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**Review of the Department of Mathematics
Naval Postgraduate School
Monterey, California**

The Committee, consisting of Dr. Richard Arthur (NSWC, Dahlgren Lab), Dr. Gerald J. Lieberman (Stanford University and Chairman), and Dr. Marvin Marcus (UC Santa Barbara), met on June 6 and 7, 1985 to review the quality of the program and faculty of the Department of Mathematics. In short, we found the Department to be extremely important to the School in its service teaching role, a function which it performs at a very high level. Since this role is somewhat unique, it leads to several problems which will be discussed in later sections of this report.

The Department is housed in satisfactory physical facilities. The quality of the NPS library in Mathematics is high, and the Micro Computer Laboratory provides excellent service to the students and faculty. Gordon Latta is an excellent chairman and is to be congratulated for the quality of his leadership. He communicates with his faculty and understands the needs of the Mathematics Department as well as the needs of the programs that the Department services.

This report includes six sections in which we explore in depth the areas that we consider to be important.

I. FACULTY QUALITY AND RESEARCH ACTIVITY

The educational background of the Mathematics faculty at NPS is certainly good by accepted academic standards. Many members of the Department earned their Ph.D. degrees from departments with international reputations for excellence: Harvard; UC Berkeley; UC Los Angeles; Princeton; University of Illinois; Carnegie Mellon. In general, the areas of specialization are pertinent to the teaching responsibilities of the Department. These specializations include Numerical Analysis, Combinatorial Theory, Mathematical Statistics, Computational Fluid Dynamics, Mathematical Physics, Discrete and Continuous Optimization Theory, Functional Analysis and Ordinary Differential Equations.

In assessing quality and level of research activity there are several accepted measures: frequency of publication in refereed journals; publication of research monographs or textbooks; evaluation in such standard journals as the Mathematical Reviews. With several important exceptions it is the case that in terms of these measures the productivity of the permanent Mathematics faculty at NPS falls somewhat below what one would expect in a research oriented department.

It is important to note, however, that faculty publications have appeared in excellent journals and continue to do so. But the level of productivity could be increased without in any way compromising the integrity of the excellent teaching performance of the Department.

The Committee believes that the level of extramurally supported research in the Department could increase. It is simplistic to attach dollar amounts to mathematical research, but certainly additional grants and contracts would provide individual faculty support, relief from teaching, an opportunity to conduct research, and important campus visibility. Research grants and contracts should be available, particularly in those areas of applied mathematics in which the Department has some expertise. Several members of the Department have been very active in research collaborations with engineering and science departments at NPS. Such interactions can form the basis for joint proposals for the support of research. (See #5 below.)

In making this recommendation the Committee must note that the teaching responsibilities of the Mathematics faculty are somewhat heavier than in other institutions in which scholarly research is a requirement for academic advancement.

II. SERVICE TEACHING

The Committee met with nine representatives from the NPS departments and programs. The one word which characterized the Mathematics Department was "service".

They expressed high regard for the performance of the Department's preparation courses. The only concerns expressed were occasional remarks about a spotty performance attributed to teacher variability. The Committee noted that the Mathematics Department has been awarded the Schefflin Prize much more frequently than can be attributed to chance. This performance certainly indicates a very high level of teaching excellence.

The NPS departments not only provide most of the students the Mathematics Department teaches, but, they also play a major role in establishing the course contents. Many of these requirements have so fragmented the course material that their pedagogical effectiveness needs to be closely monitored.

Those Ph.D. candidates choosing a mathematics major, and "Engineer" degree candidates provide a major source of students for the 4000 level mathematics courses. The Department chairperson should be encouraged to continue enrollment of such students. Periodic meetings between the Mathematics chairman and the other chairpersons is recommended to identify students for the 4000 series courses.

III. STUDENT MAJORS AND PROGRAM

The Committee met with the six mathematics majors for lunch. These Army and Marine Corps officers will fill the few billets still identified for mathematicians. No two of these men are in the same phase of their programs. The 4000 level courses they select frequently fall below the threshold level for teaching credit.

All of the men, with the seniors being the most vocal, raved about the dedication of the Mathematics faculty, and expressed their satisfaction with the educational experience at NPS. They also expressed their personal conviction that the curriculum in Mathematics provides a sound foundation for military officers and should have a more important role in their respective services.

IV. FUTURE DIRECTIONS

The Mathematics Department accepts its role as being primarily a service function department. Indeed, this is rather unusual for a department, nationally. Furthermore, the high quality of their service course teaching is also a rarity among mathematics departments. The Department should be encouraged to continue this teaching excellence in support of these vital NPS academic needs. The Committee also noted that faculty interaction, in a research capacity, with other faculty in science and engineering would be beneficial to all parties.

