SIMON FRASER UNIVERSITY

OFFICE OF THE VICE-PRESIDENT, ACADEMIC

MEMORANDUM

To: Senate

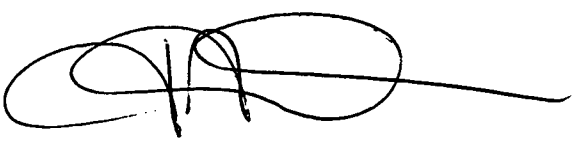
From: J. Osborne, Acting Chair
Senate Committee on Academic Planning

Subject: Establishment of the Department of Statistics and Actuarial Science
(SCAP Reference: SCAP 00-15)

Date: May 18, 2000

Action undertaken the Senate Committee on Academic Planning gives rise to the following motion

> "that Senate approve and recommend to the Board of Governors, the formation of a new Department of Statistics and Actuarial Science within the Faculty of Science effective 1 September 2001 and that the renaming of the remaining department as the Department of Mathematics, as set forth in S.00-56 ."



SCAP 00 — 15

SIMON FRASER UNIVERSITY
MEMORANDUM

To: Dr. J. Munro
VP Academic

From: W. Davidson, Dean
Faculty of Science

Subject: Formation of a Department of Statistics & Actuarial Science

Date: April 3rd, 2000

One of the recommendations that arose from the 1998 external review of the Department of Mathematics and Statistics was that: "The University should consider establishing a separate Department of Statistics within the Faculty of Science." The Statistics Group have taken this to heart and unanimously agreed that the time was right to act on this recommendation. They submitted a proposal that had the blessing of the rest of the Department of Mathematics and Statistics. It is fair to say that some faculty members will be sorry to see the Statisticians leave, but all recognize that this will ultimately benefit the teaching of Statistics and the discipline itself at Simon Fraser University. The proposal was brought to a meeting of the Faculty of Science Council last week and it passed with only a single vote against.

I am attaching a copy of the proposal that was endorsed by the Faculty of Science. You will see that the new Department will include Statistics and Actuarial Science. The rationale for this Department is sound. It is implied that the remainder of the present Department of Mathematics and Statistics will become the Department of Mathematics. The ongoing cost is minimal when one considers the overall benefits. The question of resources should not be used to prevent this plan from proceeding. It will not alter the hiring plan that is currently in place.

I ask that you personally support this initiative that has come from the faculty members and take it to the appropriate committees for University approval.

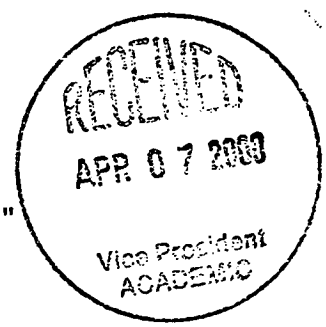
William S Davidson

W. Davidson

c: C. Dean
L. Berggren

Motion:

"That SCAP approve and recommend approval to Senate and the Board of Governors, the formation of a new Department of Statistics and Actuarial Science within the Faculty of Science effective 1 September 2001."



1.

Dr. Charmaine Dean presented the following motion at the Faculty of Science Meeting, March 28, 2000.

> ***To approve the formation of a Department of Statistics as outlined in the attached paper.***

MOVED: C. Dean
SECONDED: L. Berggren
MOTION CARRIED (with one against)

Simon Fraser University

MEMORANDUM

To: Willie Davidson, Dean Faculty of Science	**From:** Charmaine Dean Director of Statistics
Subject: Proposal for the Formation of a Department of Statistics & Actuarial Science	**Date:** March 14, 2000

Please find attached a proposal for the formation of a Department of Statistics & Actuarial Science. I am requesting that this item be included on the agenda of the next meeting of the Faculty of Science for consideration and approval.

CB Dean

3.

Proposal for the Formation of a Department of Statistics and Actuarial Science at Simon Fraser University

1. Introduction

The discipline of Statistics has expanded well beyond the strong mathematical focus that was prevalent when Simon Fraser University was founded. Actuaries and statisticians are now engaged much more in cross-disciplinary work. This fundamental change is well-represented in the faculty complement at Simon Fraser University. The creation of a new Department of Statistics and Actuarial Science would foster the further development of this dynamic field.

Specifically, the Department would promote the uniting of various faculty teaching statistics across the campus. It could promote cross-disciplinary cooperation more effectively than the existing administrative arrangement. It would provide more immediate credibility with potential research collaborators, co-op employers, and other external contacts. It would create a more secure environment for recruiting young faculty were they to know that career evaluations would be conducted primarily by a committee of their peers. Finally, the priorities for Statistics and Actuarial Science are now quite different from those for Mathematics. The Department would foster the development of facilities truly geared to the unique needs of statistics and actuarial science (e.g. undergraduate laboratories for statistical and actuarial computing and for providing direct experience with running sample surveys and designing experiments). It would create an opportunity for Simon Fraser University to become a leading center for statistical and actuarial research and education in western Canada.

The development of this initiative to form a department of Statistics and Actuarial Science has a history at Simon Fraser University, and indeed, has by no means been hasty. The Report of the External Review Committee for the Department of Mathematics and Statistics, submitted April, 1998, listed as one of its eight recommendations that

'The University should consider establishing a separate Department of Statistics within the Faculty of Science.'

This was the second consecutive time that external reviewers recommended further autonomy for Statistics. Following the previous review, the statistics group developed a proposal for an Institute for Statistics. This was approved by the Faculty of Science on February 25, 1991 (Paper FSC 3-91). Furthermore, immediately prior to the vote, a spokesperson for the statistics group made it clear that the Institute was to be viewed as a first step toward the creation of a fully autonomous Department of Statistics. Hence, the Faculty of Science has already expressed approval in principle for this development. Unfortunately, subsequent financial exigencies led to the indefinite postponement of this initiative. The external reviewers have, in effect, reminded us all that it is time to complete the task, and stimulated the development of this proposal.

