

**Marshall University**

**Undergraduate Program Assessment  
2007 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 2006-2007 was the 11<sup>th</sup> 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 addition of a new major in applied mathematics was the cornerstone of the curriculum revision of the B.S. in Mathematics program that became effective in the fall 2006 semester. The requirement of a minor was removed. The size of each major—mathematics and applied mathematics—was made dependent upon the interdisciplinarity of the program of study of the individual student. The majors are far more flexible than the major before the revision.

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

### **C. Results**

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 in the table on the following page. 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 most courses would be higher if we counted grades for mathematics majors only. Let us consider the cases of MTH 230 and MTH 445. The usable grade percentage for all students in MTH 230 in the fall 2006 semester is only 51%, while 100% of the mathematics majors earned usable grades. The usable grade percentage for all students in MTH 445 in the fall 2006 semester is only 68%, while 91% of the mathematics majors earned usable grades.

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

	98- 99	99- 00	00- 01	01- 02	02- 03	03- 04	04- 05	05- 06	06- 07	Mean
MTH 229	72	76	71	87	74	69	87	74	72	76
MTH 230	68	80	62	69	47	57	71	58	56	63
MTH 231	85	78	79	79	95	87	72	73	84	81
MTH 300	50	66	82	79	74	78	70	74	78	72
MTH 331	79	75	68	83	50	76	86	73	92	76
MTH 335	91	75	84	53	65	82	76	74	75	75
MTH 411		83		57				100		80
MTH 427	92	100	82	93	73	85	90	23	76	79
MTH 428	89		89	33	67	100	100		80	80
MTH 442							33		83	58
MTH 443	56	64	100	73	42	100	91	88	83	77
MTH 445	52	77	79	70	74	93	60	78	68	72
MTH 446		100	70	89	100	63	50	92	100	83
MTH 448	71	56	86	50	76	100	100	67	83	77
MTH 449	75	67	88	100	79	78	91	71	79	81
MTH 450	89	60	100	83	92	100	33	79	95	81
MTH 491	60	67	100	91	80	92	67	85	71	78

Note: MTH 331 was formerly MTH 330.

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 faculty of the Department of Mathematics has been active, as indicated in the table on the following page. 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 been a heightened and sustained increase in scholarly activity in the Department since 2002-2003.

### Number of Peer-Reviewed Publications Per Year

98-99	99-00	00-01	01-02	02-03	03-04	2005	2006	Average
6	3	1	6	14	21	13	12	10.3

Note: 21 publications over the 16.5 month 2003–04 annualizes as 15 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. This 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.

No major changes to the curriculum were made. MTH 440, Graph Theory and Combinatorics, was added, as planned last year. MTH 422, Applied Time Series Analysis, was deleted since it was decided that the revised content for this course made it unsuited to our undergraduates.

## 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 45<sup>th</sup> percentile of the national mean. In 2006-2007, we have again surpassed that level.

**Scores for the ETS Major Field Test**

	1999	2000	2001	2002	2003	2004	2005	2006	06-07	All
<b>Students</b>	8	0	13	10	7	11	3	11	5	68
<b>High Score</b>	189		175	181	191	178	200	181	199	200
<b>Median Score</b>	163.5		147	161	149	152	161	149	155	153
<b>Mean Score</b>	163.1		148.8	163.1	158.9	156.2	174.0	149.9	153.2	156.4
<b>Low Score</b>	141		131	149	139	140	161	131	120	120
<b>National Median</b>	149.0		149.4	149.4	149.4	152	152	152	152	
<b>National Mean</b>	151.6		152.4	152.4	152.4	154.7	154.7	154.7	155.5	
<b>MU's Percentile</b>	88		35	85	75	55	85	45	50	

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. It is expected that the small decline in 2006-2007 will be followed by near-record numbers in 2007-2008.

**Graduation Counts for Mathematics Majors and Minors**

	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07
<b>Major</b>	7	3	7	3	4	2	7	9	17	7	9	10	11	7
<b>Double</b>	1	1	0	0	0	1	1	5	5	1	3	3	6	2
<b>Minor</b>	11	13	7	15	14	19	21	22	12	5	13	21	17	13

### **III. Plans for the Current Year**

We plan to monitor and review the majors in mathematics and applied mathematics. We also want to consider adding an area of emphasis in statistics within the applied mathematics major.

### **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**

<b>Component / Course / Program Level</b>					
Student Outcome	Person or Office Responsible	Assessment Tool or Approach	Standards/ Bench-mark	Results/ Analysis	Action Taken
1. Mathematical Reasoning	Faculty	MTH 229, 300, 427, 450 course grades	usable grades for 70% of students	72%, 78%, 76%, 95%, resp.	Continue to track usable grades.
2. Personal Potential	Faculty	MTH 229, 230, 231, 427, 450, 491 course grades	usable grades for 70% of students	72%, 56%, 84%, 76%, 95%, 71%, resp.	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	78%, 75%, n/a, 76%, 80%, 83%, 100%, 95%, 71%, resp.	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	72%, 95%, 84%, 92%, n/a, 76%, 68%, 95%, 71%, resp.	Continue to track usable grades.
5. Communication and Resourcefulness	Faculty	MTH 491 course grades	usable grades for 70% of students	71%.	Continue to track usable grades.
6. Content Specific Goals	Faculty	MTH 491 course grades	usable grades for 70% of students	71%.	Continue to track usable grades.
BOT Initiative #3	Chair	ETS Major Field Test	Mean scores above 45 <sup>th</sup> percentile of national data	At the national average (50 <sup>th</sup> percentile)	Continue to administer MFT.

