

SIMON FRASER UNIVERSITY
Senate Committee on University Priorities
Memorandum

TO: Senate

FROM: John Waterhouse
Chair, SCUP
Vice President, AcademicRE: Department of Statistics and
Actuarial Sciences External Review (06-06a)

DATE: February 15, 2006

At its February 15, 2006 meeting, SCUP reviewed the External Review Report on the Department of Statistics and Actuarial Sciences, together with a response from the Department, from the Dean of Science, and input from the Associate Vice-President, Academic.

Motion

That Senate concurs with the recommendations from the Senate Committee on University Priorities concerning advice to the Department of Statistics and Actuarial Sciences on priority items resulting from the external review as outlined in SCUP 06-06a.

Background

The report of the External Review Committee for the Department of Statistics and Actuarial Sciences was submitted on April 20, 2005 following the review team's site visit, which took place March 2 – 4, 2005. The response of the Department Chair, Dr. R. Routledge, was received on August 23, 2005, followed by that of the Dean of Science, Dr. M. Plischke on August 26, 2005. There was general agreement on the recommendations in the External Review from the Department and the Dean.

SCUP recommends to Senate that the Department of Statistics and Actuarial Sciences and the Dean of Science be advised to pursue the following as priority items:

1. Undergraduate Program

1.1 Develop and implement an undergraduate recruitment plan.

- 1.2 The Departments of Statistics and Actuarial Sciences, Mathematics, and the Faculty of Business should consider appointing a Director of the MSSC program for a four or five year term.
- 1.3 The Department should consider what offerings are best placed at Surrey, for example data mining, operations research, and the MSSC program.
- 1.4 The Department should continue to develop plans to contribute to the new curriculum requirements. Similarly, the Department and the Faculty of Science should consider how best to highlight the value of a general education in statistical literacy for all undergraduates.

2. Graduate Program

- 2.1 The Department should review its graduate offerings in the theory of statistics with a view to adding at least one additional course at the Ph.D. level in this area. The Department should also discuss with Mathematics how best to provide some course availability in advanced probability theory.
- 2.2 The Department should review its requirements for the Masters degree and in particular the expectations for the Masters thesis to be sure that they are realistic and facilitate timely completion of degrees. The Department may also wish to consider an option for a course based Masters degree.
- 2.3 The Department should proceed with plans to develop a Masters option in Biostatistics and consider extending this option to the Ph.D. level.
- 2.4 The Department and the Actuarial Science group should consider mounting a Masters Program in Actuarial Sciences in three or four years time, with more immediate consideration of an additional appointment, course offerings, and a post degree diploma in this area.

3. Planning and Departmental Resources

- 3.1 There should be discussion of the allocation of additional resources to the Consulting Service to increase faculty involvement in the area, and to make the service more accessible to researchers in all areas.
- 3.2 The Department should review and renovate student space to make it more functional and hospitable.
- 3.3 The Department, in consultation with Mathematics, should develop a plan for long term computing support and consider appropriate funding models to support it.

SIMON FRASER UNIVERSITY

Office of the Dean of Science
MEMORANDUM

RECEIVED

AUG 26 2005

Vice President
ACADEMIC

TO: W.R. Krane
Associate Vice-President, Academic

FROM: Dr. Michael Plischke, Dean
Faculty of Science

RE: External Review of Statistics &
Actuarial Sciences

DATE: August 26, 2005

I am writing with regard to the report of the external review committee (ERC) for the Department of Statistics and Actuarial Sciences and the Department's response to that report. My comments will be brief since the Department seems to agree almost completely with the recommendations of the committee.

The report is highly complimentary of the Department's research and teaching programs and of the quality of recent faculty hires. This is extremely gratifying since the Faculty and University have invested significant resources in this unit. Turning now to specific recommendations:

Recommendation 2: *It is recommended that the Departments of Statistics and Actuarial Science and Mathematics and the Business School consider appointing a Director of the MSSC program for a four or five year term.*

I agree with the ERC and the Department that this quite successful program needs some attention. Rather than simply appoint a Director, I would prefer to move this program to SFU Surrey where it would become one of the first degree-completion programs in Science at that campus. All the units involved in the MSSC program will have a significant presence at Surrey and this program fits naturally with the operations research program being developed there.

Recommendation 9: *It is recommended that the Department and Actuarial Science Group consider the possibility of offering a post degree diploma in Actuarial Science with appropriate sharing of proceeds between the University and the Department.*

I fully support this recommendation and the Department's response is also positive. The implication in the recommendation that this could be a program with differential fees is most interesting from another perspective. The proposed graduate program in Actuarial Science, to be developed in a few years, would require a fourth faculty member in that area. If there is sufficient income from differential fees to offset a significant part of the cost of such an appointment, I would be inclined to strongly support it.

Recommendation 11: *It is recommended that the central administration allocate some base budget to the Statistical Consulting Service (SCS) to increase faculty involvement in the area and to make the service more accessible to researchers in all areas.*

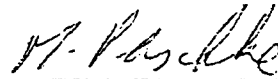
I agree with the spirit of this recommendation and would be prepared to allocate a relatively modest amount of funding, perhaps equivalent to a course buyout, to the SCS. A more significant allocation is not possible at this time.

Recommendation 14: *It is recommended that the Department change its teaching load from four to three courses per year for research active faculty. This change would also entail a review of current policies for granting teaching credits in recognition of other duties.*

I am pleased that the Department has accepted this recommendation. This will bring their policy on teaching loads and credit for administrative duties in line with normal practice across the Faculty.

Recommendation 15: *The Department should consider how it can best and most effectively be involved in the Surrey initiative. If it is to be involved in such initiatives in the program in operations research or data mining, then it needs to plan appropriate appointments and ways to integrate such appointments with the Department on the Burnaby campus.*

In my view there are significant opportunities for the Department in Surrey and I am keen to have them pursued. The required faculty positions will be made available when programs for SFU Surrey are determined.



Michael Plischke

c: Rick Routledge

SIMON FRASER UNIVERSITY

DEPARTMENT OF STATISTICS
& ACTUARIAL SCIENCE



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To: W. Krane,
Associate Vice-President, Academic

From: R. Routledge, Chair

Re: Response to External Review Report

Date: August 23, 2005

Attached is the Department's formal response to the 2005 External Review Report, as adopted in principle by strong consensus at a department meeting on May 10, 2005, with details developed subsequently through working groups and individual consultations.

Sincerely,

Rick Routledge

Response to the 2005 External Review of the Department of Statistics and Actuarial Science

June 15, 2005

We were very gratified by the generally favourable assessment of the Department, and intend to pursue all the substantive recommendations, subject to University support where needed. Following is our response to individual recommendations and other pertinent items.