In the following section we identify and describe the faculty affiliated with the proposed new Department. Section 3 identifies our immediate goals and initiatives. Section 4 discusses structural requirements. It should be emphasized that no new programs are being proposed. M.Sc. and Ph.D. programs already exist and are flourishing. We have recently created undergraduate minor, majors and honors programs, at the request of our students, because of the

benefit they receive from an official designation on their academic record as having completed these specialized programs. Our proposal is for an administrative reorganization which will lead to a clear distinction between the new Department and that of Mathematics. Only a modest administrative expenditure will be required to implement this proposal. The proposal ends with a summary of the goals of the discipline of statistics and actuarial science. A separate document, describing the teaching programs of the proposed Department of Statistics and Actuarial Science, and our teaching philosophy, is attached. The mathematicians in the Department support the creation of the Department of Statistics and Actuarial Science, and this move to create two new units has not been controversial. We anticipate that the good relationship which currently exists between Mathematics and Statistics and Actuarial Science should continue after the Department of Statistics and Actuarial Science is established.

2. Faculty Affiliated with the Proposed Department of Statistics and Actuarial Science.

The statisticians and actuarial scientist affiliated with the proposed new department form an active research group with a variety of interests, including fisheries and resource management, model checking, survey sampling, applied probability modeling, statistical computing, actuarial science, foundations of statistics, Bayesian methods, design of experiments, industrial statistics, biostatistics, genetics, epidemiology and data analysis. We have carefully nurtured links with governmental agencies, industry and medical practitioners through helpful contacts and selective hiring. Although these interactions have been fostered by individual faculty members, we have created a focus for such development through the Statistical Consulting Service. As a by-product of these endeavours we have secured the first graduate cooperative program in the university and apparently even now it is the only thriving one. This strong applied focus to the Masters graduate Statistics program distinguishes it from the more theoretical bent that UBC has taken, thus providing a complementary program in the province.

The ten regular faculty operate as a cohesive unit and have been heavily involved in work for national and international Statistical and Actuarial Societies and for NSERC - two Presidents of the Statistical Society of Canada (SSC); President, SSC Survey Methods Section; President, SSC Biostatistics Section; Chair, SSC Elections Committee; Chair, SSC Committee on Women in Statistics; Chair, SSC Education Committee; Chair, SSC Awards Committee; SSC Research Committee; SSC Programme Chair and Secretary; SSC Board Member; Chair, Joint Meetings Advisory Committee (a joint committee of five North American statistical societies); Advisory Committee on Statistical Methods for Statistics Canada; NSERC Selection Committees and Review Panels (five of the eight faculty who are Associate or Full Professors have served on these); Review Panels for the Research Programs Directorate of Health Canada, and previously Health and Welfare Canada; FRBC Selection Committee; Science Council of B.C.; International Biometric Society Regional Advisory Board; Advisory Panel to the U.S. Energy Information Administration; Associate Editor, Canadian J. Statistics; Associate Editor, Statistica Sinica; Associate Editor, Biometrics; Associate Editor, Survey Methodology; Editor and Associate Editor, Liaison; Associate Editor, Journal of Statistical Education; Statistical Appraiser for the American Association of Public Health; Associate Editor, Statistics in Medicine, Special Edition on Disease Mapping.

The statisticians have been involved in several research initiatives locally: Drs. Routledge and Schwarz at the Pacific Salmon Commission and the Department of Fisheries and Oceans; Dr. Dean at the B.C. Research Institute for Child and Family Health, St. Paul's Hospital and the B.C. Ministry of Health; Dr. Sitter at the Pulp and Paper Research Institute of Canada, MacMillan Bloedel and Pacifica Paper; Dr. Weldon at Environment Canada, MacMillan Bloedel Research and the B.C. Ministry of Forests; Dr. Schwarz at B.C. Hydro, the Pacific Urchin Harvesters Association and Klahoose Aquaculture. The discipline is rapidly evolving toward a more interactive role with the sciences and technology. Our group is well-positioned to take advantage of these newly evolving opportunities. In this regard we are particularly fortunate in our recent recruitments and in the continuing, active involvement of our two emeritus professors.

The research expertise of our group and descriptions of current research programs are outlined in Appendix A. We highlight here that Drs. Stephens and Lockhart have established a highly successful long-term collaboration on goodness-of-fit testing. Drs. Routledge and Schwarz are heavily involved in fisheries management. Dr. Swartz works in the topical area of statistical computing and algorithms for computationally intensive problems. Dr. Sitter works in survey sampling and experimental design, with much of this research directly applicable to industrial experimentation. Dr. Weldon's focus is on foundations of statistics and applied probability and statistics. Dr. Dean works in health statistics, in particular the assessment of spatial patterns in disease incidence and mortality. Dr. Graham is a statistical geneticist, while Dr. McNeney works in epidemiologic study design. Dr. Wirch, our professor of actuarial science, develops and assesses risk measures for financial risk management.

3. Future Development: Goals and Initiatives

The Department's long-term and on-going goals will be management of the Statistics and Actuarial Science undergraduate and graduate degree programs, liaison with other departments and groups which we service, creation of a centre for excellence in research, and outreach in statistics and actuarial science. We will focus our efforts on areas where we perceive there to be a strong demand for highly qualified personnel. The immediate short-term initiatives are described below.

