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TO: Dean Jaros, Dean, Graduate School

FROM: John C. Raich, Dean J.C. Raich

SUBJECT: Seven Year Department Review Document, Department of Mathematics

This memo constitutes the initial response of the dean to the departmental self-evaluation document.

I. Summary

The report presents a picture of a highly efficient instructional program. The Department has an excellent record of instructional innovation, particularly at the introductory level, and is recognized nationally as a leader in the reform of mathematics education. Quality of instruction at all levels is very good, with more than acceptable student satisfaction. Degree production per faculty is significantly above peer averages. The quality of entering undergraduate and graduate students is steadily improving. Employment prospects for graduates seem quite good. Peer comparisons show that the Department is in the upper quartile of external contract and grant funding. External reviewers have lauded the program in applied and computational mathematics as one of the nation's best. Efforts to improve national and international visibility have focused on that research/graduate program and mathematics education. This strategy has paid off in terms on quality of instruction, employment opportunities for graduates, a relatively unique research emphasis, and opportunities for interdisciplinary interactions. However, the payoff in terms of National Research Council survey rankings, which tend to favor strength in pure mathematics and larger departments, has been much less noticeable.

II. Organization of the report

The report is succinct and well-organized. It provides a good picture of activities in the Department of Mathematics without being unduly lengthy or overwhelming the reader with information. It focuses on the main components of the department's mission: the undergraduate service courses, the undergraduate majors, the graduate program, and research efforts. The review provides a compact assessment of progress made by the Department of Mathematics in each of these areas. The report also briefly outlines future plans of the Department in these areas. Documentation of comparisons with peer departments at other universities, some historical staffing, student credit hour productivity and funding comparisons, contract and grant expenditures, numbers of undergraduate and graduate majors, and undergraduate and graduate admissions statistics are used to support the report. Good use is also made of summaries of student satisfaction with undergraduate and graduate courses. A section on outcomes assessment is added to the report.

III. Comments on the report

A. Undergraduate service courses

The Department has continued a tradition of high quality service instruction. Mathematics also has a strong record in instructional innovation, ranging from K-12 through graduate education. External support for the Department's educational activities has been substantial and consistent. Student and external evaluations point to a high level of satisfaction with almost all courses, with graduate assistants being as well received as faculty. After an upsurge of enrollments in the mid 1980's, student credit hour production has declined from a high of about 36,500 in 1985-86 to about 28,600 last year. Declines occurred both in lower division and upper division courses and may be attributable in part to larger numbers of transfer students who have generally taken their mathematics courses elsewhere.

1. Individualized Mathematics Program (IMP)

The 20 year old IMP is the longest running, large scale, non-traditional instructional system in the nation. During the review period, the system underwent extensive revisions. A computer management system was introduced at the beginning of the review period. That and other upgrades have led to improved performance of students and greater campus acceptance of the IMP. The system has the added advantage that it can accommodate additional students at minimal cost, so no students are turned away. The IMP has been successfully copied at other universities, for example, the University of Colorado at Boulder. The IMP is viewed by mathematics educators as an innovation of national significance.

2. M141, Calculus in Management Sciences

The department faculty is dissatisfied with the quality of instruction in M141. Efficiency in this course has been achieved at the expense of quality. Large lectures with no recitations provide inadequate quality of instruction and make instructional reforms difficult. The Department estimates that it would cost about $70K per year for two postdoctoral fellows to reduce section sizes from the current 300 to something like 100. This is a reasonable investment and should allow the implementation of appropriate instructional technology.

3. M155, Calculus for Biological Scientists

M155 now has a higher enrollment than M160, reflecting enrollment growth in the biological sciences. The course emphasizes calculus topics motivated by biological examples. Topics are explored in small groups using graphing calculators.

4. Calculus courses M160, M161, M261

Consistent with the recommendations of national committees, the Department initiated reforms in the calculus sequences. Several of these reforms were enhanced by the interaction between Mathematics faculty and the Center for Science, Mathematics, and Technology Education (CSMATE). The changes include use of writing exercises, student centered activities in the classroom and the use of computer software (MAPLE). Faculty are not yet satisfied with the use of MAPLE in the calculus courses. Special user manuals, written by one of our faculty, and a new version of MAPLE may alleviate some of the difficulties.

5. University core

The expected implementation of a revised University core curriculum will make new demands on the Mathematics Department but will also provide new opportunities for instructional innovation. The Department seems eager to accept this challenge.

B. Undergraduate major

The Department offers three concentrations leading to the B.S. degree:

1. Actuarial Science
2. Applied Mathematics
3. General Mathematics
4. Mathematics Education

Mathematics has a high level of degree production when compared to peers. The quality of entering undergraduate students has improved over the past five years. Data on placement of B.S. graduates is incomplete but shows a diversity of employment opportunities. Almost 2/3 of current undergraduates responded to a departmental survey. Students are generally satisfied with the quality of courses, faculty expertise, effectiveness of instruction, accessibility and helpfulness of instructors, and advising.

C. Graduate program

Students expressed general satisfaction with their courses, their GTA teaching and research assignments, and the quality, accessibility, and friendliness of the faculty. Suggestions from students for improvement include more applied mathematics courses. GRE scores for entering graduate students for Fall 1995 were higher than for Fall 1992. The Department has shown success in increasing the percentage of female graduate students from 28% for Fall 1992 to 39% for Fall 1995. The Department plans to increase this percentage to 50%. Employment history of recent Ph.D.'s is good

D. Research program

The research program wisely focuses on a limited number of areas:

1. applied and computational mathematics,
2. geometric and combinatorial aspects of algebra.

