

SIMON FRASER UNIVERSITY

OFFICE OF THE VICE-PRESIDENT, ACADEMIC

MEMORANDUM

To: Senate

From: J. M. Munro, Chair
Senate Committee on Academic Planning

Subject: External Review – Department of Mathematics and Statistics
(SCAP Reference: SCAP 99 - 32)

Date: October 14, 1999

For Information

Attached are:

- the Report of the External Review Committee for the Department of Mathematics and Statistics and the Response to the Report of the External Review Committee



SFU SIMON FRASER UNIVERSITY

MEMORANDUM

To: Dr. Colin Jones, Dean of Science	Date: Friday, May 28, 1999 From: Len Berggren, Chair Department of Mathematics and Statistics
Subject: Response to External Review	

Attached please find a copy of our Department's response to the external review. It has been generated as a result of considerable effort by a number of working groups in the Department, each of whose reports was discussed at a Departmental meeting. Moreover, the whole document was approved at the Departmental meeting of May 12.

In addition to the remarks made in the document I would like to underline the important role that I see MITACS and PIMs playing in the development of the Department over the coming years, and over the next decade the Department expects to become increasingly involved both of these organizations. Indeed, the Department has, in comparison with other departments across Canada, an extremely high number of its full-time faculty members actively involved in MITACS projects, and several successful PIMs workshops have been organized by members of our Department. The Department also expects its industrial outreach to continue to grow, at both the undergraduate and graduate levels. All of this means that more of our major funding and other opportunities are likely to come from organizations committed to promoting those mathematical sciences most closely connected to information technology, complex systems, and industrial applications of the mathematical sciences. (Here 'industrial' refers not only to the traditional industries of manufacturing and natural resources but also to communications, finance, health care, and a host of industries that have grown up around the computer where the core ideas are mathematical and statistical.) The Department, with its strengths in mathematics, applied and computational mathematics, and applied statistics, and its many recent appointments in areas central to the above developments, is ideally poised to ride the crest of this new wave, and it plans to make its appointments in a way which will allow it to fully participate in and contribute to the information-based society of the coming century.

I will be pleased to discuss any aspect of this document with you. If you find it satisfactory I trust you will forward it to the appropriate University office.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "Lew". The signature is written in dark ink on a white background.

Department of Mathematics and Statistics
Response to the External Review
Spring 1999

Recommendation 1: On the Roles and Operations of the Five Workshops

Regarding the role of the workshops, the Department has reaffirmed a strong commitment to the open laboratory system and sees this as an important component both of the service we deliver to our students and of the training we provide our graduate students as future teachers of mathematics. Since mathematics and statistics are important subjects for the sciences, we wish to provide science and other students who take our introductory classes a solid educational foundation; the experience they gain in the workshops has become increasingly important especially because of the growth in class sizes.

The workshops service our larger classes, with enrollment for MATH 151 being over 700 in the Fall and taught by a single instructor, for example; or, consider STAT 301, a course with a heavy experimental component, also taught by a single instructor, with enrollments over 300. Since 1993/94 the total funding for the workshops has decreased from about \$460,500 to 312,400 while the number of students serviced by the workshops has increased from about 4,500 to 6,000. By one standard measure of productivity (students per thousand dollars) this represents an increase in productivity of very nearly 100%.

At the same time, the workshops have operated on the model that was in place from the beginning. This required marking homework for the courses served, providing one-on-one tutoring for students, marking tests for the courses served and providing the professors with a summary of the marks, on the basis of which they would assign grades. Because of the heavy demands placed on the Lab Instructors, their time has been, on the whole, devoted to these activities and a variety of service projects. And, of these activities, the marking of homework and recording grades absorbed by far the largest share of Lab Instructors' and TAs' time.

This model has served the Department and its students well, but in these financially straitened times it cannot continue. Our recent review of how the workshops operate resulted in the construction of a new method of operation for the workshops, which will reduce their cost further and will have the Laboratory Instructors more involved in teaching. (All of the Lab Instructors have advanced degrees in Mathematics and Statistics and considerable accumulated experience and wisdom in undergraduate instruction.) The price to be paid for these changes will be a reduced level of service for students and faculty, and a net decrease in the overall quality of instruction.

Two new models of operation have been developed; both of these involve:

- Less time spent marking, processing assignments, and recording grades by the workshops, more interaction with the workshops by course instructors, more sharing of acquired course material from course instructor to instructor, and the use of examinations which are easier to mark;
- Less interaction with the workshops by lab instructors, who will now be more involved in lecturing; under one current proposal Laboratory Instructors would teach three three-hour courses (or their equivalent) per year.

Recommendation 2: On Priorities and Plans for Teaching and Graduate Supervision

The Department agrees with the Reviewers that the current listing of pure and applied mathematics graduate courses in the Calendar is very much in need of revision, and it has already taken steps to eliminate seven of the twenty-four courses listed in the applied/computational area. For pure mathematics, the Department accepts the recommendation for an *ad hoc* committee to draft a new entry for Mathematics for the next Calendar.

The pure mathematicians are developing a graduate program whose core will be an M.Sc. oriented towards information technology in general and computational mathematics in particular. There will be a two-year sequence of basic courses, the majority of these with a computational component, and some will be designed so that a graduate student could take half the course for two hours of credit. This will allow the student more breadth of training at the M.Sc. level. We are committed to designing the curriculum of some of our courses so that they will appeal to students in both pure and applied mathematics, and we are presently actively exploring with our colleagues at U.B.C. the possibility of some joint offerings, possibly at Harbour Centre.

The Reviewers seemed largely satisfied with the curriculum side of the Statistics program. Their concerns about increasing the computational component of some of the courses are being addressed in specific courses at the undergraduate and graduate level. Also, the use of 4xx/8xx courses has decreased, but there are some areas where it does seem a wise use of resources with no sacrifice of pedagogy. Any increase in the graduate program in statistics would have to depend on availability of increased funding or decreased completion times.

The Department is not aware of any data suggesting that its degree completion times are inordinately long, either in comparison with other departments at SFU or in comparison with other mathematics and statistics departments nationally. Its median time to completion of the M.Sc. is 7 semesters, and only six programs have lower medians (6 semesters, and in one case 5) but four of those are highly structured professional programs. In addition, our Ph.D. median, 14 semesters to completion is as good as any one else's. It does recognize, however, the need to bring down some of the larger numbers for given individuals in this data, and it agrees that after the first year there should be some expectation that graduate students will be supported as other than TAs for one semester in three. This could be on a research grant, a graduate scholarship, a graduate co-op, or other industrial-type work, such as is provided by the statistics consulting service and have become available in other areas with the MITACS programs. All of these should help reduce the extremes.