3.1 Biostatistics and SFU's Health Initiative

We plan to develop a graduate focus in Biostatistics, with possible linkages with the University's Health Initiative. The proposal to develop a graduate focus in Biostatistics will permit a broadening of offerings in that field and in epidemiology and statistical genetics. Students will also have training in this area through their work for the Consulting Service, which we propose to have linkages to Children's Hospital (see section 3.2), likely leading to a greater number of theses in that field. We also envision cross-disciplinary training of graduate students entering the biostatistical field with supervisory committee members encompassing a variety of fields including basic sciences, epidemiology, economics, statistics. In this era when cross-disciplinary training is so important, we expect that our graduates from such a novel Biostatistical program

will be heavily recruited. There will also be enhanced recruitment to our graduate school. There are few programs in Biostatistics in Canada, and none in the west. Here is a potential to build something unique to Western Canada. The program will also be highly beneficial to Canada as a whole, by reducing the flow of Canadian students to the US for training in this important area. We will in addition experiment with offering courses in biostatistics at medical institutes in the Vancouver region to draw as an audience professional biostatisticians working at those institutes. There have been requests for such courses and we have responded with interest; in particular, we are currently consulting with Vancouver General Hospital in this regard. We intend to offer such courses jointly for our own graduates students and the external students. This will foster interactions between our graduate students and practicing biostatisticians. Our single course in survival analysis has already provided employment for many of our students. We have recently made a biostatistical adjunct appointment, Dr. Rob Balshaw, whose main 'home' of employment is a Health Consulting Firm, Synectics Health Corporation, in Vancouver. Another adjunct appointment has been made for a researcher at the BC Cancer Agency, Dr. John Spinelli, whose MRC funding has supported co-op work-terms for our students in the past, and with whom we have had on-going research collaborations. Our new NSERC UFA appointment, Dr. Graham, is a statistical geneticist with an epidemiological flavour. With her appointment, and Dr. McNeney's, a statistician whose main research focus is statistical issues in epidemiology, particularly study design, we envision further links to the medical community.

3.2 Industrial Outreach: The Statistical Consulting Service

In general, we have two main goals for this service: i) to bring an understanding of everyday concepts in statistics to as wide an audience as possible, to forge closer ties with the internal and external community of users of statistical methodology, to use modern statistical methods to improve quality and productivity and thus contribute to provincial economic development; and ii) to provide a place where our students may receive valuable professional training in consulting. We have aimed at producing 'top flight' students and have been successful, through the introduction of co-op and the training of students in the Consulting Service. Appendix B provides a brief description of the service and examples of recent projects completed by the service.

In the last 2 years the SCS has evolved into a partially self-funding service by charging faculty and graduate students from other disciplines for services rendered, and providing contract services to industry and government. Already the SCS has had contracts with such diverse clients as: The Office of National Statistics for the United Kingdom, The Pulp and Paper Research Institute of Canada, B.C. Hydro, MacMillan Bloedel, The Department of Fisheries and Oceans, the Pacific Urchin Harvesters Assoc. and Klahoose Aquaculture. This activity has many benefits to the Department: raises the profile both nationally and internationally; exposes our graduate students to current applied problems and possible future employers; funds our graduate students involved in particular contracts; exposes our faculty to currently emerging applied problems; provides sound statistical advice to other disciplines at a subsidized rate; and partially funds the position of Director of the SCS who also teaches two consulting courses to our graduate students as part of his duties.

Our first goal is secure funding for the SCS so that we can make the position of Director permanent. At present, it is a renewable term position with funding coming from the Department of Mathematics and Statistics ($20K/yr) in part for the teaching of Stat 811 and Stat 812. (Each of these 2 hour/week graduate courses in Statistical Consulting is offered two

terms per year; the two courses are required in sequence for all M.Sc. students in Statistics.) The remainder of the SCS funding has come from consulting fees charged to off-campus clients (see above) and to on-campus clients at a reduced rate ($25K/yr after SFU overhead charges). Note that about $5.5K per year has also been generated as support for graduate students from off-campus clients.

We have made some progress toward our goal of stable funding for the SCS. The ALRP of the department has agreed to let us use the remainder of a statistics faculty retirement position (part of it was used for budget cuts - approximately $20K is left) and the current support given to the service, originally from the Dean's office ($20K) as a base for securing permanent funding for the Directorship. Children's Hospital has expressed a strong interest in a joint venture to provide the remaining funding needed (approx. $25K). It is envisioned that the Director of the SCS will spend part of his working week at Children's Hospital. This will have the great benefit both for Children's and SFU that statistics graduate students become involved in research projects emanating from Children's, since graduate training for our students is an important feature of the Consulting service. Graduate students will obtain experience working with medical investigators and may be able to use studies emanating from such collaborations as bases for their M.SC. projects or theses. Such in-depth attention to studies will benefit both the students and the investigators at Children's. Children's will also benefit from the provision of biostatistical expertise. This arrangement will also permit closer collaboration between faculty at the two institutions. Such a venture can be fostered by the University's Health Initiative.

Once permanent funding is established, we envision using funds generated from external contracts to regularly support chosen graduate students, perhaps in conjunction with our graduate co-op program, to work in the SCS handling the administration and consulting for the multitude of small on-campus projects and smaller off-campus projects. This has been done for a few specific projects in the past 2 years: Derek Bingham was funded for one term for his work on a project with Macmillan Bloedel; Changbao Wu was funded for one term for his work on a project with the Office of National Statistics in the UK, Peter Lui, Chuck Paltiel, Jason Sutherland and Ruihua Yin were funded to work on smaller projects, including two from Children's Hospital. We hope that by hiring appropriately chosen statistics graduate students, we can free-up a portion of the Director's time to pursue, jointly with faculty, larger long-term projects which have substantial research components.