Recommendation 1: It is recommended that the Department develop a plan for recruitment of strong quantitative undergraduates into the statistics major program.

Response: We recognize the value of encouraging more students with the appropriate mix of talents to further their training in statistics. To this end, we propose to develop the following recruiting strategy.

- ◆ We would like to work with John Simms, high-school liaison officer in the Faculty of Science, to enhance the statistics component to his information packages and presentations. We shall also offer to participate in some of his high-school visits where appropriate, and shall continue to participate in his "Scientific I" and other similar programs.
- ◆ We also agree with the informal recommendation in the text of the report that we should take advantage of the professional certification program recently implemented by the Statistical Society of Canada. Indeed, three of us (C. Dean, R. Routledge, and C. Schwarz) are now formally certified. In addition, C. Schwarz played a key role in developing and implementing the program and has recently accepted a nomination to serve as the incoming Chair of the Accreditation Committee. R. Routledge also served on the Initial Accreditation Committee. The Initial Accreditation Committee has developed a proposal for accrediting courses for the educational component of the certification. The Society's Board of Governors has recommended minor revisions to the proposal, and is scheduled to vote on a revised proposal at its October meeting. If the proposal is approved, then we anticipate that courses in our majors and honors

programs will be accredited, and that our graduates would qualify as Associate Statisticians. We anticipate that this will be a valuable asset for our students, and shall apply for accreditation as soon as the opportunity arises.

- ◆ We further concur with the Review Committee's recommendation that we focus on introductory courses, and especially on STAT 270, that contains the largest number of students with the appropriate talents. Our two major service courses, STAT 201 (for life science students) and STAT 203 (for social science students) have also attracted students with strong quantitative skills to the discipline. We shall increase our emphasis on assigning the best possible instructors to these courses, shall provide further, more regularized, opportunities for students in these courses to learn about advantages of further education in the discipline, and shall invite the strongest students in these classes to attend a presentation on career options in statistics with a reception to follow.
- ◆ We have also been discussing with Mathematics opportunities to participate in high-school events such as their Math Camps, and to collaborate with them in developing on-campus events for current undergraduates such as the one described above.
- ◆ We do not intend to focus solely on recruiting students into our majors and honours programs. We intend also to encourage students who are already committed to programs in related disciplines to consider supplementing their education with enhanced statistical components beyond the common one or two semesters of coursework in applied techniques. We have recruited occasional students at such a level in the past, with remarkably positive benefits for both these students and their classmates. We shall also continue to promote such opportunities in our above-described recruiting efforts.
- ◆ We also recognize the value of interdisciplinary programs in providing attractive opportunities for

students to further their statistical training in the context of a specific, interdisciplinary field. To this end, we plan to continue contributing to the Management and Systems Science and Environmental Science programs, and to develop a role in similar, emerging programs at the Surrey Campus.

◆ Furthermore, even though the actuarial science programs currently attract outstanding students without proactive recruiting efforts, we would use these opportunities to promote these programs as well.

Recommendation 2: It is recommended that the Departments of Statistics and Actuarial Science and Mathematics and the Business School consider appointing a Director of the MSSC program for a four or five year term.

Response: We agree that the program would benefit from a longer-term commitment from a formal Director than the existing job-sharing arrangement with the Department of Mathematics permits. In addition, we believe that it is time that the program be reviewed in light of recent curriculum developments in the contributing disciplines, particularly including programming initiatives at the Surrey campus. We propose to open discussions with the other academic units contributing to the MSSC program. There are five such units across four faculties. We also need to conduct this review while simultaneously developing plans for our own department's potential role at the Surrey campus (Recommendation 15). Although it is not possible to state a firm completion date for such a complex task, we would like to complete the review process in time for the autumn 2006 deadline for calendar revisions.

Recommendation 3: It is recommended that the Department review its graduate offerings in the theory of statistics with a view to adding at least one additional three credit course at the Ph. D. level in this area. The Department should also discuss with Mathematics how best to provide some course availability in advanced probability theory.

Response: The Department strongly endorses the creation of an additional, doctoral-level course in

statistical theory, and aims to develop a formal proposal in the coming academic year. In addition, we are discussing with Mathematics ways to coordinate the teaching of probability with the overall objective of maximizing learning opportunities for both undergraduate and graduate students. We also recognize a need for further courses at the M. Sc. level. We intend to address this deficiency in large part through new programs in biostatistics and actuarial science (Recommendations 5 and 8).

Recommendation 4: It is recommended that the Department review its requirements for the Masters degree and in particular the expectations for the Masters thesis to be sure that they are realistic and facilitate timely completion of degrees. The Department may also wish to consider an option of a course based Masters degree, which is becoming increasingly common in Statistics programs.

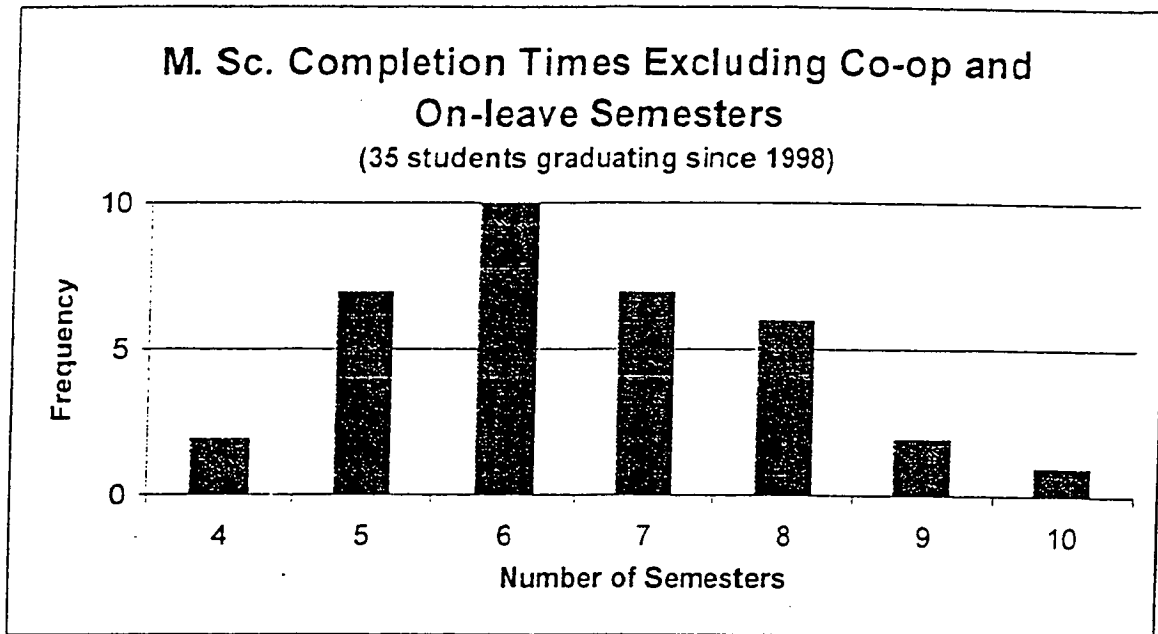
Response: The Department is committed to keeping completion times low. A case by case re-evaluation of the students cited in the self-study document shows that after discounting semesters on leave and co-op semesters, the mean completion time drops to 6.5 semesters with 19 of 35 completing in 6 or fewer semesters. Among the remaining students, all but 3 took 8 or fewer. Factors leading to longer stays in the program include part-time status, taking many courses in a second discipline while pursuing our degree, and informal work terms. The revised distribution of completion times is shown on the graph on the following page.