Recommendation 3: A five-ten year plan that addresses curriculum, resources and staffing.

The Department notes that the plans adopted as a result of the process initiated by the External Review will form part of its three year plan, and so will certainly be the determining factor in planning for the next five years. Planning beyond that horizon (to ten years) is, to a great extent, closely linked to the kinds of new faculty one hires, and the Department is now preparing for the Dean of Science a hiring plan for the next 5 years. Beyond that, the Department as a whole is suspicious of grand plans, which are so often changed in the light of unforeseen opportunities.

The Department is making a concerted effort to encourage cooperation between groups. This is particularly pressing for two reasons. The first is that MITACS and PIMs both have a strong presence at SFU and both will be encouraging a view of mathematics as a synergistic cluster of sciences rather than competing domains of 'pure' and 'applied'. The second is that our Department has just completed its plans (already approved in principle by the Ministry) for an Industrial Mathematics program, whose curriculum will certainly span pure and applied mathematics as well as statistics.

Recommendation 4: Redefine administrative functions and redefine duties to reduce faculty members' advisory work and improve working conditions of staff members.

When the review was done the Department was at a low ebb in terms of staffing. Shortly after the review a resignation in the General Office gave us an opportunity to restructure jobs so that some of the concerns of faculty and staff about the functioning of the General Office were met. In addition to our ongoing training strategies for new staff members, we are now encouraging all staff to take advantage of appropriate training workshops and seminars more frequently. The staff have

been working with the D.A. to improve backup strategies when staff are away and this, combined with hiring a replacement for some of her duties when the D.A. is on extended holidays, should provide better service to faculty and students and relieve staff stress related such service. It was recognized by the Chair that the workload of the Departmental Assistant had grown too large, and she and the Chair have been working on the revision of her job description for the past year. Although it is felt that the addition of faculty advisors has added strength to the advising services we are able to give our students, and this will continue, the Departmental Assistant has resumed her advising duties and acts as a resource to faculty advisers. The new balance has certainly relieved some of the pressure on faculty advising time. All those involved in the complex task of advising in a Department with such a large service role for the whole university now meet each term to discuss ways in which all involved (the Chair, the six faculty advisers, the D.A., and two members of the office staff,) can facilitate each other's work, and these meetings have already been productive of some good results.

The Department has taken funds from its budget to provide staff with long-awaited ergonomic desk chairs. Although we do not have funds to provide staff with up-to-date computing equipment and compatible versions of major software packages, we have been able to do memory upgrades for all staff computers and are committed to looking for opportunities to address the larger problem.

Recommendation 5: Organizational position of the CECM and links between its resources and those of the rest of the Department, and

Recommendation 9: The CECM and the rest of the Department should improve communications with a view to optimizing the benefits the CECM could provide.

The Department agrees with the Reviewers that the CECM is a valuable resource, and both have decided on a number of steps that they anticipate will eliminate some of the possible causes for misunderstanding.

- i. The ALRP should be the normal conduit through which the CECM communicates with the Department on financial and organizational matters. The Director of the CECM should meet each term with the ALRP to report on the CECM's recent initiatives. Trimesterly summaries of CECM activities should be sent to the ALRP for information. Finally, the Director of the CECM should report once each term to the Department as a whole on the activities of the CECM.
- ii. The CECM will identify the role of its employees with relationship to departmental duties with a view to maximizing the benefits that these employees could offer the Department as a whole. The Department and the CECM should make an immediate study of what would be necessary to integrate the CECM computing network with that of the Department as a whole. This should be done with a view to seeing what economies this might effect in the long run and what initial outlays might be necessary to achieve such economies.
- iii. To the extent that the departmental budget remains at its present level and departmental priorities allow, the Department should maintain its current level of support for the CECM. To assure openness and simplicity of administration the Department should establish a specific fund against which the CECM has signing authority.
- iv. A general policy should be negotiated between the CECM and the ALRP on the treatment of overhead charges in CECM contracts with outside agencies.

Recommendation 6: The University should consider establishing a separate Department of Statistics within the Faculty of Science.

The Department has already taken this quite seriously and has begun drafting a plan for the creation of an administrative unit for Statistics, to be viewed as an intermediate step in the creation of a

Department of Statistics. The unit, whose title will be determined in consultation with the Department Chair and the Dean, will provide support for the discipline of Statistics, for the Statistics graduate and undergraduate students, and for other faculty at SFU with interests in the statistics. It will serve as a vehicle to increase the profile of this emerging discipline at SFU, and to recognize its difference and independence from mathematics, as a discipline. This is important when dealing with clients from other departments, especially since the statisticians have built strengths in, and nurtured the growth of, applied statistics, both in their hirings and program content. The increased autonomy will also focus the statisticians' attention on program development and improve efficiency in such areas as program modification.

The seven and one half-time regular faculty operate as a cohesive unit and have established research credentials. They have been heavily involved in work for national and international Statistical Societies, for NSERC, and in the arena of public advocacy. In addition, with the appointment of a Director of Statistics and Associate Chair last fall, Statistics has already begun to experience freedom of movement and independent decision-making.

Some of the areas which the statisticians would like to develop are mentioned briefly here.

- The stimulation of the growth of graduate and undergraduate co-op opportunities. The Statistics degree is similar in nature to a professional accreditation and the co-op experience is vital for the students. In this regard, note that employers sometimes state that they prefer graduands from departments of Statistics. It will also be an invaluable recruiting tool as statistics students appreciate the advantages of having graduated from a department where statistics is an autonomous discipline.
- There will be an expansion of the activity of the Statistical Consulting Service (SCS) through workshops and contracts. A graduate focus in Biostatistics will be developed. This will be stimulated especially by the new NSERC UFA appointment in genetics and another new appointment whose research interests include Bioinformatics. Links with Biology and Environmental Science will be strengthened through these appointments.
- In the area of Actuarial Science the group will establish stronger ties with Business through its recent actuarial appointment and the current search for funding for an endowed Actuarial Professorship.

One specific course the statisticians envision developing is a first-year undergraduate course in Statistics. This course would stress concepts and data-analysis. It would be based on experimentation as currently very successfully used in some of the courses for the Environmental Science program. Because of changes to the school mathematics curriculum, there is now exposure to statistics in the high schools so it now makes sense to consider a first-year statistics offering as a base for our programs. Also, at the graduate level we have begun experimenting with offering our courses to graduate students at UBC, since some of our courses are unique in the province because of our special focus in applied statistics. For example, in 1998-2, four UBC students registered for our course in Biometrics. We plan to investigate further partnerships with UBC in our graduate program.

