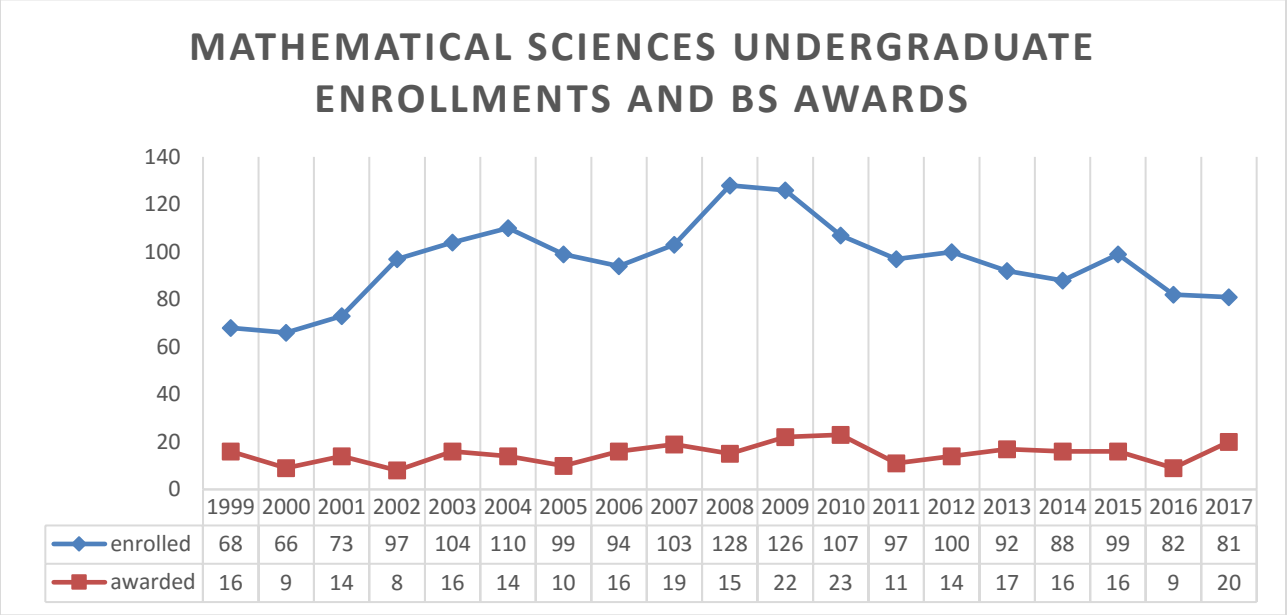
In an unrelated development, IPFW began a Dickeson-inspired (Appendix A.2, Document 1.) "University Strategic Alignment Process" (USAP) in 2014 which (as previously mentioned) eventually led to administrative scrutiny of the math degree options as if they were distinct majors, and as a result, new student admissions to the statistics, computing, and business options within the math major (Subsection 2.d) were suspended in 2016.

The current (late 2017) state of undergraduate degrees offered by DMS is:

- there is still a pure math track toward a BS degree, which has not changed much for at least twenty years
- the teaching track is being re-formed as part of a campus-wide re-design of education majors
- the actuarial track is, as originally intended, being replaced by the new BS in Actuarial Science
- the other tracks are being replaced by a new BS in Data Science and Applied Statistics.

Enrollment trends: The following Chart 2.a. refers to all declared math major students in any option for mathematical sciences BS degrees. The data is Fall semester headcount enrollments in math majors and annual BS degrees awarded.

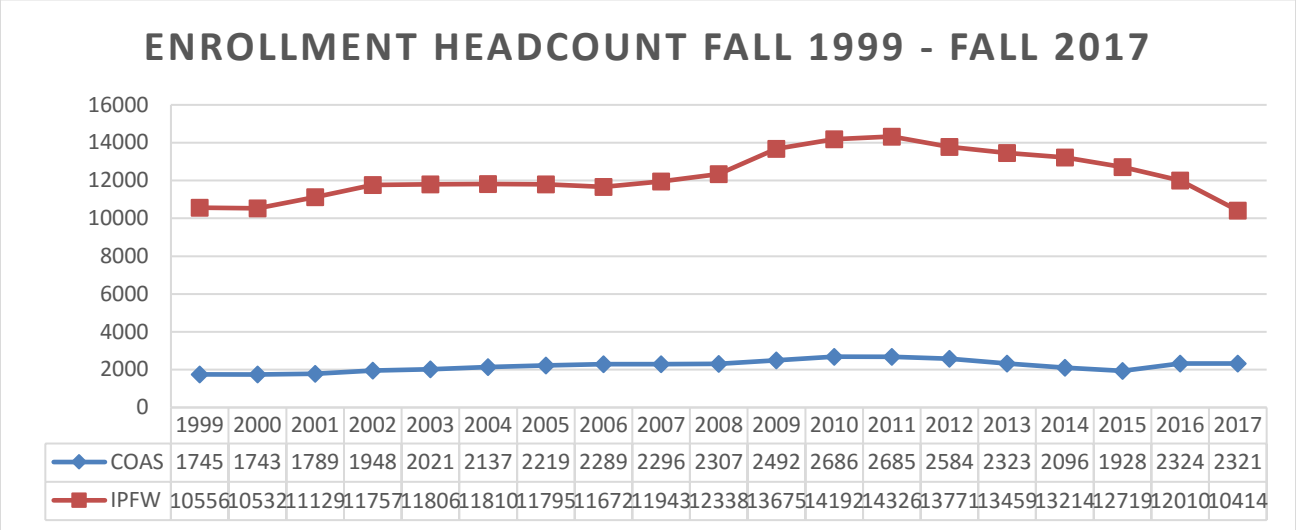
Chart 2.a.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
enrolled	68	66	73	97	104	110	99	94	103	128	126	107	97	100	92	88	99	82	81
awarded	16	9	14	8	16	14	10	16	19	15	22	23	11	14	17	16	16	9	20

There does not appear to be any significant long-term (18-year) trend in math major enrollments or degrees awarded, but over shorter intervals, the enrollment graph shows an increase 2000-2004, a peak 2008-2009, and then a return in 2011-2017 to the 2002-2006 range. To put the enrollment trends in context, the following Chart 2.b. shows total Fall semester enrollments for the IPFW campus and the College of Arts and Sciences. The peak in Charts 2.a. and 2.b. starting around 2008 follows a nationwide pattern (https://nces.ed.gov/programs/coe/indicator_cha.asp - see also Appendix C, Document 11.), which is usually attributed to external economic factors.

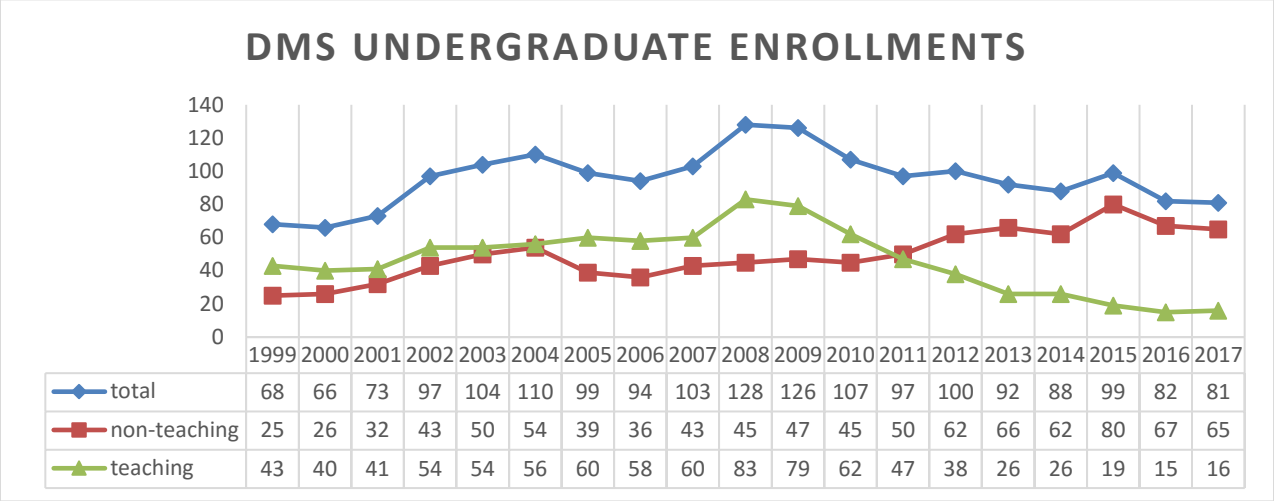
Chart 2.b.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
COAS	1745	1743	1789	1948	2021	2137	2219	2289	2296	2307	2492	2686	2685	2584	2323	2096	1928	2324	2321
IPFW	10556	10532	11129	11757	11806	11810	11795	11672	11943	12338	13675	14192	14326	13771	13459	13214	12719	12010	10414

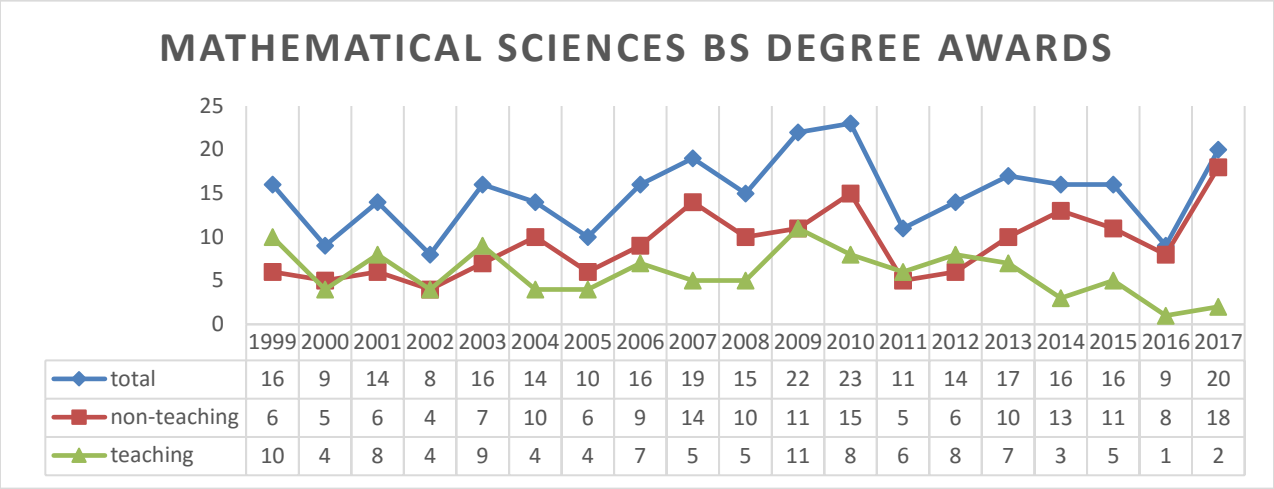
However, if the Mathematical Sciences numbers are split into the two BS programs, Mathematics and Mathematics Teaching, Charts 2.c. and 2.d. show a recent decreasing trend for teaching majors (following another nationwide trend, see Subsection 2.e), and increasing trend for the non-teaching options.

Chart 2.c.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
total	68	66	73	97	104	110	99	94	103	128	126	107	97	100	92	88	99	82	81
non-teaching	25	26	32	43	50	54	39	36	43	45	47	45	50	62	66	62	80	67	65
teaching	43	40	41	54	54	56	60	58	60	83	79	62	47	38	26	26	19	15	16

Chart 2.d.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
total	16	9	14	8	16	14	10	16	19	15	22	23	11	14	17	16	16	9	20
non-teaching	6	5	6	4	7	10	6	9	14	10	11	15	5	6	10	13	11	8	18
teaching	10	4	8	4	9	4	4	7	5	5	11	8	6	8	7	3	5	1	2

Accreditation: The Mathematical Association of America's Committee on the Undergraduate Program in Mathematics regularly publishes a "Curriculum Guide": https://www.maa.org/node/790342 The most recent (2015) report lists nine general "*Content Recommendations.*" All the options within DMS undergraduate degrees generally conform to these recommendations.

1. *Mathematical sciences major programs should include concepts and methods from calculus and linear algebra.* This is exactly the core MA 165-166-261-351 sequence.

2. *Students majoring in the mathematical sciences should learn to read, understand, analyze, and produce proofs at increasing depth as they progress through a major.* Proofs are presented in every course. There is an intentional transition from reading proofs to writing proofs in MA 175 (Discrete Math) and MA 305 (Foundations of Higher Mathematics), for pure math and teaching majors. In the applied/interdisciplinary tracks, there is a particular emphasis on proofs in STAT 516 (Probability).

3. *Mathematical sciences major programs should include concepts and methods from data analysis, computing, and mathematical modeling.* One course in Computer Science (CS) is required for all majors, and MA 314 (Introduction to Mathematical Modeling) is the DMS course for the General Education "Capstone" requirement. Data analysis is a prominent theme of several STAT

courses. The new course on Models of Financial Economics was developed specifically for the BSAS.

4. *Mathematical sciences major programs should present key ideas and concepts from a variety of perspectives to demonstrate the breadth of mathematics.* The pure math track allows a choice of at least two electives from MA, STAT, or CS courses. The applied and teaching tracks require courses outside DMS (for example, economics or education), which certainly have a different perspective.

5. *Students majoring in the mathematical sciences should experience mathematics from the perspective of another discipline.* All majors get a Bachelor of Science degree and are required to take a CS class and three science classes, including two with a lab component.

6. *Mathematical sciences major programs should present key ideas from complementary points of view: continuous and discrete; algebraic and geometric; deterministic and stochastic; exact and approximate.* These complementary points of view are prominent themes in calculus and statistics courses.

7. *Mathematical sciences major programs should require the study of at least one mathematical area in depth, with a sequence of upper-level courses.* In the pure math track, the courses MA 305-363-441 could be considered as an in-depth sequence of courses on analysis, from the Foundations (305) to techniques and applications (363) to the modern (20th century) theory (441) at a level preparatory for graduate work in mathematics. In the applied tracks, STAT 511 is a foundation for further advanced courses in statistics.

8. *Students majoring in the mathematical sciences should work, independently or in a small group, on a substantial mathematical project that involves techniques and concepts beyond the typical content of a single course*. The Mathematical Modeling class MA 314 usually is structured around such projects. Additionally, actuarial students have opportunities for such projects in their co-op/internship experiences.

9. *Mathematical sciences major programs should offer their students an orientation to careers in mathematics.* DMS works with student organizations (PI Math Club, Actuarial Student Club) and through the academic advising process to present information on careers. Students in the Actuarial program frequently participate in co-op or internship opportunities at regional employers. Students in the Teaching program usually have a student teaching experience. IPFW also has a Career Services office.

With regard to the above recommendations, one challenge faced by DMS is providing a set of BS major requirements with both breadth (item 4) and depth (item 7). The requirements for math majors are constrained by a general 120-credit cap for BS degrees, by external mandates for CEPP accreditation and teacher certification (Subsection 2.e), and the topics covered by actuarial professional exams and SOA classification (Subsection 2.c).

Assessment: The current DMS Assessment Plan (Appendix B.2, Document 1.) was adopted in 2011, after the previous Program Review. There was an earlier DMS Assessment Plan (its results are reported in the 2008 Program Review, Appendix D.2, Document 10.), but the new 2011 Plan was part of a campus-wide

restructuring of the assessment process following the 2010 HLC accreditation visit (Appendix F, Documents 5,6.).

The new DMS Assessment plan in 2011 stated learning goals and measurable outcomes for all math majors, aligned with the IPFW Baccalaureate Framework. The intent at the time was to add later amendments with more specific goals and outcomes for the degree options within the math major, and this has happened as reported below in Subsections 2.b,c,d,e, although some recent amendments have not generated much data yet. DMS prepares annual Assessment Reports and gets feedback from the College (COAS) Assessment Committee (Appendix B.1).

The DMS Goals for students in all options are copied here from the DMS Assessment Plan (Appendix B.2, Document 1.):

Program Goal G1. Students should be able to reason mathematically.

G1 outcome 1. Students will demonstrate an understanding of the calculus: The differential and integral calculus of one and multiple variables, infinite series, the geometry of Euclidean space, and theorems of Green, Gauss, and Stokes. [MA 263/261]

The success rate for this Goal is 76.3%, close to the DMS target to meet 80%.

G1 outcome 2. Students will demonstrate an understanding of elementary linear algebra: Linear transformations, finite dimensional vector spaces, matrices, determinants, systems of linear equations. [MA 351]

The success rate for this Goal is 74.1%, close to the DMS target to meet 80%.

G1 outcome 3. Students will demonstrate understanding of high-level topics such as sets, logical inference, induction, recursion, counting principles, binary relations, vectors and matrices, elementary graphs, and algorithm analysis. [MA 175]

The success rate for this Goal, 52.1%, is low, compared to both the overall 67.4% success rate for Goal 1 and the DMS 80% target. This is discussed in the 2016-17 Assessment Report. As a result of earlier Assessment Reports and discussions with the Department of Computer Science, DMS started collecting the assessment data for all students in MA 175 (many in ETCS) but the success rate for non-majors is so far about the same (49.4%). This issue will continue to be monitored. The new BS programs in Actuarial Science and in Data Science & Applied Statistics do not require MA 175, which is a significant change from the options they are replacing, but some discrete math content will continue to appear in courses in probability and statistics.

Program Goal G3. Students should be able to understand and apply mathematical concepts to other disciplines.

G3 outcome 1. Students will understand basic applications of the calculus to the physical sciences and engineering, and be able to use appropriate techniques in various contexts. [MA 263/261]

The success rate for this Goal is 74.3%, close to the DMS target to meet 80%.

G3 outcome 2. Students will understand basic applications of linear algebra and be able to use appropriate techniques in various contexts. [MA 351]

The success rate for this Goal, 56.5%, is low, compared to both the overall 65.9% success rate for Goal 3 and the DMS 80% target. The percentage of students meeting this learning objective has a large amount of

variation over time – some semesters are at 100% and others are below 30%. This remains unexplained but shows that the assessment mechanism (counting how many out of a small number of math majors correctly answer certain final exam questions) can give data with a sensitive dependence on factors like the exam questions themselves or the course instructor.

Generally, the small amount of data and its high variability are both related to the Program Review questions "are program learning outcomes measurable?" and "are the assessment data adequate?" --- issues the DMS Assessment Committee has discussed in its annual reports: see Section 3.C. of the 2016-17 Assessment Report (Appendix B.1, Document 2.).

USAP: The September 19, 2016 USAP Recommendations from the VCAA (Appendix A.2, Document 8.) reported on DMS and its programs in general:

Simplification of curricular offerings is essential. Viability of graduate education must be considered given its impact on instructional resources. Department must play a major role in addressing teaching degree concerns across COAS. Recommendation: complete curricular simplification, continue investment in actuarial science and applied mathematics, maintain as independent department.

The overall structure of BS degrees offered by DMS has changed, with the replacement of options by new BS programs as described previously. It is not clear whether this meets the recommendation for "curricular simplification" (DMS has not yet received any further clarification or guidance on this recommendation). As of Fall 2017, there had not yet been changes to the curriculum of the pure math option as a direct result of the USAP or realignment processes. The stated recommendation to "continue investment" in actuarial science and applied mathematics remains a goal of DMS but has not yet resulted in any more resources invested by IPFW. The suspension of three options (Subsection 2.d.) caused no changes in the list of courses still required by other options (see the Curriculum map, Appendix D.1, Document 10.), so the result appears to be zero savings of money or resources that could be redirected. The new programs do require new resources, most importantly, new faculty lines in relevant areas. The graduate program and its "impact on instructional resources" is discussed below in Subsection 2.f.

Entering Students: MA 165 (first semester calculus) is offered as a dual-credit class in local high schools. Students with dual credit or AP credit can start in MA 166 or MA 261 at IPFW and have a significant head start on the math major core requirements. Through Collegiate Connection, some high school students have taken major core courses (MA 165, 166, 261, 175, 351) on campus.

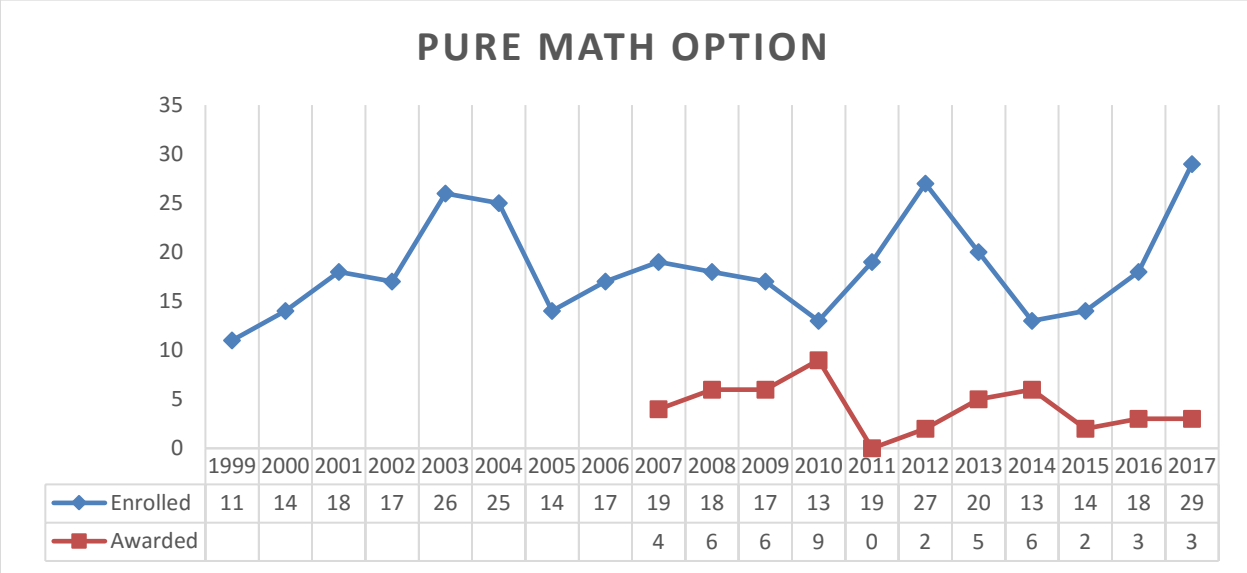
b. BS in Mathematics (option in "pure" mathematics)

History: Some recent (2009-2016) changes to the pure mathematics program are relatively minor, although they are consistent with the previously mentioned recommendation for curricular simplification:

- The MA 263 course, multivariable calculus for math majors, is no longer offered. Math majors are taking MA 261, the third semester in the calculus sequence for science and engineering majors.
- MA 275 (Intermediate Discrete Mathematics) is no longer offered. A higher-level version of MA 175 (Introductory Discrete Mathematics), was developed at the request of ETCS, but they no longer need it, so all math majors are taking MA 175.
- The General Education program at IPFW requires that students take a "capstone" course. Most math majors meet this requirement by taking MA 314 (Mathematical Modeling).