We intend to take steps to ensure that M. Sc. projects are kept manageable. In particular, we shall review the scope of completed projects each year to ensure that we are not making excessive demands on the students. We aim to set projects for students that they should be able to complete in one semester.

We regard the projects as very important components of our program since they focus on communication skills, both written and oral. We therefore believe that a course-work-only option would weaken the preparation of our graduates for the work force and are reluctant to move in that direction. We note, however, that for students with English as a second language, the process of project writing can take more time, potentially delaying graduation.

We also anticipate that planned expansion of our graduate course offerings will enhance students'

opportunities to complete their course requirements without delay.



Recommendation 5: It is recommended that the Department proceed with its plans to develop a Masters Program in Biostatistics. In so doing, it will be important to develop opportunities for student practicums and funded research assistantships in application areas.

Response: We intend to develop this program as an option within our existing M. Sc. program. (Please see Recommendation 6.) We shall begin assembling a proposal in the fall of 2005, with an expected date for a completed proposal to be forwarded for consideration by the Faculty of Science Graduate Studies Committee of April, 2006.

Recommendation 6: The pros and cons of developing a separate degree program in Biostatistics should be carefully weighed. There may be advantage in maintaining the single degree program with an option in Biostatistics.

Response: The Department has considered this issue and agrees with the implied recommendation that we create an option in Biostatistics within the existing degree program.

Recommendation 7: The Department should consider the possibility of introducing an option in Biostatistics within the Statistics Ph. D. program.

Response: The Department will consider this option as it proceeds to develop the M. Sc. option in biostatistics and other graduate programming changes. Under current regulations, we foresee a very limited impact to such an option at the Ph. D. level where students are already strongly focused on their dissertation research in a tightly focused area.

Recommendation 8: It is recommended that a Masters Program in Actuarial Science be a longer-term project to be fully mounted in three or four years' time. If the opportunity should arise, an additional appointment in Actuarial Science would give the critical mass to make such a program successful. A shorter-term priority should be the design of actuarial courses offered in the existing graduate program.

Response: The Department agrees with the recommendation. In the short term, graduate students interested in Actuarial Science will register in the Statistics program. The requirements of the

program will be modified to include some actuarial courses and possibly courses in other related fields. The students will be encouraged to work on the interface between Statistics and Actuarial Science or the one between Finance and Actuarial Science. The project will be based on an actuarial problem.

Starting in the academic year 2005-2006, three graduate courses in Actuarial Science will be offered on a regular basis. The topics identified as most appropriate at this time (and suggested course titles) are: 1) an introduction to financial and insurance risk management (Stochastic analysis of insurance portfolio); 2) an advanced course on risk theory and ruin probabilities (Advanced actuarial models); and 3) an advanced course on claim modeling or credibility theory (title to be decided). These courses are intended to be offered as Selected Topics (STAT-890) until it becomes appropriate to add them as regular courses in our graduate program.

The Department has recently joined a group of 9 other universities in an application for funding to mount an EC/Canada cooperation program in higher education and training in Actuarial Science. If funded, this project could be extremely beneficial to our graduate students.

In three to four years, the Department hopes to add at least one more faculty member in Actuarial Science and mount a complete Masters program in this area.

Recommendation 9: It is recommended that the Department and Actuarial Science Group consider the possibility of offering a post degree diploma in Actuarial Science with appropriate sharing of proceeds between the University and the Department.

Response: The Department regularly receives enquiries about the possibilities of studying in Actuarial Science from local and international students who have already completed an undergraduate degree. A Post Baccalaureate Diploma Program would definitely be an appropriate way to meet the needs of this clientele.

The Department is considering replacing the existing Certificate Program by a Post Baccalaureate Diploma. The requirements would change to include more upper division courses in Actuarial science and

related fields; and possibly a term project. In the future, most existing actuarial courses are expected to be offered every year and new elective courses in the areas of property-casualty insurance, demography and pension mathematics should be offered. Consequently, this Diploma could be completed in four or five semesters without additional course offerings.

Recommendation 10: The Department should continue to develop its plans to contribute to the new curriculum requirements. Similarly, the University should consider the value of a general education in statistical literacy for all its undergraduates.

Response: The Department agrees with this recommendation, including the proposal that the University consider the value of a general education in statistical literacy for all undergraduates. Specifically, we propose to press ahead with preliminary revisions to STAT 101, and with the creation of a further course for consideration for approval as both a designated breadth and quantitative course. To date, we have received breadth designation for STAT 100, and also for EVSC 200 that is currently taught by R. Routledge in our department.

Recommendation 11: It is recommended that the central administration allocate some base budget to the SCS [Statistical Consulting Service] to increase faculty involvement in the area and to make the service more accessible to researchers in all areas.

Response: The Department welcomes this recommendation as it represents a conception of what we feel the Consulting Service's role within the academic community should be. We believe that SFU would benefit substantially from resources that would enable us to engage more freely in consultations with researchers in other disciplines. Our current, self-funding model does not foster collaborative, applied research and education in applied statistics as effectively as do other models. For example, at the University of Waterloo, a faculty member with statistical consulting background and an interest in applications-based research was hired to run their consulting service in lieu of standard teaching requirements. Other models drawing more broadly from the pool of expertise within the

Department would also be desirable. With such a level of support, our Consulting Service could expand the scope of its research-level consultation work, provide more thorough assistance in applied statistical training of graduate students in other departments, and develop its existing initiatives in outreach teaching for local industry, hospitals, and resource management agencies.

Recommendation 12: It is recommended that the Department and Faculty renovate the student space to make it more functional and hospitable.

Response: We agree. Indeed during the site visit, the room was in particular turmoil in that an alarm system was being installed in preparation for the delivery of new computers. We have also replaced the oldest chairs, and, at the request of the students, are investigating replacing the rest of the chairs and purchasing a round table for holding discussions, reference books, and other amenities.