These initiatives will broaden the work of the statistics group further from its mathematics base, and autonomy would foster this kind of growth. The Statisticians have prepared a plan for the development of the discipline of Statistics at SFU over the next five years. The essence of the plan will give the Statistics group administrative autonomy through the creation of a Director of Statistics with stipend equivalent to that of an Associate Chair and with teaching relief equivalent to one course. The Director will represent the discipline to the Chair and, as required, to the Dean. The Director may relieve the Chair of a few specific duties relating to the management of the department as a whole, for example, replacing the Chair during his absences, but the principal duty of the Director is management of the issues relating to Statistics. The Director would serve on the Dean's Advisory Committee to deal with Program affairs and other matters relating to Statistics.

Note that a temporary position, similar to that described above, was created in September 1998 in our Department.

To manage our programs directly the plan requests separate graduate studies and undergraduate studies committees in Statistics and Actuarial Science. These will undoubtedly have good communication links with the Mathematics graduate studies and undergraduate studies committees. The chairs of these committees will represent Statistics at the Faculty Graduate Studies and Undergraduate Studies committees

In order to deal with budgetary pressures and affairs in a manner more suitable for the discipline, we request separation of budgetary items dealing with Statistics and Actuarial Science, the statisticians and the SCS to form a budget for Statistics which will be managed by the Statistics Budget Committee, with the Director of Statistics as Chair. This will enable us to deal with budgetary issues concerning statistics more effectively, for example issues relating to the operation of the statistics workshop and with the consulting service. The budget committee submits annual reports to the Department Chair. If the Department of Mathematics and Statistics decides that a X% cut/increase is to be met through the departmental budget, then the Statistics budget will carry its proportionate share of X%.

We expect to create several cross-appointments to tie together those working at SFU in the discipline, and adjunct appointments to form solid links with our industrial contacts and to allow them an opportunity to share in the development of the discipline and to help shape the graduates that emerge. There is significant potential for interdisciplinary and external partnerships here. With the creation of cross-appointments we plan to explore further program development through team-teaching and other flexible arrangements with other departments. For example, we have already been exploring the use of web-based and other innovational instructional approaches with some success, and would like to further this development. We will be able to present more credibly our applied nature to other departments, to researchers both on and off campus, and to our external contacts, and to pursue joint positions more effectively.

Recommendation 7: Review of administrative and technical support for computing and funding for a continuing staff position in system administration.

The Department's study of this matter indicates that there is a clear present need for a full-time UNIX system administrator to service its more than 50 machines. Indeed, the computer network plays the same role for the modern mathematical sciences that laboratories do for physical sciences. There is, in addition, a need for ongoing support of the Department's administrative and workshop Macintosh-based computing systems, and, to a much lesser extent, of a few faculty Macintosh machines. As an interim move to a continuing position the Department has decided to offer a two-year contract for a UNIX System Administrator, the salary being funded from a combination of departmental funds and research grants (as technical support). On the basis of our experience with this arrangement we will, near the end of the two-year period, reconsider the issue of a continuing position in systems administration.

Recommendation 8: Permanent position for Director of SCS.

The Department believes that the Statistical Consulting Service provides valuable training for graduate students in statistics. It also provides important services to graduate students and faculty of other departments, and is an important part of our outreach and service to the business/government community. The Department agrees with the recommendation of the External Review and it will be making a serious effort to obtain ongoing funding for the position of Director.

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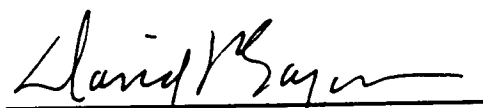
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Vice-President, Academic
Response to the Report of the Review Committee
For Mathematics and Statistics

The Report of the review committee for the Department of Mathematics and Statistics generally describes a department that is healthy, vigorous and of good quality in all its areas of academic activity. The reviewers' critical observations, and their formal recommendations, for the most part focus on essential house-keeping matters that the department simply appears to have deferred. These include: curriculum rationalization; renewal, and modernization; a re-evaluation of graduate student support and completion times; faculty workload disparities; better communications between the department and those university departments/programs for whom it provides service courses; and the role of sessional instructors. A somewhat more serious matter appears to be administrative morale and potential administrative dysfunction within the department.

More critical is the reviewers' perception that the department lacks a clear forward plan that enunciates a vision for the future and a strategy for achieving a set of essential objectives that might include: the creation of a separate Department of Statistics or Actuarial Science; a faculty renewal plan based on the desirability of building bridges to link individual curriculum and research interests across the breadth of the disciplines as defined by a more modern, integrated curriculum; and the desirability of defining more rigorously the links between the department and CECM in order to establish a more symbiotic, mutually beneficial relationship.

The department, in consultation with the Dean of the Faculty of Science, should be encouraged to revise and extend its current three-year plan - looking towards its next review - in a way that addresses these critical issues.



David P. Gagan
Vice-President, Academic

12 May 1998
Date

REPORT OF THE EXTERNAL REVIEW COMMITTEE FOR THE
DEPARTMENT OF MATHEMATICS AND STATISTICS
SIMON FRASER UNIVERSITY

B. Keyfitz
J. Lawless (Chair)
M. Plischke (Internal member)
H. Williams

April 13, 1998

Executive Summary

Through its reading of the Department's self-study document and other material, and through interviews with faculty, staff, students and alumni of the university, the Review Committee formed an impression of a department with many strengths in research, teaching and service. Areas where improvements could be made also caught our attention. This report summarizes our impressions and conclusions; separate sections address Programs, Faculty, Administration, and Outreach and Collaboration. In concordance with our terms of reference, much of the discussion and the nine recommendations deal with suggestions for improvement, but we hope it is clear that there is much to admire.

The Department runs programs in mathematics, statistics, and actuarial science. The programs at both the undergraduate and graduate levels are good, but in the pure and applied mathematics areas there is a need for revision of curriculum to provide broader coverage of important areas and to reflect changes in faculty interests. The availability and scheduling of courses in all areas also needs attention. Recommendations 1 and 2 urge the Department to review its plans for teaching and to develop a vision and priorities for the next five years.