Recent activity at the SCS has had a major effect in the arena of public advocacy. In response to the 1992 Pearse-Larkin Report, Dr. Routledge was asked by the Pacific Salmon Commission to help assess the potential for errors in their estimates of fish passage at Mission. This project formed the basis of a Ph.D. student's dissertation, and led to Dr. Routledge being asked to serve on the Fraser River Sockeye Public Review Board in 1994. One of the Review Board's key recommendations was for the creation of a Pacific Fisheries Conservation Council to provide independent assessments of the health of our fish stocks and fish habitat. Dr. Routledge was seconded to serve on this council for a three-year term starting September, 1998.

3.3 Actuarial Research and Education

We are working to create an endowed Chair in Actuarial Science with strong links to the Faculty of Business. SFU is the only university in British Columbia to offer a program of studies in Actuarial Science. Students entering the actuarial program are typically very talented

and interested in business careers. They also have an interest in the mathematical sciences and show good statistical and computing skills. They are generally employed by financial institutions, pension and employee benefits consulting firms, and employee benefits departments of large corporations or government. They are expected to write the professional examinations set by the Society of Actuaries. Our graduates rank among those who have received the highest scores in the world on the first of these international examinations. Last year, five actuarial firms came to campus to recruit our graduating students. Our multidisciplinary approach requires students to build a foundation of statistics, business, economics, computing, and literary skills. Our new actuarial appointment, Dr. Julia Wirch, with bachelor's degrees in commerce and in mathematics and a masters and doctorate in Actuarial Science, and with considerable experience in the actuarial industry, will bring both academic and practical strength to the program. Our Certificate program in Actuarial Science provides a convenient conduit for students who have completed degrees in other areas, such as business, economics or computing, to pursue careers in the actuarial field.

We are exploring an opportunity to secure sufficient endowment to hire a first-rate Economic Actuary and to use this hiring to build bridges to Economic Policy and to the Business faculty in general. We have been working on this initiative with the SFU Development Office. With such a position in place there will be opportunities for the development of professional courses for practicing actuaries and for specialized courses in employee benefits and pension and retirement plans.

3.4 Experimentation in Teaching

We plan to expand the role of the Statistics Workshop. We have been utilizing a concept called 'Activity-Based Statistics' in a few of our courses. This requires experimentation, and has been an extremely successful teaching tool. In particular, those students whose home departments are in the other sciences readily appreciate the focus on concepts, the experience with real experiments and surveys, and the proficiency they develop in computer-assisted data analysis. However, the space occupied by the Statistics Workshop is not suited to experimentation, and, in addition, we would like to expand the role of the workshop to accommodate such experimentation in many of our courses. To this end, we will request support in the future for expanding the workshop space and facilities. We require an additional space about the same size as the existing workshop to run the experiments.

We have been offering every semester since 97-3, a completely online version of our basic service course STAT 101. Recent developments include the use of a JAVA-based suite of interactive modules for learning statistics. Study groups of students are involved through use of online conferencing, and interaction with a tutor on an almost continuous basis is achieved. Our statistics workshop is not currently used for this initiative but with some upgrading could do so.

3.5 Course Development

Course development is an on-going process and priority. Currently, we plan to develop a new first-year undergraduate course in Statistics, aimed at potential majors in Statistics. The course would stress the broad applicability of concepts in probability and data analysis, and would include the use of statistical software for simulation experiments and data analysis projects. In the past, the need for calculus in our introductory statistics course required that our introductory course (STAT 270) be at the 200-level. However, the advent of statistical

software has made in-depth coverage of probability and data-analytic ideas accessible without calculus. Moreover, because of changes to the school mathematics curriculum, more statistical ideas are being taught at high school, and students are ready for these ideas in first year. The development of this course will impact the current core courses in our program.

Because of changes in the high school curriculum to provide greater exposure to statistical ideas, we will also be exploring, with the Faculty of Education, the creation of a course for high-school educators on the teaching of statistical concepts and experimentation.

In addition, we propose to replace several introductory courses in Statistics for non-majors by a new course. In this course, the technical expertise developed will be similar to that developed in current introductory statistics courses. Students from a variety of disciplines will receive three hours of lectures per week jointly. However, there will be scheduled tutorials which are subject-specific, each with a maximum of thirty students. In these tutorials, specific examples taken from the students' home departments will be explored. The tutorials may include experimentation. The content of the tutorials will be developed in consultation with home departments. Assignments will also be discipline specific. In conjunction with this, the role of the senior lecturer in coordinating and overseeing these courses will be reviewed.

Finally, we are revising our offerings in Actuarial Science to correspond with the new syllabus for the actuarial examinations. These revisions will include proposals for the introduction of some graduate level Actuarial Science courses.

3.6 Bridges with other Departments

We envision creating several cross-appointments to tie together those working at SFU in the discipline of Statistics. Adjunct appointments in statistics and actuarial science will also form solid links with our industrial contacts. These will allow them an opportunity to share in the development of the disciplines 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. With an autonomous department, we shall be able to present more credibly our applied nature to other departments, to researchers both on and off campus, and to our external contacts.

3.7 Linkages with UBC

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. Graduate students from UBC attended STAT 890 Biometrics in 98-2 and will do so again in 00-2. We held all lectures and tutorials on a single day every week to facilitate attendance by UBC students, as they requested. They have also expressed an interest in attending our Longitudinal and Life-History Data Analysis course and we have agreed to try to schedule it at a convenient time for them in the future. Conversely, we encourage our students to take advantage of courses available at UBC whenever these can be used to complement our own offerings.