Enrollment trends: The following numbers refer only to students in the "pure math" option for the BS degree. The graduation data for options within the BS in Mathematics degree only goes back to 2007.

Chart 2.e.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Enrolled	11	14	18	17	26	25	14	17	19	18	17	13	19	27	20	13	14	18	29
Awarded									4	6	6	9	0	2	5	6	2	3	3

Enrollment and graduations in the pure math option appear to be stable over time, although with the small numbers at this level of detail, there is a low signal-to-noise ratio. The enrollment uptick in 2017 is due to new students being advised in 2016 and 2017 to enroll in the pure math option while other options were suspended and new degree programs were scheduled for opening in 2017/2018.

Assessment: The DMS Goals for students in the pure math track are copied here from the DMS Assessment Plan (Appendix B.2, Document 1.):

Program Goal G4. Students should know and be able to apply fundamental concepts of advanced undergraduate mathematics.

G4 outcome 1. Students will demonstrate knowledge of concepts of higher mathematics, including logic and proof techniques, functions, relations, and the real numbers as a complete ordered field. [MA 305]

The Assessment data for MA 305 has been collected for only three courses, but the success rate 47.4% (18 out of 38 majors meeting the goal) is low, compared to the overall 76% success rate for Goal 4. The 2014-15 Assessment Report (Appendix B.1, Document 5.) discusses some changes already made, but this course remains flagged as a topic for further consideration.

G4 outcome 2. Students will demonstrate the ability to solve a variety of differential equations [including first order differential equations, higher order linear differential equations, systems of first order equations, and basic PDEs]. [MA 363]

The success rate for the MA 363 Goal 4 is 78.6%, very close to the DMS target to meet 80%.

G4 outcome 3. Students will demonstrate knowledge of the fundamentals of real analysis [theory of functions of a real variable, theory of differentiation and Riemann integration, sequences and series of functions, uniform convergence]. [MA 441]

The success rate for the MA 441 Goal 4 is 88.9%, which exceeds the DMS 80% target.

G4 outcome 4. Students will demonstrate knowledge of the fundamental properties of the constructs of abstract algebra [groups, rings, the integers, polynomials, and fields]. [MA 453]

The success rate for the MA 453 Goal 4 is 78.8%, very close to the DMS target to meet 80%.

Accreditation: There is no accreditation for the math major. See the comments in Subsection 2.a. about the MAA Curriculum Guide's "*Content Recommendations*."

USAP: The September 19, 2016 USAP Recommendations from the VCAA (Appendix A.2, Document 8.) reported on the pure math option as follows:

The core degree option offered by the Department of Mathematics. Characterized by modest demand, low participation and low graduation, as well as very high student attrition. Recommendation: identify curricular barriers and causes for student attrition. Develop and implement plans to improve student retention and success. Continue to monitor and report on programmatic metrics. Expectations: Student retention and success plan developed and implemented by the end of AY 16/17.

The main DMS retention and success initiative for math majors is the Math MALL, which is already achieving measurable outcomes (Section 4).

c. BS in Mathematics (the "actuarial" option)
BS in Actuarial Science

History: DMS has had an actuarial track in the BS in Mathematics since before the previous program review. The BS in Actuarial Science (BSAS), after being developed since 2015 and receiving final approval from ICHE in May 2017, was opened for new students starting in Fall 2017. The BS Proposal Document (Appendix D.2, Document 13) details the rationale for the new degree and includes letters of support from the local actuarial community. The intention was (and is) for this to replace the actuarial track in the math major, although currently enrolled students may continue with the old program or switch into the new one. Unlike some other DMS programs, the BSAS curriculum is aligned with a sequence of national professional exams from the Society of Actuaries.

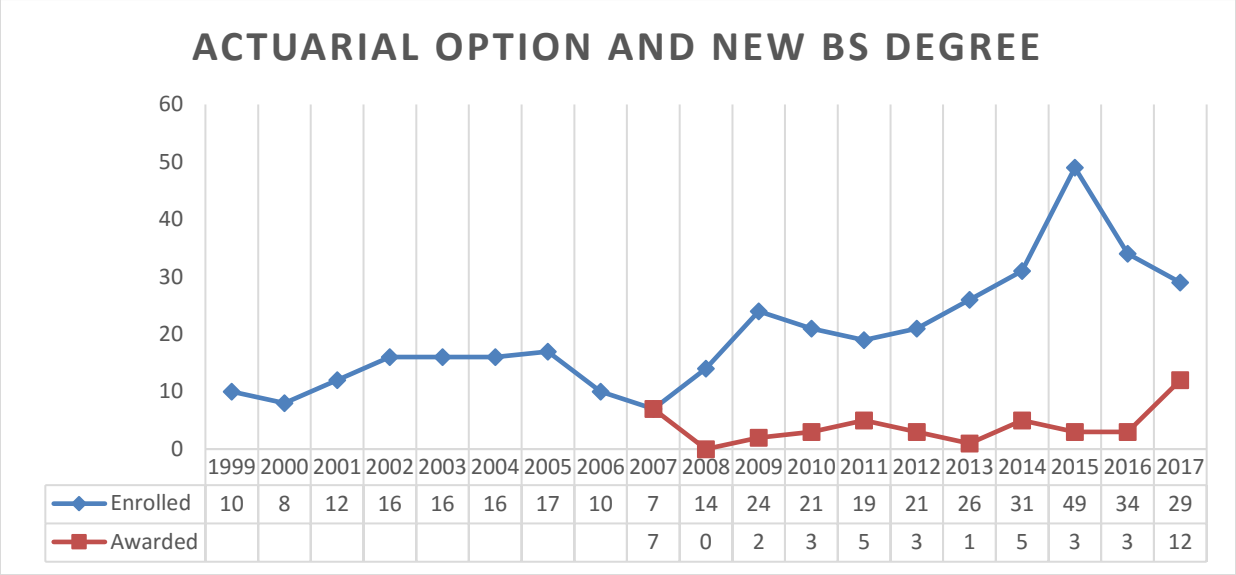
The following list of recent events shows the growth of this program:

- Until Fall 2013, the actuarial option prepared students for one SOA exam (Exam P).
- After meeting with Swiss Re executives, the Exam FM curriculum was added in Fall 2013.
- The IPFW Actuarial Student club and an Actuarial Award (jointly with Swiss Re) were established in Spring 2014.
- In Fall 2014, an IPFW Actuarial Advisory Board was constituted, with representatives from Swiss Re, LFG, MedPro; Conduent (formerly Buck Consultants). Starting in 2017, there is also representation from Central Mutual Insurance of Van Wert, OH.
- In Spring 2015, the SOA granted UCAP classification to IPFW (Universities and Colleges with Actuarial Program).
- The first (now annual) IPFW Actuarial Picnic was organized in Summer 2015.
- In Fall 2015, IPFW hired J. Francis, Professional Actuary-in-Residence.
- The Exam MFE curriculum was added in Spring 2016.

- A practicum course for the FM exam, MA 490 (Financial Math Practicum) has been taught every Spring semester since 2016.
- In Fall 2016, a Lincoln Foundation (LF) curriculum grant ($45,000) supported alignment with FM/MFE SOA curriculum changes.
- In Fall 2017, another LF curriculum grant ($35,000) is supporting the development of a Predictive Analytics curriculum for Exams SRM (Statistics of Risk Modeling) and PAM (Predictive Analytics Module).

Enrollment trends: The following numbers refer to students in the actuarial option for the BS in Mathematics degree. The 2017 data point also includes students enrolled in the new BSAS.

Chart 2.f.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Enrolled	10	8	12	16	16	16	17	10	7	14	24	21	19	21	26	31	49	34	29
Awarded									7	0	2	3	5	3	1	5	3	3	12

Enrollments have shown significant growth. This is the primary driver of the previously mentioned growth in non-teaching options. The most recent report (Spring 2018) shows **35** actuarial students.

Assessment: The DMS Goals for students in the actuarial track appear in the Assessment Plan (Appendix B.2, Document 1.); they are measured by learning outcomes in 500-level Statistics courses. The results of the Assessment process so far are that the goals are being met with the target 80% success rate in three out of the four classes, and close to the target (73.9%) in STAT 516 (Probability).

The Assessment Plan was developed before any of the enhancements to the program (listed above), so a new Plan will need to be written by DMS, with learning goals and metrics specifically for the new BS in Actuarial Science degree. The assessment data collected so far may someday allow a comparison of success rates for some learning goals before and after the changes to the program.

DMS also assesses the success of the program by tracking "high-impact experiences" for students – such as passing professional exams, participating in co-ops or internships with regional employers, and employment offers secured prior to graduation. See Page 6 of the 2016-17 DMS Annual Report (Appendix D.2, Document 2.) for the 2014-2017 list, showing that over half of recent graduates have at least one such experience. Considering that Fort Wayne is one of the national hubs for the actuarial industry and that our students (with an even gender distribution) are successfully competing for positions, this method of assessment gives external evidence at a national level for the quality of this program at IPFW.

Accreditation: Although there is no accreditation for the math major in general, the comments in Subsection 2.a. about the MAA Curriculum Guide's "*Content Recommendations*" apply to the actuarial program. More importantly (but also more narrowly), the Society of Actuaries has criteria for inclusion in its UCAP list:

- **UCAP–Introductory Curriculum (UCAP-IC)**: Must maintain course coverage for at least two SOA preliminary exams and have approved courses for at least one VEE topic area.

The DMS meets these criteria. There are 17 Indiana institutions with at least this level of classification, including Purdue WL, Ball State, Taylor University, and Indiana Wesleyan (the Marion/Upland area geographically the closest to here), but IPFW is the only one in the northeast Indiana region. The criteria change over time – DMS adapted to a recent major curriculum change with the help of the Lincoln Foundation grant. Currently, D. Yorgov and J. Francis are in the process of obtaining approval from SOA for IPFW courses corresponding to revised standards for the Validation by Educational Experience (VEE).

The next level (currently 4 Indiana institutions: BSU, Butler, IUNW, PWL) is:

- **UCAP–Advanced Curriculum (UCAP-AC)**: Must maintain course coverage for at least four SOA preliminary exams with one of those being Exam MLC or Exam C and approved courses for all Validation by Educational Experience (VEE) topic areas.

Meeting these criteria is a major goal of the DMS that can only be met by offering at least one new course and hiring qualified faculty. The current curriculum is a "3-exam" program; to move to a "5-exam" curriculum and achieve UCAP – Advanced classification we must cover (effective July 1, 2018) the Long-Term Actuarial Mathematics Exam (replacing exam MLC) OR the Short-Term Actuarial Mathematics Exam (replacing exam C). (For both the current DMS curriculum and the SOA schedule of exams, see the Curriculum Maps in Appendix D.1., Document 10.)

In addition to the curriculum development currently underway with the support of the LF grant, the following actions are being taken to enhance the new degree program:

- A new course, STAT 421 "Modern Statistical Modeling and Learning," is being developed.
- A new practicum course for Exam P preparation is being developed and should be delivered in the 2018-19 academic year.
- Changes to already existing courses are being developed, including adding an introduction to R (software) to STAT 511, adding the GARCH model to STAT 520.

USAP: The following Goal, Actions, and Metrics stated in the **Dec. 2014** USAP report (Appendix A.1, Document 1.), align with the IPFW goal (Appendix E.1, Document 1.) to "Foster Student Success":
USAP UNIT GOAL 1: Increase number of baccalaureate degrees granted in actuarial sciences, statistics, and business options, and have Actuarial Science Program classified as "undergraduate-advanced" by the Society of Actuaries.

Action Step. **Continue to expand number and frequency of course offerings in statistics and actuarial science.**

***Metric*: Number of majors and degrees awarded- increase by 35% over three years, 60% over five. There are currently 45 students majoring in the three options, up from 19 in 2006-2007. Three-year goal of 61, five-year goal of 70.**

***Needed Resources*: Actuary in residence expanded from quarter time position to full time Clinical Instructor Appointment. Tenure track hire in Statistics, so actuarial program courses STAT 516, 517, STAT 520 be delivered yearly, instead of biennially.**

***Challenge*: The Department needs to develop three to five professional actuarial exam preparation courses**

***Timeline*: Three to five years**

The second report from DMS to USAP in **2015** (March 2016, Appendix A.1, Document 4.) modified Goal 1:

We are modifying this goal to address student demand and NE Indiana regional needs. BS degree in Actuarial Sciences has been developed by the department and has passed the COAS Curriculum Committee. BS degree in Applied Statistics is on the COAS Curriculum Committee agenda. These are envisioned as signature programs.

The September 19, 2016 USAP Recommendations from the VCAA (Appendix A.2, Document 8.) reported on the actuarial option as follows:

Math Actuarial Sci – One of six degree options offered by the Department of Mathematics. Characterized by modest demand, low participation, and small numbers of graduates, the Actuarial Science degree program also has a low graduating efficiency. Strong regional demand for graduates, the potential for significant philanthropic contributions in support of the program, and strong growth in number of majors are positives. Moving the program to "undergraduate advanced" status as indicated in the departmental USAP report is a critical next step. Recommendation: develop, implement, and report the outcomes of a student recruiting plan. Monitor student graduation efficiency and evaluate potential curricular changes that would enhance student success. Expectations: expand student participation by integration of degree marketing and expanded partnerships with employers of graduates.

Current (2017) status of USAP UNIT GOAL 1:

The 2015 USAP report explains how DMS met the goal of having its program classified by the Society of Actuaries.

This Subsection has already detailed the steps DMS has taken toward meeting all these goals, and the current state of enrollments and degrees awarded. A curriculum map (Appendix D.1, Document 10.) shows how the proposed BS program differs from the old option, and also shows even further changes from the proposed version to the currently implemented set of requirements. Continued curriculum development is underway, to meet changing SOA standards and toward achieving the next level of SOA recognition.

The new degree programs (BSAS and the new BS in Data Science and Applied Statistics) received support from all levels of the IPFW and Purdue system administrations and ICHE in 2016 and 2017. The approved degree program proposals clearly indicated a need for **three** new faculty lines to support the new programs; this has not yet materialized. In 2016, there was one new Assistant Professor hired in the area of statistics, while an Associate Professor entered partial retirement.

In 2017, DMS worked with the Division of Continuing Studies on a marketing plan to promote BSAS and BSDSAS to IPFW Dual Credit program students.

d. BS in Mathematics (the "statistics" option)
BS in Mathematics (the "computing" option)
BS in Mathematics (the "business" option)
BS in Data Science and Applied Statistics

History: The DMS BS in Mathematics program has had options in Business, Computing, and Statistics since before the previous program review. These options are being phased out as described below, with a plan to be superseded by a new BS program.

Since the late 19th century, when the sciences underwent a "probabilistic revolution," reasoning with incomplete information and under uncertainty has become a pressing issue and therefore a major focus of mathematical reasoning and modeling. Probabilistic and statistical methods are gaining in prominence and incorporating technological advances; there is a new academic and applied field of data science.[8] As described in Subsection 2.a, DMS responded (starting in 2015) to these global trends by developing a new BS in Applied Statistics, with the intent to replace the Statistics option in the BS in Mathematics. During the approval process for the new degree, the Applied Statistics proposal was modified to a BS in Data Science and Applied Statistics. This aligns with the Purdue University Data Science Initiative[9]. The current DMS plan is to launch this degree in 2018, subject to adequate staffing levels, with a recruiting strategy to appeal to prospective students with a wide variety of interests, including students that would otherwise have been interested in the business, computing, or statistics options in the math major.

The implementation of this new degree proposal will require new resources, as described in the new program proposal document (Appendix D.2, Document 14.). The proposal document also goes into detail regarding employment opportunities for graduates in this area, and growth projections for the job market and regional needs. Data Scientist is currently (2018) the top-rated job by glassdoor.com.

Supplemental Report: With this report being prepared during a time of major changes in this area, when some programs are becoming obsolete while the new program has not yet launched, this Subsection will be even more brief than some others. A working group of DMS faculty has prepared a longer self-study report on these programs, with more data and analysis (Appendix D.1, Document 7.).

Enrollment trends: The following graph combines headcounts in three options from the BS in Mathematics that were offered until 2016 – statistics, computing, and business (for the separate counts, see Appendix D.1, Document 7.). Individually, these options had low enrollment, but considered as a "cluster" of interdisciplinary/applied concentrations, they showed some growth in the long term, contributing to the previously observed growth in non-teaching options within the math major. These numbers serve for now as both a baseline and a projection for the new BS degree in Data Science and Applied Statistics.

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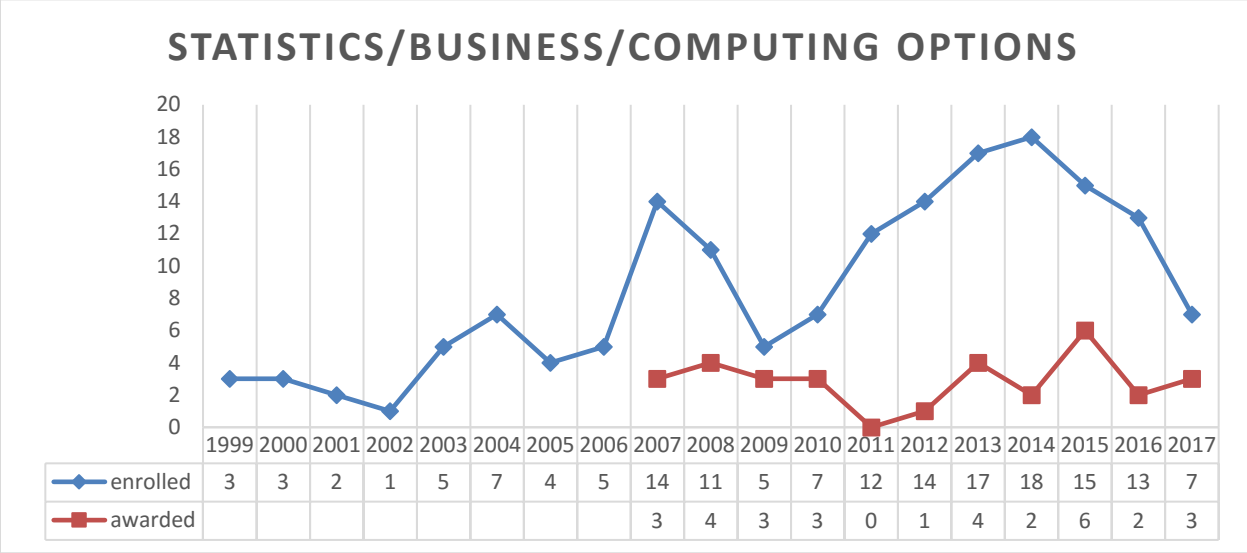
[8] J. Manyika, M. Chui, et al., *Big Data: The Next Frontier for Innovation, Competition, and Productivity*. New York: McKinsey & Co (2011).

[9] http://tinyurl.com/y97abkrj

Chart 2.g.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
enrolled	3	3	2	1	5	7	4	5	14	11	5	7	12	14	17	18	15	13	7
awarded									3	4	3	3	0	1	4	2	6	2	3

The big drop in enrollment in 2017 is due to the 2016 suspension of admissions. New students were advised to register as "pure" math majors until the roll-out of the new degree programs. In Fall 2016, there were about a dozen students enrolled in the three suspended options; this was confirmed in Jan. 2017 by the COAS advising office. The Nov. 2016 COAS Restructuring Guidelines (Appendix A.2, Documents 12, 13.) include a teach-out plan to allow these students to complete their degree under the old requirements, as long as they stay enrolled at IPFW.

Accreditation: Although there is no accreditation for the math major in general, the comments in Subsection 2.a about the MAA Curriculum Guide's "*Content Recommendations*" apply to all of the interdisciplinary tracks and the new BSDSAS degree.

The American Statistical Association also has Curriculum Guidelines for Undergraduate Programs in Statistical Science; the BSDSAS new program proposal (Appendix D.2, Document 14.) states that the new degree requirements were developed following these guidelines.
http://www.amstat.org/asa/education/Curriculum-Guidelines-for-Undergraduate-Programs-in-Statistical-Science.aspx

There is also a recently published article that proposes Curriculum Guidelines for undergraduate programs in data science.
https://www.annualreviews.org/doi/abs/10.1146/annurev-statistics-060116-053930

The new BSDSAS degree has some upper-level STAT course requirements which coincide with the BS in Actuarial Science requirements related to the SOA UCAP listing.

Assessment: The DMS Goals for students in the (now suspended) Statistics option appear in the Assessment Plan (Appendix B.2, Document 1.); they were measured by learning outcomes in 500-level STAT courses. The results of the Assessment process so far are that the goals are being met with the target 80% success rate in three out of the five classes, and close to the target (73.9%) in STAT 516 (Probability). There is data from only one section of STAT 514 (Design of Experiments), where the success rate was 75%.

As of 2016, there was not yet a DMS assessment plan specific to the Computing option; efforts to develop a plan were abandoned after admissions were suspended.

The DMS Assessment Goal for students in the (now suspended) Business option was assessed from 2015 to 2017:

Goal 4: Students will develop and apply knowledge in the fundamentals of business with emphasis in mathematical finance and business models.

There are 8 learning outcomes corresponding to this goal, 7 of which are measured in MA 273 (Models of Financial Economics). The success rate, 79.3%, is close to the DMS target of 80%.