The quality of the faculty members in the Department is high, with some very strong researchers and good teachers. The Centre for Experimental and Constructive Mathematics (CECM) is an important new research presence that has a high profile externally. The primary issues that we identify as needing attention deal with breadth and renewal; it is not clear that the department has a clear vision for faculty renewal nor for the mentoring of its next generation of leaders. This is not unrelated to uncertainties about teaching priorities mentioned in the preceding paragraph. Recommendation 3 urges the development of a coherent five to ten year plan.

In the Administration area we perceived several important issues. One concerns inadequacies in administrative support that have created workload and morale problems; see Recommendation 4. A second deals with the organizational position of the CECM and links between its resources and those of the department proper; Recommendation 5 suggests that these be clarified. A third issue concerns the desire of the Statistics group to form a separate department; we support the general principle and in Recommendation 6 suggest that this be considered. Finally, we considered the role of two staff positions: a computing system administrator and a Statistics Consulting Service director. Both positions are important to the mission of the Department, and Recommendations 7 and 8 support their continuation.

The Department has a strong record of outreach and collaboration in research, teaching and service. The most important issue is an internal one and concerns the relationship between the department and the CECM. Some friction seems to exist, and it does not appear that a real sense of collaboration and communication has emerged. Recommendation 9 addresses this.

1. Introduction

The Review Committee visited the Simon Fraser University campus from March 18-20, during which time it met with University administration; faculty, staff and students inside the Department of Mathematics and Statistics; faculty and students from other departments; and alumni of the Department. These meetings, the Department's self-study document and various other pieces of information portrayed a department staffed with many excellent people, and one which offers programs that are perceived by its students and alumni as being of very good quality. We were struck by the collegial atmosphere in the department and the respect that its members have for one another. The Department also collaborates in numerous teaching ventures with other departments, and is expanding its outreach through the activities of several of the mathematicians and statisticians in the department, through the newly established Centre for Constructive and Experimental Mathematics (CECM), and through its membership in the Pacific Institute for Mathematical Sciences (PIMS).

There are, however, areas which are running less smoothly or where planning and decisive action seem to be lacking. These touch all aspects of the department: personnel, curriculum, and resources. In this report we identify what we perceive to be the most crucial problems and issues. The Department appears to recognize most, and perhaps all, of the issues, but our addressing them here should serve to emphasize their importance. The fact that we use more space discussing problem areas than in praising excellent activities is based on principles of constructive criticism and the fact that we have been asked to make recommendations on opportunities for improvement. We hope that we have made clear the many areas in which we feel the Department and its members excel.

Sections follow on Programs, Faculty, Administration, and Outreach and Collaboration. Recommendations are collected in a final section.

2. Programs

2.1 Undergraduate Programs

The Department offers or participates in a wide variety of undergraduate programs. The joint programs in Environmental Science, Management and Systems Science, Mathematical Physics, and Mathematics and Computing Science appear very sound. General satisfaction was expressed by students and collaborating departments, aside from a few concerns about scheduling and about the need for better communication among program partners in some cases. It is recognized that this is not the sole responsibility of Mathematics and Statistics. Additional comments about service courses are made in Section 5.

The remainder of our remarks concern the main departmental programs in Mathematics, Applied Mathematics, Statistics and Actuarial Science.

The Mathematics lower division courses with their emphasis on analysis and linear algebra seem appropriate to the department's evident mission to produce a good grounding in the fundamentals of mathematics. The upper division courses, while good in themselves, do not cover as much of mathematics as they might. For example, we noted that there seemed to be little available to students interested in topology or geometry. This, of course, is to some degree understandable given the interests of the faculty members and the resources available to the department, but it still seems that though what the students get in the Major or Honours programs in Mathematics is of good quality, it is also somewhat narrow. In a subject as broad as mathematics this is something of a disadvantage to students who might be seeking a postgraduate degree in another institution. Also, the calendar lists many courses as available to undergraduates, but it appeared to us that only a few of these seem to be offered, particularly in the pure mathematics area. It would be a good idea for the Department to review its undergraduate offerings with a view to producing a list of courses which cover more of mathematics and can actually be made available. We realize that this is not an easy matter, but the attempt might produce some very positive results.

In applied mathematics, there are a number of undergraduate tracks, including a major in Applied Mathematics, and Honours in Applied Mathematics, Mathematical Physics or Mathematics and Computing Science. The programs are solid and rigorous, though rather classical. Since the faculty voiced the opinion that the program needed revising, and since the students remarked that the program no longer matched what was in fact scheduled, we should perhaps just encourage the revisions that seem to be beginning. There are a couple of specific areas where the offerings could usefully be updated: a course in nonlinear dynamics or dynamical systems (this could be an alternative to the ordinary differential equations course which emphasizes linear theory, or could replace some of the material in that course), and a course in mathematical modelling (this is mentioned in the industrial mathematics proposal). The courses on the books offer an odd mixture of topics aimed at specific fields ("Mechanics of Deformable Media") which use particular mathematics (boundary value problems in this case) and mathematical techniques ("Variational Calculus") which are used in particular fields (mechanics in this case). Most likely, modernizing and rationalizing the whole set of offerings would be superior to superimposing further courses on this already lengthy list.

The Statistics Honours and Major programs are reasonably comprehensive, given the available resources, and should prepare students well either for careers after a bachelor's degree or for graduate study. The honours program has a few gaps. In particular, it is desirable to expose students to more topics in stochastic processes and applied probability, statistical computing and simulation. In addition, the nonparametric statistics course (Stat 420) appears

rather old-fashioned; modern computer-intensive methods such as smoothing and nonparametric regression could be introduced here. The fact that the program has a very full mathematics component, and that there is a course on decision theory and Bayesian methods provides options for adding new topics without an increase in resources: it is likely that some of this material could be trimmed without decreasing the quality of the program.

The existing Actuarial Science Certificate program and the proposed honours program have good modern curricula, and there is a strong interest from students. Although some emphasis on professional actuarial examinations is appropriate, this should not in our opinion be given too much weight. The program should continue to provide a broad education in actuarial science, mathematics, statistics and business, and to prepare students for a variety of careers in which actuarial training is important. A point that we stress in Section 3.3 is that in order to mount an honours program it is important to have at least one full time professorial position in actuarial science.

The proposed Industrial Mathematics program seems comprehensive and well balanced. We note the need to introduce new topics or courses in some parts of mathematics and statistics; for example, statistical computing, simulation, stochastic modelling, time series and process control are valuable statistical tools in industrial settings. In the mathematics areas, courses emphasizing modelling are needed. This is a promising new initiative, given the Department's interest in co-op programs and its outreach to industry and the public sector.

