

Minnesota State University Moorhead
2008-2009 Assessment Report Cover Sheet

(An electronic version of this form can be accessed at <http://www.mnstate.edu/assess>)

Note: All non-accredited programs are required to complete this form. Include Assessment Reporting Forms for each learning outcome assessed.

Academic Program: B.A.'s and B.S.'s in Mathematics

Department: Mathematics

College: Social and Natural Sciences

Date: October 23, 2008

1. Name(s) of Department Assessment Coordinator and/or Assessment Committee Members

Ellen Hill (department assessment committee chair)

2. List of All Student Learning Outcomes. (List all outcomes, placing an asterisk (*) by the outcomes you are assessing this year.)

- *1. Students should understand the theory and applications of calculus and linear algebra.
- *2. Students should develop the capacity for rigorous analytical thought and the ability to communicate ideas in a precise manner.
- *3. Students should possess an awareness of the abstract nature of theoretical mathematics and the ability to write proofs.
- *4. Students should possess an understanding of the breadth of the mathematical sciences and their deep interconnecting principles.
- *5. Students should be able to solve multi-step problems and perform complex tasks.
- *6. Students should develop the ability to detect basic mathematical structures (patterns) and make generalizations from them.

3. Describe how your program has addressed the comments from the Student Learning Outcomes Assessment Committee during the past two academic years? (If you have made changes to your plan, file a revised Assessment Plan Cover Sheet and Assessment Planning Form(s).)

The SLOAC suggested that we change the scale for our capstone surveys to reduce the choices and improve inter-rater reliability. Last year we agreed that such a change would help and adjusted the scale to be 1-5 rather than 1-9. On the new scale, 1 is 'very poor', 3 is 'adequate' and 5 is 'excellent'. We are using the same 5-point scale this year.

As is usual for us, when we interpret the scores, we are paying more attention to trends rather than (arbitrary) numerical goals, whether we are talking about the capstone surveys or the ETS Major Field exam.

4. If you have received an Instructional Improvement Grant in the past two years, identify the outcomes on which the grant was based and provide a summary here of the results from your grant.

We received an Instructional Improvement Grant in 2007. The grant was intended to primarily focus on the first of our student learning outcomes in regards to calculus. The main purpose of the project is to start to develop the labs for use in Calculus I and Calculus II. The idea was to start developing the labs during the summer and continue during the fall and spring semesters as Calculus I and Calculus II are taught. The labs for both classes have been created, and both courses have been taught with the labs at least once. Calculus I was taught with the labs during Fall 2007, Spring 2008, and currently in Fall 2008. Calculus II was taught with the labs in Spring 2008 and currently in Fall 2008. It is too early to report on the results of using the labs since the students who have learned calculus with the new format will not take the ETS Major Field Exam until their senior year, likely in December 2011. However, anecdotal evidence at this point indicate that the students like the opportunity to have the graded feedback, and the MSUM students take the labs seriously, making heavy use of the tutor lab and instructor office hours.

We received an Instructional Improvement Grant in 2008 that was intended to focus primarily on outcomes #3 above. The grant was geared towards redesigning Math 225, Discrete Mathematics. In Spring 2008 we processed changes in our major through APAC making Math 225 a required course for all mathematics majors (regardless of track). Therefore, every students entering MSUM in Fall 2008 or later in a math major will be required to take Math 225 to complete the major. In addition, we are increasing the frequency with which the course is offered, from every other spring to every semester. This fall, we had twelve students sign up for it, ten of which were math majors and two of which are computer science majors (the course has been required for the CS degree for some time). Four of the ten math majors are new transfer students, for whom Math 225 is a required part of the degree. The other six were not required to take it, but did so on our advice and, anecdotally, the advise of their peers who took it last spring before it was fully redesigned. Although it is too early to see any meaningful assessment results as the redesigned course is only partway through its first offering, anecdotal evidence from conversations with the students in the class show that the students feel that the course, although difficult, is useful.