It is worth highlighting the areas we have recently helped to develop and wish to focus on: (i) environmental statistics, through the environmental science program, and (ii) biostatistics, though our specialized courses, co-op positions, adjunct appointments and our vision for our

graduate program. These are areas which NSERC itself targets as ones in which development in statistics should focus. There were four emerging areas identified as important by NSERC: statistical methodology for massive data sets and information technology, genetics and medical science, stochastic modeling, and statistics and probability in environmental science. We have focussed on two of these, blending our interests with those of other members of the Faculty of Science.

3.8 Training and the Job Market

We will promote the growth of graduate and undergraduate co-op opportunities to their full potential. Actuaries and statisticians find employment in a wide variety of fields, and the relatively few graduates from Canadian statistical and actuarial programs are in high demand. Our own graduates have been highly successful in gaining employment, not only because of the state of the market and of the profession, but also because we provide opportunities for training and experience in industry and government. We have one of the few thriving graduate co-op Masters' programs at SFU and one of only two in Statistics in Canada. We aim to become nationally and internationally recognized as a centre for excellence in our Applied Co-op Masters' Program. We believe that we are well underway. Recently, admission into our Statistics Masters' program has been highly competitive. Our graduates typically find employment before they actually complete their studies. Appendix C provides a list of our recent graduates and their current employment. Appendix D lists graduate co-op placements since the program's inception in 1995. Our Statistics Masters' degree is similar in nature to a professional accreditation and the co-op experience is vital for the students. There are 5 or more placements per year from our Masters' student body, which is usually comprised of about 15 students. We wish to build upon our ability to offer students good career prospects. To this end, we are aggressive in seeking co-op placements for our graduate and undergraduate students. In this work, we find that employers sometimes state that they prefer students from departments or programs of Statistics. See Appendix E for four letters from recent doctoral graduates in this regard. Though we are well-known in the statistical community as an emerging group, housing our students under an official Department will enhance their employment opportunities.

4. Structural Requirements

4.1. Physical Space

It would be desirable that the proposed Department of Statistics and Actuarial Science be given new space. However, contingency plans which separate the current departmental space into space for the two units are developed in Appendix F.

Creating physically separate Departments of Statistics and Actuarial Science and of Mathematics from the existing Department of Mathematics and Statistics will be challenging. The main reasons for this are: (a) the need to create two separate departmental offices; and (b) the fact that the current Department of Mathematics and Statistics is already under-spaced. In light of these two points we have tried to identify the space currently being used solely for the Statistics and Actuarial Science programs within the present department and the space which

is currently shared between mathematics, statistics and actuarial science. In Appendix F, we then propose how the space could be reallocated in such a way that the new Department of Statistics and Actuarial Science shoulders some of the current space burden. In addition we have tried to build into our proposal a net gain in usable space for both departments. We finish with an evaluation of additional space that the Department of Statistics and Actuarial Science will need as soon as it can be obtained.

4.2 Administrative Staff

We shall need one full-time, and one half-time secretary and one Departmental Assistant. This seems to reflect current practice for units the size of the proposed department.

4.3 Technical Support

A half-time UNIX/Mac/PC technician. The technician manages computing support required for teaching and for research endeavours.

4.4 Budget

A general budget description is provided in Appendix G. However, no specific details are listed there regarding the Teaching Assistant and Operating Budget allocations for Statistics and Actuarial Science. These allocations, and that for Mathematics, would follow the normal criteria for the Faculty of Science.

Note that no additional resources for the library will be required for the formation of the Department since no new programs are being planned. The incremental cost for creating a Department of Statistics and Actuarial Science and one of Mathematics is the salary for a departmental assistant and a half-time secretary, and minor renovation and equipment non-recurring costs.

5. The Vision of the Department of Statistics and Actuarial Science

As the 20th century comes to a close, Statistics and Actuarial Science has completed its development into a dynamic, highly interactive discipline. Simon Fraser University is well-positioned to move forward on this front. The core of the proposed department has a strong focus on applied research with special expertise in health, genetics, industrial experimentation, sample surveys, resource management, and actuarial science. This expertise is enhanced through our Statistical Consulting Service, adjunct professors in biomedical research, and informal interactions with faculty in other departments at the university.

We see the new Department of Statistics and Actuarial Science at Simon Fraser University emerging as a high-profile, internationally recognized centre for applied research, and a graduate and undergraduate training centre with graduates placed throughout local industry and government and further afield.

The following page provides a declaration of internal support by all the current members of our group for the formation of the Department of Statistics and Actuarial Science.

Department of Statistics and Actuarial Science
Declaration of Internal Support

We, the undersigned[1], support the creation of a Department of Statistics and Actuarial Science at Simon Fraser University, and wish to be a part of this new venture.

Charmaine Dean, Associate Professor and Director of Statistics

Jinko Graham, Assistant Professor

Richard Lockhart, Professor

Brad McNeney, Assistant Professor

Rick Routledge, Professor

Carl Schwarz, Associate Professor

Randy Sitter, Associate Professor

Tim Swartz, Associate Professor

Larry Weldon, Associate Professor

Julia Wirch, Assistant Professor

Ian Bercovitz, Director of Statistical Consulting Service

Robin Insley, Laboratory Instructor

Rob Balshaw, Adjunct Professor

John Spinelli, Adjunct Professor

Michael Stephens, Professor Emeritus

Cesareo Villegas, Professor Emeritus

[1] This list represents the entire complement of SFU faculty and academic support staff associated with statistics who are currently employed in the Department of Mathematics and Statistics at Simon Fraser University. The venture has the unanimous support of this group.

Teaching Programs in the Proposed Department of Statistics and Actuarial Science at Simon Fraser University

1. Our Philosophy as a Department with regards to our Teaching Responsibilities

We have adopted an organizational management philosophy of continual quality improvement as a means to reach our goals in our teaching responsibilities. We are committed to (i) excellence, (ii) exceeding 'customer needs', (iii) the creating of a reputation for total quality, (iv) working together as a team, and (v) providing members in all categories with opportunities to improve relevant skills. Goals related to undergraduate and graduate teaching are itemized below.