An eighth learning outcome is measured in MA 314 (Mathematical Modeling):

Outcome 8: Students will be able to develop and use mathematical models that describe business problems. [MA 31400]

There is data from only two sections of this course. The success rate for this outcome, 59.3%, was below both the DMS target of 80% and the overall DMS rate for Goal 4, 76.1%.

The assessment data from MA and STAT courses used for the old options may still be useful in new assessment plans for the new degrees; the short-term plan is to continue to collect the same data.

The new BSDSAS degree has a list of learning outcomes; this list appears in the August 2017 curriculum revision document (Appendix D.2, Document 15.). This should be, but has not yet been, integrated into the DMS assessment plan.

USAP: The September 19, 2016 USAP Recommendations from the VCAA (Appendix A.2, Document 8.) reported on the three interdisciplinary/applied options as follows:

Math Business – One of six degree options offered by the Department of Mathematics. Characterized by low student demand, participation, and graduation as well as low graduation efficiency and high student attrition. Departmental USAP goal 1 calls for an increase in the number of baccalaureate degrees granted by the Math Business program but does not address how such a goal could be achieved. The utility and viability of the Math Business degree program is unclear. Is this degree distinct from Actuarial Science, if so what are the instructional costs? If not, why maintain it as an option? Recommendation: suspend admissions. Expectations: suspend admissions.

Math Computing – The smallest of the six degree options offered by the Department of Mathematics. Characterized by very low student demand, participation, and graduation. It is not clear what the curricular costs are for maintaining the Math Computing degree option. The growth of the computer science and information systems programs in ETCS suggest student demand is being met. The degree is likely a hold-over from the former combination of the departments of Mathematics and Computer Science. Recommendation: suspend admissions. Expectations: suspend admissions.

Math Statistics – One of the six degree options offered by the Department of Mathematics. Characterized by low student demand, participation, and graduation as well as low graduation efficiency and high student attrition. Departmental USAP goal 1 calls for an increase in the number of baccalaureate degrees granted by the Math Statistics program but does not address how such a goal could be achieved. Expansion in regional engagement in applied mathematics and statistics suggests this program could be more successful. Recommendation: provide compelling evidence for the viability of program or suspend admissions. Expectations: conduct viability analysis, curricular cost analysis, and market demand analysis during AY 16/17, provide plan for program growth or suspend admissions.

The recommendation to review "instructional" and "curricular" costs was undertaken immediately; a brief inspection of the curriculum map of requirements for these options (Appendix D.1, Document 10.) showed that there were no DMS courses they required that were not already required by other options. Any gains in efficiency of resource usage that would follow from a suspension of any of the options were not apparent at the time. All three options were abruptly suspended in Fall 2016 as part of the campus-wide academic restructuring resulting from the USAP process.

The recommendation for a market demand analysis had already been accomplished in the proposal for the new BS in Applied Statistics (Appendix D.2, Document 14.). As described in the 2015 report (Appendix A.1, Document 4.) from DMS to USAP, the **USAP Goal 1** (see the above Subsection 2.c on the actuarial programs) to increase enrollments in math degree options was **modified in 2015** to instead implement a plan to replace the actuarial and statistics options by the new BS degrees, which were in near-final form and passing through approval levels (unrelated to USAP) in the course of 2016. Since then, the Applied Statistics degree has been re-named the "BS in Data Science and Applied Statistics" and it is now a successor to the three options: business, computing, and statistics.

The curriculum map (Appendix D.1, Document 10.) shows how the originally proposed Applied Statistics program differed from the old statistics option, and also shows even further changes from the 2015-16 degree proposal to the currently (2017) proposed set of requirements for the Data Science and Applied Statistics degree. Many of the new courses and curriculum changes being introduced for the Actuarial Science degree (Subsection 2.c) will also support the new BSDSAS program.

e. BS in Mathematics (the "teaching" option)
B.S in Mathematics Teaching

History: DMS has had a BS program for students interested in secondary school teaching since before the previous program review. At times, the IPFW Bulletin listed "teaching" as one of the six options for the BS in Mathematics, in addition to the "BS in Mathematics Teaching" as a separate major. This redundancy was of no consequence until the USAP reporting brought the Registrar's list of major codes under administrative review. For purposes of this Program Review, students in any teaching program through 2017 are counted together. Starting in 2018, as the "option" structure is phased out, it may become more difficult to use university data to distinguish teaching majors from other DMS undergraduate students.

According to the *Management and Academic Mission Agreement Indiana University-Purdue University Fort Wayne* (Appendix E.2, Document 1.), DMS has "… curriculum authority over all secondary education programs offering majors in disciplines of their mission assignments." This statement makes DMS responsible for EDUC M448.

In Fall 2009, the DMS faculty member responsible for M448 (Prof. Mau) started making changes to the field experience in both high school and middle school. In 2010 when the CEPP decided to do a single student-teaching placement, replacing the prior policy of placements in both middle and high school, field experience changed to a single placement at the middle school level. The intent was to create a mini-student teaching experience at the middle school level. As the years progressed, changes in scheduling and field assignments have improved this 60-hour experience. In 2015, Professor Mau's work was acknowledged with the College of Arts and Sciences Enhancement of Teaching Award.

Since the last Program Review, the MA 460 (College Geometry) class was redesigned. This course is designed specifically for teaching majors, but pure math students will also find it to be a rich overview of geometry content including Euclidean and non-Euclidean topics addressed from several approaches including a synthetic approach, an analytical approach and a transformational approach. The course includes content recommended by the National Council of Teachers of Mathematics and provides students the opportunity to investigate ideas first encountered in their high school courses and to explore new topics in geometry including taxicab geometry, transformational geometry, and projective geometry through the use of Geometer's Sketchpad. This software allows students to explore diagrams, see relationships, make and test conjectures and develop understanding to write good mathematical proofs.

Enrollment trends: Charts 2.c. and 2.d. in Subsection 2.a show the enrollment and graduation trends for students in the teaching track, compared to the other tracks and the total number of math majors.

Over the last 20 years, the enrollment in Math Teaching at IPFW had a high enrollment of 83 and a low enrollment of 15. In 1999, the enrollment was 42 and rose to 83 in 2008. Since then, enrollment numbers in the teaching track have seen a steady decline: in 2010, we had 62 math teaching majors, which declined to 16, a 74% drop, in 2017. This mirrors national trends. What could account for this?

In an Association of Mathematics Teacher Educator (AMTE) survey in late 2015-early 2016: https://amte.net/connections/2016/05/results-amte%E2%80%99s-survey-enrollment-mathematics-teacher-preparation-programs
87 programs responded with enrollment data and answers to the question, "Based on program data and your experience, what are the 3 most important factors that lead to declining enrollment in mathematics teacher education programs?" Over 94% of AMTE members' answers fit within these 10 categories.

- Job market for teachers with significant mathematics background—factors include more lucrative job options to individuals who might be qualified to enter a mathematics teacher education program (actuarial science, data science, statistics, etc.)
- Concerns with specific aspects of the teaching profession— factors include over emphasis on high stakes testing, de-professionalization of teaching, lack of bargaining rights, and perceived burnout of teachers.
- Negative perception of or lack of respect for teachers
- Teacher education programs— factors include the nature of mathematics content courses and education courses, length and difficulty of program
- Certification/licensing requirements— factors include the cost of required exams and increased certification requirements
- Student financial cost of teacher education programs— factors include the high cost of tuition, lack of available scholarship, and need for large loans
- State of the economy
- General enrollment decline in K—12 and in higher education (beyond teacher education)
- Pathways to being hired as a teacher— factors include the perception of easier, alternative routes to becoming a mathematics teacher
- Quality of potential applicants

Assessment: The DMS Goals for students in the teaching track are copied here from the Assessment Plan (Appendix B.2, Document 1.):

Program Goal G2. Students should be good problem solvers.

G2 outcome 1. Students will demonstrate the ability to translate real-world or discipline-specific problems into mathematical language, and the solutions of mathematical problems into ordinary language. [MA 460]

G2 outcome 2. Students will demonstrate the ability to choose, apply, and adapt appropriate strategies to solve diverse problems. [MA 460]

This goal for teaching majors was added to the DMS Assessment plan in 2015 and there has been data from only one section of MA 460 (geometry) since then, where 100% of math majors were reported to succeed in both outcomes.

Program Goal 4: Students will be prepared to deliver necessary mathematics content to high school students.

G4 outcome 1: Students will demonstrate mathematical knowledge necessary for high school teaching by scoring at or above the minimum score for the CASA exam. [assessment via CASA exam]

The DMS Assessment Committee has not yet begun collecting data on the CASA exam.

G4 outcome 2: Students will demonstrate their knowledge of geometry, especially those concepts typically taught in high school geometry courses. [MA 460]

There is data from only two sections of MA 460 since DMS adopted its assessment policy. So far, 100% of math majors met this goal.

G4 outcome 3: Students will demonstrate their ability to implement lessons successfully by completing CEPP Key Assessment 6 and receiving an acceptable score for certification. [EDUC M448]

G4 outcome 4: Students will demonstrate the ability to teach by receiving scores of Target or Acceptable for all items assessed for student teaching. [EDUC M480]

The DMS Assessment Committee has collected only a small amount of data for EDUC M448 and EDUC M480, due in part to the low enrollment, but also the individualized nature of student teaching supervision. There is not yet enough data with which the Committee can draw any useful conclusion, nor report without confidentiality concerns.

In addition to the DMS Assessment plan, the faculty cooperate with the IPFW College of Education and Public Policy (CEPP) in their assessment process. With each CAEP Accreditation cycle, CEPP asks DMS to identify the courses where the content standards are met. Additionally, the CEPP asks us to identify technology used in each of these courses.

Students are assessed for CAEP Program Standards in their methods courses. CAEP Program Standards for Secondary Math Teachers can be found at:
https://www.nctm.org/Standards-and-Positions/CAEP-Standards/
and scrolling down to Secondary Math Teacher Preparation Program—Program Standards Secondary (PDF). This document includes commentary about:

- Content Knowledge, which includes the content topics listed in #4 below.
- Mathematical Practices—focus in MA 490, Problem Solving course; tried to pick this up in M448 but tough because of time constraints
- Content Pedagogy—focus in EDUC M448, taught by a math educator in DMS
- Mathematical Learning Environment—focus of M448
- Impact on Student Learning—focus in M448 and during student teaching
- Professional Knowledge and Skills—focus in M448
- Secondary Mathematics Field Experience and Clinical Practice—part of M448

During Methods (EDUC M448), students complete Key Assessment 3, the Unit Plan. This assessment addresses NCTM Program Standards 3.a, 3.b, 3.c, 3.f, 4.b, and 4.c; InTASC Standards 2, 4, 7, 8, and 9; and CAEP Standards 1.1, 1.4, and 3.6.

During student teaching (EDUC M480), students complete Key Assessment 6, Analysis of Teaching Video, and Key Assessment 5, Impact on Student Learning. KA5 addresses NCTM Professional Standards 3.a, 3.c, 3.f, 3.g, and 5.c; InTASC Standards 1, 2, 6, 7, and 9; and CAEP Standards 1.1, 1.2, and 1.4. KA6 addresses NCTM Program Standards 4.c, 3.e, 5.b, and 5.c.

At one time, MA 490 was offered as a problem solving course, largely for math teaching majors. This course specifically addressed the Mathematical Practices Standard. Problems were chosen partially for their math content and largely for the mathematical thinking required to solve them. Specifically, problems were chosen so that pre-service math teachers would

> **2a)** Use problem solving to develop conceptual understanding, make sense of a wide variety of problems and persevere in solving them, apply and adapt a variety of strategies in solving problems confronted within the field of mathematics and other contexts, and formulate and test conjectures in order to frame generalizations.
> **2b)** Reason abstractly, reflectively, and quantitatively with attention to units, constructing viable arguments and proofs, and critiquing the reasoning of others; represent and model generalizations using mathematics; recognize structure and express regularity in patterns of mathematical reasoning; use multiple representations to model and describe mathematics; and utilize appropriate mathematical vocabulary and symbols to communicate mathematical ideas to others.
> **2c)** Formulate, represent, analyze, and interpret mathematical models derived from real-world contexts or mathematical problems.
> **2d)** Organize mathematical thinking and use the language of mathematics to express ideas precisely, both orally and in writing to multiple audiences.
> **2e)** Demonstrate the interconnectedness of mathematical ideas and how they build on one another and recognize and apply mathematical connections among mathematical ideas and across various content areas and real-world contexts.
> **2f)** Model how the development of mathematical understanding within and among mathematical domains intersects with the mathematical practices of problem solving, reasoning, communicating, connecting, and representing.

Accreditation: Although there is no accreditation for the math major in general, the comments in Subsection 2.a. about the MAA Curriculum Guide's "*Content Recommendations*" apply to the teaching track. Also, as mentioned previously, CEPP has its own accreditation process which includes curriculum requirements. Additionally, there are State of Indiana requirements for individuals to be granted a teaching license for secondary school, including having a Bachelor's degree in the subject area. DMS cooperates with CEPP to keep the BS curriculum aligned with specific requirements as they change over time.

The Interstate Teacher Assessment and Support Consortium (InTASC) was formed by the Council of Chief State School Officers (CCSSO) in 1987. Indiana joined InTASC early and used their standards as the guiding assessment model for teacher preparation. In Indiana, Governor Evan Bayh moved licensing from the Indiana Department of Education (IDOE) to the newly created Indiana Professional Standards Board (IPSB), who promulgated the Standards for new teachers throughout the State. In short, the IPSB used Rules 2002 to license beginning teachers.

With the election in 2005, a new governor took control of Indiana's state government and dissolved the IPSB. Governor Daniels returned the teacher licensing authority to the IDOE. In 2010, the Advisory Board for Professional Standards approved Rules for Educator Preparation and Accountability (REPA). Students had until August 2013 to complete their program under Rules 2002. We now have REPA 3, which took effect in January 2015.

In July 2013, the National Council for Accreditation of Teacher Education (NCATE) merged with Teacher Education Accreditation Council (TEAC) to form Council for the Accreditation of Teachers (CAEP). CAEP leaves many accreditation issues to the specialized professional associations, which for us means National Council of Teachers of Mathematics. To see CAEP content standards for high school math teachers, visit: https://www.nctm.org/Standards-and-Positions/CAEP-Standards/ and scroll down to Secondary Math Teacher Preparation Program—Mathematics Content-secondary (PDF). The list of topics, including subpoints, is:

- Number and Quantity—five subpoints
- Algebra—seven subpoints
- Geometry and Trigonometry—10 subpoints
- Statistics and Probability—six subpoints
- Calculus—six subpoints
- Discrete Mathematics—five subpoints

USAP: The September 19, 2016 USAP Recommendations from the VCAA (Appendix A.2, Document 8.) reported on the math teaching track as follows:

One of the six degree options offered by the Department of Mathematics. Unlike other teaching degree programs in COAS, Math Teaching has dedicated TT/T faculty lines within the Department of Mathematics. Characterized by modest demand, participation, and success, the Math Teaching degree is currently the most viable of all programs offered by the department. However, it is also characterized by a significant decline in participation (Trend = 0.76). The future of these teaching degree programs is complicated by an anticipated shortage of secondary teachers. Recommendation: stabilize enrollment, develop and implement marketing plan for new students. Expectations: develop and implement marketing plan for new students, annually report student retention and success data.

Regarding teaching programs in general (DMS and other departments), the Sept. 19 Recommendations also commented:

One of the most challenging of the recommendations deals with the various secondary education preparation programs housed by departments in the College of Arts and Sciences. I expect the departments that currently offer such programs to work closely with the department of Educational Studies to establish a secondary education program that will support expected future regional workforce needs.

The main DMS retention and success initiative for math majors is the Math MALL, which is already achieving measurable outcomes (Section 4).

DMS and other departments are currently (2017) still working with CEPP on a campus-wide restructuring of the teaching programs. Going forward as a Purdue campus, our plan is to have math teaching majors double major with math as the first major and education in the CEPP as their second major. This should help

enrollment numbers, especially in the CEPP, but whatever changes we make may affect the CEPP's accreditation process.

The curriculum map for **2016** (Appendix D.1, Document 10.) shows how the teaching and pure math options were different at that time --- there is now (2018) a need to revise both programs to make them more closely aligned, and the requirements for teaching majors will significantly constrain the content and number of required courses. The declining enrollment trend is another complication, since low-enrolled courses have been subject to course cancellations, in particular, MA 460 (required by CAEP), MA 490 (strongly suggested by CAEP), MA 580 (History of Mathematics, required by CAEP), and EDUC M448 (absolutely required by CAEP and by the State of Indiana Department of Education). A recommendation under consideration is that *all* math majors take MA 460 and MA 580. Working with the CEPP, we have both prospective middle school and secondary teachers in M448. Although we firmly believe the *Problem Solving* (MA 490) course for prospective teachers is critical in redirecting their thinking about connections between and among math topics, we have satisfied CAEP by citing problem-solving experiences in other courses, most notably in MA 314. The mathematics educators firmly believe this course should be reinstated, regardless of low enrollments. It is critical to prospective teachers developing a more cohesive vision of mathematics and to their continuing growth in mathematical practices.

Connecting this issue with another DMS priority, HLC qualification for dual credit teachers now includes a requirement for all dual credit teachers to have 18 credit hours of graduate-level content courses. In order to be pre-emptive concerning this requirement, we plan to encourage our undergraduate teaching majors to take more 500-level courses. Proposals under consideration include MA 580, changing the MA 460 requirement to MA 560 (Fundamental Concepts of Geometry), including MA 556 (Introduction to Number Theory) as an elective option, or possibly replacing MA 453 (Elements of Algebra) with a combination of MA 556 and another course.

f. MS in Mathematics (option in "pure" mathematics) MS in Mathematics (option in "applied mathematics and operations research")

History: DMS has offered graduate-level courses since before the formation of IPFW as a joint campus, and is the only institution in the northeast Indiana region to offer any graduate-level degrees in mathematics.

Since before the last Program Review, the MS degree has offered two tracks to students: The MS with a major in Mathematics (with a "pure math" curriculum), and the (somewhat awkwardly titled) MS with a major in Mathematics and Option in Applied Mathematics/Operations Research. DMS also offers a graduate-level Certificate in Applied Statistics.

Students accepted into the graduate program work with the graduate program director on a path to graduation, but administratively were allowed to register under either option, or to switch options at any time, and some internal IPFW reports separate MS students into two groups, one for each of the corresponding codes recorded by the registrar. (A similar problem with the coding for the BS options was described in Section 2.a.) The IPFW registrar's code was of no consequence as far as what appears on student diplomas (which read only "MS with a major in Mathematics" for either option), or what is recorded by the Purdue University Graduate School's Enrollment reports:
https://www.purdue.edu/gradschool/faculty/enrollment.html

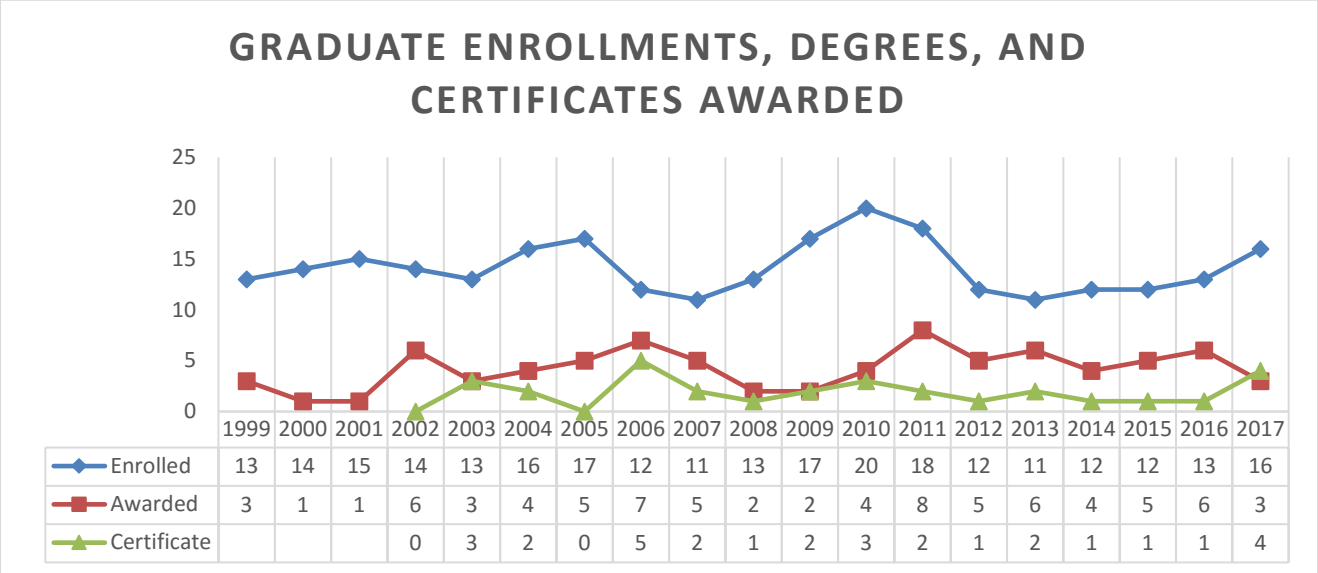
The graduation numbers also appear as just one MS in Mathematics, and one "CIP" code (Classification of Instructional Programs) in external reporting, for example, as recorded by the National Center for Education Statistics (NCES) (Appendix C, Document 11.).

Admissions to the MS programs were temporarily suspended in Fall 2016 as part of campus-wide academic restructuring resulting from the USAP process (see the USAP comments below). Admissions have since reopened, although the enrollment situation continues to be monitored by both DMS and the administration.

A new graduate course, STAT 520 (Time Series and Applications) was developed since the previous Program Review.

Enrollment trends: The following Enrolled numbers refer to students enrolled in any graduate-level program in DMS, including the MS degree program, the Certificate in Applied Statistics, and the MAT. Anecdotally, students in a degree program often wait until near the end of their program to enroll for the Certificate, just because there is a registration fee. The graduation data is separated into degree awards and Certificate awards.

Chart 2.h.



