**Bachelor's Degree in Mathematics**
***DRAFT* Assessment of Student Learning Program**
Kansas State University

**A.** College, Department, and Date of This Submission

College: Arts and Sciences
Department: Mathematics
Date of Submission: April 4, 2008

**B.** Contact Person(s) for the Assessment Plans

Louis Pigno, Department Head
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**C**. Program – degree, minor, or certification

B.S./B.A. in Mathematics

**D**. Annual Progress Reports on Assessment of Student Learning, Fall 2007

1. **List the Student Learning Outcomes that were assessed during the year, including those for which data were gathered as well as those for which developmental work was done, such as the creation or piloting of assessment measures.**

   R-2: Students will be able to compose and explain mathematical proofs and counterexamples; make logical inferences.

   K-1: Students will know the standard facts and algorithms of calculus and differential equations.

   K-4 Students will know the standard facts and algorithms of a specialized area of mathematics at a basic level (as defined by the student's advisor).

   Relationship to K-State SLO

| Program SLOs | Knowledge | Critical Thinking | Comm. | Diversity | Integrity | Program SLO is conceptually different from K-State SLOs |
|---|---|---|---|---|---|---|
| R-2 | X | X | X | | | |
| K-1 | X | | | | | |
| K-4 | X | X | X | | | |

2. **For each learning outcome, describe the measures used, the sample of students from whom data were collected, the timetable for the collection, and the forum in which the measures were administered. Remember that over a three-year period at least one-half of the measures used must be direct measures.**

R-2

- The assessment for this learning outcome is under development. Our plan (which we are following) calls for the outcome to be assessed in upper division mathematics courses. Majors take a minimum of six such classes. Our plan is that eventually all students enrolled in these courses will be assessed. Two proof problems on assignments/exams will be designated for evaluation for program assessment. In order to provide consistent scoring, the curriculum committee has developed a rubric for grading proofs (attached). This rubric was used during the past year in Math 512, Math 633, which are the recommended proof courses for math majors planning on attending graduate school, and in Math 572, which is a recommended proof course for math majors planning on working in education.
- Majors are asked during their exit interviews whether they believe they understand how to compose and explain proofs and what examples or reasons they have to support their belief. All graduating seniors are invited for such interviews and over 90% participate.

K-1

- Math 240, Elementary Differential Equations, serves as the capstone course for the calculus sequence. Students taking this course are assigned to complete 18-21 computerized assignments demonstrating their skill in calculus and differential equations (most differential equations are solved by reducing them to calculus problems) during the semester. Success of math majors on these problems will be recorded. Math 240 is a required course and over 90**%** of majors take the course on campus and so will complete the computerized assessments.
- Majors are asked during exit interviews whether they believe they have knowledge of basic calculus and differential equations and what examples or reasons they have to support their belief. All graduating seniors are invited for such interviews and over 90% participate.

K-4

- Advisors will be responsible for selecting a performance assessment (if available) for whether students have met this student learning outcome. Because students take a mathematics degree as preparation for a wide range of careers, many different measures will be appropriate in different circumstances. A list of nine different possible assessments that have been used in the past has been developed, but other measures may be suitable in the future. Since this is a new outcome for our program, current graduates may not have completed any such assessment. Majors were asked during exit interviews about whether they had completed any such performance measures, but only 50% had attempted such measures.

- Placement data and alumni surveys will follow up on performance in selected area after graduation.

3. **Describe the results of the assessment. (What did you learn? What is working well? Where are improvements needed?) If specific results are not available, describe the progress that has been made on the initiatives included in the approved assessment plan.**

For each student learning outcome, we have defined "exemplary," "proficient," "acceptable," and "developing" levels of performance. For our program as a whole, we have the following standards.

The *program* will be *exemplary* in a particular outcome if at least 90% of students are proficient or better in that outcome and at least 50% are exemplary.

The *program* will be *proficient* in a particular outcome if at least 80% of students are proficient or better in that outcome and at least 30% are exemplary.

The *program* will be *acceptable* in a particular outcome if at least 70% of students are proficient or better in that outcome and at least 10% are exemplary.

Otherwise, the *program* will be *developing* in that outcome.