Our Undergraduate Service Course Goals are

- to provide a curriculum that reflects the needs of "customers": students, faculty teaching those courses which depend upon this course as a prerequisite, future employers, and Canadian society at large
- to increase the numeracy skills of students and foster an ability to think statistically
- to enable students to understand and evaluate statistical descriptions and the information they contain
- to enable students to use statistical tools to help with problems encountered at work, research, and everyday life
- to engender an appreciation for the usefulness and relevance of statistics
- to teach students new and interesting facts about the world via the use of real data (e.g. through Chance News and newspaper and magazine articles)

Goals of the Undergraduate Major Program are

- to provide a curriculum that gives a basic training for entry level positions as Statisticians or entry to a graduate program at other institutions
- to provide an emphasis on applied statistics
- to provide attractive lower division courses that will stimulate capable students to pursue our major program
- to extensively use real life data and experimentation in our courses
- to extensively use computer packages in our courses

Graduate Course Goals are

15.

- to provide graduate instruction to develop high caliber applied statisticians
- to increase the written and oral communication skills of the graduate students
- to increase the computer competency of our students
- to enable M.Sc. graduates to write a research report based on a problem they have analyzed.
- to enable Ph.D. graduates to start an academic career. Upon completion of Ph.D. a student should have the potential of three papers in their thesis.

Delivery Goals

- that all staff involved in the course are committed to continuous improvement and the development of both the course and their own skills in areas that impact the course
- that all students are treated with respect and that no student encounters unnecessary barriers or problems in regard to their learning or experience of the course
- that all students are helped to meet the goals of the course and program as efficiently as possible
- that the course be conducted in a manner that encourages everyone involved (students, lecturers, tutors, markers and support staff) to feel that they are integral members of a team, that they have both rights and responsibilities in ensuring its effectiveness and its improvement
- graduate students should receive adequate financial support (as allowed by our resources) through TA and RAs.

In general we try to ensure that quality problems are promptly investigated and appropriate action taken, as far as possible, to prevent recurrences. We also share material related to courses and course development and provide an environment where the learning experience and particularly the successes of the course team in improving the quality of this course be documented as far as possible so they can be made available to assist future providers of the course and others wanting to improve the quality of their own courses. We conduct regular "one minute papers" in our courses to receive feedback from students on what is going right and wrong in courses. Mid-semester post-mortems are held at Statistics group meetings to discuss course progress. Each service course is assigned a steering committee consisting of a statistician and members of client departments. These steering committees are responsible for development and modifications to the course outlines, and for assessing student progress and feedback.

2. Undergraduate Programs

The department offers honors, major and minor degrees in Actuarial Science and in Statistics. The Actuarial Science degree is offered within the Faculty of Science while the statistics

degrees can be held within the Faculty of Science or the Faculty of Arts. We also offer interdisciplinary degrees with Statistical content in Mathematics and Computing Science, Environmental Science and Management and Systems Science, and a certificate program in Actuarial Science. Both our Statistics and Actuarial Science degree programs have only recently been formally approved. This is of substantial importance to our students who will benefit from an official designation as having completed these specialized programs. Our interdisciplinary programs offer students flexibility and encourage them to extend their focus of knowledge. It should be noted that we offer a large number of courses for servicing the statistical requirements of other programs. In the sections which follow are descriptions of our programs and their sizes, how we operate our workshop and our mechanism for advising students.

2.1 Core Programs

The Actuarial programs are designed to give students a strong foundation in actuarial science and to prepare them to apply their actuarial skills in a business context to problems concerning the evaluation of financial risk and financial risk management, particularly as it relates to the insurance industry. In particular, the core courses have been chosen to prepare students for the examinations of the Society of Actuaries/Canadian Institute of Actuaries and the Casuality Actuary Society.

The Statistics programs have a distinctly applied flavour. They emphasize, along with the necessary foundations and theory, specific techniques that will make our graduates attractive to potential employers. Many students take advantage of valuable co-op education opportunities in business, industry, and government agencies. Our statistics major and honors programs also provide a solid basis for post-graduate work. Graduates have been accepted at such major schools as Waterloo and Carnegie-Mellon. Statistical methodology plays a fundamental role in such key fields as quality control, industrial experimentation, environmental health, and natural resource management. One of the requirements of the program is a minor in another field to provide the student with a good background in an area of application. We are continually working to ensure that our undergraduate programs are relevant to important potential fields of application.

Appendix I lists the requirements of these programs.

2.2 Joint Programs

The department administers two quantitative streams in the university's Environmental Science undergraduate program: Environmetrics and Quantitative Techniques for Resource Management. This is a recently established program. It is distinguished by its heavy emphasis on core science disciplines. All students must take, e.g., at least 2 semesters of calculus and 3 semesters of statistics. The quantitative streams provide in-depth training in statistics and quantitative modelling. The aim of it is to prepare students for such tasks as designing a sample survey of a contaminated site or studying the dynamics of a highly unpredictable fish stock.