Finally, we draw attention to the Department's workshops in Applied Calculus (ACW), Basic Mathematics (BMW), Calculus and Linear Algebra (CLAW), Statistics (SW) and Computer-Aided Tutoring (WCAT). The first three are used on a drop-in basis for tutoring and general assistance, and for collecting assignments. We saw evidence that ACW, BMW, CLAW and SW, each of which has a dedicated Laboratory Instructor (LI) and teaching assistants (TAs), are heavily utilized and well-received by students, in spite of over-crowding in some cases. The degree of collaboration between LIs and faculty members responsible for courses that utilize the workshops is unclear to us, as are mechanisms for setting priorities or new directions in the operation of the workshops. In addition, WCAT appears to be used much less than the other workshops, and we did not perceive a clear vision for what it hopes to achieve. We are not suggesting that the workshops necessarily need major alterations, but periodic reviews of their roles and methods of operation would seem valuable.

Recommendation 1: The Department should review the roles and operations of the five Workshops in order to adopt a clear vision for them over the next five years, and to integrate this with overall resource allocation decisions involving teaching.

2.2 Graduate Programs

The Department has graduate programs in (Pure) Mathematics, Applied and Computational Mathematics, and Statistics, supported by a strong group of faculty members. We will address each area briefly.

The "Pure" component of the Department lists a fairly large number (25) of graduate-level courses, not including seminar, practicum and thesis courses, which are available to graduate students. The courses that are offered appear of high quality and are presented by very capable people. However, both the faculty and students mentioned that few of the listed courses are ever offered at any given time and several never seem to be offered. This projects a misleading impression of the graduate program and can be an irritation to students. This component of the Department should revamp its graduate offerings so that the list reflects the reality of the program; this process may have already begun. The Committee was also told that a plan for a "computational" masters degree in pure mathematics was being developed. This could be a positive step in the revisions for the graduate mathematics curriculum.

In the same vein, the 24 Applied Mathematics graduate courses listed in the catalogue no longer represent the interests of the faculty; on the one hand, they suggest extensive interest in continuum mechanics, now represented by a single faculty member; on the other hand, they do not do justice to the computational fluid dynamics and numerical linear algebra programs of current faculty. Not surprisingly, the applied analysis, partial differential equations, and modelling interests of the new applied mathematics faculty are not yet represented at all in research level courses.

The sizes of the student population in the mathematics areas seems appropriate to the faculty complement and the demand for graduates. Our impression is that there is a sizeable group of very talented students, who are able to move on to good positions after graduation.

The Statistics Masters Program emphasizes applied work. This is appropriate, given the interests of faculty and the strong demand for applied statisticians. The Department is to be commended for the way that it has built the co-op option; this is very valuable for an applied program. A small Ph.D program is also in place. The course offerings are reasonably adequate at the Masters level, though as for the undergraduate programs, more exposure to computer-intensive methods, statistical computing, simulation and stochastic modelling seems desirable. The courses appear to be well received by students, though some concerns were expressed about the level of courses that are taught jointly as Masters and fourth year offerings. The Ph.D program is viable, given the strong research programs of faculty members, but clearly has to focus on a few specific areas. There are very few advanced level courses available for Ph.D students, except as directed reading courses. Enrolments in the Masters and Ph.D programs are satisfactory, though there is the capacity and the demand for a modest increase in the number of Masters students.

The completion times for both Masters and Ph.D students are quite long in many cases. This seems partly to be a function of the low tuition fees and the fact that students are provided with TA support well beyond when they would be at most institutions. In spite of the demand for TAs to service courses, one might question whether this is in the best interests of the students. TAs work rather long hours, and more balanced financial support based on TAs and research assistantships would provide broader experience and allow faster progress, particularly for students working on theses.

2.3 Discussion

The Department offers a very broad range of programs, given its size. Co-op programs are also popular, and Simon Fraser University has a trimester system. The practical experience provided by co-op and the flexibility of the trimester system are two of the University's major strengths and are much appreciated by students. The down side includes staffing and scheduling difficulties which affect both students and faculty. We heard numerous comments from students about difficulties in getting needed courses, and we note the Department's relatively high dependence on sessional teaching, especially in statistics and actuarial science. Many faculty members are moreover "owed" a substantial number of course hours at present. At the same time, the Department is contemplating expansion in some areas, such as industrial mathematics and biostatistics. It is not clear to us that the resource issues associated with current and proposed programs have been adequately addressed. A modest expansion of the faculty complement in both mathematics and statistics is desirable and would alleviate some of the problems described, but we are aware that the University's resources are limited and perhaps shrinking. Requests for increased resources must obviously be made very convincingly.

Recommendation 2: The Department should develop priorities and plans for teaching and graduate supervision in accordance with the resources available; it would be sensible to do this under a number of funding and staffing scenarios.

3. Faculty

3.1 Quality of Research and Research Support

The faculty divides itself into three groups – applied, pure and statistics, while recognizing that the first two are not as clearly delineated nor as aptly named as the third. The level of research is high, includes a large majority of the faculty, is funded for the most part, and involves graduate students to a very healthy degree. The fact that the department was able to attract two star researchers (Jonathan and Peter Borwein) five years ago should not eclipse previous research accomplishments. In the pure mathematics area this includes

the work of a group in logic, with Lachlan an FRSC and arguably the most eminent logician in Canada, and in combinatorics, with Alspach and Hell prominent members of a connected group of five (the others are Brown, Goddyn, and Heinrich). Reilly and Thomson carry out research and supervision in algebra and analysis, respectively. Berggren and Gerber provide strength in history of mathematics and mathematical education.

The group identified as "applied" remains active in classical applied mathematics, with senior researchers in continuum mechanics (Graham), electromagnetism (Shen) and mathematical physics (Das and Pechlaner). The group also boasts a senior numerical analyst (Russell), and two mid-career researchers, Tang (computational fluid dynamics) and Trummer (numerical analysis, especially spectral methods), who are building international reputations in fields of great current interest. The applied group has been revitalised in the last three years with the arrival of three excellent young researchers, Promislow, Kropinski and Choksi, who work in related areas of nonlinear analysis, nonlinear optics, modern fluid dynamics and materials science, and large-scale computation.