R-2

- Rubric-based evaluations of proofs were collected from 24 students in upper-division courses during spring 2007. Note that this double counts some students who took more than one course where evaluations were performed. In each course, two representative problems were evaluated on a 6-point rubric. The standards of performance for the sum of the scores on the two problems was

| *Rating* | *Score* |
|---|---|
| Exemplary | 11-12 |
| Proficient | 9-10 |
| Acceptable | 7-8 |
| Developing | 0-6 |

With these standards, student performance was rated as follows

| *Rating* | *Number* | *Percent* |
|---|---|---|
| Exemplary | 15 | 62.5% |
| Proficient | 4 | 16.7% |
| Acceptable | 2 | 8.3% |
| Developing | 3 | 12.5% |

This continues a trend of improvement over the last two years.

- Evaluations similar to these were scheduled to be collected in fall 2007 as well. These plans were disrupted when the final schedule was changed due to the ice-storm. Our policy involves taking student work from final exam

problems and then evaluating them separately according to our common rubric (so that assessment results are based on our common standards, rather than student grades). Because some courses cancelled finals, we had much less data than expected. Students taking finals performance was likely worse than it would have been under normal circumstances. Furthermore, in some classes students were offered the option of accepting their grade heading into the final as their overall course grade (especially for students who had travel plans and hadn't planned to be around on Saturday). Naturally this introduced self-selection issues, where students who had A's didn't take the final while weak students did. We report our results below, but we do not feel they are a reliable summary of our program.

| *Rating* | *Number* | *Percent* |
|---|---|---|
| Exemplary | 0 | 0% |
| Proficient | 3 | 30% |
| Acceptable | 0 | 0% |
| Developing | 7 | 70% |

- For the future, we are looking at whether we can establish a reasonable time outside finals for data collection so we have more flexibility with when work is recorded in the future. We also strongly suggest the university avoid having an ice storm during finals in the future.

- Nine of fifteen students reported confidence in their ability to compose and explain proofs. It appears this topic was omitted by accident in five interviews.

K-1

- Fifteen undergraduate majors completed Math 240 in 2007. Their average scores on the online assignments were computed. The following standards of performance were specified last year based on an analysis of student performance among both majors and non-majors.

| *Rating* | *Score* |
|---|---|
| Exemplary | 90 – 100% |
| Proficient | 80 – 90% |
| Acceptable | 70 – 80% |
| Developing | 0 – 60% |

Based on these standards, undergraduate majors' performances were rated as follows:

| *Rating* | *Number* | *Percent* |
|---|---|---|
| Exemplary | 10 | 66.7% |
| Proficient | 1 | 6.7% |
| Acceptable | 1 | 6.7% |
| Developing | 3 | 20.0% |

These values are similar to previous years. Note that this assessment measures students at the midway point in their work, rather than at exit, so we get feedback on how students are doing in a more timely fashion.

K-4

- Sixteen of the nineteen students who went through exit interviews this spring had completed performance assessments tied to their knowledge of a specialized area of mathematics. As this outcome was specified after these students began their studies, we are pleased that we already have 80% of our students meeting this goal. We have also developed plans to help more majors reach this outcome as detailed in section 5 below.

- Placements for the 19 students who graduated in spring 2007 were

| *Placement* | *Number* | *Percent* |
|---|---|---|
| Grad School | 8 | 40.0% |
| High Tech Job | 3 | 20.0% |
| Teaching | 5 | 20.0% |
| Low Tech Job | 0 | 0.0% |
| Unknown | 3 | 20.0% |

4. **Describe the process by which faculty reviewed the results and decided on the actions and/or revisions that were indicated by them.**

   This annual assessment report is brought to the attention of the faculty each spring and is available for them to read in the department office. We have not yet received any comments that actions or revisions are appropriate.

5. **Describe the actions and/or revisions that were (or will be) implemented in response to the assessment results.**

   This data is better in some areas and worse in others, but within reasonable fluctuations of previous results. Outcome K-4 is new to the department and while we are pleased that over half the students are already meeting the outcome, we have developed a plan to support all majors in this work. In particular, we have added a departmental position to facilitate undergraduate research and introduced a Center for the Integration of Undergraduate and Graduate Research to support students in developing expertise in the specialization of their choice.

6. **In second and subsequent years, describe the efforts on student learning of the previous year's actions.**

   A post-doc has been hired by the Center for the Integration of Undergraduate and Graduate Research who began teaching this fall. Since he has been here less than one year, we have no results to report as yet.