The Management and Systems Science Program (MSSC) is an interdisciplinary program involving the Faculty of Business, the School of Computing Science, the Department of Economics, and the Department of Mathematics and Statistics. It is administered through Mathematics and Statistics. The Program is designed to produce graduates with solid problem solving and computational skills for the increasing information technology spreading through the business world. The courses in Business and Economics in the program build a general knowledge

Table 1: Average Enrolment in Undergraduate Courses between 94/95 and 97/98 by Course Type and Level

Course	Year	1–	2–	3–	4–
ACMA	1994/95			14.0	
	1995/96			10.5	
	1996/97			15.3	
	1997/98			15.8	
MACM	1994/95			51.3	
	1995/96		78.0	69.3	
	1996/97		105.0	55.3	
	1997/98	120.5	178.5	97.8	
MATH	1994/95	111.5	82.4	42.2	15.7
	1995/96	117.8	68.4	38.7	14.5
	1996/97	123.8	88.2	40.4	11.1
	1997/98	144.1	108.5	45.9	15.1
STAT	1994/95	147.7	98.5	50.2	12.5
	1995/96	188.0	85.6	65.7	16.4
	1996/97	164.5	136.0	57.3	15.8
	1997/98	234.0	120.0	105.8	17.8

in these two areas. The courses in Computing are oriented towards software and algorithms. The courses from Mathematics and Statistics emphasize discrete mathematics, optimization and statistics. The Program has been well received by the business community. The students in the co-op program find placements easily and graduates of the program have been quick to find employment.

The department offers, jointly with the School of Computing Science, an honors program in Mathematics and Computing Science (MACM). This program is designed for students interested in the mathematical aspects of computing or the computational aspects of mathematics. It establishes a solid base in both disciplines, and then allows the choice of a specialty in a wide variety of areas, including statistics.

We intend to continue our participation in these valuable programs, and will initiate discussions with other stakeholders to address whether significant changes are required to the programs resulting from the formation of a Department of Statistics and Actuarial Science.

2.3 Class Sizes

Details on enrolment for our various course types, and those for mathematics, for comparison, are given in Table 1. We are experiencing larger enrolments in many of our courses, and even some of our 300 level courses have enrolments of over 100 students. Large courses include STAT 203, with enrolments of about 100 students, STAT 270 (Introduction to Probability and Statistics), offered every term with typical enrolments of over 150 students, STAT 301 (Statistics for the Life Sciences), with typical enrollment of over 300 students.

2.4 The Statistics Workshop

The department runs scheduled tutorials for some upper-year courses. In addition, the Statistics Workshop provides instruction to students studying introductory level material. It is open usually five days a week and is staffed with teaching assistants who provide instruction on a one-to-one basis. The operation of the workshop is coordinated by a permanent faculty member, the Laboratory Instructor or Workshop Coordinator, who also provides assistance to students coming to the workshops. Marking of homework assignments, midterms and examinations is also organized through the workshop. The Statistics Workshop and tutorials offer students different styles of teaching by providing access to various teaching assistants in addition to faculty. They also provide an opportunity for students to meet others from their classes, to work in teams and study and learn together. The laboratory instructor and teaching assistants encourage and organize cooperative learning. The laboratory instructor will often organize review sessions, discussion groups and other activities to help students succeed in their course or to enrich their learning experience. The courses covered in the Statistics Workshop are listed in the table below.

Courses: STAT 101 Introduction to Statistics
STAT 203 Introduction to Statistics for the Social Sciences
STAT 270 Introduction to Probability and Statistics
STAT 301 Statistics for the Life Sciences
STAT 302 Analysis of Experimental and Observational Data

The courses covered in the Statistics Workshop provide an introduction to statistical methods for students enrolled in both the sciences and the social sciences. In any one semester it is normal to service three of the above courses. Occasionally, only two courses may be serviced depending upon course offerings.

Each of the courses serviced, except Statistics 270, makes quite extensive use of the statistical software which is available on each of the workshop's fifteen computers. The courses also require that the Workshop operate as a laboratory since students are expected to carry out real experimentation; this is a major challenge for the tutors because of the large numbers of students requiring help in the planning and design of their experiments. Such 'hands-on' studies illustrate important points of applied statistics and statistical reasoning. They provide the student with exposure to sampling, design, data collection, variability, model development, selection of factors, outliers, interactions, the need for randomization and many other statistical activities and concepts. The students tend to enjoy such work and through it, gain a reasonably solid understanding of these statistical concepts and an appreciation of statistics.

Two examples of this occur in Statistics 301 where students are required to gather and analyze both survey data and experimental data:

Survey- Students are required to gather and analyze data that they obtain about the types of automobiles that park in 'B lot' at the University.

Experimental- Students conduct an experiment and analyze the data obtained on the effect of wing design on the distance that paper planes will fly.

2.5 Directed Studies Courses

The department offers directed studies courses to undergraduates on an individual basis. These courses would not be counted as part of the faculty member's regular contribution to teaching, and are purely voluntary. Faculty members are often sympathetic to offering courses

to students who require them for completion of their program in a timely fashion, or offering specialized courses to highly motivated students.

2.6 Advising

Much procedural advice on registering is available from staff in our general office. The department also provides advice through faculty advisors who provide academic advice to students taking our courses, including providing career and graduate school information and approving programs. There are two faculty advisors in Statistics, and one for Actuarial Science. We encourage our majors and honors students to speak with a departmental advisor at least once per term. Usually advisors speak quite regularly with students, sometimes on an informal basis, and are a vital part of their support structure.

2.7 Endowments

The department has a joint mathematics and statistics endowment fund. It is used for funding undergraduate course awards at the lower level, student travel awards to attend the Canadian Undergraduate Mathematics Conference, Putman awards, and it has been proposed that some funds are used for awards to our majors. We propose that one-third of the endowment be used for creating an endowment fund for the Statistics and Actuarial Science Department.

3. Graduate Programs

Statistics

We currently offer programs in statistics leading to an M.Sc. or a Ph.D.