Jon and Peter Borwein are outstanding researchers who between them cover many areas of analysis, number theory, computation, and optimization. Jon is the Department's second FRSC, currently holds a Shrum Chair, and has established the Centre for Experimental and Constructive Mathematics (CECM), of which he is the Director. The CECM has a most impressive research program, part of which involves the development of new paradigms for mathematics research, using high-performance computing and software tools to obtain results in core mathematics. Michael Monagan is a new faculty member associated with and partially supported by the CECM; his area is symbolic computation. Other activities include research on imaging problems and the development of systems for the deployment and communication of mathematical and computational tools over the internet.

Several individual faculty members have outstanding international reputations, are frequent conference speakers, and members of many prestigious editorial boards. Heinrich is currently President of the Canadian Mathematics Society. The new hires in applied mathematics display outstanding potential, with Promislow a recipient of NATO and NSF Postdoctoral awards, and Kropinski of an NSERC Women's Faculty award. Of the 24 mathematicians in the Department, 18 currently have NSERC funding. Very substantial funding has also been obtained by the CECM. It is a major research presence on a scale which is unusual in a Canadian mathematics department.

The statisticians also form a strong research group, with activity in both theoretical and applied areas. Major strengths are in biometry and animal ecology (Routledge, Schwarz), biostatistics and public health (Dean), asymptotic theory (Lockhart), goodness-of fit (Lockhart, Professor Emeritus Stephens), statistical computing (Swartz), survey sampling and experimental design (Sitter),

and education (Weldon). Six out of the eight individuals have NSERC Research Grants; their support is well above the national average for the statistical sciences, with Sitter, Routledge and Lockhart the top three. Sitter is one of the top two or three in Canada in his cohort.

Four of the eight statisticians (actually 7.5 positions) have served on NSERC grant selection committees or panels, and several are associate editors of major journals. The group has also made substantial contributions to specific areas of science, for example disease epidemiology (Dean), animal population biology and resource management (Routledge and Schwarz), official statistics and industrial statistics (Sitter), and forestry (Weldon). Finally, the group has an outstanding record of professional service in Canadian and international statistics organizations. Lockhart is Past- President of the Statistical Society of Canada.

While overall research funding in the department is good , the Review Committee was struck by the apparent paucity of RA funding. It appeared that most students, aside from scholarship holders, are supported primarily by TAs.

3.2 Teaching and Internal Service

Anecdotal evidence from students that we interviewed indicated general satisfaction with the quality of teaching in the Department. We did not see, however, any direct information relating to the evaluation of teaching, though the University's planning documents emphasize this.

We heard complaints of an increasing workload. On the other hand, the WICH ratio, 10.35 hours, appears to be lower than the overall Faculty ratio, which on average seems to have been over 11.5 hours (and jumped to 12.5 in the most recent year). The department maintains a balance sheet of teaching obligations, which shows it currently to be in debt to almost every faculty member. Either for this or other reasons, faculty are concerned about trends. While the current instructional workload appears reasonable to us, and appears to allow sufficient time for research, scholarship and a good level of service, levels for each individual should clearly be monitored. We note that there do not seem to be any differential teaching loads to reflect levels of research productivity or graduate supervision. It is unclear whether this enters into service assignments, but we note that some productive researchers have quite heavy service obligations.

The Lab Instructors lecture in addition to running their respective workshops, but we did not hear concerns about workload from them. (As staff members, their hours of employment may be more formally set than those of faculty, however.) It also deserves comment that, as is not unusual, the department contains some spousal and family connections. We presume that assignment of duties and reviews are done by a person at arm's length in each instance.

The reliance on sessional teaching in the Department seems high, particularly in statistics and in actuarial science. This is expected in actuarial science, but otherwise attempts should be made to decrease the dependence on sessionals. Whether some of the dependence is a temporary consequence of many faculty members being "owed" teaching credits is not clear. We once again draw attention to Recommendation 2 in Section 2.3.

The service workload is moderately high; some faculty, especially, in statistics are carrying a heavy committee and administrative load. We could not assess how much of this is due to current deficits in administrative support, which we discuss in Section 4.1. Most of the service seems important and useful, including the careful monitoring of the many interdisciplinary undergraduate programs. Faculty seconded to service tasks appear to be doing an outstanding job. The incentive and reward structure in the department ought to recognize this; it is not clear that it always does.

The recent addition of a high-profile research presence (the CECM) with a style which is new to the department, which is seen to be quite highly rewarded, and which operates in a manner quite different from earlier research groups has perhaps also increased tension. Several issues have arisen from the disequilibrium associated with the formation of the CECM, including equity, trust and communication; we address this later in the report. It is critical to the success of the CECM and of the department that these issues be dealt with positively.

We were asked to comment separately on the "teaching, research and service contributions of faculty members, including involvement in the CECM". We interpret this as asking us to assess the relation of the current and projected research, teaching and service of the department as a whole to the mission of the CECM. Besides assessing the role that faculty are playing in the success of the CECM, the Review Committee also considered contributions of the CECM to the success of the research programs of individual department members, in particular, any efforts at research collaborations, revitalization, or support of research in the department.

The Director and Associate Director currently each have low teaching loads, so are compensated for service time spent on the Centre. They are no doubt primarily responsible for the exceptional level of activity and success of the Centre to this point. The CECM includes graduate students, postdoctoral fellows and visitors and is thus a vital research presence. However, it appears to us that at present the CECM is an important, but specialized, research component of the department. While it has had considerable success and an impact on several areas of mathematics, the research of most faculty members continues on a separate track, and so far the degree of involvement with the Centre seems rather small. Some interactions are beginning to take place, but there was a feeling among mathematics faculty that more could be done by the Centre. That said, it appears that faculty have not yet taken maximum opportunity to find out what the CECM does, or to access its computing facilities,

attend colloquia and interact with its visitors. Further, the Department does not appear to have a clear vision of the CECM's future role. At the same time, the CECM has quite a clear vision concerning research and outreach outside the department, but we did not see anything that addresses its roles in teaching or service within the Department. We consider this issue again in Section 5.

3.3 Breadth and Renewal

While the quality of faculty currently is high, the Department anticipates a number of retirements, including those of some outstanding faculty, in about five years. Since, according to SFU's planning priorities, "The VP Academic will look for ways to fund the bridging of positions to future retirements", it would be appropriate for the Department to begin planning now. The review committee heard many references to the impending retirements, but relatively little discussion of a bridge to the future.