The computers are also now in place, though not at individual student desks as recommended by the Review Committee. These desks are too small to support even a flat screen monitor while still leaving enough usable workspace for other tasks. We have asked Facilities Management to provide us with an estimate of the number of workstations that could be installed in this room with sufficient workspace to accommodate a computer, and the cost of the associated renovations. We estimate that this would likely result in a net loss of four workstations. If this is indeed the case, then we shall not be able to make these substantive improvements until we obtain access to further space.

Indeed, even without these desirable renovations, we have a chronic space shortage. Furthermore, although it is particularly acute for our graduate students, we are now pressed to the limit for faculty offices, and have no space available to position a workstation for the further secretarial position that the committee has recommended. Nonetheless, we recognize the chronic space shortage at the Burnaby campus, and greatly appreciate the efforts of the Dean of Science to help to alleviate this problem. We look forward to whatever improvements can be provided.

Recommendation 13: It is recommended that the Department, perhaps with Mathematics, develop a plan for longer term computing support.

Response: Both departments propose to construct this plan in conjunction with the new systems administrator who will be employed on an interim basis as soon as we complete the recruiting process.

Recommendation 14: It is recommended that the Department change its teaching load from four to three courses per year for research active faculty. This change would also entail a review of current policies for granting teaching credits in recognition of other duties.

Response: We very much welcome this recommendation, and shall begin implementing it in the 2006-7 academic year. We have already begun the review of our current policy for granting teaching credit in recognition of other duties. In a unanimous vote, the Department has accepted the principle that reductions to the expected teaching load of three courses per year for research-active faculty members with regular appointments be made only for the following: (i) major administrative tasks such as chairing the departmental undergraduate and graduate studies committees, and (ii) high-profile external appointments of clear benefit to the university such as serving on NSERC grant selection committees or editing major academic journals.

We anticipate a phase-in period for this change. Many of our faculty members are currently on externally funded, modified contracts with reduced teaching responsibilities. The resources needed to implement this recommendation will become fully available only as these modified contracts roll over into regular appointments with full teaching responsibilities. Hence, if we are not to rely too heavily on sessional appointments, we shall have to implement this recommendation incrementally. We would clearly prefer to implement this recommendation as soon as possible, but are prepared to delay full implementation if necessary to avoid compromising the integrity of our teaching responsibilities.

Recommendation 15: The Department should consider how it can best and most effectively be involved in the Surrey initiative. If it is to be involved in such initiatives as the program in

operations research or data mining, then it needs to plan appropriate appointments and ways to integrate such appointments with the Department on the Burnaby campus.

Response: We believe that this is the most important challenge facing the department in the immediate future. It is essential that we establish a strong presence for our keystone discipline at the new campus. Our immediate goal is to work with the Department of Mathematics to support their new program in operations research, and to provide whatever introductory-level teaching is required for other programs. We believe that we must do more. Of primary concern, is the need to build a strong group of faculty members who can develop a full suite of educational and research activities. In addition, we believe that, with strategic hiring, we can build a group that will complement the research interests of others at both the Surrey and Burnaby campuses in statistics and related disciplines. In particular, we foresee involvement in the operations research program as a natural opportunity to augment our expertise in industrial statistics and, as recommended by the review committee in a more general context, in probability theory.

We are also encouraged by the favourable initial response to our tentative proposal for a program in data mining. We intend to give this particularly careful consideration. We propose to discuss detailed plans with Mathematics in the coming months with the aim of generating a hiring plan whose first phase would begin with advertisements for one or two faculty positions in the fall of 2005, and to develop a further plan for broader academic consideration over the coming academic year.

Other Salient Issues:

1. *Interaction with Faculty of Health Sciences:* *In Section 2 of the report, the committee refers to expertise in the department in biostatistics as "very valuable in the development of the new Faculty of Health Sciences."*

Response: We concur that we have an important role to play. The Department is indeed unanimous in its concern that we maintain close, collaborative ties

with the Faculty of Health Sciences. We have benefited tremendously from Charmaine Dean's pivotal role in the early development of the Faculty as Associate Dean. We value greatly the joint appointment of Dr. Leilei Zeng between the two units, and have recommended that another potential member of the Faculty of Health Sciences be appointed as an Associate Member of our department. Carl Schwarz has also been chairing their Tenure and Promotions Committee. In addition, Jinko Graham, Joan Hu, Richard Lockhart, and Brad McNeney have associate memberships in Health Sciences, and Richard Lockhart has been seconded to chair their Graduate Studies Committee for the 2005-6 academic year. We intend to continue making active use of these links to build a strong, cooperative relationship that will be of benefit to both units and the university as a whole.

2. *Support Staff:* *In Section 10 of the report, the committee states, "Only two secretaries in a Department of this size seems a low level of staffing and we recommend that it be reviewed.)"*

Response: We appreciate this recognition of a pressing need, and also the expression of support from the Dean of Science, and look forward to a timely solution. Nonetheless, we cannot implement this recommendation until we find adequate space in which to create a work station for the new appointee.

3. *International Programming:* *In Section 10, the report raises the potential for "an international program, especially in actuarial science where excellent students could be found in Asia and possibly even in the US."*

Response: In due time, the Post Baccalaureate Diploma and the graduate courses in Actuarial Science could be used to offer an international program in this field.

EXTERNAL REVIEW

**THE DEPARTMENT OF STATISTICS AND ACTUARIAL SCIENCE
SIMON FRASER UNIVERSITY**

April 20, 2005

**Review team: Loveday Conquest, University of Washington, Seattle
Jose Garrido, Concordia University, Montreal
Jack Kalbfleisch (Chair), University of Michigan, Ann Arbor
Alton Harestad, (Internal Member), Simon Fraser University**

Dates of Site Visit: March 2, 3 and 4, 2005

Report prepared by: L. Conquest, J. Garrido and J. Kalbfleisch

EXTERNAL REVIEW OF THE DEPARTMENT OF STATISTICS AND ACTUARIAL SCIENCE AT SIMON FRASER UNIVERSITY

1. INTRODUCTION

The review took place on March 2, 3 and 4, 2005. This is the first review since the Department of Statistics and Actuarial Science separated from the Department of Mathematics and Statistics in 2001. The review team consisted of Loveday Conquest (University of Washington), Jose Garrido (Concordia University) and Jack Kalbfleisch (University of Michigan) as external members. Dr. Alton Harestad served as an internal member of the Committee. The Committee had meetings with many individuals over the three days, and we found the meetings to be very informative and interesting; we thank all those involved for their full and frank discussions with the committee. We found the self study document that the Department prepared to be very helpful to us. It was remarkably objective and provided an excellent overview of the Department's strengths and challenges as well as a clear picture of the environment in which it operates.

