Marshall University

Undergraduate Program Assessment
2005 Report

B.S. in Mathematics

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I. Assessment Activities

A. Program Goals

The B.S. in Mathematics was extensively revised in the 1995-96 academic year, with the new requirements going into effect in summer 1996. Academic Year 2004-2005 was the ninth year of implementation of the Mathematics Department's more focused, more application-oriented, and more technology-intensive B.S. program. Calculators, especially graphing calculators, and computer software, such as *Mathematica*, *Excel*, and *SAS*, have been integrated into the coursework.

The B.S. in Mathematics has the following program goals as indicated in its Program Assessment Plan:

1. **Mathematical Reasoning** – *Students should be able to perform intellectually demanding mathematical tasks and reason rigorously in mathematical arguments.*
2. **Personal Potential** – *Students should be able to undertake independent work and possess an advanced level of critical thinking and analytical skills.*
3. **Nature of Mathematics** – *Students should develop knowledge of the breadth of the mathematical sciences and of the fundamental dichotomy of mathematics as an object of study and a tool for application.*
4. **Mathematical Modeling** – *Students should be able to apply mathematics to a broad spectrum of complex problems and issues.*
5. **Communication and Resourcefulness** – *Students should be able to read, write, listen and speak mathematically and contribute effectively to group efforts.*
6. **Content Specific Goals** – *Students should be able to apply the theory and basic techniques of calculus, modern algebra, discrete mathematics, and probability and statistics.*

B. Learning Outcomes/Data Collection

The program goals given above and in the Program Assessment Plan include the following associated student learning outcomes:

1. a. ability to demonstrate proofs using three methods of deductive reasoning: direct, contrapositive, and contradiction
   b. ability to demonstrate proofs by mathematical induction
   c. ability to verify the need for hypotheses by finding counterexamples for the alternative statements
2. a. ability to use the library to find books and journal articles on a specified mathematical topic
   b. ability to recognize when a certain theorem may be applied in a given problem situation
   c. ability to assimilate and critique a mathematical paper independently
3. a. study two additional areas of the mathematical sciences outside the required core
   b. deepen understanding and appreciation of the real number system
   c. develop an appreciation of mathematics as a unique discipline with aspects of both art and science

4. a. ability to use probability distributions to model situations exhibiting random behavior in the real world
   b. ability to read, interpret, organize, analyze, and solve complex multi-step mathematical problems
   c. ability to use computer software and graphing calculator for simulation and visualization of complex mathematical ideas and processes
5. a. ability to conduct research and make written and oral presentations on various topics
   b. ability to work effectively in a team to organize effective approaches to solving mathematical problems
   c. ability to create and document algorithms and to write computer programs in a high-level language to solve mathematical problems
6. a. ability to use combinatorial formulas to determine the number of outcomes in an event and to compute its probability
   b. ability to use numerical measures and graphic displays to describe sets of data
   c. ability to use the differential and integral calculus to solve problems dealing with rates of change and geometric areas and volumes
   d. ability to use techniques of linear algebra and abstract algebra to solve equations and systems of equations

Percentage of Usable Course Grades (A, B, C, CR)

	98-99	99-00	00-01	01-02	02-03	03-04	04-05
MTH 229	72	76	71	87	74	69	87
MTH 230	68	80	62	69	47	57	71
MTH 231	85	78	79	79	95	87	72
MTH 300	50	66	82	79			70
MTH 331	79	75	68	83	50		86
MTH 335	91	75	84	53			76
MTH 340	94	88	69	36	71	60	100
MTH 411		83		57			
MTH 427	92	100	82	93	73	85	90
MTH 428	89		89	33			100
MTH 442							33
MTH 443	56	64	100	73		100	91
MTH 445	52	77	79	70	74	93	60
MTH 446		100	70	89			50
MTH 448	71	56	86	50	76	100	100
MTH 449	75	67	88	100			91
MTH 450	89	60	100	83	92	100	33
MTH 491	60	67	100	91			67

Notes: 02-03 and 03-04 are based on Fall data only; complete data was not made available to the Department. MTH 331 was formerly MTH 330.