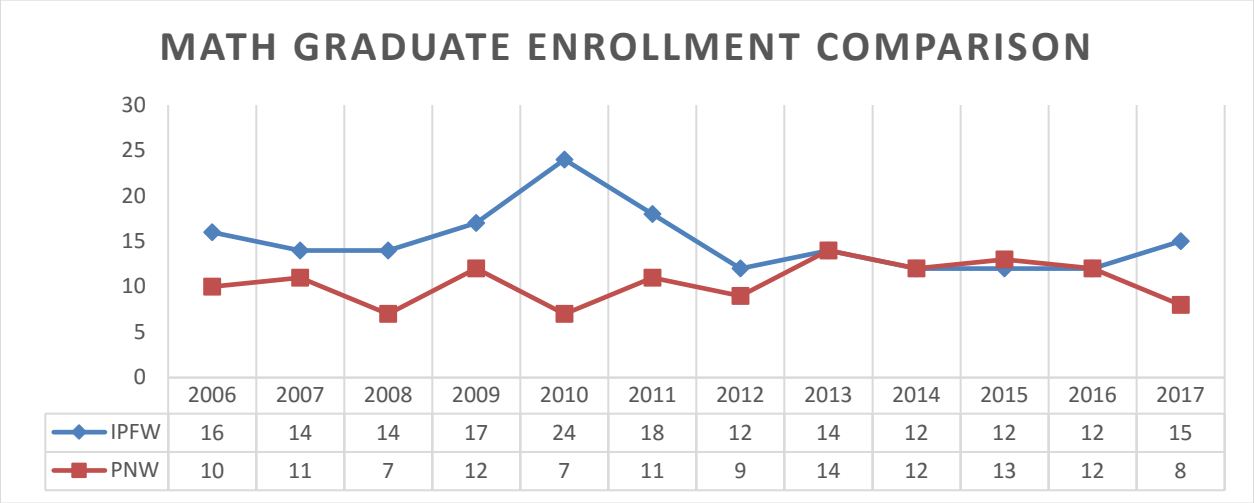
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Enrolled	13	14	15	14	13	16	17	12	11	13	17	20	18	12	11	12	12	13	16
Awarded	3	1	1	6	3	4	5	7	5	2	2	4	8	5	6	4	5	6	3
Certificate				0	3	2	0	5	2	1	2	3	2	1	2	1	1	1	4

Enrollment and degrees/certificates awarded appear to be stable over time. The bump in 2009-2011 was due to a cohort of MAT students (4 enrolled in 2009 and 2010, 2 in 2011, but 0 in years before or after). Another three MS degrees were already awarded in Fall 2017 (not included in Chart 2.h., which reports Summer-Fall-Spring academic years).

For purposes of comparison to a Peer Institution (see the DMS report, Appendix D.1, Document 2.), we consider Purdue University Northwest. The Purdue University system's Graduate School has administrative authority over graduate programs at all campuses (see the Management Agreement expiring in 2018, Appendix E.2, Document 1.), and its web site has enrollment summaries from both IPFW and PNW (Appendix C, Document 10.). The PNW data is reported from 2006 to 2011 as one MS degree in mathematics from the Purdue Calumet campus. In 2010, Purdue Calumet opened a new MS degree in computer science, and from 2012 to 2015, Purdue Calumet reported two different MS degrees, one in math and the other in computer science. The following Chart 2.i. lists only their math count. In 2016, the Calumet and North Central campuses merged to form PNW; the reports continue to list math and CS degrees

separately. The data from IPFW has always been reported as just one degree. A few of the data points show some variation between the enrollment numbers in the IPFW data (Chart 2.h.) and the Purdue Graduate School data (Chart 2.i.) but only by an insignificant amount.

Chart 2.i.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
IPFW	16	14	14	17	24	18	12	14	12	12	12	15
PNW	10	11	7	12	7	11	9	14	12	13	12	8

Assessment: The DMS has not been actively conducting an assessment process for graduate programs. The 2008 Program Review (Appendix D.2, Document 10.) described an assessment process that was followed before the 2011 adoption of the current assessment policy, which now covers only the undergraduate programs.

Accreditation: The graduate programs are not subject to any accreditation (other than that general to the campus). Some graduate students may take upper-level STAT courses which are related to the SOA UCAP listing. The American Mathematical Society classifies university mathematics departments very broadly as "Bachelors", "Masters", "Doctoral-Public" or "Doctoral-Private", so IPFW falls into the Masters category, but this classification is most useful statistically for a peer-group comparison of salaries (Subsection 5.f) or demographics, not for accreditation or curriculum.

Having a Masters-level classification is very valuable for quality faculty recruitment and when applying for external grant funding, and is consistent with IPFW's aspirations as a Metropolitan university.

USAP: The following Goal, Actions, and Metrics stated in the **Dec. 2014** report from DMS to USAP align with the IPFW goal (Appendix E.1, Document 1.) to "Create a Stronger University" and specifically the Plan 2020 target to maintain graduate enrollments at 1,000:

USAP UNIT GOAL 6: Increase by 30% number of graduate students in the Mathematical Sciences (includes MS programs in mathematics and applied mathematics, MAT program, and graduate certificate in statistics).

Action Step. **Work with the Doermer School of Business and ETCS to develop interdisciplinary certificates/degrees in the areas of financial mathematics, control theory, and image/signal processing.**

Needed Resources **- Fill in a replacement line in analysis/discrete math (see Goal 2). Tenure track hire in Statistics, so graduate certificate courses STAT 512, 514, 519, 520, 528 be delivered yearly, instead of biennially (see Goal 1 and 4).**

***Challenges* - Overall climate in the State discouraging Math high school teachers to seek Masters education.**

***Timeline* - Three to five years**

In the **2015** DMS report (Appendix A.1, Document 4), there were further comments on **Goal 6**, paraphrased here:

Why is this goal important to your unit, the university or both?
As forecasted by the Regional Intel Report by the CRI. "Approximately 17% (nearly 3,600) of regional openings over the next decade will be in analytical fields –potential connections to growth areas like Big Data, fraud prevention, market research, etc.", we anticipate that the NE Indiana regional needs for advanced graduate work in applied mathematics and applied statistics will increase. Since IPFW has the only graduate program in NE Indiana, we believe that increasing graduate enrollment directly supports the Plan 2020 mission statement.

Moreover, recent enforcement of HLC qualification for concurrent enrollment instructors creates a significant challenge in delivering the School-Based program classes. Increasing educational opportunities at the graduate level is of highest priority.

What progress have you made or which action steps have been completed?
Tenure track hire in Statistics allowed to increase the offering of STAT 516, 517, 520 to once a year from once every other year.

We have hired a current graduate student for the equivalent of a 1 course GTA to revise the departmental web site, which includes specific attention to the grad part of the site. We anticipate this will help with recruitment. We have increased enrollment of international students in the program.

The Feedback to DMS from the USAP Task Force in May 2016 stated that this goal was "***clearly aligned with the University's goals***" and that "***External Forces – HLC – should drive demand***". The overall USAP report (May 2016) did not mention DMS or IPFW graduate programs specifically, but did direct the VCAA to use viability standards at the degree level to assess programs for closure, restructuring, and investment.

The September 19, 2016 USAP Recommendations from the VCAA (Appendix A.2, Document 8.) reported on the graduate program as follows:

Applied Math Operations Research: One of three graduate programs offered by the department of Mathematical Sciences. Characterized by low demand, low participation, and low numbers of graduates. Recommendation: suspend program in favor of graduate program in actuarial science. Expectation: program suspended.

Math Applied Statistics Graduate Certificate: The second of three graduate programs offered by the department of Mathematical Sciences. Characterized by low demand, low participation, and low numbers of graduates low graduation efficiency and high attrition. Recommendation: suspend program in favor of graduate program in actuarial science. Expectation: program suspended.

Mathematics: The largest of the three graduate programs offered by the department of Mathematical Sciences. Characterized by low demand, low participation, and low numbers of graduates and declining enrollment. Recommendation: suspend program in favor of graduate program in actuarial science. Expectation: program suspended.

The subsequent action by the IPFW administration, following the intrusion of the Purdue Trustees into the campus strategic planning process and their directive to the IPFW administration to prematurely implement all USAP recommendations (Appendix A.2, Documents 9, 14.), was to "suspend admissions" to all DMS graduate programs, as announced in the Oct. 18, 2016 VCAA report on Academic Restructuring and confirmed in the Dec. 6, 2016 report. (Appendix A.2, Documents 10, 15.)

As a result of discussion in Fall 2016 and Spring 2017 between the DMS chair, COAS dean, and the vice chancellor, admissions were re-opened, with a plan to restructure the curriculum into just one advising track instead of two, and to set new enrollment targets. (See the Nov. 2016 COAS plan, Appendix A.2, Document 12., and the Feb. 2017 DMS plan, Appendix D.2, Document 1.). Current students may finish their programs under a teach-out plan. The new curriculum is still under development but will more closely follow the old applied track; some courses will no longer be offered, and some new dual-level (undergrad/graduate) courses will be available, such as the course in Predictive Analytics being developed for the SOA exams.

The graduate-level Certificate in Applied Statistics will also continue, as long as it does not require any courses not already required by other programs. The current curriculum has a significant overlap with dual-level courses required by the new BS degrees, and may be revised as new STAT courses are developed.

The recommendation to develop a new actuarial science graduate program was abandoned after it was determined there is no interest among prospective students or employers in any such degree beyond the new BS program.

The **Goal 6** target of increasing graduate enrollments by 30% over 3-5 years was accomplished by growing enrollments from 12 in 2014 to 16 in 2017 (see the above graph), a 33% increase even with the widely publicized suspension in 2016.

Part of the current enrollment is (as mentioned earlier) a number of high school teachers, who are enrolled in the MS program or are taking courses as post-baccalaureate students, in order to meet the Higher Learning Commission's requirements for dual credit teaching in high schools.

Return on Investment: Most 500-level MA/STAT courses are dual-level, with both undergraduates and graduate students attending. The graduate-only courses are MA 540, STAT 519, and STAT 528, delivered once every other year, offset by the .25 FTE of Cindy Weakley. The other graduate courses are utilized by undergraduate math, actuarial science, and data science students, and occasionally other engineering and science majors, as well as graduate students in Engineering, CS, and Business (see Chart 3.e., and also Appendix C, Document 5., for a "Historical Course Analysis" report on enrollment in 500-level MA/STAT courses).

A cost analysis (see the summary Table below and the detailed spreadsheet, Appendix D.1, Document 9.) of the all the Graduate Teaching Assistants (GTA) and Cindy Weakley's .25 FTE for the duration of Fall 2011-Fall 2017 reveals an estimated cost of $621,000, while tuition revenue from courses taught by GTAs is $2,539,680. State support being 40% of total budget extrapolates at 4/6 of this number to $1,693,120 for a total of $4,232,800 total revenue, or 682% Return on Investment (an .25 FTE of GTA stipend is evaluated at average of $3,300+$1,200 tuition waiver, Cindy's .25 FTE per semester is $4,500).

What is more important is that the GTAs are an integral part of the Higher Learning Commission certification of the Department's teaching staff. There is a significant shortage of LTLs with such certification; even fewer are available to teach on-campus sections in the morning or early afternoon. The only way to replace the

typical GTA teaching workload (six 0.5 FTE GTA assistantships), since an LTL alternative is impractical, would be to hire three new Continuing Lecturers (at $46,000 per year plus 30% fringe), almost doubling the cost of delivery.

Further, in the long term, having graduate-level education available in the NE Indiana region is needed to maintain a population of HLC-qualified LTLs and dual-credit teachers.

Table 2.j. DMS Graduate Teaching Aide workload 2011-2018

GTA Workload*				
Semester	FTE	Student headcount		Credit Hours
Fall '11	2.75	323		969
Spring '12	2.75	316		948
Fall '12	1.75	154		462
Spring '13	1.25	62		186
Fall '13	3	267		801
Spring '14	2	179		537
Fall '14	3.5	391		1173
Spring '15	2.75	299		897
Fall '15	2.50	260		780
Spring '16	3.50	259		777
Fall '16	2.75	238		714
Spring '17	2.75	224		672
Fall '17	3.25	284		852
Spring '18	2.25	218		556
Total	36.75	3474		10324
Cost		**661,500.00**	**CL alternative**	**1098825**
Tuition Revenue		2,684,240.00	at $23,000 per semester FTE	
State support @40%		1,789,493.33	and 30% fringe	
Total Revenue		**4,473,733.33**		
Return on investment		**676%**		

g. MAT (Master of Arts in Teaching)

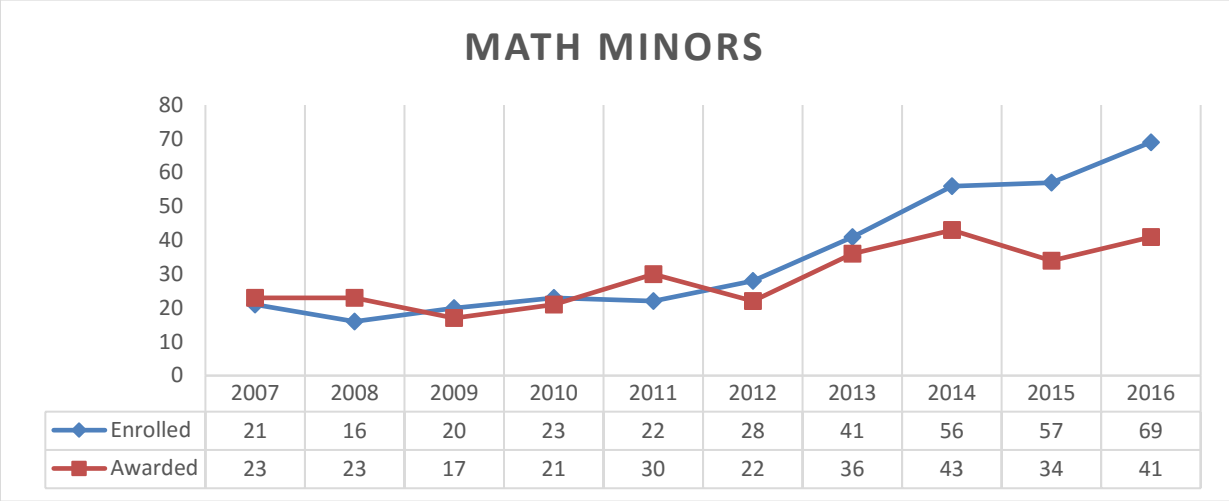
At the time of the previous Program Review in 2008, DMS was preparing to launch a Master of Arts in Teaching degree. Although IPFW had already long been authorized to offer such a degree (the M.A.T. was previously offered in the 1980's), a new curriculum was developed with a "cohort" structure so that all students in a cohort would start the sequence at the same time and take mostly the same classes. From 2009 to 2011, ten students completed this program. Since then, there have not been enough new students to start another cohort, but there is no administrative reason it could not be restarted if a number of new students were interested.

h. Math minors and research certificates

Students from any IPFW college may apply to DMS for a math minor. A DMS committee reviews a list of six math courses submitted by the student for approval. Anecdotally, many students wait until most of the courses are completed, which is why enrollment numbers are close to the number of minors awarded at

graduation. Many STEM programs already have a requirement of four or five qualifying math classes, so this program is popular! The recent growth in enrollments is unexplained but welcome; academic advisors, especially in ETCS, should all be made aware of this opportunity for students.

Chart 2.k.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Enrolled	21	16	20	23	22	28	41	56	57	69
Awarded	23	23	17	21	30	22	36	43	34	41

DMS also offers a Research Certificate to undergraduates who have completed a research project in mathematics or statistics. There have been only four such awards so far, all in 2015-2017.

3. Service and General Education Courses

a. History

DMS has historically offered a large number of sections of 100-level MA and STAT courses, for students meeting general education requirements, to meet basic mathematics requirements for majors outside of STEM areas, or to prepare students for the calculus-and-above MA and STAT courses. Some of the changes to the 100-level service courses since the previous Program Review (2008) are listed here:

- MA 109 and MA 113 are no longer offered. They have been replaced by MA 111 (Algebra) and MA 124 (both credit-bearing courses).
- MA 124 (Introduction to Mathematical Ideas) was introduced in Fall 2012, including an online section, it is used as a prerequisite for MA 140 and STAT 125. In Fall 2017, there was a shift from a 2 contact hour + 1 lab hour format to a traditional 3 contact hours.
- MA 111, 124, 140, 153 are now offered online as well as face-to-face.
- MA 153 and MA 140 are now part of the Course Transfer Library (CTL).
- Dual Credit for MA 153, MA 154, MA 140, and STAT 125 is offered.
- Online homework (MyMathLab (MML), Maple TA, WebAssign (EWA)) is utilized for all Pre-Calculus courses.
- A one-credit lab component (MA 11101) has been created for MA 11100.
- Video lectures have been created and are available online for all IPFW-enrolled MA 153 and STAT 125 students (including Dual-Credit students).
- MA 153, MA 140, and STAT 125 are General Education (Gen Ed) courses.
- Some Pre-Calculus instructors (both LTL and Full-time) spend Common Office Hours in CASA and/or the MALL.
- MA 168 had a name change to MA 140 because of misconceptions with the higher numeric value of the name creating the appearance of being more difficult than MA 153 (with the hopes of appealing to a wider audience).

- In 2016, the prerequisite for MA 153 was changed to MA 111 or 113 with a grade of B- or higher (previously, a grade of C- or better was permitted).
- MA 149 (Basic and College Algebra) is no longer offered.
- A new Placement exam has been created and is currently (2017) being piloted.

b. Enrollment trends

Table 3.a. 2012-2017 DMS Fall credit hour production

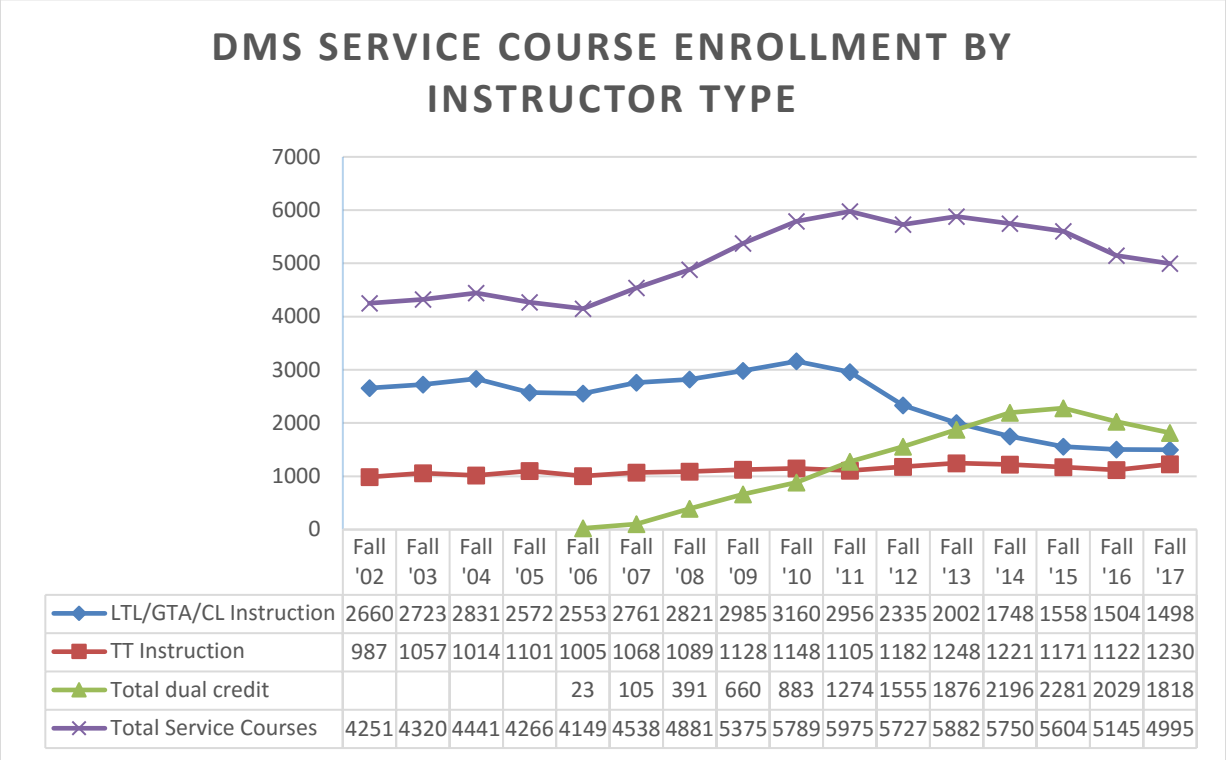
Fall	In-Major	Service	Total	Service %
Fall 2017	416	8331	8747	95.2%
Fall 2016	344	8530	8874	96.1%
Fall 2015	517	8972	9489	94.6%
Fall 2014	457	9660	10117	95.5%
Fall 2013	497	10665	11162	95.5%
Fall 2012	421	11646	12067	96.5%

Table 3.a. (see also Chart 3.c., below) compares in-major and service non-dual credit hour production of the Department of Mathematical Sciences. The first component of the service component includes LTL/CL taught pre-college, pre-calculus, quantitative reasoning, and statistics courses. A second component is the non-engineering service courses in Math Ed, Bio-statistics, Discrete and Finite mathematics, and applied Calculus. Together with the engineering calculus and advanced mathematics component, this constitutes the bulk of the TT instruction in the Department. The concurrent enrollment ("dual credit") program is the largest at IPFW and in NE Indiana with Fall 2017 enrollment of over 1,800 students in over 80 sections of Precalculus, Calculus, Quantitative Reasoning, and Statistics.