The Department of Statistics and Actuarial Science was formed in 2001 and over the past four years has grown from a small group of only 7 or 8 to a group that will number almost 20 next year. It has enjoyed exceptionally strong support from the University and from the Faculty of Science. It has made many excellent appointments and has built a strong research and teaching unit. The Department has been exceptionally innovative in taking advantage of opportunities for external funding in its recruiting efforts. It has obtained support for three NSERC University Faculty Awards, a Tier 2 Canada Research Chair, and most recently has made an excellent senior appointment to SFU's Shrum Chair. This record of externally funded appointments is outstanding in the national context of similar departments, and perhaps of any departments.

We were impressed that the Department has managed this period of remarkable growth very well. It is very collegial and all members work well together. It has developed an excellent core of younger faculty members who are well assimilated into all aspects of the Department's activities, and are very involved in all aspects of its work..

With a period of such remarkable growth and innovation, it is always a challenge to balance the need for consolidation that naturally arises against the development of new initiatives and growth opportunities. It is clearly important that the Department continue to be innovative and look for new opportunities. It is also important however that there be the time for the Department to consolidate its existing strengths and fully develop its current activities. The Department has shown excellent judgment and taste in the past and we expect it to continue to be a growing force in statistics and actuarial science in Canada and beyond, as well as a leading department at SFU.

2. AN OVERVIEW OF RESEARCH

As mentioned in the Introduction, the Department has experienced tremendous growth since its inception, in 2001. It has made exceptionally good appointments and it is currently on a very steep trajectory; it is quickly becoming one of the very best departments in Canada and with a growing international reputation.

The Department has good coverage of the areas of statistics and actuarial science. There are very fine researchers working in the areas of experimental design, sampling theory, Bayesian methods, the statistics of bioinformatics and genetics, statistical education and the theory of statistics. The individual and collective scholarship is impressive as is indicated by the very substantial grant and contract support the Department enjoys.

The Department has developed an outstanding group in Biostatistics, which includes a team of accomplished senior and mid-career researchers as well as a number of excellent younger faculty. Its focus includes medical and health research, genetics and bioinformatics and as well as more traditional areas of biometrics including ecological and environmental applications. This expertise will be very valuable in the development of the new Faculty of Health Sciences, and there are current plans for new (possibly joint) appointments in Biostatistics associated with this initiative. There is great potential for further development of this group.

The Department also has a smaller but excellent group in Industrial Statistics. This is a second major application area and a promising one for further development. It is notable that the journal *Technometrics* is currently edited in the Department.

With a third new appointment this year, the actuarial group will have rebuilt a very good base on which it can consolidate its present activities and take on new initiatives. The current research expertise, in Insurance Portfolio and Risk Theory, provides a good mixture of applied and theoretical research. Further development of the Actuarial Science group should be a priority in the Department and the Faculty.

The Department has lots of strength in theory in various areas, but it has a definite applied orientation. This has great advantage and the Department is well positioned to respond to current high priority areas. The theory of statistics and mathematical statistics were traditional strengths of the Department, and there is still an excellent core in this area. If the opportunity arose, an additional appointment in statistical theory would be useful. Likewise, expertise in the theory of probability and stochastic processes would strengthen the actuarial group and help them expand into mathematical finance.

The Department is outward looking for significant parts of its research, teaching and service activities. It has created links with many parts of the campus. Its collaborations extend to other universities, the community, government, research centers and industry.

3. UNDERGRADUATE PROGRAMS

The number of undergraduate majors in the combined programs has tripled since the mid-1990s, a sign of substantial growth. Current students commented on the "great teaching" and "great faculty attitude" in the Department of Statistics and Actuarial Science (SAS). Undergraduate statistics and actuarial science students generally have a good feeling about the Department; they find that faculty are accessible, helpful and genuinely care about their learning.

3.1 The Actuarial Science (AS) program is unique on the west coast of North America; the undergraduate AS program draws very strong students. The career pathway of actuarial sciences is well known, and students tend to self-select due to the rigorous nature of coursework associated with the program. Many of the top performing students

in the Department are in AS. The Department is a good place to house such a program, as there is a natural alliance with topics of statistical theory and methods. Regarding the business/finance courses associated with this program, AS students reported no difficulties getting into those classes.

Since the previous external review, the Department has managed to reconstitute its actuarial group. The new appointment, scheduled for this year, should provide the critical mass and stability required to strengthen the existing Bachelor and Certificate programs. In that respect, the Department can consider more frequent offerings of advanced undergraduate actuarial courses, as well as an expansion into the areas of Property-Casualty Insurance and Pension Mathematics.

The AS group is now well positioned to expand some of its undergraduate activities and to be entrepreneurial about it, if it wishes. For instance, there is potential for an actuarial post-Baccalaureate Diploma for students who already have a degree in another discipline (e.g. mathematics, business) but are interested in a career change to Actuarial Sciences. (Further discussion of this possibility can be found under Graduate Programs below.)

AS alumni were very satisfied with their undergraduate program and particularly with the co-op experience. There was some concern voiced from AS students and alumni about competing for co-op positions with students from the older, well-established AS programs in the east, particularly with Waterloo and Manitoba. However, as a result of successful co-op placements of AS students from SFU in firms in eastern Canada, it seems that SFU opportunities are being established and growing. Increasingly, SFU's program in Actuarial Sciences is recognized as one that is growing and producing good students.

3.2 The Statistics part of SAS as an undergraduate major has experienced less success in attracting strong students (a phenomenon assuredly not confined to SFU). In large measure, this is because the career potential of a Statistics major is less clear to the typical undergraduate, and it is consequently harder to attract strong students into the majors programs. Some members of the department expressed some concern regarding the mathematical strength of some of the Statistics majors and the admission requirements into the major are currently being reviewed. In order to attract strong students into its undergraduate statistics programs, the department is encouraged to develop a recruitment plan. The committee was told that awards are given to the best students in STAT 270; those students form a natural cohort from which to recruit Statistics majors. The Statistical Society of Canada has recently developed an accreditation process which could help to lend the same kind of "certification cachet" to a Statistics degree that a degree in Actuarial Sciences now holds. If students can be made aware of the many career opportunities to which a Statistics degree can lead, this may help attract strong students in the same way that the AS major does. The faculty at SFU has the advantage of having many young members who are doing interesting work and who may be able to serve as role models for undergraduates. Certainly areas of statistics like biostatistics, environmetrics, statistical genetics, bioinformatics and industrial statistics have the potential to be drawing cards.

Recommendation 1. It is recommended that the Department develop a plan for recruitment of strong quantitative undergraduates into the statistics major program.

Co-op placements for Statistics majors are somewhat more difficult to find than are placements in AS. A point to note is that placements with federal agencies (e.g. Environment Canada, Fisheries & Oceans) are restricted to Canadian citizens. In addition, students whose first language is not English may have additional communication barriers to overcome. Nonetheless, suitable co-op placements are being found for Statistics majors. The faculty may be able to play an increased role here in helping to identify potential employers through collaborative contacts, and perhaps through alumni.