Percentages of students achieving usable course grades (A, B, C) in courses that are either required or elective for majors in mathematics were collected and are reported below. Percentages are reported including withdrawals. Many of these courses are required for students in other programs (Physics, Chemistry, Biology, Geology, Computer Science, Pre-Engineering, Mathematics Education 5-9 or 5-8, Mathematics Education 5-12 or 5-Adult). In fact, every course on this list except MTH 300, 411, 427, 428, and 491 is required by at least one other major on campus. We suspect that the usable grade percentages in the other courses would be higher if we counted grades for mathematics majors only.

C. Results

The data collected indicates progress toward the goals of this program as enumerated in section A, as measured by the indicators for the various outcome criteria that are detailed above. See the attached Assessment Chart in conjunction with the Percentage of Usable Course Grades table.

Each student in *Senior Seminar,* MTH 491, is required to give written and oral presentations and do research in the mathematical literature. This, in addition to the course grade, is an indicator of the student's growth in the areas of personal potential, communication, and resourcefulness. Students in this course improve their abilities to work both independently and in teams, and to make written and oral reports.

Two additional goals are indicated in the Program Assessment Plan: Faculty Development and Curriculum Development.

> **Faculty Development** – *Program faculty should maintain an effective level of professional activity.*

The Mathematics faculty have been active, as indicated in the table below. The data is from annual faculty reports that cover academic years (August 17-August 16) through 2002–03, calendar years beginning January 1, 2005, and a 16.5 month transitional period from August 17, 2003 to December 31, 2004. There has clearly been a heightened and sustained increase in scholarly activity in the Department since 2002.

Number of Peer-Reviewed Publications Per Year

98-99	99-00	00-01	01-02	02-03	03-04	2005	Average
6	3	1	6	14	16	13	8.0

Note: 16 publications over the 16.5 month 2003–04 annualizes as 12 publications.

Faculty are keeping abreast of current usage of instructional technology and making increasing use of it in their courses. This has included the integration of more hardware and software. Following a committee recommendation, the standard graphical calculator was changed. The use of software such as *Excel* and *SAS* for statistics classes and *Mathematica* and *MATLAB* for computational mathematics classes has increased. Faculty teaching IST math courses have been revising the curriculum to include computer lab work.

Curriculum Development – *Faculty should adjust the curriculum to serve the needs of students and society.*

The department regularly monitors the curriculum. The is done through our assessment process and other anecdotal evidence. Also, the curricula at our peer institutions are used for comparison and the curriculum recommendations of the Mathematical Association of America (MAA), particularly from the Committee on the Undergraduate Program in Mathematics (CUPM), are closely followed.

We studied the major in detail this year. Both the national recommendations and the peer data that we gathered indicated moves towards more flexible and more applied (or applicable) options, including statistics and applied mathematics, which can range from theoretical physics to numerical/computational mathematics. Multiple majors are quite common for mathematics majors, both at Marshall and nationally. After much tinkering with our Capstone course, MTH 491, our assessment showed that it was still dysfunctional; problems are still existed with MTH 331. It was noted that MTH 331 needed more class time while MTH 491 did not need much class time for its research seminar goals.

As a result of our analyses, we did the following:

- added a second major in applied mathematics,
- reduced the core requirements and increased the number of elective options,
- increased the sequence requirement from one to two sequences,
- added a sequence in topology (MTH 430, 431),
- reactivated MTH 452 as the second half of the sequence in algebra,
- reactivated the sequence in complex variables (MTH 460, 461),
- increased MTH 331 from 3 to 4 credit hours,
- decreased MTH 491 from 3 to 2 credit hours, and
- tied the number of major electives required for the majors to individual choices regarding outside minors and double majors.

In light of the reduced core, the increased sequence requirement maintains the breadth of the major. The sequence options differentiate the two majors. Other minor changes were made including title changes and course prerequisites. While this is a major overhaul of the degree program, it is not as radical as it could be: no statistics major was created because we do not have the faculty to do so at this time. Mathematics remains a small degree program, but we hope that these change and the attractiveness of the word "applied" will push our annual graduation numbers into double figures regularly.