The grant was used to create a sequence of “Miniprojects” for use during the course. These miniprojects can be found on the instructor’s website, www.mnstate.edu/elhill/f2008/m225.htm. The projects range in difficulty level from some of the harder homework problems to problems that really stretch the imagination and reasoning skills of the students. The purposes of individual miniprojects can be quite varied, and include reinforcing topics from the class, getting students to practice some of the higher order thinking skills required in mathematics, introducing related and required topics, introducing related but optional topics, giving a preview of topics that will appear later in the course, introducing topics that might be of interest only to the CS

majors (or other subpopulations), etc.. The students are required to do only a subset of the miniprojects, based on their own interests and abilities. These miniprojects have not all be written yet, since some are very time-consuming to create, but are at the time of this report about three-quarters done. A large enough collection is being created to allow future instructors to choose a subset should they wish and to appeal to the students' interests.

5. Signatures

Department Chair or Program Director

Dean or Director

Required Attachments:

1. Assessment Reporting Forms
2. Records of department meetings when Assessment Report was discussed and approved.

Minnesota State University Moorhead
2008-2009 Assessment Reporting Form

(An electronic version of this form can be accessed at <http://www.mnstate.edu/assess>)

Instructions: Include this form for each student learning outcome assessed during the previous year. Include Assessment Report Cover Sheet.

Academic Program: B.A.'s and B.S.'s in Mathematics

1. Learning outcome assessed (please include the number of the outcome to correspond with the list on the cover sheet).

1. Students should understand the theory and applications of calculus and linear algebra.

2. Describe assessment measure used for this learning outcome (attach instrument or rubric)

ETS Major Field Test in Mathematics.
Success on the Society of Actuaries Exam I.

3. Expected/satisfactory student results (from assessment plan)

None is prescribed. We study the results for trends and react accordingly.

4. Actual results from the past year (attach additional information, if necessary)

In comparison to the institutions taking the Major Field Test in Mathematics, our students were at the 30th percentile in the “Calculus” subscore. For the “Algebra” subscore, which includes both linear algebra and abstract algebra, our students were at the 80th percentile. In the previous two years, the “Calculus” subscores were at the 15th and 15th percentiles. The “Algebra” subscores were at the 50th and 55th percentiles. Due to small numbers, some variability is expected. We note that our scores do seem to be a little better this year. We have noticed that our scores are often better when most of the students taking the exam are non-transfers (that is, students who only attended MSUM). In this year’s cohort of exam takers, 75% were non-transfer students, an unusually high number. Starting with the students who take Calculus I in Fall 2007 or later, we have redesigned the first year calculus sequence in an attempt to improve the “Calculus” scores, but do not expect to see any results from this redesign until those students take the ETS exam in their senior year, likely Fall 2010. Starting with the students who entered the university in Fall 2008 or later, due to the new requirement of Math 225, we hope to see improvement in the “Algebra” subscore (since the topics include abstract reasoning), but do not expect to see any results until Fall 2010 (for transfers) or Fall 2011 (for new entering freshmen).

Of the five students who took the actuarial exam in the last year, three passed, one did not, and one score is unknown. This is the same result as in the previous year.

5. Describe and explain available trend data for student performance on this outcome over the past several years. In other words, describe how the results of this measure have changed over the past several years.

See above for the ETS exam. Two years ago, three out of four students who attempted the Society of Actuaries Exam I passed the exam. Last year and this year, three of five passed with one student each year with an unknown result.

6. Proposed action in response to results. (Please note if improvements can be made with existing department resources. If improvements cannot be made with existing department resources, consider applying for an Instructional Improvement Grant.)

The department has already redesigned the first year calculus sequence to address the issues with calculus. The course was changed from four days a week lectures to three days a week lectures and two days a week lab time. The labs were developed with the help of an Instructional Improvement Grant.

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Academic Program: B.A.'s and B.S.'s in Mathematics

1. Learning outcome assessed (please include the number of the outcome to correspond with the list on the cover sheet).

2. Students should develop the capacity for rigorous analytical thought and the ability to communicate ideas in a precise manner.

2. Describe assessment measure used for this learning outcome (attach instrument or rubric)

ETS Major Field Test in Mathematics.
Survey in capstone courses.
Success on the Society of Actuaries Exam I.