The Department of Mathematics has successfully concluded searches for three "young" mathematicians. This is important for the Department, and a continued flow of new people (and consequently new ideas) is essential for the health of the Department. The Committee noted that additional appointments are scheduled over the next few years, and endorses this move.

As part of a plan for continued vitality within the Department, professional rejuvenation of its permanent members is desirable. This often can be accomplished through leaves of absence, particularly when the faculty visit naval laboratories or other similar installations. Encouragement also should be given to faculty to apply for sabbatical leaves. At the other end of the spectrum, the Department has benefited greatly in the past from visitors to the ONR chair, and hence, visiting faculty should be encouraged to come to the NPS in the future.

V. CONCENTRATIONS OF FACULTY SPECIALIZATION

In a small department (about 15 members in 1985), it is important to concentrate research specializations in relatively few fields. Virtually every member of the present faculty is competent to teach the full range of courses offered by the Department. Thus, such concentration in research expertise in no way jeopardizes the teaching program.

It is important that research mathematicians have the opportunity to exchange ideas. Good departments recognize the danger of isolation, particularly for younger people. Mathematical productivity is greater than the sum of its individual parts. It is possible to be regarded as a center of excellence on the basis of the research activities of relatively few people. The most recent appointment of two persons in computational fluid mechanics certainly makes good sense for the Department.

Modern applied mathematics has become increasingly oriented towards discrete mathematics: combinatorial optimization; data structures; computability and the study of algorithms, etc. The Committee believes that discrete mathematics and modern combinatorial theory could be a focus for research in the Department at NPS. There are several members of the Department whose training and research activities are relevant: Owen, Russak, Fredricksen, and Welr. The field has important applications to Electrical Engineering, Operations Research and Computer Science and, hence, could form the basis for collaborative research with members of these departments.

Another area of possible specialization is numerical analysis. There has been a recent phenomenal increase in the level and breadth of research activity in the general field and particularly in numerical linear algebra, and boundary value problems for partial differential equations.

If the size of the Department is to be limited to less than 20 members, which seems quite likely at least for the near future, it is important that new appointments be confined to relatively few specializations. Although discrete mathematics and numerical analysis are reasonable choices, clearly other areas are also possible, e.g., fluid mechanics.

VI. SOME IMPORTANT RECOMMENDATIONS

The Department of Mathematics is different from the other departments in the School. It has a small handful of majors, few thesis students and it functions primarily in a service role for other departments and programs. This latter role permits these departments and programs to carry out their teaching and research missions. Because of this unique position, the Mathematics Department presents some serious problems which must be addressed:

If the NPS wishes to view the Department solely as a service course teaching department, its high teaching load (with courses generally taught in an excellent manner) probably is appropriate. However, such a department should not be expected to measure up to the School standards on the other scholarly scales, e.g., research. For NPS to change its appointment and promotion criteria for this department is not in the best interests of the School, and the Committee rejects this alternative.

Another model for teaching mathematics in the NPS is to

disband the Department of Mathematics, and have all teaching done in the Science and Engineering Departments. Again, the Committee rejects this alternative because it would be costly, and the end result would be a diminution in quality of the teaching of mathematics.

The third alternative, which the Committee unanimously supports, is to encourage the Mathematics Department to function as do other departments in the School in its scholarly endeavors. In order for mathematics to be successful in this endeavor, the Committee submits the following two recommendations:

(1) Encourage and support the growth of a mathematics degree program. We recognize that degree programs flourish at the NPS when Navy sponsors see their benefit to the Navy. We are aware that no such sponsors appear to be visible in the near future. Nevertheless, there is evidence that the Army and Marine Corp are interested in sponsoring students in such a degree program. Further, there may be foreign nations that wish to send students to a mathematics program. The Administration should encourage the other services and foreign countries to support this mathematics program. Even a modest increase in numbers would provide substantial benefits to the Department in morale, in supervision of thesis students, and in teaching of advanced mathematics courses (3000 and 4000) level.

(2) The NPS should at least double its support for the teaching of advanced mathematics courses (from the current 15 units per year to at least 30 units per year.) In its interviews with department and program representatives, the Committee frequently heard the need for more advanced mathematics courses from the Mathematics Department for their students enrolled in Engineers and Ph.D. degree programs. This increased support could be used to satisfy this need, as well as satisfy the faculty need to keep professionally alive. Teaching advanced courses in a means to keep at the forefront of a field, and, furthermore, often provides ideas for research opportunities. Since the Department has few thesis students, advanced course teaching is a splendid interface with research.

Richard Arthur

Gerald J. Lieberman, Chairman

Marvin Marcus