II. Board of Trustees Initiative 3 Compliance

BOT Initiative 3 requires that our graduates be evaluated with a nationally normed exam. We have been using the *ETS Major Field Test in Mathematics* for several years now. The planned benchmark was the 45th percentile of the national mean. In three of the four years we administered the exam, we have surpassed that level.

Scores for the ETS Major Field Test

	1999	2000	2001	2002	2003	2004	2005	Totals
Number of Examinees	8	0	13	10	7	11	3	52
High Score	189		176	181	191	178	200	200
Median Score	163.5		147	161	149	152	161	155.6
Mean Score	163.1		148.8	163.1	158.9	156.2	174	160.7
Low Score	141		131	149	139	140	161	131
Comparative Data Report	99-00		99-02	99-02	99-02	04-05	04-05	
National Median	149		149.4	149.4	149.4	152	152	
National Mean	151.6		152.4	152.4	152.4	154.7	154.7	
MU Mean Percentile	88		35	85	75	55	85	

Our graduation numbers are steady since the academic year 1999–2000, at a higher rate than 1994–1999, after incorporating a bulge that occurred with the suspension of the Computer Science and Software Development degree program.

Graduation Counts for Mathematics Majors and Minors

	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05
Math major	3	7	3	4	2	7	9	17	7	9	8
Math double	1	0	0	0	1	1	5	5	1	4	3
Math minor	13	7	15	14	19	21	22	12	5	13	17

III. Plans for the Current Year

After having completed the review and revision of the minor, we plan to review the requirements for the major in mathematics. We also want to consider tracks leading to applied mathematics and/or statistics degrees.

IV. Assistance Needed

The use of the *Major Field Test* remains an unfunded mandate by the state and the university administration.

V. What one most important thing has the department learned through this process?

We have learned by the results of the *Major Field Test* that our students stand up very well against other mathematics programs in the United States.

Marshall University
Assessment of Student Outcomes: Component/Course/Program Level

Component Area/Program/Discipline: B.S. Mathematics

Component / Course / Program Level					
Student Outcome	Person or Office Responsible	Assessment Tool or Approach	Standards/ Benchmark	Results/Analysis	Action Taken
1. Mathematical Reasoning	Faculty	MTH 229, 300, 427, 450 course grades	usable grades for 70% of students	87%, 70%, 90%, 33%, resp. Modern Algebra was a class of only 9 students with a D, 2 F's, and 3 W's.	Continue to track usable grades.
2. Personal Potential	Faculty	MTH 229, 230, 231, 427, 450, 491 course grades	usable grades for 70% of students	87%, 71%, 72%, 70%, 33%, 67%, resp. Modern Algebra was a class of only 9 students with a D, 2 F's, and 3 W's. Senior Seminar had only 3 students with one D.	Continue to track usable grades.
3.Nature of Mathematics	Faculty	MTH 300, 335, 411, 427, 428, 443, 446, 450, 491 course grades	usable grades for 70% of students	70%, 76%, n/a, 90%, 100%, 91%, 50%, 33%, 67%, resp. Statistics II had only 6 students with an F and 2 W's. Modern Algebra was a class of only 9 students with a D, 2 F's, and 3 W's. Senior Seminar had only 3 students with one D.	Continue to track usable grades.

4. Mathematical Modeling	Faculty	MTH 229, 230, 231, 331, 411 , 427, 445, 450, 491 course grades	usable grades for 70% of students	87%, 71%, 72%, 86%, n/a, 90%, 60%, 33%, 67%, resp. Statistics I had only 15 students with 4 D's, an F and a W. Modern Algebra was a class of only 9 students with a D, 2 F's, and 3 W's. Senior Seminar had only 3 students with one D.	Continue to track usable grades. Changes to Linear Algebra were executed (see the narrative).
5. Communication and Resourcefulness	Faculty	MTH 491 course grades	usable grades for 70% of students	67%. Senior Seminar had only 3 students with one D.	Continue to track usable grades.
6. Content Specific Goals	Faculty	MTH 491 course grades	usable grades for 70% of students	67%. Senior Seminar had only 3 students with one D.	Continue to track usable grades.
BOT Initiative #3	Chair	ETS Major Field Test	Mean scores above 45^{th} percentile of national data	Above national average (85^{th} percentile)	Continue to administer MFT. When more data is available, analyze the subscores.