3. Expected/satisfactory student results (from assessment plan)

None is prescribed. We study the results for trends and react accordingly.

4. Actual results from the past year (attach additional information, if necessary)

In comparison to the other institutions taking the Major Field Test in Mathematics, our students were at the 15th percentile last year in the “Non-Routine Problems” subscore. In the previous two years they scores at the 20th and 10th percentile.

For the questions on the capstone surveys, the students are ranked on a scale of 1 to 5 where 1 is “very poor”, 3 is “adequate”, and 5 is “excellent.” For the question regarding rigorous analytical thought, the students were given a mean score of 3.45. Last year the average was 3.91. The scores two years ago, which were on a scale of 1 to 9, averaged 5.96. The scores look to be either even or decreasing slightly. For the question regarding the communication of ideas in a precise manner, the students were given a mean score of 3.47. Last year the average was 3.91. Two years ago the average was 6.20 (out of a nine-point scale). Again, the scores appear to be either even or decreasing slightly.

Of the five students who took the actuarial exam in the last year, three passed, one did not, and one score is unknown. This result is identical to the previous year. Two years ago three out of four students who attempted the Society of Actuaries Exam I passed the exam.

5. Describe and explain available trend data for student performance on this outcome over the past several years. In other words, describe how the results of this measure have changed over the past several years.

See above.

6. Proposed action in response to results. (Please note if improvements can be made with existing department resources. If improvements cannot be made with existing department resources, consider applying for an Instructional Improvement Grant.)

We have made Math 225 (Discrete Mathematics), in a modified form, a required course for our majors. The purpose of this change is to provide our students with an introduction to proofs and be our gateway course for our abstract classes. The ability to do mathematical proofs is directly relevant to both rigorous thought about mathematical ideas and the ability to communicate ideas in a precise manner.

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2007-2008 Assessment Reporting Form

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Academic Program: B.A.'s and B.S.'s in Mathematics

1. Learning outcome assessed (please include the number of the outcome to correspond with the list on the cover sheet).

3. Students should possess an awareness of the abstract nature of theoretical mathematics and the ability to write proofs.

2. Describe assessment measure used for this learning outcome (attach instrument or rubric)

Survey in capstone courses.

3. Expected/satisfactory student results (from assessment plan)

None is prescribed. We study the results for trends and react accordingly.

4. Actual results from the past year (attach additional information, if necessary)

Awareness of the abstract nature of theoretical mathematics and the ability to write proofs are difficult things to assess in students. However, these skills are not only highly intertwined with each other, to the point of being difficult to separate, they are also highly intertwined with the critical thinking skills and thought processes that are inherent in the other student learning outcomes. Therefore, all of the questions on the capstone surveys in some way touch on this student learning outcome.

For the questions on the capstone surveys, the students are ranked on a scale of 1 to 5 where 1 is "very poor", 3 is "adequate", and 5 is "excellent". Two years ago, the scale was 1 to 9 where 1 was "very poor", 5 was "adequate", and 9 was "excellent". The scores from the prior two years are listed in parenthesis.

For the question regarding rigorous analytical thought, the students were given a mean score of 3.45 (3.91 and 5.96/9).

For the question regarding the communication of ideas in a precise manner, the students were given a mean score of 3.47 (3.91 and 6.20/9).

For the question regarding the understanding of the breadth of the field, the students were given a mean score of 3.75 (3.72 and 5.78/9).

For the question regarding the understanding of the deep interconnecting principles in mathematics, the students were given a mean score of 3.57 (3.38 and 5.60/9).

For the question regarding the ability to solve multistep problems, the students were given a mean score of 3.67 (4.13 and 5.90/9).

For the question regarding the ability to perform complex tasks, the students were given a mean score of 3.63 (3.91 and 5.88/9).

For the question regarding the ability to detect basic mathematical patterns, the students were given a mean score of 3.86 (3.75 and 5.72/9)

For the question regarding the ability to generalize from basic mathematical structures, the students were given a mean score of 3.45 (3.31 and 5.44/9).

None of these scores appear to be changing in highly significant ways, although the overall trend appears to be a decreasing one.

5. Describe and explain available trend data for student performance on this outcome over the past several years. In other words, describe how the results of this measure have changed over the past several years.