Table 3.b. 2002-2017 Fall headcount in service and dual credit courses

	Fall '02	Fall '03	Fall '04	Fall '05	Fall '06	Fall '07	Fall '08	Fall '09	Fall '10	Fall '11	Fall '12	Fall '13	Fall '14	Fall '15	Fall '16	Fall '17
Pre-college Math (111/12401)	**1338**	**1379**	**1305**	**1091**	**1025**	**1124**	**1037**	**1151**	**1339**	**1142**	**737**	**580**	**470**	**451**	**425**	**569**
Precalculus (153/154/159)	**1073**	**1032**	**1172**	**1145**	**1198**	**1235**	**1421**	**1400**	**1395**	**1328**	**1097**	**968**	**861**	**743**	**696**	**582**
QR (140/168)	**66**	**91**	**99**	**94**	**81**	**106**	**86**	**92**	**88**	**84**	**103**	**89**	**78**	**78**	**84**	**92**
Stat 125	**183**	**221**	**255**	**242**	**249**	**296**	**277**	**342**	**338**	**402**	**398**	**365**	**339**	**286**	**299**	**255**
LTL/GTA/CL Instruction	**2660**	**2723**	**2831**	**2572**	**2553**	**2761**	**2821**	**2985**	**3160**	**2956**	**2335**	**2002**	**1748**	**1558**	**1504**	**1498**
Math Ed (101/102/103)	**301**	**366**	**285**	**338**	**239**	**323**	**316**	**315**	**276**	**251**	**258**	**238**	**286**	**234**	**265**	**270**
Bio Stat 240	**32**	**36**	**65**	**50**	**51**	**57**	**55**	**61**	**65**	**49**	**67**	**59**	**79**	**82**	**82**	**88**
Discrete 175	**80**	**92**	**66**	**57**	**59**	**36**	**39**	**34**	**34**	**39**	**73**	**40**	**72**	**88**	**83**	**79**
Finite 213 (IUFW)																**125**
Applied Calculus 229	**276**	**265**	**287**	**298**	**305**	**323**	**311**	**287**	**292**	**323**	**311**	**405**	**300**	**284**	**252**	**236**
Calculus (165/166)	**214**	**210**	**199**	**222**	**235**	**214**	**232**	**278**	**304**	**282**	**282**	**290**	**271**	**294**	**264**	**273**
Advanced (261/351/363)	**84**	**88**	**112**	**136**	**116**	**115**	**136**	**153**	**177**	**161**	**191**	**216**	**213**	**189**	**176**	**159**
TT Instruction	**987**	**1057**	**1014**	**1101**	**1005**	**1068**	**1089**	**1128**	**1148**	**1105**	**1182**	**1248**	**1221**	**1171**	**1122**	**1230**
Total on-campus	**4251**	**4320**	**4441**	**4266**	**4126**	**4433**	**4490**	**4715**	**4906**	**4701**	**4172**	**4006**	**3554**	**3323**	**3116**	**3177**
Total dual credit					**23**	**105**	**391**	**660**	**883**	**1274**	**1555**	**1876**	**2196**	**2281**	**2029**	**1818**

Chart 3.c. (Based on Table 3.b.)



	Fall '02	Fall '03	Fall '04	Fall '05	Fall '06	Fall '07	Fall '08	Fall '09	Fall '10	Fall '11	Fall '12	Fall '13	Fall '14	Fall '15	Fall '16	Fall '17
LTL/GTA/CL Instruction	2660	2723	2831	2572	2553	2761	2821	2985	3160	2956	2335	2002	1748	1558	1504	1498
TT Instruction	987	1057	1014	1101	1005	1068	1089	1128	1148	1105	1182	1248	1221	1171	1122	1230
Total dual credit					23	105	391	660	883	1274	1555	1876	2196	2281	2029	1818
Total Service Courses	4251	4320	4441	4266	4149	4538	4881	5375	5789	5975	5727	5882	5750	5604	5145	4995

Table 3.b. and Chart 3.c., showing the 2002-2017 data, reveals that LTL/CL instruction has declined, primarily as pre-college math is transferred to Ivy Tech and pre-calculus to dual-credit. At the same time, enrollment in service classes with TT instruction remains relatively static. The total DMS service course enrollment follows a pattern comparable to the overall campus enrollment (Chart 2.b.). See also the report generated by IR data (Appendix C, Document 5.): Historical Course Analysis: Enrollment by course level (100/200/300/400/grad), which shows some growth in 300-level courses (including linear algebra MA 351 and differential equations MA 363 for STEM majors).

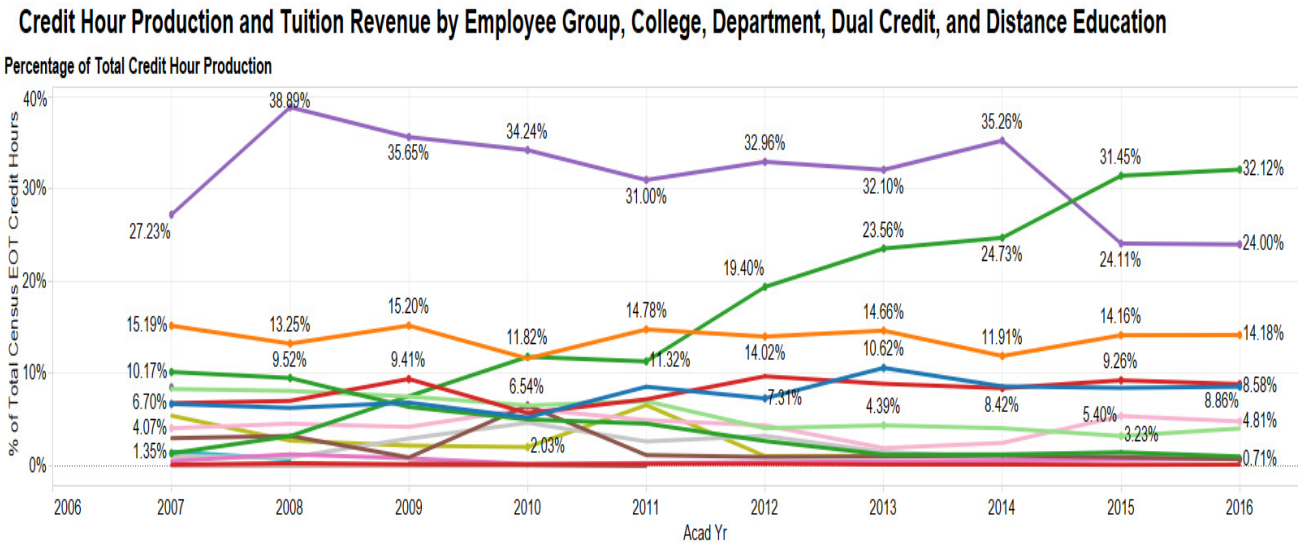
As IPFW trended toward a more traditional student population, with higher demand for upper-level Math courses, the following sections were added after 2012:

Fall and Spring sections of MA 175, MA 351, MA 363, STAT 340/240; Summer sections of MA 165 (2), MA 165 (2), MA 175, MA 261, MA 351, STAT 511;

This was done without additional resources by redirecting TT instructors and moving more qualified LTLs and GTAs to MA 140, MA 229, and STAT 125.

The shift from on-campus to dual-credit instruction in DMS is also clearly visible in the following Chart 3.d. from IPFW Institutional Research (for a snapshot of the entire Factbook report as a PDF, see Appendix C, Document 3.). It shows Mathematical Sciences credit hours graphed in terms of percentages of the total, taught by different categories of instructor.

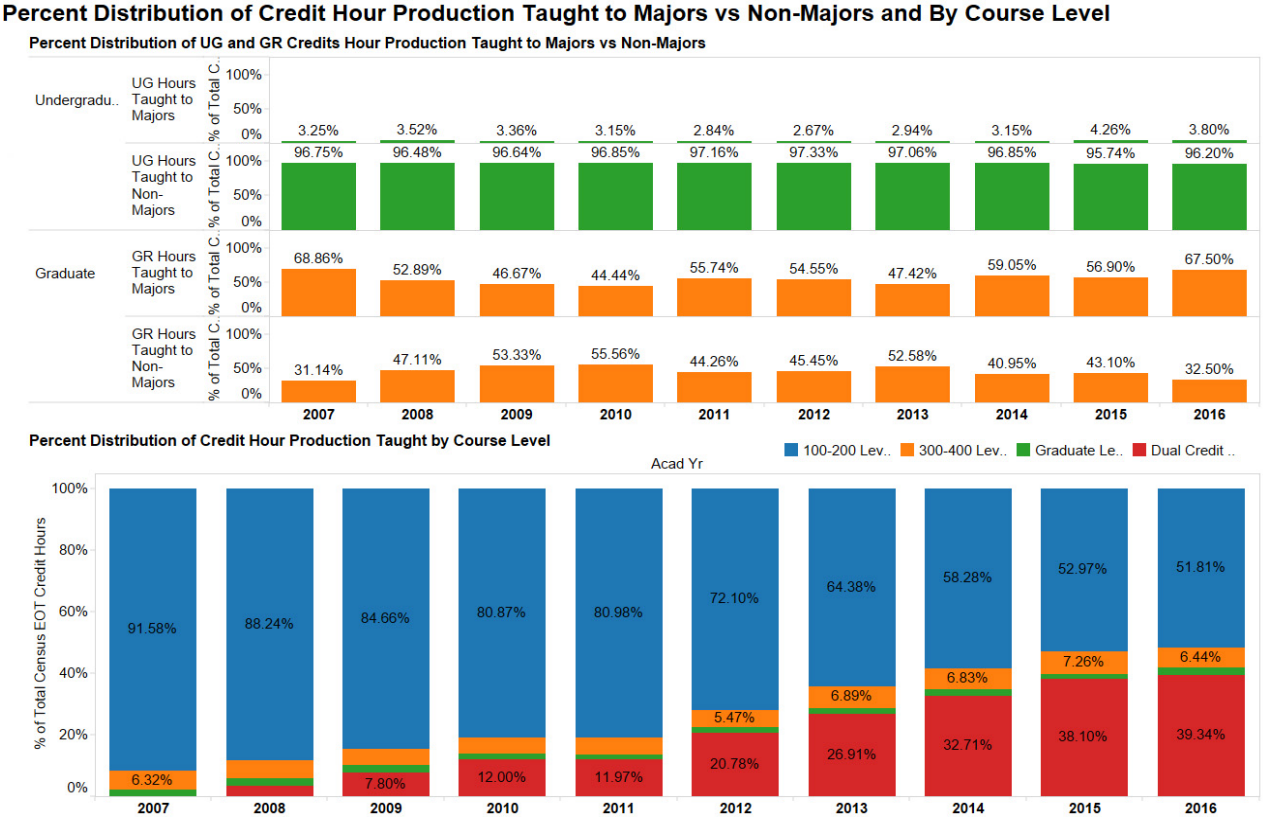
Chart 3.d.



Most employee categories (Associate Professor, GTA, etc.) stay in a stable percentage range. The purple graph, peaking at 38.89% of DMS credit hours in 2008, and dropping to 24.00% in 2016, is the percentage taught by LTLs. The green graph, climbing from 1.35% in 2007 to 32.12% in 2016, is the percentage taught by high school teachers in dual-credit classes. The only other significant trend in Chart 3.d. is the steady decline in percentage of credits taught by Assistant Professors (the other green graph), from 10.17% in 2007 to 0.71% in 2016. This is explained below in Chart 5.a. in Subsection 5.d.

The importance of service courses to DMS and the role of DMS as a service department at IPFW is also demonstrated by the following chart from the same IR Factbook.

Chart 3.e.



Observations from Chart 3.e:

- The undergraduate hours (top green) do not include dual credit courses taught by high school teachers.
- Consistently over time, more than 95% of DMS undergraduate credits are taught to non-majors.
- A significant percentage of graduate-level credits (top orange) are taught to non-majors.
- The lower part of Chart 3.e. also shows the dramatic increase in the percentage of credits at the dual-credit level (red).

c. Concurrent Enrollment (Dual-credit)

DMS oversees a robust, National Alliance of Concurrent Enrollment Programs (NACEP) accredited dual credit program comprising eight courses:

- Precalculus: MA 15300-15400;
- Calculus: MA 16500-16600;
- Statistics: STAT 12500 and STAT 30100;
- Quantitative Reasoning: MA 14000; and
- Finite Mathematics: MA 21300.

The program is housed in 23 school districts in Northeast Indiana. For Fall 2017 there are in excess of 5500 credit hours taught by 58 teachers in 33 high schools. We are the largest dual credit program by credit hour at IPFW (for historical snapshots, see the Dual Credit Enrollment Report in Appendix D.1, Document 6.).

The program is overseen by Departmental Representative, Dr. Jim Hersberger, who is also the Associate Chair of Mathematical Sciences and the DMS representative to the Indiana Commission for Higher Education (ICHE) Core Transfer Library (CTL). He, along with Ms. Linda Wagner and Mr. Bob Lovell, observe each instructor's classroom once per year per course. Ms. Wagner is a Continuing Lecturer and member of the DMS Precalculus Committee, and Mr. Lovell is a former high school department chair, DMS Visiting Instructor (2009-10), and Indiana Presidential Award winner in Mathematics. Hersberger observes calculus, STAT 30100 and Finite Mathematics, while Wagner and Lovell observe precalculus, quantitative reasoning, and STAT 12500.

Observations are used to ensure that the rigor of the material is appropriate and make sure individual students are engaged at a sufficient level. Current syllabi and examples of classroom assessment instruments are collected, and Dr. Hersberger compares and contrasts them with DMS examples. Teachers must follow DMS guidelines, including the expectation that at least 25% of the course grade be a comprehensive Final Exam.

All teachers receive an initial orientation, and all teachers participate in yearly professional development. Teachers use the DMS submission to the CTL (Appendix D.2, Document 9.) in courses where appropriate (MA 14000, 15300, 15400, 16500, 16600 and 21300) and approved DMS syllabi in the others. Sections of MA 16500 and 16600, as well as STAT 30100 must also follow the College Board's Advanced Placement syllabus expectations. Teachers are expected to meet Higher Learning Commission credentialing expectations, and have until 2021 to meet them. Of the 58, 55 hold a master's degree while three are currently enrolled in our graduate programs. Of the 55, 25 have completely met the HLC credentialing requirement (for a list of teachers who have taught dual credit courses, see the Dual Credit Enrollment Report, Appendix D.1, Document 6.).

d. Assessment

DMS follows the assessment guidelines and process established by the Senate and the General Education Subcommittee (Appendix B.2, Document 5). DMS curriculum committees (listed below) prepare the assessment reports for each of the courses on the General Education list. These reports appear in Appendix B.1, Document 11.

MA 101 – Elementary Concepts ; MA 140, 153, 159 – Precalculus ; MA 165, 166, 227, 229 – Calculus ; MA 314 – Discrete Math ; STAT 125 – Statistics.

For the dual-credit courses offered off-campus, student achievement in courses which meet the IPFW General Education requirement (MA 15300, MA 16500, 16600, and STAT 12500) are assessed in the same manner as on campus sections. DMS regularly monitors success rates as collected by Institutional Research, and has utilized data collected by ICHE in its Mathematics Pathways report (Appendix C, Document 12.).

e. Accreditation

i. The DMS general education courses are part of the IPFW General Education program, which is compatible with the Indiana Statewide Transfer General Education Core, as described in the IPFW Bulletin.

- IPFW web page on Gen. Ed. https://www.pfw.edu/offices/oaa/programs/general-education-program.html
- ICHE web page on STGEC http://www.in.gov/che/4628.htm

ii. IPFW participates in the Indiana Core Transfer Library, including many DMS courses. (For some CTL course submission forms, see Appendix D.2, Document 9.). https://transferin.net/earned-credits/core-transfer-library/

iii. The DMS dual credit courses are accredited by the National Alliance of Concurrent Enrollment Programs (NACEP). http://www.nacep.org/

iv. The recent change in HLC standards for LTL qualifications is a challenge for DMS teaching assignments, especially for sections in the pre-college courses MA 111 and MA 12401. Moreover, as the student body trends to a more traditional demographic, evening sections, where there is LTL capacity, are not meeting minimum enrollment levels. This contributes to the need to keep using GTAs (Subsection 2.f) and to replace TT faculty (Section 5).

f. USAP

The following Goals, Actions, and Metrics stated in the Dec. 2014 USAP report (Appendix A.1, Document 1), align with the IPFW goal (Appendix E.1, Document 1.) to "Foster Student Success":

USAP UNIT GOAL 2: Increase success rates by 10% in high volume service courses that function as gateways to students' majors or satisfy IPFW general education requirements.

Action Step 1. **Partner with Indiana Commission for Higher Education's Mathematics Innovation Council to determine current success rates by major in gateway mathematics courses.**

Action Step 2**. Increase student engagement with department faculty and tutors in the MATH Mall and CASA.**

***Action Step 3*. Increase student and instructor usage of instructional videos developed for MA 15300/15400/15900, MA 16500/16600, and STAT 12500 in all instructional delivery modes (on campus, online and dual credit).**

***Metric*: Track changes in DFW rate in STAT 12500, MA 14000, MA 15300/15400/15900, MA 16500/16600, MA 22700/22800, and MA 22900. Track number of student visits to the MATH Mall and CASA, as well as usage of videos.**

***Needed Resources*: Replacement line in analysis/discrete math to have all calculus and above courses taught by PhD qualified faculty (see also graduate program goal).**

***Timeline*: Three to five years**

USAP UNIT GOAL 3: Improve student achievement in calculus for science and engineering (MA 16500 & MA 16600).

***Action Step 1*. Develop and administer comprehensive exam in all on campus, online, and school based sections in the 2014-2015 academic year.**

***Action Step 2*. Analyze results to determine consistency of achievement across and within delivery modes, and identify focus areas for instructional reform.**

***Metric*: [2014-15 is an…] Information gathering year. Metrics established for 2015-2016 following analysis of data.**

***Challenges*: Both development of the instrument and method of analysis will be challenges. Physical collection of data will be challenging due to differences in IPFW and school corporation calendars.**

The second report from DMS to USAP in **2015** (Appendix A.1, Document 4.) modified Goals 2 and 3:

In light of the Mathematics Pathways report from the Indiana Higher Education Council's Mathematics Innovation Committee, which differentiates pathways for calculus and non-calculus tracks in mathematics, we have combined and modified Goal 2 and Goal 3 of the 2014-2015 USAP report.

The report details success rates at all Indiana public colleges in required entry level math courses, and makes recommendations regarding a restructuring of what is expected in various majors. A key focus is the desire to create a Quantitative Literacy course which would serve as the requirement for majors which do not require calculus. It is expected that a consequence of such a switch would be fewer under-prepared students taking College Algebra, or in the case of high school students, pre-calculus. We want to design better placement that will put students in the correct pathway.

The second USAP report gives details on the rationale behind the goal for improved placement and what steps had been taken so far toward this goal and also toward increased student success in the general education courses and calculus sequence. The Math MALL was mentioned as an Action Step; the results since then have been positive (see Section 4).

By the time of the second USAP report, the plan for a “comprehensive exam” (a common final exam for all calculus sections including dual-credit) was abandoned, due to the (anticipated) practical difficulties.

Current (2017) status of USAP UNIT GOALS 2 and 3:

DMS is in the process of implementing new placement tool, and has educated advisors that students in majors not requiring calculus should consider alternative Gen Ed courses MA 140 and STAT 125.

DMS is continuing to collaborate with CASA on MA 140 and STAT 125 tutors.

Student success in general education courses, including calculus, is being tracked through the Assessment process (for data and reports, see Appendix B.1, Document 11.). See also Section 4 for data showing the impact of the MALL.

Instead of a common final exam for calculus, the Assessment process for calculus courses now asks for a small number of common questions to appear on exams in every section, corresponding to specific learning outcomes.

Prior to the opening of the MALL in 2014, DMS organized "common office hours" for calculus or pre-calculus - where faculty in their individual offices opened some office hours to students in any section. Since the MALL opened in Kettler G38 in 2014, faculty now, instead, volunteer to hold some office hours there. http://users.pfw.edu/CoffmanA/OfficeHoursArchive.html

USAP UNIT GOAL 4: Increase by 50% student enrollment in honors courses delivered by the Department.

The second report from DMS to USAP in **2015** (Appendix A.1, Document 4.) abandoned Goal 4. There was insufficient student demand for Honors versions of MA 103 (elementary education) or STAT 125. The Honors Calculus section has continued to be offered regularly and is slowly growing since being developed in 2000; in Spring 2018, there are 17 students (out of a maximum of 20) registered for the Honors section of MA 166 (second-semester calculus).

4. Student Success and Retention

DMS Goals in the USAP reports (Appendix A.1, Documents 1,4.) and Recommendations from the administration in response to USAP (Appendix A.2) all refer to investments in, and continued monitoring of, student success and retention at IPFW.

a. Assessment

A commonly used measure of student success is a **low** "DFW rate" – or equivalently, a **high** percentage of all enrolled students getting a grade (A/B/C) allowing them to pass to the next class, instead of a "D" or "F" grade or a "W" indicating Withdrawal. A different measure would be to consider just the subset of students who completed the course by taking the final exam. This may be a more accurate assessment of the effectiveness of instruction, and gives greater consideration to students who are relatively more motivated, and engaged in the classroom. There are also other measures of student engagement in coursework, such as electronic homework scores or completion rates, so several other metrics could be developed to give even more detailed measurement of, and indications of contributing factors for, student success. It is a reasonable Goal for DMS to improve a recomputed DFW rate, accounting for these students more engaged in the instruction process. The following summary of **Fall 2017 success rates** compares the usual metric (third column, A/B/C = Success) to the proposed new metric which counts only students taking the final (last column).