3.3 Management and Systems Sciences (MSSC) appears to be a good program that combines statistics, mathematics, computer science and business. The committee heard relatively few comments on MSSC during the site visit and wonders if its potential is being exploited to the fullest extent possible. It was noted that administrative responsibilities for the MSSC program alternate between Statistics and Mathematics on a biennial basis. Thus, neither department claims real ownership of MSSC. The committee feels that the full potential of this program may be better realized with a more permanent director. Such a person could more effectively exercise leadership, develop the program's potential, and create a suitable home and identity for the students.

Recommendation 2. It is recommended that the Departments of Statistics and Actuarial Science and Mathematics and the Business School consider appointing a Director of the MSSC program for a four or five year term.

3.4 Course Offerings and Recommendations for Coursework. The committee heard from SAS majors the desire to have certain types of undergraduate courses offered (particularly at the advanced levels—time series analysis was mentioned), or offered more often than they are at present. An advanced course that is offered in alternate years can leave a student with undesirable choices: take the course before having satisfied prerequisites; wait to take the course two years later (thereby delaying graduation); or try to learn the material as a reading course. If tightening up on admission requirements to the major can be thought of a “weeding” process, then the undergraduate curriculum also may need some “fertilizing” through upper level courses being available to students each year. Having two new hires on board (one in AS, one in Statistics) will presumably help address this issue.

Some statistics alumni suggested that the undergraduate program should include more mathematics requirements (e.g., courses in real analysis) for statistics majors. For those intending to pursue graduate school in a theoretical statistics program, more math electives are recommended. This may best be handled as an advising issue for the Department, rather than ending up with an overly restrictive major.

4. GRADUATE PROGRAMS

4.1 *General.* The graduate programs offered by the Department are very healthy. There has been a substantial growth this year to about 35 graduate students from a previous baseline of about 24 students. Graduates of both the Masters and the Ph.D. programs are

able to find very good jobs in areas related to their specialties. Especially with the increase in faculty complement, a further increase in graduate enrollment over the next three or four years would seem appropriate.

We heard from the graduate students that they would like to have more regular offerings of the more senior courses. Some students felt that, especially in the masters program, there was sometimes not the opportunity to take some courses of interest. In the first year, they lacked the prerequisites and in the second year, the course was not offered.

One notable omission in the curriculum was a second Ph.D. level course in the theory of statistics, and the committee feels that it is very important to remedy that deficiency. It was also noted that there were no advanced courses in probability theory. It would be worthwhile to explore with Mathematics how some course work in this important area could be included in the graduate program in both Departments.

Recommendation 3. It is recommended that the Department should review its graduate offerings in the theory of statistics with a view to adding at least one additional course at the Ph.D. level in this area. The Department should also discuss with Mathematics how best to provide some course availability in advanced probability theory.

Completion times for the graduate degrees are generally good, but there was a rather long tail in the historical data on time to complete the Masters degree. Some of this may be due to co-op work terms or interrupted study, but it also seems clear that some students are taking a long time to complete the degree. Especially with a thesis based masters degree, there is danger that the expectations may sometimes be too great. The committee feels that a masters program should not normally take in excess of six academic terms for completion and recommends that the Department review the requirements of its masters program and takes measures to assure that most students would complete in a two-year time frame. Completion times for the Ph.D. degree seemed to be more or less at an average level. Again, there were some very long completion times and the Department should look to see how best to reduce these.

Recommendation 4. It is recommended that the Department review its requirements for the Masters degree and in particular the expectations for the Masters thesis to be sure that they are realistic and facilitate timely completion of degrees. The Department may also wish to consider an option for a course based Masters degree, which is becoming increasingly common in Statistics programs.

4.2 Proposed Masters program in Biostatistics. Biostatistics is a high demand area that has grown rapidly over the past two or three decades. There are many strong programs in this area in Canada and the US, and graduates at both the masters and Ph.D. levels are in high demand in Universities, industry, government and research enterprises. In the light of this and the strengths of the Department, the proposed masters program in Biostatistics seems very natural. The faculty contains an excellent core of individuals working in various areas of biostatistics, biometrics and environmetrics and certainly has the internal expertise to mount the program; the creation of the new Faculty of Health Sciences makes this an even more natural initiative. It is currently planned to hire two biostatisticians connected with that initiative and this will add further to the expertise. One disadvantage is the lack of a Medical School at SFU; interactions with the Medical School provide a very natural source of student research support and practical experience

for many programs in Biostatistics. Nonetheless, there are examples in both Canada and the US of strong biostatistical programs at universities that have no medical school. The biostatistics group at SFU has a number of good sources of practicum experience through its connections with the British Columbia Cancer Agency, local hospitals, Department of Fisheries and Oceans, the Ministry of Forests, and the development of the new Faculty of Health Sciences should help to provide additional opportunities. Further development of these connections and seeking new opportunities seems especially important.

It was not clear to the committee that there would be particular advantage in creating a new degree program in Biostatistics. It appeared to us that most of the advantage could be obtained by introducing a Biostatistics option within the existing masters program. This latter approach could be undertaken with approvals within the University only. Well developed and packaged, this would enable the Department to market a Biostatistics program to prospective students and to further build its teaching and research activities in this area. It is possible that we are missing the advantages of developing a new program with Ministerial approval; it is clear that a strong proposal to do so could be developed and, if this is the direction undertaken, we would expect the application to be strong and to gain approval.

In our discussions with those in Biostatistics, the possibility of a Biostatistics option at both the Masters and the Ph.D. level was raised. Many students are seeking both levels of training, and it may be easier to recruit strong students into the Masters program if they knew there was a Ph.D. option to follow. The introduction of a Ph.D. program in this area would also recognize the substantial faculty expertise and the capability that the Department has in research supervision in this area.

Recommendation 5: It is recommended that the Department proceed with its plans to develop a Masters Program in Biostatistics. In so doing, it will be important to develop opportunities for student practicums and funded research assistantships in application areas.

Recommendation 6: The pros and cons of developing a separate degree program in Biostatistics should be carefully weighed. There may be advantage in maintaining the single degree program with an option in Biostatistics.

Recommendation 7: The Department should consider the possibility of introducing a option in Biostatistics within the Statistics Ph.D. program.

4.3 Proposed Masters Program in Actuarial Science. The development of a proposed Masters program in Actuarial Science seems a natural project for the Department to undertake. This project has great potential, and there is certainly a market for a program in this area.

At the moment, however, the Department has only two faculty members in Actuarial Science and is currently seeking to add a third member at the Assistant Professor level. There is time needed for members of this group to develop further their research programs and to consolidate the undergraduate program. It would also seem important to have some time to build additional links with the business school and other related areas. The committee felt that some time and the addition of at least one more faculty member in this area would be important before mounting a graduate program.