External support for research compares well with peer institutions. Contract and grant expenditures per faculty member are about $25K per year. This places Colorado State ahead of Ohio State, Texas A&M, Texas, and Illinois. Much of the contract and grant funding is due to the applied computational group which averages more than $50K per faculty member. Mathematics education also has a consistent record of external support.

The ranking of the Department of Mathematics in the most recent National Research Council survey of Research-Doctorate Programs in the United States at 96th out of 139 programs ranked is disappointing. This is particularly true in view of the number three ranking of the Colorado State program among a sample of 11 state universities in the midwest and west in terms of contract and grant support and degree production per faculty. The Department's explanation of the relatively low NRC ranking in spite of excellent objective performance measures are the relatively small size of our department and the emphasis on applied/computational mathematics rather than pure mathematics.

The Department has not developed a comprehensive plan for future research directions but has defined two future research directions as pattern analysis in applied/computational mathematics and coding theory in geometric and combinatorial aspects of algebra. The report mentions that attention needs to be paid to the mathematics of information intensive science, but needs to flesh out that initiative in more detail.

E. Outreach to K-12

Accomplishments in mathematics education and educational innovation are considerable. The Department has a strong record of working with K-12 schools to on a broad range of educational improvements. External funding for mathematics education has been strong. The Department is recognized as an innovator in this area. Mathematics is one of only a handful of departments at Colorado State University to commit faculty positions to focus on educational aspects and K-12 connections. The Department should be commended for that commitment. As a result, we are now well positioned to become the major player in Colorado in the area of mathematics education. The strong association with CSMATE should be a definite asset in building an even stronger program in K-16 mathematics education.

F. Personnel

1. Faculty workload and instructional efficiency

Teaching loads in the Department of Mathematics at two courses per semester (12 classroom credit hours per academic year) are higher than the national average of mathematics departments with comparable research missions. The report points out that the Department has achieved a remarkable instructional efficiency. The figure compared is instructional salaries (including GTA and support staff salaries) per course registration. The Colorado State number is about 66% of the average of 11 western and midwestern state university mathematics departments. Although this number may be high because of the mode of instruction of the IMP, similar comparisons of instructional budget per student credit hour point to a high instructional efficiency relative to peer institutions. Faculty and GTA teaching staff were reduced by almost 15% over the past six years.

2. Postdoctoral teaching fellows

Given the tightness of the job market for new mathematics Ph.D.'s , a reallocation of a small portion of the resources devoted to GTA positions to postdoctoral teaching fellows seems appropriate. The Department also deserves support from the University for a portion of the salaries for such teaching fellows.

3. Surge of retirements

There are 20 faculty in the age group of 50-65. The Department points to the need to develop a longer-term hiring plan. In this hiring plan, the Department should project teaching needs for majors and non-majors, K-12 interactions, the likely demands of a new University core curriculum, instructional technology, continued partnerships with CSMATE, new research initiatives, and possible areas for collaborations with other disciplines, Suitable retirement incentives should also be explored.

4. Diversity

The Department has made progress in increasing the proportion of female graduate students and is striving to increase the percentage of female graduate students and faculty to 50%. A major recruitment effort will be required to increase the percentage of female faculty although considerable turnover on faculty is expected over the next 10 years.

G. Facilities

1. Weber Building

The report makes an excellent case for the inadequacy of 90 sq. ft. faculty offices to provide space for computers and student advising. The University must make the relocation of the Department of Mathematics to a remodeled Weber Building a high priority.

2. Computer labs and intensive technology classrooms

The Department is currently using space in CSMATE for some of its student computing laboratories associated with calculus courses. This is not a good long term solution. The Department and the College plan to convert the current college student general purpose computing facility in the Weber Building to a student computer lab to be shared by the Departments of Mathematics and Statistics. For this shift to occur, the College needs to move its student computing facility to the Clark Building. This can occur only after the space is vacated by the College of Business.

Mathematics needs 3 classrooms which are equipped for multi-media presentations and computer demonstrations. These facilities could also be provided in the remodeled Weber Building space.

To support computer facilities for students and faculty, the Department is asking for \$80K in annual support for high end graphics workstations, software and computer support staff.

H. Fiscal resources

The report points out that the Mathematics budget has stabilized as a result of the transfer of turnaway funds (\$120K per year) to the departmental RI base budget. Increases in external contract and grant activities has led to enhanced DA/RSP funding (\$40K). However, there have been losses of revenues attributable to policy changes in Continuing Education (\$80K). Costs for computing equipment and support structure (\$100K) have increased significantly. Departmental staffing flexibility was also reduced as a result of the elimination of leaves without pay.

Department requests for new base budget resources are focused on the following:

1.	Reduce the size of sections of M141	\$70K
2.	High end graphics workstations, software, and technical support	\$80K
3.	Implementation of undergraduate instructional innovations	\$80K
4.	Accommodate enrollment increases of 15%	\$115K

The first three requests are certainly supportable, the fourth will need to be evaluated in the light of actual enrollment patterns.

IV. Future planning efforts

The Department of Mathematics should update its strategic plan to include the following:

A. Undergraduate service courses and impact of a University core curriculum
B. Outreach to K-12
C. Application of technology in mathematics education
D. Continuation of improvements in the undergraduate program concentrations
E. New research directions and interdisciplinary interactions

F. Matching the size and emphasis of the graduate program to faculty expertise and job market

G. A facilities plan for the Weber Building

Several of these focus areas will overlap major strategic initiatives of Colorado State University during the next planning period. Whenever possible, these strategies should be supported by comparisons with peer departments and an analysis of national trends.

xc.: D. A. Young
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