Course	# Enrolled	% Success	A's	B's	C's	D's	F's	W's	I's	# Completed (took final)	% Success Given Completed
MA10100	109	83.5	64	17	10	1	10	5	2	95	95.8
MA10200	72	84.7	22	19	20	4	2	5	0	65	93.8
MA10300	52	86.5	8	22	15	4	1	1	1	50	90.0
MA11100	177	44.1	11	32	35	28	52	18	0	112	69.6
MA11101	172	59.3	51	35	16	11	42	17	0	113	90.3
MA12401	223	37.7	15	20	49	34	64	41	0	133	63.2
MA14000	92	46.7	7	12	24	6	17	26	0	59	72.9
MA15300	440	48.4	49	69	95	50	94	81	4	290	73.4
MA15400	130	53.1	16	30	23	12	30	19	0	96	71.9
MA15900	7	85.7	1	2	3	0	0	1	0	6	100.0
MA16500	152	59.2	19	32	39	12	22	28	0	112	80.4
MA16600	120	63.3	25	23	28	10	20	15	0	92	82.6
MA17500	79	74.7	15	26	18	1	8	10	1	61	96.7
MA21300	125	70.4	50	22	16	8	20	9	0	103	85.4
MA22700	48	66.7	5	15	12	2	9	5	0	35	91.4
MA22800	8	75.0	1	3	2	0	2	0	0	6	100.0
MA22900	237	53.2	44	40	42	30	38	43	0	168	75.0
MA26100	51	82.4	19	7	16	1	5	3	0	46	91.3
MA27300	17	41.2	5	2	0	1	3	6	0	10	70.0
MA28400	1	100.0	0	0	1	0	0	0	0	1	100.0
MA35100	61	75.4	15	21	10	5	6	4	0	54	85.2
MA36300	47	85.1	17	13	10	2	1	4	0	42	95.2
MA45300	7	85.7	2	3	1	0	1	0	0	6	100.0
MA46000	9	88.9	5	3	0	0	0	1	0	8	100.0
MA48700	1	100.0	0	0	1	0	0	0	0	1	100.0
MA49000	3	66.7	2	0	0	0	0	1	0	2	100.0
MA51100	12	83.3	5	4	1	1	0	1	0	11	90.9
MA55300	4	100.0	2	1	1	0	0	0	0	4	100.0
MA57100	4	100.0	3	1	0	0	0	0	0	4	100.0
TOTALS	**2460**	**58.5**	**478**	**474**	**488**	**223**	**447**	**344**	**8**	**1785**	**80.7**
STAT12500	251	55.8	34	57	49	32	48	29	1	188	74.5
STAT30100	52	67.3	13	14	8	7	4	6	0	43	81.4
STAT34000	87	82.8	23	29	20	5	7	3	0	81	88.9
STAT51100	35	94.3	16	14	3	2	0	0	0	35	94.3
STAT51200	22	86.4	5	9	5	0	1	2	0	20	95.0
STAT51600	24	95.8	15	5	3	0	0	1	0	23	100.0
TOTALS	**471**	**68.4**	**106**	**128**	**88**	**46**	**60**	**41**	**1**	**390**	**82.6**

b. Report on Retention Initiative

A major goal of the previous Program Review (2008, Appendix D.2, Document 10.) was the establishment of a resource and tutoring center for undergraduate students. This was accomplished by the efforts of DMS faculty in founding the Math Assistance Learning Lab (MALL). This Subsection reports on the success of this effort so far. More details, including supporting data and the original grant proposal, are given in Appendix D.2. The start-up funding for the MALL, from the Transformational Allocation Program (TAP), was mentioned in the Chancellor's remarks at the Fall 2014 faculty convocation (Appendix E.1, Document 5).

Mathematics Assistance Learning Lab (MALL)
3-year Analysis

In the fall semester of 2014, the IPFW Department of Mathematical Sciences, in conjunction with the Academic Success Center (ASC), introduced the Mathematics Assistance Learning Lab, or MALL. The project was funded in part with a TAP grant. The original TAP proposal notes that the D, W, F rates in introductory mathematics and statistics courses are among the highest at IPFW. Universities throughout the country, IPFW included, count students' inability to successfully complete these required courses as the number one academic roadblock to student retention and graduation. The TAP proposal goes on to say, "The intention of this project is to increase success in entry level mathematics and statistics courses, and to assist students in more advanced courses that are a required part of several popular majors, thus increasing year-to-year retention rates and 4-year graduation rates." The purpose of this report is to attempt to evaluate the success of the MALL in achieving this goal.

In accordance with the project's proposal, the MALL consists of two distinct, but related, parts: an Online MALL and a Physical MALL, created in Kettler Hall, room G38 (KT G38). The goal of the online MALL was to provide many resources to all IPFW students, including those taking concurrent enrollment courses at area high schools as part of IPFW's School Based Program (SBP). These resources were to include, but not be limited to, instructional videos for most introductory mathematics and statistics courses, a library of worksheets and activities, as well as the offering of online tutoring.

Instructional videos for MA15300, MA16500 and STAT12500 were created and are available for student use, with the creation and inclusion of videos for additional courses expected to happen soon. Although it is difficult to track how much usage these videos get, instructors in online sections of these courses report that their students have watched the videos and report that they are felt to be quite effective. No feedback was available, however, to ascertain whether SBP students are going online to watch these videos. A survey of the high school teachers who teach these sections to see if they believe that this resource is being utilized by their students and if it is found helpful would be suggested going forward.

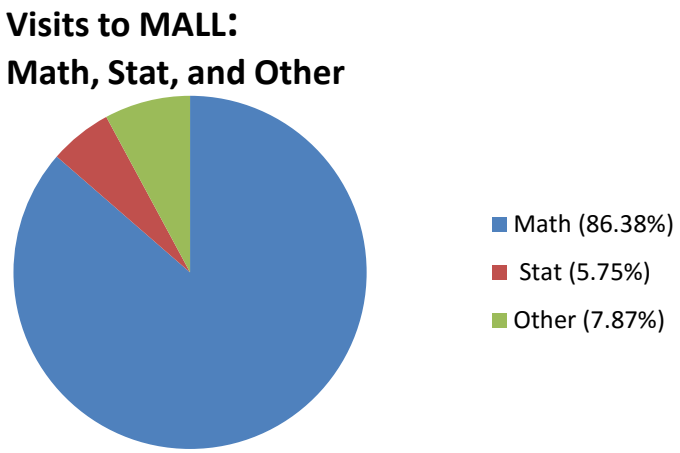
The library of worksheets and activities and the offering of online learning have not yet materialized. The building of the activity library is reliant on instructors offering their materials to the MALL, and few instructors have come forward to do so at this time. However, Academic Success Center (ASC) is currently working on implementing online tutoring. It is expected to be piloted in spring of 2018 in the online sections of MA12401 and MA15300, with hopes of it being more widely offered in fall of 2018.

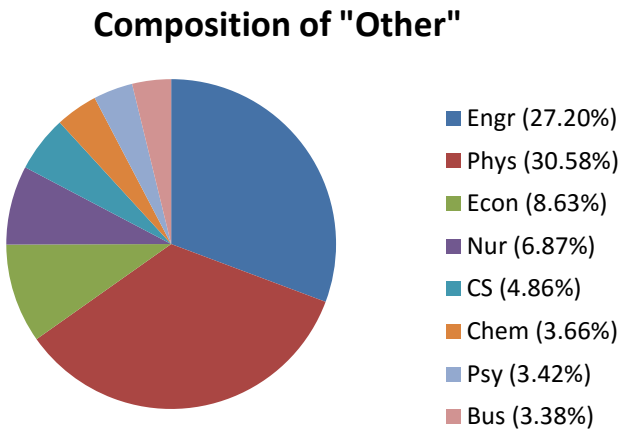
The intent for the physical MALL was to offer a place for students in calculus and above to work in groups, often with the help of a tutor or a faculty member. Tutors working in the MALL must have 4

semesters of calculus and above, and maintain a 3.0 overall GPA. Dianna Zook, the MALL administrator, has stated she is pleased with the quality of tutors we are able to provide our students as well as with the amount of students seeking tutoring at the MALL. In analysis of this utilization, a list of all visits to the MALL from Fall 2014 through Spring 2017 was obtained and organized in Table 1 by semester, discipline, and course (see Table 1 in the Fall 2017 MALL report, Appendix D.2, Document 8). The table lists the number of visits as well as the total length of the visits. This data set is reliant on students correctly signing in to the tracking system. Students are required to log in and out by swiping their student ID in the card reader. The students also select which of their courses they are seeking assistance with from a list of their currently enrolled courses.

Each semester, the MALL averages 993 visits from students enrolled in more than 40 different courses, with visits lasting an average of 1.16 hours. Of these visits, approximately 86% are by students in mathematics courses and about 6% are in statistics courses (see figures below). The remaining 8% is comprised of students from a variety of disciplines, including many other science-based courses such as engineering, chemistry, physics, and computer science. Additionally, students from nursing, business, psychology and economics courses have been regular clients of the MALL.

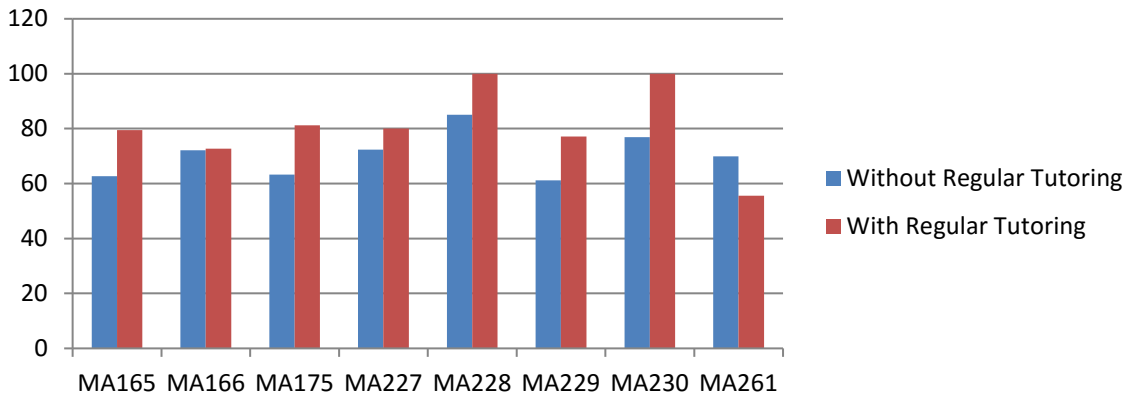
Chart 4.a.





The primary goal of the MALL is to increase success in entry level mathematics and statistics courses. By comparing the success rates of students who are regular users of the MALL to the success rates of non-users, we hope to see the increase we aspire to. However, this first requires a definition of what "regular" MALL attendance is. Conferring with Dianna Zook, the average of one visit per week was agreed upon as a definition of "regular." However, since the MALL is not open the first week of classes or the week of final exams, and since usage is low the second week of classes and holiday weeks, a benchmark level of 10 visits per semester in a single course was the final cutoff number agreed upon. Using this benchmark, the students who were regular users of the MALL had a higher final grade than those not receiving regular tutoring. The bar graph below shows significant improvement for students in all of the calculus courses, and especially in MA16500 and MA229000, which are the courses representing the highest utilization of the MALL. The weighted average of success rates over the six semesters, from fall 2014 through spring 2017, for MA16500 students who did not seek regular help at the MALL was about 63%, compared to 79% for those who did regularly attend MALL tutoring. Similarly, the weighted average of success rates in MA22900 without regular tutoring for the same 6 semesters was about 61% versus the 77% success rate achieved by regular MALL users.

Chart 4.b.



According to the original TAP proposal, "The intention of this project is to increase success in entry level mathematics and statistics courses, and to assist students in more advanced courses that are a required part of several popular majors, thus increasing year-to-year retention rates and 4-year graduation rates." While it is impossible at this early date to determine whether the MALL has had any effect on retention and graduation rates, it clearly has raised the success rates in most of the calculus level courses, which was the primary audience on which creation of this resource was focused. With continued endorsement by instructors of these courses and word-of-mouth recommendations of students who use it regularly, the MALL will likely continue to grow as a valuable resource for students looking to improve their outcome in these courses.

5. Faculty

a. Lists of Faculty

Table: List of DMS faculty 2017-18 with Δ=Partial Retirement

Tenure-track	
1. **Safwan Akkari**, Assoc. Prof.	16. **Robert Vandell**, Assoc. Prof.
2. **Jeff Anderson**, Prof.	17. **W. Douglas Weakley**, Prof.
3. Δ **Lowell Beineke**, Schrey Professor	18. **Daniel Yorgov**, Assistant Prof.
4. **Betsy S. Berry**, Assoc. Prof.	19. **Yuan Zhang**, Assoc. Prof.
5. **Bernd Buldt**, Prof.	20. **Dianna Zook**, Instructor
6. Δ **Chand Chauhan**, Assoc. Prof.	21. **Yvonne Zubovic**, Assoc. Prof.
7. **Adam Coffman**, Prof.	**Non-Tenure-track**
8. **Dan Coroian**, Assoc. Prof.	22. **Deana Alexander**, CL
9. **Yihao Deng**, Assoc. Prof.	23. **Joe Francis**; part-time CL/actuary in residence
10. **Peter Dragnev**, Prof.	24. **Alan Legg**, Visiting Assistant Prof.
11. **James Hersberger**, Prof.	25. **John Osowski**, CL
12. **John LaMaster**, Senior Instructor	26. **Cindy Vanderlaan**, CL
13. Δ **Sue Mau**, Assoc. Prof.	27. **Linda Wagner**, CL
14. **Yifei Pan**, Prof.	28. **Matthew Walsh**, Special LTL
15. **Douglas Townsend**, Prof.	29. **Cecilia Weakley**, part-time Assistant Prof.

Supplemental Reports with current and historical information on DMS faculty, specifically prepared for this Program Review, appear in Appendix D.1:

- **DMS Detailed Faculty Profile**
  http://users.pfw.edu/coffmana/PR2017/2017ProgReviewFacultyProfile.pdf
- **DMS Report on Faculty Salaries**
  http://users.pfw.edu/coffmana/PR2017/2017ProgReviewSalary.pdf
- **DMS Report on Faculty Awards**
  http://users.pfw.edu/coffmana/PR2017/2017ProgReviewFacultyAwards.pdf
- **DMS Summary of Concurrent Enrollment courses**, listing off-campus dual credit teachers
  http://users.pfw.edu/coffmana/PR2017/ProgRev17DualCreditEnrollment.pdf

A current list of DMS faculty is maintained on the DMS web site:
https://www.pfw.edu/departments/coas/depts/math/current-students-and-faculty/faculty.html
Separate web pages list the current (Fall or Spring) semester's Limited Term Lecturers (LTL):
https://www.pfw.edu/departments/coas/depts/math/current-students-and-faculty/associate.html
and Graduate Teaching Assistants (GTA):
https://www.pfw.edu/departments/coas/depts/math/current-students-and-faculty/assistants.html

The DMS Associate Chair maintains a list of available and qualified LTLs and manages one-semester contracts. The number of individuals hired as LTLs depends on the expected need for staffing lower-level courses. The IPFW Division of Continuing Studies also hires some LTLs for online-only mathematics and statistics courses. The GTAs are chosen from among enrolled graduate students by the DMS Graduate Director, who coordinates with the Associate Chair on teaching assignments.

b. Qualifications of Faculty

100% of the Professor/Associate Professor/Assistant Professor faculty have terminal (PhD) degrees and have published in their area of research. Most continue to be sufficiently active in research to meet the DMS criteria for a 25% research workload assignment. The Senior Instructor, Instructor, and Continuing Lecturers have Master's degrees. The Actuary in Residence is a Fellow of the Society of Actuaries.

The LTL qualifications have been the subject of discussion after recent changes in standards by the Higher Learning Commission. The qualifications guidelines applying to LTLs in DMS (and more widely across IPFW) appear in this document (Appendix F, Document 1.):
http://download.hlcommission.org/FacultyGuidelines_2016_OPB.pdf

> *Faculty teaching general education courses, or other non-occupational courses, hold a master's degree or higher in the discipline or subfield. If a faculty member holds a master's degree or higher in a discipline or subfield other than that in which he or she is teaching, that faculty member should have completed a minimum of 18 graduate credit hours in the discipline or subfield in which they teach.*

The HLC document goes on to explain that this standard also applies to Dual Credit teachers – high school teachers who are teaching courses that IPFW will accept for college credit. See Subsection 3.c and the DMS Report on Concurrent Enrollment (Appendix D.1, Document 6.).

c. Quality teaching, research, and service

DMS is the only institution for research in mathematical sciences in northeast Indiana and we regard ourselves as a world-class research and teaching department and the top non-PhD-granting mathematical sciences department in Indiana. A strong mathematical sciences research program supports our teaching and service, and is important to the campus in its academic and regional missions.

DMS faculty research groups fall into these broad categories: discrete math, analysis, statistics, and mathematics education. These roughly correspond to curriculum areas in courses and programs. We expect future hires will have expertise compatible with existing research groups, rather than trying to diversify into other areas not currently represented, such as number theory.

For purposes of promotion and tenure, the main source of evidence of the quality of an individual faculty member's research is letters of evaluation from external experts --- which are not included in this Program Review. However, we believe that the quality of DMS faculty research output is second to none among all IPFW Departments. DMS faculty have given invited talks around the world, and have published in high quality journals such as *Discrete Mathematics*, *Journal of Mathematical Analysis and Applications*, *Journal of Graph Theory*, *Pacific Journal of Mathematics*, *Communications in Statistics – Theory and Methods*, and the *Proceedings*, *Transactions*, and *Memoirs* of the American Mathematical Society. The 50-year history of DMS publications and presentations is the foundation of its **international reputation for research**.

The results of faculty research, specifically publications and presentations, are recorded in IPFW's open-access institutional repository, Opus. http://opus.ipfw.edu/

Mathematical publications are indexed and reviewed on the searchable online database, MathSciNet (available on campus). For information on both articles and article reviews written by IPFW faculty, type (with quotes) "fort wayne" into the Anywhere search field: http://www.ams.org/mathscinet/search.html Such a search gives over 120 publications in the date range 2008-2018; this database is comprehensive for mathematics, but may not include all DMS publications in areas such as statistics or education, or co-authored papers in other fields.

DMS faculty receive national competitive research grants. A highlight is Dr. Zhang's consecutive individual research grants from the National Science Foundation.
https://www.pfw.edu/departments/coas/depts/math/cams/grants.html

The Department organizes academic and social extra-curricular activities on campus, including an active Colloquium series, research seminars, and collaboration with the PI Math Club on talks and other events for students. These events are advertised by paper posters, emails to students, and frequent updates to the DMS web site, although this method of communication may need to change after the new campus web site replaces the current one.

- Current page: https://www.pfw.edu/departments/coas/depts/math/news/
- Archives: http://users.pfw.edu/CoffmanA/MathNews0918.html
- http://users.pfw.edu/CoffmanA/Seminars0918.html
- https://sites.google.com/a/students.ipfw.edu/pi/pi-news-2009-2018

DMS faculty frequently receive internal (IPFW or Indiana/Purdue Systems) awards recognizing excellence in teaching, research, or service, see the following web page (and Appendix D.1, Document 4.):
https://www.pfw.edu/departments/coas/depts/math/current-students-and-faculty/math-faculty-award-archive

DMS faculty are also very engaged in service to the university through committees, governance, and in various roles outside the departmental level (Dean, VCAA, Purdue Faculty Speaker, Featured Faculty). A decreasing tenure-track population has led to a higher service load on the remaining faculty.

DMS faculty are active members of their various professional organizations. In 2014, Professor Beineke received a national award for service to the profession from the Mathematical Association of America:
https://www.pfw.edu/departments/coas/depts/math/news/math-news-events/MAA2014.html

DMS occasionally takes advantage of Fort Wayne's geographically convenient location in the Midwest to attract researchers and students to academic conferences on our campus:

- Midwestern Graph Theory 2011: http://users.pfw.edu/walshm/mli/
- Indiana MAA meeting 2014: http://sections.maa.org/indiana/meetings/Spring14/program.html
- Midwestern Workshop on Asymptotic Analysis 2014
  https://www.pfw.edu/departments/coas/depts/math/news/math-news-events/analysis-2014.html
- Midwestern Graph Theory 2014:
  https://www.pfw.edu/departments/coas/depts/math/news/math-news-events/mightyphotos2014.html
- Midwestern Workshop on Asymptotic Analysis 2016 (with NSF grant support):
  http://mwaa.math.iupui.edu/
- Midwestern Graph Theory 2018: planned for September

d. Staffing levels and program delivery

Previous program reviews (2001, 2008) stated a goal of having all calculus (and above) courses on campus taught by Ph.D.-qualified faculty. This is still a goal and has still not yet been met, primarily due to a chronically low number of such faculty. Some calculus sections are being covered by Instructors or LTLs.

A Supplemental Report to this Program Review is the DMS Detailed Faculty Profile (Appendix D.1, Document 1.). The following two Charts are copied from that Profile:

Chart 5.a.