At present, there is the opportunity for students to work on the interface between statistics and actuarial science at both the Masters and the Ph.D. level, and to develop their thesis work in an area of Actuarial Science. This seems to work reasonably well and provides an opportunity to develop additional strength in graduate studies in Actuarial Science. The first step toward a separate graduate program in Actuarial Science may be to develop one or two graduate courses to be offered on a regular basis.

Recommendation 8: It is recommended that a Masters Program in Actuarial Science be a longer term project to be mounted in three or four years' time. If the opportunity should arise, an additional appointment in Actuarial Science would give the critical mass to make such a program successful. A shorter term priority should be the design of actuarial courses offered in the existing graduate program.

4.4 A Post Degree Diploma in Actuarial Science. In discussion with the actuarial science group, the idea of a Post Degree Diploma arose. This would provide an opportunity for graduates in other areas to take a one or two year program in Actuarial Science to develop their knowledge and skills in that area. Many individuals with various undergraduate degrees see great career opportunities in Actuarial Science and the market for such a diploma could be substantial. This program could utilize various undergraduate courses and involve rather modest additional course offerings along with a project. Such a program could be financially beneficial.

Recommendation 9: It is recommended that the Department and the Actuarial Science Group consider the possibility of offering a post degree diploma in Actuarial Science with appropriate sharing of proceeds between the University and the Department.

5. SERVICE TEACHING

Both undergraduate and graduate service teaching are given high priority in the Department. Faculty in SAS see this as an important responsibility. An introduction to statistical thinking, regardless of one's major, is a very important ingredient of a general education. Tutorial support for the service-teaching role is provided in a somewhat unusual manner. The Department operates a drop-in facility or Workshop where students can come to get help with lecture material and assignments. The facility has a number of computers that run statistical software packages and is staffed by a Director and several Teaching Assistants, who also grade assignments for the various courses. It was our impression that this Workshop works well in providing a resource for students to seek help.

The Department has a key role to play in SFU's new initiatives for the Quantitative, Writing, and Breadth requirements as part of the undergraduate curriculum. It is natural to develop quantitative skills in the context of statistical applications; in addition, there may be room for certain statistics courses for non-majors to fulfill part of the breadth requirement. The Department is revising the STAT 100 course into a "Statistics for Everyday Life" course that would meet the quantitative requirement for humanities majors. There is also the intention to review and revise STAT 201 (Statistics for Biologists) and STAT 203 (Statistics for Social Scientists) by the spring of 2007. The Department is already offering one service course (STAT 270) at the Surrey campus,

with plans to add at least one more. As the Surrey campus grows, the Department plans to continue to ascertain the statistics needs of Surrey students.

Recommendation 10: The Department should continue to develop its plans to contribute to the new curriculum requirements. Similarly, the University should consider the value of a general education in statistical literacy for all its undergraduates.

6. CONSULTING SERVICE

The Statistical Consulting Service (SCS) serves SFU in teaching, research, and service roles. In a previous review, it was recommended that the SCS become self-supporting by developing appropriate revenue streams. SCS has accomplished that, primarily through taking on contracts for statistical consulting services from organizations outside the university. The current level of outside contracting along with some Departmental funds for teaching a graduate consulting course is sufficient to fund the salary and benefits of the director position. Sometimes a company or agency in need of a statistical consulting service will contact a Departmental faculty member, and then be referred to the SCS. Extension of the SCS into the area of actuarial sciences is a distinct possibility with the growth of that core group in the department. Such an extension would benefit graduate students with a particular interest in actuarial science who currently have statistical consulting course requirements.

Graduate students in Statistics are required to take a course in statistical consulting, STAT 811-812, which is taught by the SCS director and supported by Departmental funds. Engaging in statistical consulting on real problems and interacting with real clients provides excellent training. Students learn how to work with clients, and to progress from initially broad inquiries to more focused questions that can be answered with suitable statistical design and analysis. Skills gained in the process include thinking on one's feet, communicating statistical concepts to non-statisticians, and writing statistical recommendations for clients in language they can understand.

The SCS also makes a substantial contribution to scientific research at SFU. From the point of view of statistics, there is always the possibility that a consulting project will develop into a co-authored journal paper or thesis topic for a statistics student. More broadly, however, such services can help to raise the quality of research in a variety of disciplines that depend on good statistical analysis and design for valid research.

There is the potential for the SCS to be a much stronger resource for SFU than it is now. Currently only those who have access to budgeted funds can avail themselves of the SCS for a long-term or intensive consulting arrangement. The SCS offers brief advice via online statistical consulting (Ask Dr. Stats); it also provides *pro bono* consulting, necessarily for a limited time, for graduate students and faculty. Currently only the Director is funded and there is little incentive for SAS faculty to increase their involvement with SCS activities. It is the committee's impression that the Department would like to develop this facility further.

In view of the university-wide role the SCS already plays, we recommend that the SFU administration allocate some central funding to the SCS. This could pay for some faculty release time to increase and regularize SAS faculty involvement in the SCS and perhaps

fund the involvement of an advanced statistics graduate student in the SCS as an additional consultant. Involvement of Statistics faculty on a regular basis would bring much more expertise to bear on the SCS's work and integrate the service more into the mainstream of the Department's activities. This funding would be an investment that would have substantial dividends in increased research quality in many disciplines.

Recommendation 11: It is recommended that the central administration allocate some base budget to the SCS to increase faculty involvement in the area and to make the service more accessible to researchers in all areas.

7. SPACE

The Department is housed in satisfactory, though certainly not elaborate, quarters. It is becoming very crowded with very little common space and no extra offices for visitors, for example. New appointments will add more pressures and accommodations will need to be found. As the Department continues to grow, providing some increase in space should be a priority of the Faculty.

There was great variation in the quality of space for graduate students which seemed to be based on their research area and the ability of their supervisors to pay for upgraded facilities. Committee members felt that the quality of space for many of the graduate students was the worst that they had seen anywhere. One of the main areas houses almost 20 students in a converted classroom. It has very old and run down workstations with a few computers available for student use; we heard time and again complaints about broken chairs and a generally inhospitable environment. No students were occupying the space when we visited and we thought we understood why. The committee strongly recommends that there be an investment made to convert this space into something more attractive and more functional. This is an issue of quality of life for students and should be quickly addressed. Nowadays, most statistics departments would provide students with a large enough working service to have a computer on each desk.

Recommendation 12: It is recommended that the Department and Faculty renovate the student space to make it more functional and hospitable.

7. COMPUTING

The issue of computing came up time and again in conversations that we had with faculty. Several felt that the level of support for computing in the Department, the School and the University was not meeting their needs. The Department currently contracts with the Netware Support Group in the Faculty of Applied Science for computing and software support. There was a definite feeling, however, that while this arrangement met some of the basic needs, it could not respond adequately or in a timely manner to specific issues as they arose.