To this committee, it does not appear that the split between "applied" and "departmental" mathematics, which may have been appropriate when there was a small group doing classical engineering-oriented applied mathematics, continues to be justified when there is now a substantial group doing applied analysis, with strong intellectual links to core mathematics, as well as a strong computational effort in the rest of the department, with at least functional links to the applied group. We have the impression that the two groups do not, by and large, talk to each other, or follow each other's research and educational progress. For example, the graduate course offerings are all distinct, and do not reflect the fact that recent faculty additions have interests that overlap both areas. The committee identifies as a priority the need for the two groups to co-operate, and for department-wide planning for bridging hires in the near term and replacements in three to five years. The department must assert its collective responsibility for the whole breadth of mathematics. Areas that now need or will soon need faculty to handle undergraduate teaching are algebra, geometry and differential equations; areas that would contribute to current strengths in research and graduate training, without duplicating them, include algebraic geometry, topology, functional analysis, optimization, dynamical systems, mathematical biology, and control theory. While it is not possible for every current research area to be represented in the department, these are areas in which well-trained and talented young people are likely to be available in the next few years, and where imaginative hiring could build connections between existing groups in the department. The review committee does not find it appropriate to recommend priorities in this matter, but merely to point out that it is time for the department to begin serious discussion; see also Recommendations 2 and 3.

The self-study document and interviews with faculty did not indicate that the Department has a definite and coherent vision of where it wants to be in the core and applied mathematics areas. There is time to build consensus and a well-considered strategy; we do not see the mechanisms in place at the moment. It is

important that future directions be discussed and debated at the full department level, presumably with the Appointments and Long Range Planning Committee providing initial ideas.

Recommendation 3: The Department should develop a coherent plan for the mathematics areas over the next five to ten years, which addresses curriculum, research and staffing.

It should be remarked that the Statistics group has a quite clear vision of where they want to be in the next few years. In fact, one of the issues they raise is a desire for a separate department; this is discussed in Section 4.2. The actuarial science program, however, deserves more attention: planning for the eventuality that the current single faculty member does not return at the end of his leave, and a discussion of the need for at least one full time faculty member in this area, was not apparent to the Committee. This is crucial because it is hard to imagine a high quality honours program without at least one full time faculty member in the area.

Another concern is administrative leadership. The current Chair appears to be the unique department member with the requisite administrative skills, research reputation, seniority, and trust of all three segments of the department. The Department needs to give thought to who will do this job next and to mentoring its next generation to assume administrative roles. The group of mid-career mathematicians available or willing to assume such duties is not large. At present both the undergraduate and the graduate chairs are from the smallest group, statistics; this deprives statistics of needed teaching, research and graduate supervision time.

4. Administration

4.1 Administrative Support Staff

The Department has an administrative support structure that in principle should serve it well, with staff, faculty and students interacting comfortably and efficiently. There are, however, some concerns which seem to revolve around two factors. One is the reduction in the number of clerical positions from six to five as a response to budget cuts. The other is an apparent shift in the role of the Departmental Assistant (DA): student advisory work has moved from that position to faculty members, and the time allotted for the DA to supervise and collaborate with the clerical staff seems to have decreased. As a result the clerical staff seem somewhat adrift and demoralized, and faculty members are doing advisory work which could be handled by staff. In addition, restructuring of the administrative unit to address the loss of a position and new ventures such as the CECM is not proceeding in a timely way. Comments that the Review Committee

heard from faculty, staff and students indicate severe inadequacies in the administrative function, and suggest that immediate attention is essential.

Recommendation 4: The Department should move quickly to redefine administrative functions and to reassign duties so as to reduce the advisory and logistics work needed from faculty members and to improve the working conditions of staff members.

The Department's committee structure appears satisfactory. Two professors serving under the Chair head the Undergraduate Studies and Graduate Studies Committees and are responsible for co-ordination in those areas. It appears that chairing these two committees is rather time-consuming and we heard suggestions that the two hour teaching release given is a little low.

The organizational position of the CECM is not clear to us. We assume that many of the negotiations surrounding Dr. J. Borwein's Shrum Chair and the establishment of the CECM were with the Dean of Science. However, the Shrum Chair is finished soon and it seems crucial to specify who the CECM Director reports to and any arrangements which link the CECM budget and the Department budget. This issue is also important in terms of department morale, as we discuss in Section 5.

Recommendation 5: The organizational position of the CECM and links between its resources and those of the Department should be spelled out.

4.2 Statistics

The Statistics group in the Department has developed a clear and cohesive vision for the future, emphasizing undergraduate studies, a Masters program in applied statistics, and a small Ph.D program tailored to the faculty's research areas. The Review Committee read in the Statistics and Actuarial Mathematics Three Year Plan, and heard from faculty members during interviews, a strong desire for the creation of an autonomous Department of Statistics.

Statistics is a discipline as separate from mathematics as is computer science. On many campuses a separate department is best for it to grow to full potential. A careful analysis of student numbers, resources, and potential for growth is needed to assess the economic consequences of such an initiative, but we note that this has worked well elsewhere. Modern actuarial science has become increasingly statistical, and so that program might also well reside in such a department. We feel that a separate Statistics Department would be viable given the current faculty complement of eight statisticians and one actuarial scientist. A larger department would be stronger and could attract more students, and given the level of activity one or two more positions seem warranted in the short term. The Statistics group has the potential to be a top flight department, of which there are few in Canada, but it will require a commitment from the University to do so. We add that the role of, and emphasis

on, actuarial science, either within or outside of a separate department of statistics, needs to be clarified.

Recommendation 6: The University should consider establishing a separate Department of Statistics within the Faculty of Science.

4.3 Resources and Facilities

With some exceptions, the resources which support teaching and research in the Department are reasonably adequate. The library facilities and faculty and staff office space seem satisfactory, though the absence of a lounge area is unfortunate. However, space is a major problem for graduate students, postdoctoral fellows, visitors, and in some labs. In some instances graduate students do not even have their own desk, and they are clustered in very tight spaces. The fact that graduate TA's often receive students at their desks must make it very hard for others to concentrate on their work. Space is similarly inadequate in the CECM. We recognize that this is a problem not easily solved, but it must affect the productivity and morale of those involved in a detrimental way. We note the University's intention to make "student study and recreation space" a high priority.

Computing equipment in the Department seems adequate, with some areas needing improvement clearly identified: upgrading the network, replacement of ageing workstations and terminals, and the need for a dedicated system administrator. The SW and WCAT machines are quite old, and more space and machines in SW seem needed. The future of the WCAT lab is unclear to us, so it is hard to make recommendations about it.

Recommendation 7: The Department should review its administrative and technical support for computing, and seek to secure funding for a continuing staff position in system administration.