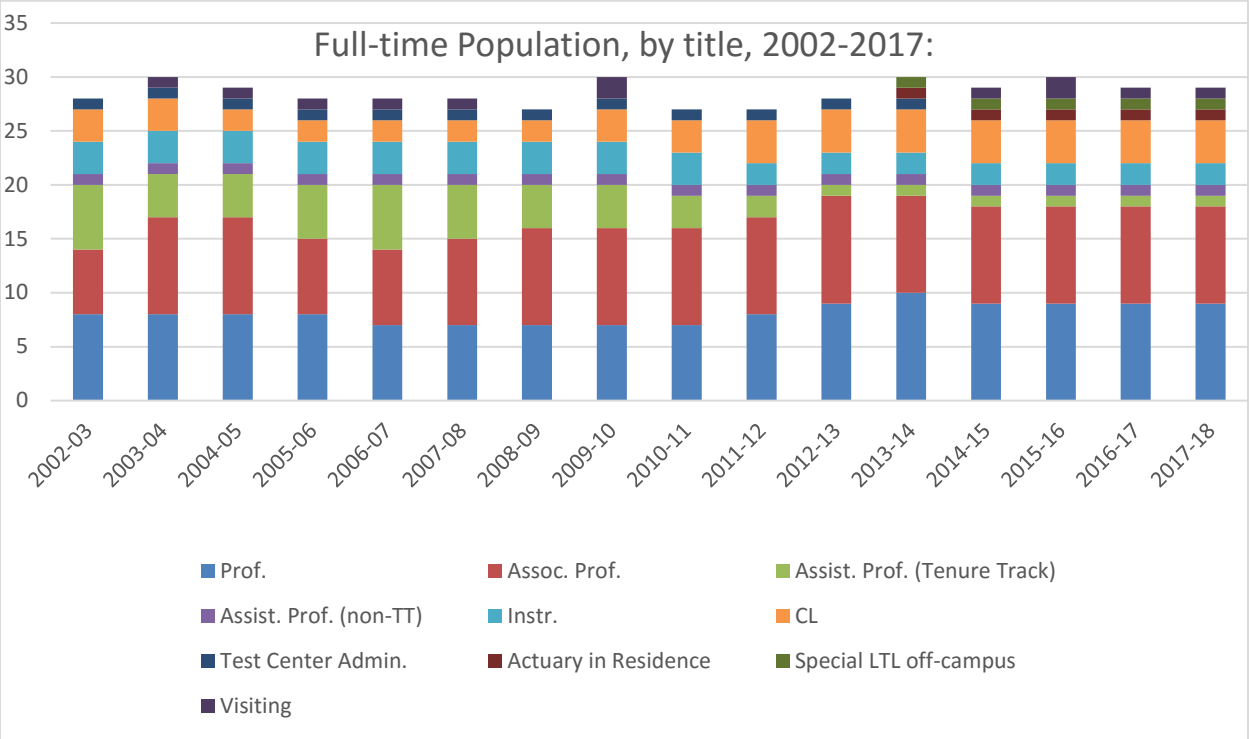
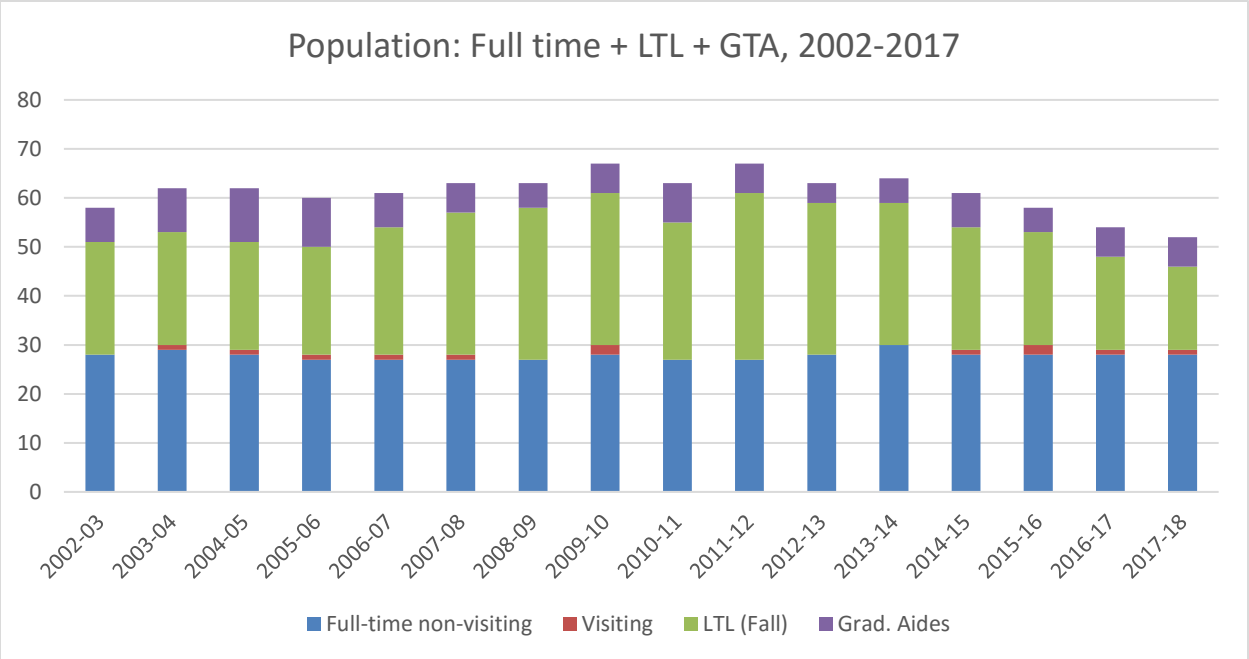


Chart 5.b.



Here are some observations on the data from the Profile report, including the above charts:

- The total full-time population (Chart 5.a.) has stayed in the 27-30 range for the entire 2002-17 period, although the number of faculty with tenure (professors + instructors) has slowly declined from a high of **24** in 2003 to the current low of **21** since 2014.
- The most visible change in the 2002-2017 graph of population by rank (Chart 5.a.) is the number of tenure-track Assistant Professors – changing from a range of 4 to 6 from 2002 to 2006, to **only 1 Assistant Professor** every year since 2012.
- The jump from 27 to 30 in 2009 (in Chart 5.a.) is due in part to including two visiting positions to cover a number of sabbaticals that year.
- DMS welcomed Prof. Buldt as a member in Jan. 2017 (and he is included in the above count of **21** tenured faculty), but he is continuing to teach PHIL classes and not MA classes for at least the next few years.
- The total population (full time + LTL + GTA) in Chart 5.b. shows a bump from 2007 to 2013, corresponding to a temporary period of increased enrollment at IPFW (Chart 2.b.). Chart 5.b. shows that the increased number of math courses taught during that period was covered entirely by an increased number of LTL positions. The full-time teaching levels were roughly constant and the GTA assignments fluctuated in their normal range.
- Chart 5.b. also shows a continued decrease after 2013 in the total population. This is again entirely due to a lower number of LTL positions, reflecting a campus-wide decline in the number of remedial and lower-level courses usually taught by LTLs and a significant increase in dual-credit courses taught off-campus by qualified high school teachers.
- In the Math Education group (Chart D.2.f. in Appendix D.1, Document 1.), one of the three tenured faculty members has started voluntary early partial retirement. The other two would both qualify for partial retirement if it is offered again. It is an understatement to say we need new blood in mathematics education. Additionally, we need to staff eight math content courses for prospective elementary school teachers (MA 101, 102, 103) each semester, EDUC M448 and MA 460 in the fall semester, and EDUC M480 (student teaching) in the spring. The amounts to 19 courses covered by three faculty members teaching 6 courses each year.
- The Discrete Math group (Chart D.2.d. in Appendix D.1, Document 1.) has historically been one of IPFW's most nationally prominent research groups. There has been a steady decline in headcount and one partial retirement is underway, after which there will remain only 3 tenured faculty, compared to 8 in 2004.

Faculty changes 2009-2017

- Buldt moves to DMS as Professor, transferring from Philosophy, 2017
- Lipman retires, 2016
- Redett resigns, 2016
- Yorgov hired as new tenure-track Assistant Professor, 2016
- Zhang promoted to Associate Professor, 2016
- Hersberger replaces Townsend as DMS Associate Chair, 2016
- Francis assigned 0.5 FTE Continuing Lecturer, Professional Actuary in Residence
- Anderson moves to DMS as Professor, 2014
- Clark retires as Administrator of the IPFW Math Test Center, 2014 (this position is now part of CASA, not DMS)

- Anderson hired as Professor and VCAA, 2013
- Francis hired as Actuary in Residence, 2013 (Special LTL)
- Walsh resigns as Associate Professor, continues off-campus as Special LTL for online courses, 2013
- Legg retires, replaced as Chair by Dragnev, 2012
- Deng and Berry promoted to Associate Professor, Coffman promoted to Professor, 2012
- Zhang hired as new tenure-track Assistant Professor, 2012
- Redett promoted to Associate Professor, Dragnev promoted to Professor, 2011
- Vanderlaan hired as Continuing Lecturer, 2011
- Vetter retired, 2011
- Frederick retired, 2010
- Vandell promoted to Associate Professor, 2010
- Lipman moves to DMS after seven years of service as Dean of COAS, 2010
- Townsend returned to the DMS Associate Chair position, replacing Hersberger, after a term as Associate Vice Chancellor for Academic Programs and Director of Graduate Studies, 2010
- Alexander hired as Continuing Lecturer, 2009

Visiting Positions:

- Alan Legg, Visiting Assistant Professor, 2016-2018 (expected to continue 2018-2019)
- David Benko, Visiting Associate Professor, 2015-16
- Jay Bagga, Visiting Professor, Spring 2016
- Yang Liu, Visiting Researcher, 2014-15
- G. Applegate and R. Lovell, Visiting Instructors, 2009-10

e. Faculty Development

All faculty, whether tenure-track or not, participate in the student evaluation process established by DMS policy.

DMS has a policy to measure the research productivity of Associate Professors and Professors, and to assign a 25% workload for research for faculty meeting the productivity standard. DMS has a policy on criteria and internal peer review for sabbatical applications. Sabbaticals have been taken by many tenure-track faculty. (Both of these policies appear in Appendix D.2, Document 12.)

New faculty have the opportunity to apply for IPFW or Purdue Research Foundation summer grants. Yorgov successfully applied during his first semester for a Summer 2017 grant. Zhang's research was supported by a major individual NSF grant. Conference travel for all faculty, and scholar-in-residence visits to IPFW, are supported from the DMS budget, and there are also opportunities for research and travel funding from IPFW and the IU and Purdue systems. (The proposed campus restructuring will mean a loss of such support from IU.) There are also funding opportunities for curriculum development and teaching-related projects through IPFW's CELT. Faculty research is very well supported by Helmke Library, including its collection of books, its subscription to journals and databases, and its connections to other academic libraries – the library's transition from the IU system to the Purdue system has not yet caused major problems for DMS.

The DMS promotion and tenure documents establish that tenure-track faculty must document and prove competence in teaching, research, and service, and excellence in either teaching or research. Each pre-tenure faculty member is evaluated annually by the chair for re-appointment, and has a faculty review

committee for the purposes of both assessment and mentoring. There is a DMS policy for a third-year review process, including a recommendation from a committee of most of the tenured faculty.

In 2014, IPFW Senate documents SD 14-35, SD 14-36 gave new guidelines for principles and procedures for department promotion and tenure documents. DMS revised its **procedures** for promotion and tenure, and for third-year review, in a series of documents that were reviewed and approved at all levels (Senate and College) in 2016 and are now in effect. There remains some work to be done to bring the DMS document's language on **criteria** for promotion and tenure (most recent version from 2014) into alignment with the Senate documents.

The current DMS documents for promotion, tenure, and third-year review are on the College web site: https://www.pfw.edu/departments/coas/resources/pt-docs/index.html

f. Faculty Salaries

A separate supplement to this Program Review document reports on Faculty Salaries (Appendix D.1, Document 3.).

Some significant conclusions from the data in the report:

- Associate Professor salaries are below national and IPFW averages, close to the 25th percentile nationally. This issue was noted in both of the previous Program Review reports (2001 and 2008).
- Assistant Professor salaries have been near national and IPFW averages, although future hires in more specialized areas (actuarial, data science, math education) may need entry-level offers that are higher than the average over all mathematical sciences areas. The recruiting of only one Assistant Professor position from 2006 to 2015 was a missed opportunity for hiring very talented faculty at low cost.

g. Engagement with Students and Alumni

DMS is affiliated with two student organizations: the PI Math Club and the IPFW Actuarial Students Club, and one honor society: Pi Mu Epsilon. The PI Math Club has been active for the entire 50-year history of DMS and hosts talks by faculty and other student events. The Actuarial Club started around 2014 and hosts visits from local employers and recent alumni to talk about actuarial internships and career opportunities. Pi Mu Epsilon is a national honor society for mathematics; the IPFW chapter has had an annual induction ceremony every year since 2003, and it collaborates with the PI Math Club on an annual student talks event. https://www.pfw.edu/departments/coas/depts/math/current-students-and-faculty/pi.html

DMS faculty participate as judges or event coordinators at events for IPFW students, including the annual Student Research Symposium and the Sigma Xi student research competition.

The Indiana MAA operates an annual Indiana College Mathematics Competition. DMS usually sends a team of undergraduates, who have prepared in a problem solving seminar run by long-time contest coach, Prof. D. Weakley.

DMS maintains its https://www.pfw.edu/math/ web site with information on academic programs, resources for courses and tutoring, and contact information for faculty. The web site also announces DMS news and events, and archives photos and information from past events. The web site underwent a major conversion to a new content management platform starting in 2010. In 2015-16, a student worker was hired

to implement some changes to make the site more attractive and useful to prospective students. In 2017, even more changes were implemented in cooperation with a marketing team from the IPFW Division of Continuing Studies. The campus web site is due for another campus-wide upgrade to accommodate advances in technology and the proposed PFW/IUFW realignment; the URL name change from `ipfw.edu` to `pfw.edu` is effective Summer 2018, to be followed by further upgrades.

DMS maintains an alumni contact list and updates it with an occasional survey, to keep close ties with alumni, via a newsletter, scholarship fundraising (the "Pieces of Pi" campaign), and an annual alumni dinner. There is also an IPFW Math Alumni Facebook page.
https://www.pfw.edu/departments/coas/depts/math/current-students-and-faculty/alumni.html

h. Outreach and Engagement with the Community

DMS faculty collaborate with local industry on mathematical problems through the Center for Applied Mathematics and Statistics (CAMS):
https://www.pfw.edu/departments/coas/depts/math/cams/

In collaboration with the IPFW Actuarial Students Club, DMS has hosted a summer picnic for local professional actuaries to meet students, in 2015, 2016, and 2017, with the next scheduled for August 2018. This could become an annual tradition in the regional actuarial community.
https://www.pfw.edu/departments/coas/depts/math/news/math-news-events/events-2017/actuarypicnic2017.html

The main DMS outreach event for pre-college math students is the annual MathCounts competition for middle school students (at the regional level, where winners go on to the state competition).
https://sites.google.com/a/students.ipfw.edu/pi/news/mathcounts-2018

At the high school level, DMS hosts the annual regional ICTM mathematics competition. From 2009 to 2014, faculty participated in the regional Science Olympiad event. Some high school students take math classes on campus through the IPFW Collegiate Connection program. DMS faculty interact with the high school teachers who teach courses for dual credit at IPFW. There is the potential for increased marketing/recruiting activity by DMS, COAS, and the campus to reach out to these high school students to consider math or other programs at Purdue University Fort Wayne.

i. USAP

USAP GOAL 5: The following Goal stated in the **Dec. 2014** USAP report aligns with the IPFW goal (Appendix E.1, Document 1.) to "Promote the Creation, Integration, and Application of Knowledge":
Unit Goal: External academic collaborations: Increase from three (Institute of Mathematics at the Ukrainian Academy, Institute of Mathematics and Informatics at the Bulgarian Academy Sciences, Zhejiang Normal University) to five.

USAP NEW GOAL 1: The following Goal stated in the **2015** USAP report aligns with the IPFW goal (Appendix E.1, Document 1.) to "Promote the Creation, Integration, and Application of Knowledge":
Continue to expand reputation of department's research groups in the region (Midwest) and internationally

Current (2017) status of USAP 2014 GOAL 5 / 2015 NEW GOAL 1:

The academic collaborations goal was already met and surpassed by the time of the 2015 USAP report. The number of international Research Collaboration Agreements is currently at 7.
https://www.pfw.edu/departments/coas/depts/math/cams/grants.html

The 2015 USAP report's New Goal 1 described plans and challenges for continued research and collaboration; the DMS research programs and consulting projects have been generally successful since then, but maintaining the high quality research and global reputation of DMS will require continued investments, including new and replacement tenure-track lines.

The 2015 report mentioned two specific funding opportunities, both of which were obtained: conference funding from the National Science Foundation, and an internal grant for summer research by the new Assistant Professor.

6. The 5-year Enhancement Plan

a. Short-term Plans for Major Programs:

DMS committees are charged with resolving the following issues that have come up as a result of Program Review or other recent changes.[10]

- The Bulletin description for the BS in Mathematics needs to be compatible with the campus-wide redesign of the secondary teaching curriculum. The plan is to structure the 300/400/500-level requirements for the BS in Mathematics to be flexible enough so that students in a double major with education can meet the requirements for teaching certification. DMS will need to figure out an internal advising mechanism to keep track of teaching majors separately from other math majors.
- There has been discussion on revising the BS in Mathematics requirements, in particular with regard to the content of MA 175, MA 305, and MA 441. The current structure, with a long chain of prerequisites and some overlap of material, may be necessary for an in-depth study of some topics (as recommended by the MAA Curriculum Guide), but is also inflexible for students and poses scheduling problems, with 305 and 441 having low enrollments and only offered once a year. There should be a holistic approach to curriculum changes and new course development, taking into account the details of the course content and the needs of all undergraduate and graduate programs.
- A "capstone" course in data science/applied statistics is being developed. This will need to be submitted for approval to be included in the campus General Education plan as satisfying the capstone requirement.
- The DMS Assessment Plan needs to be significantly revised to take into account recent changes in the degree programs. There may be ways to use the electronic homework/course management systems to more efficiently and uniformly collect assessment data. The recent changes in the BS programs offer a previously unavailable opportunity for a before/after statistical analysis of the assessment data, to test whether student learning outcomes will improve (or not).

[10] See below, in Subsection 6.f., for updates describing some progress on these 2017 plans, as of Summer 2018.

b. Short-term Plans for General Education Programs and Service Courses

After this Program Review (and before the next one), DMS curriculum committees have the following plans:

- The Calculus Curriculum Committee has plans to meet with representatives from Pearson and Cengage during Spring 2018. Current options under consideration are a new edition of "Stewart" with WebAssign, or a completely new textbook from Pearson (two possibilities: Briggs, Cochran, Gilbert – *Calculus: Early Transcendentals*, or Thomas' *Calculus: Early Transc.*) with MyMathLab.
- MA 213 (Finite Mathematics) is already being affected by the transition to PFW/IUFW and could be offered more frequently, subject to available staffing.
- New editions or textbooks will need to be selected for MA 111, 124, 140, 213, and STAT 125.
- The placement exam will continue to be monitored and adjusted as needed.
- Continue to suggest to other IPFW departments that they accept MA 124 (Introduction to Mathematical Ideas) as an alternative to MA 153 (College Algebra) as a prerequisite or program requirement.

c. Short-term Plans for Department Policies and Governance:

After this Program Review (and before the next one), DMS has the following plans regarding faculty policies and governance:

- Revise Promotion and Tenure criteria documents to meet campus guidelines
- Revise Research Release policy into a more comprehensive Workload policy
- Develop policies recognizing faculty work on consulting projects or applied research – through the CAMS or independently – in particular with regard to workload and P&T criteria
- Revise the procedures to nominate and elect/appoint DMS Chair and Associate Chair positions
- Continue to work with LTL pool and dual credit teachers on meeting HLC qualifications
- There has been some discussion on re-organizing the DMS committee structure to move to a "continuous improvement" rather than a "periodic assessment" (or, often, "crisis-to-crisis") model of data collection, analysis, and programming/policy updates. This discussion will continue. Having fewer crises would help.
- DMS needs a new Mission Statement (or Mission-Vision-Values, etc.). Some discussion on this has already occurred during the realignment and program review processes; there should be a resolution before the end of 2018.
- DMS should review its community outreach efforts, including whether to continue with MathCounts, and how to incorporate PFW students in outreach activities.

In Nov. 2017, DMS prepared requests to begin tenure-track searches in three different areas – analysis, discrete math, and data science. The search requests give details on the needs in these areas (see Appendix D.2, Document 16.). An ideal candidate for the discrete math position would also be able to contribute to the development of the new BSDSAS program. Similar search request documents will be prepared if there are hiring opportunities at any time, and as previously mentioned, it is anticipated there will soon be a need for hiring in the math education area also.

d. Long-term Goals:

- Previous Program Review reports have stated the goal of having all courses in the math major, starting with calculus (MA 165), taught by professor-rank faculty. This has not yet been met and remains an important goal.
- It is a goal of DMS to lower the D/F/W rate for engaged/motivated students in service courses; this will continue to be monitored with useful metrics as described in Section 4.a.
- There is a 2021 target date for LTLs and dual-credit teachers to meet HLC qualifications. Our goal is 100% compliance.
- The "capstone" experience for upper-level DMS majors could be integrated (case-by-case or more systematically) into activities in the Center for Applied Math and Statistics, or a more structured approach to undergraduate research, or other DMS outreach efforts.
- Similarly, there could be some framework for including graduate students in CAMS activities and DMS research and outreach. One possibility is a Graduate Research Assistant position, funded in part by CAMS income.
- DMS has a goal of being classified as **UCAP – Advanced** by the Society of Actuaries. The current classification must be maintained until this goal can be achieved, as described in Subsection 2.c.
- The new (post-USAP) Department Annual Report format requests data on specific goals. In addition, there is the opportunity for the DMS to report on its own data, goals, and metrics, so there should be a plan for future reporting.
- Remaining an internationally recognized research department will require replacing retiring PhDs (Section 5.d) with new faculty with PhD qualifications and the potential to meet our promotion and tenure criteria for research and teaching. The hiring process should also take into consideration both faculty diversity and the potential for future service to the department, university, profession, and community.

e. Recommendations:

The following goals involve the support of the College and University administration.

- To maintain the quality of the undergraduate program, there must be enough professor-rank faculty to teach the required courses for majors and service courses at the 200-level and above. This will involve **replacing** faculty who have already retired and those who are on a partial retirement track (Section 5.d), and/or converting Visiting positions to Tenure Track.
- There needs to be a stable program for math majors interested in secondary education. This includes a campus-wide framework for degrees in education, keeping in mind the CEPP accreditation. There must be a sufficient number of math education faculty (Subsection 5.d) in DMS to support math education programs at secondary and other levels.
- Hiring additional faculty qualified in the area of data science and statistics is **critical** to achieve the following goals of DMS (which should also be University priorities):
    - Achieving a higher UCAP classification
    - Launching the (already approved) BS in Data Science and Applied Statistics
    - Maintaining our international reputation as a research department
    - Attracting more students to graduate-level study at IPFW
- At least one **new** (non-replacement) Tenure Track line is needed as soon as possible, with a goal of at least **three** new lines over the next three years. Some of these hires may need to occur outside

the annual COAS request process if the Purdue University system is serious about developing new academic programs at Purdue Fort Wayne.

- The new BS in Data Science and Applied Statistics is very closely aligned with the Purdue University interdisciplinary initiative on data science. This is an opportunity for increased collaboration between PFW and PUWL, especially if new resources are available on either end.
- To help with staffing 100-level service courses with HLC-qualified instructors, DMS recommends a return to 2012 levels of **eight** GTA positions (0.5 FTE, teaching assistantships or other paid assistantships; currently, six are authorized). This will also help with recruiting into the graduate program.
- The campus General Education plan and the College of Arts and Sciences have requirements for the BS which seem to be frequently under review. Future adjustments to these requirements should take into account the unique situation of teaching majors. DMS would also be favorably inclined to changes making it easier for students from another College to double-major in math, or to switch to a math major.
- In cooperation with DCS, COAS, CEPP, and the campus, DMS will continue to develop and implement its plans to promote/market all its degrees, including the new programs, to prospective and current students.
- DMS will upgrade its web site as part of a major campus-wide effort to establish the new Purdue Fort Wayne brand and improve communication on and off campus, with prospective students, current students, and the public.
- The PFW Realignment is currently (2017) operating under a Transfer Agreement that replaces the previous IU/PU Management Agreement for IPFW (Appendix E.2, Document 1.) – pending HLC approval. The old agreement (effective until July 2018) indicates that graduate programs at IPFW are under the administrative control of the Purdue University Graduate School. It would be useful to have some clarification on graduate degree administration under the new agreement.

f. Updates – Summer 2018

Rather than revise the document from the late 2017 draft, the following list was added in July/August 2018 to record recent actions relevant to the above goals and recommendations.