See above.

6. Proposed action in response to results. (Please note if improvements can be made with existing department resources. If improvements cannot be made with existing department resources, consider applying for an Instructional Improvement Grant.)

We have made Math 225 (Discrete Mathematics), in a modified form, a required course for our majors. The purpose of this change is to provide our students with an introduction to proofs and be our gateway course for our abstract classes. The ability to do mathematical proofs is fundamental when dealing with abstract mathematical concepts.

Minnesota State University Moorhead
2007-2008 Assessment Reporting Form

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Instructions: Include this form for each student learning outcome assessed during the previous year. Include Assessment Report Cover Sheet.

Academic Program: B.A.'s and B.S.'s in Mathematics

1. Learning outcome assessed (please include the number of the outcome to correspond with the list on the cover sheet).

4. Students should possess an understanding of the breadth of the mathematical sciences and their deep interconnecting principles.

2. Describe assessment measure used for this learning outcome (attach instrument or rubric)

Survey in capstone courses.

3. Expected/satisfactory student results (from assessment plan)

None is prescribed. We study the results for trends and react accordingly.

4. Actual results from the past year (attach additional information, if necessary)

For the questions on the capstone surveys, the students are ranked on a scale of 1 to 5 where 1 is "very poor", 3 is "adequate", and 5 is "excellent". For the question regarding the understanding of the breadth of the field, the students were given a mean score of 3.75. Last year's mean was 3.72. The scores two years ago averaged 5.78 (on a scale of 1 to 9). For the question regarding the understanding of the deep interconnecting principles in mathematics, the mean score was 3.57. Last years scores averaged 3.38. The scores two years ago averaged 5.60 (on a scale of 1 to 9). The scores appear to be staying the same for the question regarding breadth of the field, and appear to be staying the same or slightly increasing for the question regarding the deep interconnecting principles.

5. Describe and explain available trend data for student performance on this outcome over the past several years. In other words, describe how the results of this measure have changed over the past several years.

See above.

6. Proposed action in response to results. (Please note if improvements can be made with existing department resources. If improvements cannot be made with existing department resources, consider applying for an Instructional Improvement Grant.)

We have made Math 225 (Discrete Mathematics), in a modified form, a required course for our majors. The purpose of this change is to provide our students with an introduction to proofs and be our gateway course for our abstract classes. In addition to focusing on proofs, dealing with discrete mathematics will add breadth to our major. The other lower-level courses (in particular the calculus sequence) focus on mathematics in continuous spaces rather than discrete ones. Proofs also help students build an understanding of how skills in one field of mathematics affects other fields.

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Academic Program: B.A.'s and B.S.'s in Mathematics

1. Learning outcome assessed (please include the number of the outcome to correspond with the list on the cover sheet).

5. Students should be able to solve multi-step problems and perform complex tasks.

2. Describe assessment measure used for this learning outcome (attach instrument or rubric)

ETS Major Field Test in Mathematics.
Survey in capstone courses.
Success on the Society of Actuaries Exam I.

3. Expected/satisfactory student results (from assessment plan)

None is prescribed. We study the results for trends and react accordingly.

4. Actual results from the past year (attach additional information, if necessary)

In comparison to the other institutions taking the Major Field Test in Mathematics, our students were at the 15th percentile in the “Non-Routine Problems” subscore and at the 60th percentile in the “Applied Problems” subscore. In the previous two years, for “Non-Routine Problems”, our students were at the 20th and 10th percentiles, and for the “Applied Problems” were at the 35th percentile in both years. We note that our scores appear to be staying the same in the “Non-Routine Problems” category. The “Applied Problems” category showed significant improvement, but the cause is unknown. Some variation is expected due to small numbers of students taking the exam each year. We also note that the number of transfer students in the current cohort was particularly small, and we have noticed in the past that when we have a large number of transfer students the scores tend to go down. We are clearly not happy with these results, particularly the results in the “Non-Routine Problems” category. We hope that the introduction of Math 225 as a gateway course to the major will help in this category.

