ASSESSMENT PLAN FOR THE MATHEMATICS MAJOR

The Department of Mathematics offers degree programs leading to the BA and BS degrees in mathematics. A departmental committee was formed to devise a plan to provide ongoing assessment of the mathematics major. The committee solicited the input of the entire department, and the proposal was approved by the faculty.

1. Goals of the Program

Recipients of an undergraduate degree in mathematics are expected to understand and apply:

- basic real analysis of one variable;
- calculus of several variables and vector analysis;
- basic linear algebra and theory of vector spaces;
- concerted study of at least one advanced topic of mathematics, chosen from: advanced calculus, abstract algebra, set theory and logic, probability and statistics, partial differential equations, and numerical analysis.

In addition, they are expected to acquire the ability and skills to:

- give direct proofs, proofs by contradiction, and proofs by induction;
- formulate definitions and give examples and counterexamples;
- read mathematics without supervision;
- follow and explain algorithms; and
- apply mathematics to other fields.

Degree Requirements. For the BA degree in mathematics, students must complete 21 credit hours in mathematics courses numbered above 300, including

- Math 321 (an introduction to understanding and writing formal proofs),
- 3 credit hours in a writing-intensive mathematics course,
- 6 credit hours in a sustained two-course sequence approved by the department.

For the BS degree in mathematics, students must complete 24 credit hours in mathematics courses numbered above 300, and 15 credit hours in additional upper division mathematics courses or appropriate non-introductory courses in the natural or information sciences, including

- Math 321,
- 6 credit hours in writing-intensive mathematics courses,
- 6 credit hours in a sustained two-course sequence approved by the department.

In addition, students in the BS program must demonstrate ability to program scientific problems on a computer by passing one of an approved list of courses.

The Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America established national guidelines for the mathematics major in its 1991 report [1]. The CUPM Report lists seven components which form the structure of the mathematical sciences major:

A. Calculus (with differential equations),
B. Linear algebra,
C. Probability and statistics,
D. Proof-based courses,
E. An in-depth experience in mathematics,
F. Applications and connections,
G. Track courses, departmental requirements and electives.

All of our mathematics majors take linear algebra Most mathematics majors at UH Manoa take probability and statistics; it has been suggested that this be added as a requirement for the major. Our requirements fit the national guidelines well. The degree requirements also correspond well to the departmental "Goals of the Program" given above.

Other MAA guidelines for the mathematics major, taken from [3], include that the department should provide:

- quality faculty advising,
- undergraduate seminars,
- special meeting rooms for majors,
- undergraduate research opportunities.

Math majors are encouraged to see their adviser at least once per semester (and are required to do so once per year). We have weekly undergraduate seminars and a lounge for math majors.

2. Assessment Plans

Assessment practices in mathematics departments at American colleges and universities are described in the MAA book *Assessment Practices in Undergraduate Mathematics* [2]. The departments described therein use a variety of techniques for assessing the major program:

(1) capstone seminars,
(2) senior projects or presentations,
(3) standardized exams,
(4) departmental exams for assessment,
(5) comprehensive exams,
(6) alumni questionnaires,
(7) portfolios,
(8) focus groups.

Most departments use more than one method. We use a capstone seminar, which includes a senior paper and presentation and a departmentally devised assessment exam, while continuing our use of alumni questionnaires. In addition, we keep track of what courses our graduating seniors actually took; i.e., we assess how they are actually meeting the major requirements.

Capstone Seminar. The Mathematics Department has a one-credit capstone seminar, Math 480, required of senior mathematics majors.

Each student in the seminar is required to write a short paper on a mathematical topic, and to present it to the seminar. This provides our majors with a research experience not available in most courses. It provides faculty representatives with an opportunity to evaluate the graduating seniors as a group. The faculty member responsible for the seminar provides a report to the department indicating the strengths and weaknesses of that group of students. This is part of the assessment.

To receive credit, a student has to present an acceptable paper and take the assessment examination. The assessment exam does not affect the student's grade for the course. It serves as one of the department's objective assessment tools.

The articles on Saint Mary's College, Kutztown University and Wabash College in [2] provide detailed accounts of those institutions' experience with capstone courses.

Assessment Examination. The design of the examination is crucial to the effectiveness of the department's evaluation. It is divided into three parts. The first part tests the student's retention of basic calculus and linear algebra. The second part tests the student's ability to produce and write elementary proofs and examples, that is, to think mathematically. The third part contains questions from each of the six specializations available in our program, and the student is asked to answer only questions relevant to the courses he or she has taken (and to indicate on the exam which these are). The exams are graded, summarized, and the summary results distributed to the faculty.

The articles on Franklin College, Ball State University and Wabash College in [2] provide detailed accounts of those institutions' experience with a variety of assessment and comprehensive examinations.

Alumni Questionnaires. The Mathematics Department sends questionnaires to all mathematics majors after graduation. The response rate has varied, but averages close to 50%. Most respondents write favorably of their experience as math majors at UHM. The results are summarized and reported regularly to the faculty.

The model program in this area is that of the Department of Statistics at Iowa State University, described in detail in [2].

References

[1] Committee on the Undergraduate Program in Mathematics, *The Undergraduate Major in the Mathematical Sciences*, Mathematical Association of America, 1991.

[2] B. Gold, S. Keith, W. Marion, eds., *Assessment Practices in Undergraduate Mathematics*, Mathematical Association of America, 1999.

[3] Task Force to Review the 1993 Guidelines, *Guidelines for Programs and Departments in Undergraduate Mathematical Sciences*, Revised edition, Mathematical Association of America, 2000.