- The campus realignment from IPFW into separate institutions, Purdue University Fort Wayne and Indiana University Fort Wayne, received HLC approval, and became effective July 1, 2018.
- The URL name change for campus web sites, from `ipfw.edu` to `pfw.edu`, was implemented as planned – this Program Review document was updated to use the new address in its links, although in the long term, some links in this document may be relocated or may disappear entirely.
- Following discussions with COAS and CEPP stakeholders, the DMS took action to revise the requirements for the BS in Mathematics, so that there is no longer a separate track for Math Teaching. Students interested in secondary education may double major in math and education. The most significant change to the math major was to drop the requirement for MA 305, the Foundations/Intro to Proof course. The curriculum map (Appendix D.1, Document 10.) will need to be revised.
- DMS has approved a new curriculum for the MS degree, replacing the previous two-option program.
- DMS has been authorized to begin a tenure-track search in the area of data science and applied statistics.
- An update on enrollment numbers, comparing Fall 2018 to Fall 2017, appears in Appendix D.1, Document 13. Enrollments are up in all categories, including a jump to 23 students enrolled in the graduate program, already exceeding growth targets (Appendix D.2, Document 1.).

Appendix **A.1.** - Program Review 2017-18

Department of Mathematical Sciences

USAP Documentation Index

University Strategic Alignment Process

Documents specific to DMS and CAMS

(most recent last)

1. First Report from DMS to USAP – Dec. 23, 2014 – PDF 11 pages
   http://users.pfw.edu/coffmana/PR2017/USAP_Math.pdf
2. Feedback from USAP to DMS - April 28, 2015 – PDF 19 pages
   http://users.pfw.edu/coffmana/PR2017/USAPFeedback2015Math.pdf
3. Feedback from USAP to CAMS – April 29, 2015 – PDF 17 pages
   http://users.pfw.edu/coffmana/PR2017/CAMSFeedback2015.pdf
4. Second Report from DMS to USAP – March 4, 2016 – PDF 73 pages
   http://users.pfw.edu/coffmana/PR2017/MathToUSAP2015.pdf
5. Second Report from CAMS to USAP – March 4, 2016 - PDF 54 pages
   http://users.pfw.edu/coffmana/PR2017/CAMSsecondUSAP.pdf
6. Feedback from USAP to DMS - May 24, 2016 – PDF 12 pages
   http://users.pfw.edu/coffmana/PR2017/Math(USAPFeedbackMay2016).pdf
7. Feedback from USAP to CAMS - May 23, 2016 – PDF 12 pages
   http://users.pfw.edu/coffmana/PR2017/CAMSFeedback2016.pdf

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USAP Documentation Index

University Strategic Alignment Process
Documents generally pertaining to COAS or IPFW

The IPFW USAP web address was https://www.ipfw.edu/usap/ but is no longer available. The documents appearing in these Appendices were copied to the following addresses before this content was deleted from the campus web site.

Documents for the College of Arts and Sciences, or for the IPFW campus (most recent last)

1. Prioritization process – April 28, 2014 – email from Chancellor 2 pages
   http://users.pfw.edu/coffmana/PR2017/PrioritizationProcess4-28-2014.pdf
2. Program Prioritization – May 5, 2014 – Powerpoint from VCAA 13 pages
   http://users.pfw.edu/coffmana/PR2017/prioritization5May2014.pptx
3. USAP Report and Recommendations – May 6, 2016 – 36 pages
   http://users.pfw.edu/coffmana/PR2017/IPFWUSAPReport6May2016.pdf
4. Response from COAS Dean to USAP – June 17, 2016 – 20 pages
   http://users.pfw.edu/coffmana/PR2017/LinkUSAPResponse.pdf
5. Response from VCAA and Deans to USAP –Aug. 8, 2016 - 22 pages
   http://users.pfw.edu/coffmana/PR2017/ResponseToUSAP2.pdf
6. Response from COAS Departments (including 14 pages from DMS) to USAP–Sept. 7, 2016 – 51 pages
   http://users.pfw.edu/coffmana/PR2017/COASDeptResponsesUSAP.pdf
7. Action Plan 41 from Chancellor – Sept. 8, 2016 – 12 pages
   http://users.pfw.edu/coffmana/PR2017/ActionPlan41.pdf
8. Recommendations for Academic Programs from VCAA – Sept. 19, 2016 – 37 pages
   http://users.pfw.edu/coffmana/PR2017/ReviewOfProgramsAndDepartments.pdf
9. Report from VCAA to IPFW Senate re: Purdue Trustees and USAP – Oct. 17, 2016 – 5 pages
   http://users.pfw.edu/coffmana/PR2017/Senate101716.pdf
10. Revised Recommendations for Academic Programs from VCAA – Oct. 18, 2016 – 2 pages
    http://users.pfw.edu/coffmana/PR2017/ShutdownsOct182016.pdf
11. Email from VCAA to DMS re: Workload – Nov. 3, 2016 1 page
    http://users.pfw.edu/coffmana/PR2017/VCAAemail03Nov2016.pdf
12. COAS Restructuring Plan – Nov. 15, 2016 -- 7 pages
    http://users.pfw.edu/coffmana/PR2017/COASRestructuringPlan.pdf
13. COAS Restructuring guidelines for affected students and faculty – Nov. 15, 2016 PDF - 2 pages
    http://users.pfw.edu/coffmana/PR2017/RestructuringGuidelines.pdf
14. Senate document SD 16-16 on No Confidence – Nov. 21, 2016 PDF 12 pages
    https://www.pfw.edu/committees/senate/documents/documents/2016-17/SD%2016-16.pdf
15. Final report from VCAA on Academic Restructuring – Dec. 6, 2016 PDF 2 pages
    http://users.pfw.edu/coffmana/PR2017/USAPFinalAcademicRestructuring.pdf

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Assessment Documentation Index

Annual Departmental Assessment Reports

Purdue University Fort Wayne College Index for Programmatic Assessment Reports:
https://www.pfw.edu/offices/assessment/reports/reports-program.html

(most recent first)

1. COAS Assessment Committee Response to 2016-17 Report
   http://users.pfw.edu/coffmana/PR2017/MathAssessResponseLetter2017.pdf
2. DMS Assessment Report 2016-17 and COAS Assessment Committee Response to 2015-16 Report
   http://users.pfw.edu/coffmana/PR2017/Math-Asmt-Rpt-2016-17.pdf
3. DMS Assessment Report 2015-16 and COAS Assessment Committee Response to 2014-15 Report
   https://www.pfw.edu/offices/assessment/reports/pdf/MATH-Asmt-Rpt-2015-16.pdf
4. DMS Assessment Reports 2014-15 and 2013-14, and COAS Assessment Committee Response to 2012-13 Report (there does not appear to be a response to the 2013-14 Report)
   https://www.pfw.edu/offices/assessment/reports/pdf/Math-Asmt-Rpt-2014-15.pdf
5. DMS Assessment Report 2012-13
   https://www.pfw.edu/offices/assessment/reports/pdf/Math-Asmt-Rpt-2013-14.pdf
6. DMS Assessment Report 2011-12
   https://www.pfw.edu/offices/assessment/reports/pdf/Math-Asmt-Rpt-2011-12.pdf
7. DMS Assessment Report 2008-09
   https://www.pfw.edu/offices/assessment/reports/pdf/Math-Asmt-Rpt-2008-09.pdf
8. DMS Assessment Report 2007-08
   https://www.pfw.edu/offices/assessment/reports/pdf/Math-Asmt-Rpt-2007-08.pdf
9. DMS Assessment Report 2005-06
   https://www.pfw.edu/offices/assessment/reports/pdf/Math-Asmt-Rpt-2005-06.pdf
10. General Education Assessment Reports, from 2013-14 to 2016-17
    http://users.pfw.edu/coffmana/PR2017/GenEdAsmtReports.pdf
    - Elementary Education MA 101
    - Quantitative Reasoning MA 124, MA 140 (formerly MA 168)
    - Pre-calculus MA 153, MA 159
    - Calculus MA 165, MA 166, MA 227, MA 229
    - Modeling/capstone MA 314
    - Statistics STAT 125

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Assessment Documentation Index

1. Departmental Assessment Policy Document - for BS programs and General Education.
   http://users.pfw.edu/coffmana/PR2017/AssessmentUnifiedDocument2017.pdf
2. Departmental BS programs Curriculum Map for Assessment:
   http://users.pfw.edu/coffmana/PR2017/CurriculumMap2016.pdf
3. Departmental Assessment Data – grouped by course from Spring 2011 to Fall 2017
   http://users.pfw.edu/coffmana/PR2017/ProgAssessDec2017.pdf
4. IPFW Baccalaureate Framework
   https://www.pfw.edu/academics/programs/baccalaureate-framework.html
5. IPFW Assessment Plan – Senate Document SD 15-6 (proposed 2015, approved 2016)
   https://www.pfw.edu/dotAsset/0b3ed91b-2219-486c-b0ae-9bea62c970c8.pdf

Appendix **C.** - Program Review 2017-18

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Institutional Reports

1. OAA memo 16-2 on Principles for Program Review
   https://www.pfw.edu/offices/oaa/2016-about-academic-affairs/memoranda/16_2OAA_Memo_ProgramReviewApril%202017.pdf
2. OAA memo 16-3 on Framework for Program Review
   https://www.pfw.edu/offices/oaa/2016-about-academic-affairs/memoranda/16_3%20OAA_Memo_ProgramReviewApril2017.pdf
3. IPFW Institutional Research (IR) report: Interactive Factbook data – DMS report downloaded Jan. 2018
   https://www.pfw.edu/offices/ir/factbook/ (Requires Purdue login, possibly further authorization)
   http://users.pfw.edu/coffmana/PR2017/MathFactbook.pdf
4. IPFW Institutional Research (IR) report: Department Profile for Mathematical Sciences – Dec. 2016
   http://users.pfw.edu/coffmana/PR2017/MathematicalSciencesIRDec2017.pdf
5. IPFW IR report: Historical Course Analysis: Enrollment by course level (100/200/300/400/grad)
   http://users.pfw.edu/coffmana/PR2017/2017IRCensus.pdf
6. Data on Faculty Workload – COAS Departments – Nov. 2016
   http://users.pfw.edu/coffmana/PR2017/COASWorkload2016.pdf
7. IPFW Career Services – First Destination Survey for new alumni – 2013-2017 reports
   https://www.pfw.edu/offices/career/resources/
8. First Destination Survey results for 2016 Mathematical Sciences Alumni
   http://users.pfw.edu/coffmana/PR2017/FDSMath2016.pdf
9. Regional Intel Report 2016 – IPFW Community Research Institute
   http://users.pfw.edu/coffmana/PR2017/RegionIntelReport.pdf
10. Purdue Graduate School report on enrollments:
    https://www.purdue.edu/gradschool/faculty/enrollment.html
    a. graduate programs at IPFW:
       https://www.purdue.edu/gradschool/documents/ima/enrollment/fall-2017-fw-enrollment-summary.pdf
    b. graduate programs at PNW:
       https://www.purdue.edu/gradschool/documents/ima/enrollment/fall-enrollment-pnw-2017.pdf
11. National Center for Education Statistics (NCES)
    a. https://nces.ed.gov/collegenavigator/
    b. https://nces.ed.gov/ipeds/cipcode/
    c. https://nces.ed.gov/programs/coe/indicator_cha.asp (National Enrollment Trends)
12. Indiana's Math Pathways Recommendations – an ICHE report, Sept. 2015
    http://users.pfw.edu/coffmana/PR2017/2015MathPathways.pdf

Another resource for national data and trends on undergraduate mathematics programs is the Conference Board of Mathematical Science (CBMS) 2015 Survey Report: Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States:
http://www.ams.org/profession/data/cbms-survey/cbms2015

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Department Reports

Supplemental Reports prepared specifically for the 2017-18 Program Review

1. DMS Detailed Faculty Profile
   http://users.pfw.edu/coffmana/PR2017/2017ProgReviewFacultyProfile.pdf
2. DMS Report on Peer Institutions
   http://users.pfw.edu/coffmana/PR2017/2017PeerComparison.pdf
3. DMS Report on Faculty Salaries
   http://users.pfw.edu/coffmana/PR2017/2017ProgReviewSalary.pdf
4. DMS Report on Faculty Awards
   http://users.pfw.edu/coffmana/PR2017/2018ProgReviewFacultyAwards.pdf
5. DMS Historical Summary of Enrollments in grad/undergrad programs
   http://users.pfw.edu/coffmana/PR2017/MathEnrollment1999-2017.xlsx
6. DMS Historical Summary of Enrollments in Concurrent Enrollment courses
   http://users.pfw.edu/coffmana/PR2017/ProgRev17DualCreditEnrollment.pdf
7. DMS Supplemental Self-Study on statistics and interdisciplinary programs
   http://users.pfw.edu/coffmana/PR2017/2017ProgReviewDSAS.pdf
8. Center for Applied Math and Statistics – Revenue Report Nov. 2017
   http://users.pfw.edu/coffmana/PR2017/CAMSRevenue2017.pdf
9. DMS Report on Graduate Teaching Assistant Workload 2011-2018
   http://users.pfw.edu/coffmana/PR2017/ProgRev17GTAworkload.pdf
10. DMS Curriculum Maps and Prerequisite Chart
    http://users.pfw.edu/coffmana/PR2017/ProgRev17CurriculumMaps.pdf
11. DMS Archive of Common Office Hours, 2010-2018 (including the MALL, 2014-2018)
    http://users.pfw.edu/CoffmanA/OfficeHoursArchive.html
12. DMS Archive of Long-Term Course Sequencing, 2003-2018
    http://users.pfw.edu/CoffmanA/MathCourseSequenceArchive.html
13. ***Summer 2018 Update***: DMS report on enrollment numbers, comparing Fall 2018 to 2017
    http://users.pfw.edu/coffmana/PR2017/Fall2018EnrollmentComparison.pdf

Appendix **D.2.** - Program Review 2017-18

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Department Reports

Other DMS Reports

1. Plan to deliver Math Graduate Program Spring 2017-2021 --- Feb. 2017
   http://users.pfw.edu/coffmana/PR2017/GradProgramPlan2017-2021.pdf
2. DMS Annual Report 2016-17
   http://users.pfw.edu/coffmana/PR2017/MathAnnualReport2017.pdf
3. DMS Annual Report 2013-14
   http://users.pfw.edu/coffmana/PR2017/MathAnnualReport2014.pdf
4. CAMS Annual Report 2013-14
   http://users.pfw.edu/coffmana/PR2017/CAMSAnnualReport2014.pdf
5. Math MALL Proposal – Fall 2013
   http://users.pfw.edu/coffmana/PR2017/TAPMALLProposal.pdf
6. Math MALL final grant report – Fall 2016
   http://users.pfw.edu/coffmana/PR2017/TAPgrantfinalreport.pdf
7. Math MALL post-grant report – Spring 2017
   http://users.pfw.edu/coffmana/PR2017/MALLreportSpring2017.pdf
8. Math MALL 3-year analysis – Fall 2017 – 4 pages with 4 more pages of data
   http://users.pfw.edu/coffmana/PR2017/MALLreportF2017.pdf
9. CTL (Course Transfer Library) course submission forms
   http://users.pfw.edu/coffmana/PR2017/CTLSubmissionsBinder2017.pdf
10. DMS – previous Program Review 2008-09
    http://users.pfw.edu/coffmana/PR2017/ProgramReview2008-09.pdf
11. DMS – Strategic Plan and Goals 2010
    http://users.pfw.edu/coffmana/PR2017/mathstrategicplan2010.pdf
12. DMS Policy Documents on Research Release/Workload and Sabbaticals
    http://users.pfw.edu/CoffmanA/PR2017/DMSWorkloadPolicy.pdf
13. Proposal Documents for new BS in Actuarial Sciences – Nov. 2016 - 83 pages
    http://users.pfw.edu/coffmana/PR2017/ipfwBSAS2017.pdf
14. Proposal Documents for new BS in Data Science and Applied Statistics – Nov. 2016 – 71 pages
    http://users.pfw.edu/coffmana/PR2017/ipfwBSDSAS2017.pdf
15. Proposed Revision to Data Science and Applied Statistics curriculum – Aug. 2017 – 5 pages
    http://users.pfw.edu/coffmana/PR2017/RevisedDSAS2017.pdf
16. Tenure-Track Search Requests, Nov. 2017
    - Analysis http://users.pfw.edu/coffmana/PR2017/2017AnalysisSearchRequest.pdf
    - Data Science http://users.pfw.edu/coffmana/PR2017/2017DataScienceSearchRequest.pdf
    - Discrete Math http://users.pfw.edu/coffmana/PR2017/2017DiscreteMathSearchRequest.pdf

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Strategic Plan

Documentation Index

(most recent last)

1. IPFW Strategic Plan 2014-2020 web site
   https://www.pfw.edu/about/strategic-plan/
2. IPFW Strategic Plan 2014-2020 Executive Summary – PDF 2 pages
   https://www.pfw.edu/dotAsset/d98aeda9-2487-4883-a137-4edec506d5b1.pdf
3. IPFW Strategic Plan 2014-2020 – PDF 4 pages
   https://www.pfw.edu/dotAsset/d4a43e12-69e1-4101-bc43-3684c0af4324.pdf
4. IPFW Strategic Plan Goals, Metrics, and Outcomes – Aug. 1, 2014.
   a. http://users.pfw.edu/coffmana/PR2017/PLAN2020OutcomeMeasures.pdf – PDF 3 pages
   b. https://www.pfw.edu/about/strategic-plan/goals-and-metric-areas.html -HTML version
5. Chancellor Carwein's Remarks for the Fall Convocation – August 2014
   a. http://users.pfw.edu/CoffmanA/PR2017/2014FallConvocation.pdf -PDF 4 pages
   b. https://www.pfw.edu/offices/chancellor/messages/2014-fall-convocation.html -HTML version
6. IPFW Chancellor's Legislative Agenda for 2015 – archived copy, no longer on PFW site
   http://users.pfw.edu/coffmana/PR2017/2015LegislativeAgendaChancellor.html
7. IPFW Chancellor's letter to *The Journal Gazette*, March 2016
   http://www.journalgazette.net/opinion/columns/Statehouse-key-partner-in-IPFW-s-future-4401631
8. ICHE (Indiana Commission for Higher Education) policy on Multisystem Metropolitan University designation – June 11, 2015 – PDF 2 pages
   https://www.in.gov/che/files/Policy_on_IPFW_Multisystem_Metropolitan_Campus_2015.pdf
9. VCAA Statement of Guiding Principles for the Future of IPFW – Feb. 5, 2016 – PDF 3 pages
   http://users.pfw.edu/coffmana/PR2017/IPFWGuidingPrinciplesFeb2016.pdf
10. Chancellor Carwein's Remarks for the Fall Convocation – Aug. 22, 2016 – PDF 14 pages
    https://www.pfw.edu/offices/chancellor/docs/2016-fall-convocation.pdf
11. Chancellor Elsenbaumer's "First 100 days" email, Feb. 2018
    http://users.pfw.edu/coffmana/PR2017/ChancellorREmessageFeb2018.pdf

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Realignment Plan

Documentation Index

(most recent last)

1. Old – 2008 – Purdue – IU Management Agreement – PDF 7 pages
   https://www.pfw.edu/committees/senate/docs/managementAgreement.pdf
2. Purdue University System Graduate School Council Mission
   https://purdue.edu/gradschool/faculty/council/mission.html
3. IPFW to PFW/IUFW Realignment documents:
   https://www.pfw.edu/about/future/downloads.html
4. LSA (Legislative Services Agency) Report on Role and Governance of IPFW – Jan. 15, 2016 – PDF 55 pages
   https://www.pfw.edu/dotAsset/10c6d811-8e55-48c0-b331-7587d305ad0a.pdf
5. Proposed (Dec. 2016) new IU/PU management agreement (See Appendix F)
   https://www.pfw.edu/offices/oaa/realignment/docs/1612-ipfw-agreement.pdf
6. Departmental (including DMS) Feedback on College-level Academic Reorganization – March 9, 2017 – PDF 72 pages
   https://www.pfw.edu/offices/oaa/realignment/docs/Departmental_feedback_reorg.pdf
7. IPFW Senate Document SD 16-39 on Academic Reorganization – May 1, 2017 – pages 1-6 excerpted from 113-page PDF
   https://www.pfw.edu/offices/oaa/realignment/docs/SD16-39.pdf

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Higher Learning Commission

Documentation Index

The Higher Learning Commission:
https://www.hlcommission.org/

1. HLC Guidelines for "Determining Qualified Faculty" (2015-2016)
   http://download.hlcommission.org/FacultyGuidelines_2016_OPB.pdf
2. IPFW/PFW Change in Organization Application submitted to Higher Learning Commission
   - https://www.pfw.edu/about/future/files/Change%20in%20Organization%20Full%20App.pdf
   - The application includes the final (pre-HLC-approval) version of the IU/PU management plan (the "Program Transfer Agreement")
3. Itinerary for fact-finding visit by HLC Representatives, Sept. 5-6, 2017
   http://users.pfw.edu/coffmana/PR2017/HLCVisitAgendaSept2017.pdf
4. IPFW 2010 Self-Study and Request for HLC Accreditation
   https://www.pfw.edu/offices/accreditation/docs/ipfw-2010-self-study-entire-report.pdf
5. HLC 2010 Site Visit Report (Comprehensive Evaluation – Advancement Section)
   http://users.pfw.edu/coffmana/PR2017/ipfw2010HLC.pdf