For the questions on the capstone surveys, the students are ranked on a scale of 1 to 5 where 1 is "very poor", 3 is "adequate", and 5 is "excellent". For the question regarding the ability to solve multistep problems, the students were given a mean score of 3.67. The mean score last year was 4.13. The mean score two years ago was 5.90 (on a scale of 1 to 9). For the question regarding the ability to perform complex tasks, the students

were given a mean score of 3.63. Last year the mean score was 3.91. The mean score two years ago was 5.88 (on a scale of 1 to 9). The scores for either of these questions appear to be decreasing.

Of the five students who took the actuarial exam in the last year, three passed, one did not, and one score is unknown. In the previous year, there were also five students who took the exam, three of whom passed, one did not, and one score was unknown. Two years ago, three out of four students who attempted the Society of Actuaries Exam I passed the exam.

5. Describe and explain available trend data for student performance on this outcome over the past several years. In other words, describe how the results of this measure have changed over the past several years.

See above.

6. Proposed action in response to results. (Please note if improvements can be made with existing department resources. If improvements cannot be made with existing department resources, consider applying for an Instructional Improvement Grant.)

Our changes in the calculus sequence implemented in Fall 2007 included an attempt, through the lab activities, to get students to use calculus in applied situations, which often include more than just one step to solve. As such, we anticipate that those students who go through the calculus sequence after our changes will improve in this measure. As in the case with student learning outcome 1, we don't expect to see much affect from these changes until those students take the ETS exam and capstone courses as seniors (Fall 2010).

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Academic Program: B.A.'s and B.S.'s in Mathematics

1. Learning outcome assessed (please include the number of the outcome to correspond with the list on the cover sheet).

6. Students should develop the ability to detect basic mathematical structures (patterns) and make generalizations from them.

2. Describe assessment measure used for this learning outcome (attach instrument or rubric)

ETS Major Field Test in Mathematics.
Survey in capstone courses.

3. Expected/satisfactory student results (from assessment plan)

None is prescribed. We study the results for trends and react accordingly.

4. Actual results from the past year (attach additional information, if necessary)

In comparison to the other institutions taking the Major Field Test in Mathematics, our students were at the 15th percentile in the “Non-Routine Problems” subscore and at the 60th percentile in the “Applied Problems” subscore. In the previous two years, for “Non-Routine Problems”, our students were at the 20th and 10th percentiles, and for the “Applied Problems” were at the 35th percentile in both years. We note that our scores appear to be staying the same in the “Non-Routine Problems” category. The “Applied Problems” category showed significant improvement, but the cause is unknown. Some variation is expected due to small numbers of students taking the exam each year. We also note that the number of transfer students in the current cohort was particularly small, and we have noticed in the past that when we have a large number of transfer students the scores tend to go down. We are clearly not happy with these results, particularly the results in the “Non-Routine Problems” category. We hope that the introduction of Math 225 as a gateway course to the major will help in this category.

For the questions on the capstone surveys, the students are ranked on a scale of 1 to 5 where 1 is "very poor", 3 is "adequate", and 5 is "excellent". For the question regarding the ability to detect basic mathematical patterns, the students were given a mean score of 3.86. The mean score last year was 3.75. The mean score two years ago was 5.72 (on a scale of 1 to 9). For the question regarding the ability to generalize from basic

mathematical structures, the students were given a mean score of 3.45. The mean score last year was 3.31. The mean score two years ago was 5.44 (on a scale of 1 to 9). We note that the scores for detecting mathematical patterns are either staying the same or increasing slightly. The scores for generalizing from mathematical structures appear to be staying the same or increasing slightly.

5. Describe and explain available trend data for student performance on this outcome over the past several years. In other words, describe how the results of this measure have changed over the past several years.

See above.

6. Proposed action in response to results. (Please note if improvements can be made with existing department resources. If improvements cannot be made with existing department resources, consider applying for an Instructional Improvement Grant.)

We have made Math 225 (Discrete Mathematics), in a modified form, a required course for our majors. The purpose of this change is to provide our students with an introduction to proofs and be our gateway course for our abstract classes. By their very nature, proofs encourage students to think in terms of the basic mathematical structures of the issue that they are dealing with and make generalizations.