Members of the Department were pleased that the Dean of Science has agreed to fund, at least for one or two years, a position for a computing technician that would be shared with Mathematics. There is a strong hope that this will provide the needed support, at least on the shorter term. The review committee really does not have the expertise

needed to comment in any detail on these issues. It is clear, however, that there has been a problem in computing support and that it has, at least in some instances, interfered with efficient use of time and resources. This issue was also raised in the 1998 External Review (see their Recommendation 7).

There is now at least a one year period during which SAS together with the Department of Mathematics can consider how best to use this new position. This should also provide the time to prepare more clearly the case for this kind of computing support and to develop a long-term plan. Some portion of the budget for computing support should come from research funds and some from Faculty or Department operating funds; building a workable model for longer term computing support should be a high priority of the Department.

Recommendation 13: It is recommended that the Department, perhaps with Mathematics, develop a plan for longer term computing support along with appropriate budget models.

8. WORKLOAD TEACHING LOADS

Issues of workload, and in particular teaching loads, were raised in several interviews. At the moment, SAS operates with a nominal four course teaching load, but with a fairly extensive schedule of teaching releases for various internal and external service contributions as well as some releases for graduate supervision. In statistics departments in Canada, faculty members who are active in research and in supervising graduate students would normally have a three course teaching load. In addition, SFU's Department of Mathematics has changed the normal teaching load from four to three courses per year. The committee recommends that the Department establish three courses per year as the normal teaching load of research active faculty members.

As is the case in many departments in Canada that have been successful in attracting UFAs, specially funded chairs, or Canada Research Chairs, there are a number of faculty who have special arrangements for reduced teaching and service responsibilities so that they can devote more of their time to developing their research program. Such differences can cause some difficulties in the Department as colleagues with similar expectations on research are given very different assignments in teaching and service. SAS seems to have handled these differences very well, and there is a strong esprit de corps with a general appreciation of the considerable value to the Department as a whole of these specially funded positions. As well, the faculty members who hold these awards are very willing to help out where they can and are undoubtedly going to be very strong Departmental citizens in the future.

Even among those who are not on such special awards, it is relatively rare that SAS faculty have taught four courses in a given year. Some senior faculty members have received release time from teaching in order to take on major administrative responsibilities or to engage full-time in funded research. The current algorithm for teaching credit is based on 12 credits a year and gives credit for many, but not all, major responsibilities outside the classroom. The committee feels that it would be better for the norm to be 9 credits per year with the Department recognizing that there are a variety of administrative and supervisory tasks that must be collectively shouldered in an equitable

manner. Such a change would require that the algorithm for granting teaching credits be replaced by a new, perhaps less generous, set of guidelines developed through Departmental discussions. This is entirely feasible, given the highly collegial nature of relationships within the Department.

Recommendation 14: It is recommended that the Department change its teaching load from four to three courses per year for research active faculty. This change would also entail a review of current policies for granting teaching credits in recognition of other duties.

9. SURREY

The role that Statistics and Actuarial Science should play is not completely clear. It is clear, however, that there will need to be a presence of SAS at the Surrey campus even if only through a service role. The Department currently offers Stat 270 at Surrey, and it seems likely that additional service courses will be needed to support various activities there.

There are also a number of potential places where Statistics and Actuarial Science could be substantially involved. One proposal, about which we heard relatively little, is to mount an interdisciplinary program in data mining which would combine basic training in statistics and computer science with more advanced work on statistical methods of prediction and classification and computer science work on data base systems, artificial intelligence and machine learning. This could be a very good program and the skeleton outline given in the self study document might be further developed to give an excellent program for some students in Computer Science or Statistics.

A more immediate possibility arises with the proposed new program in Operations Research (OR) that is being coordinated through the Department of Mathematics. Any such program would absolutely need to have some fairly substantial involvement of statistical methods as well as stochastic modeling. Certainly statistical methods to the level of regression methodology and courses on stochastic processes and their applications would be essential. It is important that there be discussion with Mathematics as to how these needs will be met.

There may be a real opportunity for the Department to become involved in this area and, at a minimum, it should provide some basic support for the initiative as it unfolds. There may be a larger role to play in this initiative and there could be substantial value to an appointment of someone in stochastic and statistical aspects of OR. The issue of isolation of such an appointment at the Surrey campus is a real concern and the Department needs to think through how it can best contribute to this University initiative.

Recommendation 15: The Department should consider how it can best and most effectively be involved in the Surrey initiative. If it is to be involved in such initiatives as the program in operations research or data mining, then it needs to plan appropriate appointments and ways to integrate such appointments with the Department on the Burnaby campus.

10. FOR THE RECORD:

- The Department staff seemed to be operating very effectively and had a very positive outlook. There may be a need for an increase in the staffing levels in the Department. One secretary currently provides support for the Chair as well as graduate studies. Only two secretaries in a Department of this size seems a low level of staffing and we recommend that it be reviewed.
- The library support and facilities appeared to be very good. We heard no concerns about library facilities and were impressed with the information we received in our interviews.
- The split from Mathematics seems to have been accomplished in a very amicable way and there seems to be very good relations between the two Departments. Such collegial relationships are not always seen when such divisions take place. The division has been very well handled administratively with excellent leadership on all sides.
- There are concerns expressed in the document that the Department is left to find resources to pay benefits for faculty members who are funded from external sources. We understand that this charge to the Department was a mistake and that steps are being taken to correct this. It seems obvious that such charges are not in the interest of promoting initiative at the Department level.
- The Alumni were extremely positive about the Department and their educational experience (except for the quality of space and computing facilities).
- Leadership in the Department is deep and very strong. Several senior members have played outstanding leadership roles in establishing the Department and in seeking out external opportunities for development. Several of the younger members of the Department also have great potential in this respect. The University and the Faculty have been willing to invest heavily in backing these leaders and this has and will continue to pay great dividends.
- The committee heard comments from several faculty members that more and more work has been devolved to the Department and faculty level with no more, and often fewer, resources. This is of course a common, but also justified complaint; such additional responsibilities do increase the stress of the faculty position, and leave less time for the main responsibilities of research and teaching.
- There would be potential for an international program, especially in actuarial science where excellent students could be found in Asia and possibly even in the US. With good incentives in revenue sharing from the University, this may be an option worth investigating.

Summary of recommendations

Recommendation 1. It is recommended that the Department develop a plan for recruitment of strong quantitative undergraduates into the statistics major program.

Recommendation 2. It is recommended that the Departments of Statistics and Actuarial Science and Mathematics and the Business School consider appointing a Director of the MSSC program for a four or five year term.

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