A final area of concern is the Statistics Consulting Service (SCS), which fulfils a valuable role in forging links with researchers on and off campus, and in the education of graduate students. The SCS has a Director as its sole staff position. Full or, at worst, partial support from the University is appropriate in recognition of the internal consulting and teaching activities of the unit. At the same time, it is clear that any expansion of activity must be based on funding from research grants or contracts.

Recommendation 8: The Department should affirm its commitment to the SCS by making a serious effort to procure ongoing funding for the position of Director.

5. Outreach and Collaboration

The Department has established connections, through its many undergraduate programs, to a number of other units on campus. These include

the Departments of Chemistry, Physics and Economics and the Schools of Computing Science, Business and Engineering Science. The interaction of the Department with these units was found to be both cordial and mutually beneficial. However, some departments such as Sociology and Anthropology and Biological Sciences, which prescribe certain statistics courses in their programs, did seem to be having trouble communicating their concerns about these courses. If it does not now exist, there should be put in place some simple and informal mechanism by which client units are easily able to discuss difficulties which they perceive in the Department's delivery of such courses. These difficulties could be easily resolved through such a process, as none that we were made aware of seemed very serious. It should also be pointed out that several external units complained that scheduling changes in some courses offered by the Department had not been communicated to them in a timely manner. With the exception of these relatively minor irritants, the Committee found that the Department maintains excellent relations with many units within the University. Given the record of most mathematics departments in this regard, this represents a remarkable achievement for which the Department deserves considerable credit.

The Committee did discover, somewhat to its dismay, that there are frictions in the Department's relationship with the Centre for Experimental and Constructive Mathematics (CECM). This is a pity because the Centre is a most valuable resource. Not only does it provide graduate instruction and supervision, but it brings to the Department many talented postdoctoral fellows and world-class visitors, and provides a number of computer tools for assisting in the conduct of mathematical research. Furthermore, it has a well-deserved international reputation which should serve to enhance the Department's recruitment efforts. Nevertheless, we perceive that the Centre has become something of a victim of its own rapid success, and that more attention to interactions with department members is needed. The CECM has, due to the enormous energy of its officers, particularly its Director, grown considerably faster than anyone could have predicted. As these individuals are also members of the Department, this growth has created concerns in the minds of some department members. At the same time, others indicated that they were delighted with the Centre and pleased by its success.

The main sources of concern in the Department regarding the CECM are (1) the division of resources between the Department and the CECM and (2) an occasionally difficult interface between the two units. It is true that some of the Department's limited discretionary funding is diverted to maintaining the CECM. Also, the Centre's Director and Associate Director receive teaching relief in order to attend to its affairs; in the case of the Director this relief is very substantial. In addition, the Department contributes part of the time of one of its secretaries. In a period when the Department's funding is being cut and workloads are increasing, these arrangements raise questions. The situation is not enhanced by what several Department members perceive as a somewhat highhanded style in the approach by the Centre to the Department. Although it is

easy to appreciate the day-to-day pressures of running a rather large operation like the CECM with limited discretionary funding, the Centre should, nevertheless, exhibit a greater level of sensitivity in its dealings with the Department than it has apparently done recently.

In spite of these very understandable concerns, the Committee feels that the Department receives excellent value from the Centre for its current investment. It would probably be helpful if the financial relationship between the two units could be presented to Department members so that everyone might understand exactly what is being contributed and what the Department receives. See in particular Recommendation 5 in Section 4.1. Also, as mentioned previously, it appears that some members of the Department who might benefit from the Centre do not yet do so. The Centre should perhaps inaugurate a more proactive program to involve Department members in its activities, and actively discuss the Centre's role in the Department. We see this relationship problem as one which has developed through a lack of communication in both directions. It should be resolvable by improving communications.

Recommendation 9: The Department and the CECM should actively plan mechanisms for improving communications between the two bodies and for optimizing the benefits that the CECM provides to the Department.

Through its Co-operative Program the Department also maintains a number of valuable connections to the local corporate sector. This seems to be functioning very well and will continue to enhance the reputation of both the Department and the University as a whole in the local community. Our interviews with several alumni confirmed our impression of the success of this program and also revealed the existence of a very cordial relationship between the Department and its alumni. Although little was said about this during our visit, we should also commend the Department's active and successful outreach program with the local high-schools.

There are many external connections in research, service and scholarly activity through the efforts of individuals involved in collaborative research work, service on editorial boards and in conference organization, and service for national and international societies. The current President of the Canadian Mathematics Society, the current Past-President of the Statistical Society of Canada, and the Secretary of the Canadian Applied and Industrial Mathematics Society are all department members. The Department has a very strong record in these areas.

The Department has also recently joined in the formation of the Pacific Institute for Mathematical Sciences (PIMS), together with the mathematics departments at the Universities of Alberta, British Columbia, Calgary and Victoria. The Committee detected some unhappiness in a few individuals concerning PIMS, largely because they consider the annual contribution to PIMS to have cost the Department a position. The benefits of belonging to PIMS include networking, contacts with industry, and partial funding for postdoctoral

fellows, workshops and conferences. In this sense the University's support for PIMS represents a transfer of resources from one area to another, assuming the Department partakes fully in the PIMS activities. As department members make use of PIMS over the next while, the trade-offs in the allocation of resources should become clearer.

6. Recommendations

Recommendation 1: The Department should review the roles and operations of the five Workshops in order to adopt a clear vision for them over the next five years, and to integrate this with overall resource allocation decisions involving teaching.

Recommendation 2: The Department should develop priorities and plans for teaching and graduate supervision in accordance with the resources available; it would be sensible to do this under a number of funding and staffing scenarios.

Recommendation 3: The Department should develop a coherent plan for the mathematics areas over the next five to ten years, which addresses curriculum, research and staffing.

Recommendation 4: The Department should move quickly to redefine administrative functions and to reassign duties so as to reduce the advisory and logistics work needed from faculty members and to improve the working conditions of staff members.

Recommendation 5: The organizational position of the CECM and links between its resources and those of the Department should be spelled out.

Recommendation 6: The University should consider establishing a separate Department of Statistics within the Faculty of Science.

Recommendation 7: The Department should review its administrative and technical support for computing, and seek to secure funding for a continuing staff position in system administration.

Recommendation 8: The Department should affirm its commitment to the SCS by making a serious effort to procure ongoing funding for the position of Director.

Recommendation 9: The Department and the CECM should actively plan mechanisms for improving communications between the two bodies and for optimizing the benefits that the CECM provides to the Department.