The M.Sc. degree has a strong applied focus and requires a project of statistical analysis and 30 semester hours of course work including a minimum of 2 semesters participation in the Statistical Consulting Service through the courses STAT 811-2 and 812-2. The program has an optional co-op component which has been very successful, providing solid practical training to participants. There are currently two sets of rules under which a statistics student within the Department of Mathematics and Statistics can get an M.Sc. degree. One set of rules is common to the entire department and requires a thesis and 20 units of course work of which at least 12 must be at the graduate level. The other set of rules is based on a project and more extensive course work. We have not had any students graduate under the thesis rules in recent years and propose not to maintain such a set of rules in our new department. However, we wish to make sure it is still possible for a student to substitute a thesis for the project when the department agrees that this would be in the student's best interest. We therefore propose to make some small changes to the rules to make explicit the possibility of using the thesis.

At the Ph.D. level we propose no changes to the rules currently in place for statistics students. We believe that these rules will serve well those Ph.D. students wishing to write dissertations in areas on the Actuarial Science/Statistics interface.

Actuarial Science

Students interested in Actuarial Science can currently do either an M.Sc. or a Ph.D. in the Department of Mathematics and Statistics following either the department's general rules or

20.

the special statistics rules. We propose to modify the statistics rules to make it clear that the project or thesis could focus on actuarial science. We further propose to create reading and special topics numbers in Actuarial Science to give us the flexibility to accommodate students.

Here are the basic ingredients of our current programs together with the proposed modifications.

The M.Sc. Program

- We require 30 semester hours of credit. Of these at least 24 must be at the graduate level.
- We require completion of STAT 801-4 (Mathematical Statistics).
- We require completion of our two Statistical Consulting Courses: STAT 811-2 and STAT 812-2.
- We require completion of a project; our proposal is to modify the wording to permit the substitution of a thesis for the project. A project is essentially a work of data analysis; a thesis would require either a research component or a substantial survey of a methodological area.
- Students are able to participate in the Co-op program. This has been very successful; see Appendix D of the proposal for the formation of a Department of Statistics and Actuarial Science for details of recent placements.

The Ph.D. Program

- We require 30 semester hours of credit beyond the B.Sc. level. Of these at least 24 must be at the graduate level. We currently give credit for 22 of these hours to students with an M.Sc. Students with an M.Sc. then require 8 semester hours of credit at least 4 of which are at the graduate level.
- We require successful completion of a general examination covering senior undergraduate statistics material. We propose to make explicit our commitment to modify the syllabus for Actuarial Science students.
- We will modify the language describing the thesis to include the possibilities of contributions to Actuarial Science rather than simply statistics.

Appendix II contains a proposed graduate statistics calendar entry which has received approval at the Faculty committee level. The proposed entry is only slightly changed from the 1999/2000 entry. It also contains the current graduate statistics calendar entry.

Funding for Students

The department has always provided financial support for all its graduate students without external funding. Some support is provided through research assistantships from the research grants of individual faculty members. We have about 20 students at any one time, with 3 to 6 of these being doctoral students. In conjunction with our colleagues in Mathematics we maintain an active recruiting program; we intend to continue that collaboration through PIMS.

We anticipate no significant change in the size of the program. We seek to maintain current annual teaching assistantship and Graduate Fellowship funding levels for our students.

Student Employment

Graduates of our program have been very successful in the job market. In Appendix C of the proposal for the formation of a Department we show recent graduates and their current employment. We are particularly proud of the success rate of our Ph.D. graduates in gaining faculty positions.

Appendix I

Undergraduate Program Requirements

Statistics Program

TLX10512 Shrum Science Centre, (604) 291-3331/3332 Tel, (604) 291-4947 Fax, http://www.math.sfu.ca

Director of Statistics

C.B. Dean BSc (Sask), MMath, PhD (Wat)

Professors Emeriti

M.A. Stephens BSc (Brist), AM (Harv), PhD (Tor)

C. Villegas Ing Ind (Uruguay)

Associated Faculty within Department of Mathematics and Statistics

C.B. Dean
R.A. Lockhart
R.D. Routledge
C. Schwarz
R.R. Sitter
T.B. Swartz
K.L. Weldon

Laboratory Instruction

R. Insley BSc, MSc (Br Col)

Advisor

Mrs. M. Fankboner BA (Occidental), MSc (S Fraser), TLX10511 Shrum Science Centre, (604) 291-4849

The department also maintains a committee of faculty advisors each year, and their office hours are available through the Department of Mathematics and Statistics general office. Students wishing to major in statistics should seek advice early in their academic careers about program planning from these department faculty advisors.

The Department of Mathematics and Statistics offers a program of study within the Faculty of Science leading to the degree of bachelor of science with a major or honors in statistics. Students interested in a bachelor of arts degree in statistics should refer to the *Faculty of Arts* section in this Calendar. The department also offers a minor in statistics.

The following programs in statistics train students not only in the analysis of large data sets, but also in the design and analysis of scientific experiments and sample surveys. These techniques are

applied in a broad range of fields. To fully appreciate their application, it is important that students also gain advanced training in an area of potential application. To this end, students pursuing a major or honors in statistics are required to complete a minor in a field other than mathematics and statistics. In keeping with the almost universal applicability of statistical methodology, there are no other restrictions on the selection of a minor. Students are encouraged to discuss the selection of a minor with an advisor early in their program.

Prerequisite Grade Requirement

Students must have obtained a grade of C- or better in prerequisites for courses offered by the Department of Mathematics and Statistics.

Faculty of Science Requirements

Students must satisfy the Faculty of Science upper division credit, breadth and grade point average requirements.

Major Program

Students will also be required by the Department of Mathematics and Statistics to obtain credit for the following courses.

a) Lower Division Requirements

Mathematics

Students must complete one of

- MATH 151-3 Calculus I
- MATH 154-3 Calculus I for the Biological Sciences
- MATH 157-3 Calculus for the Social Sciences I

plus one of

- MATH 152-3 Calculus II
- MATH 155-3 Calculus II for the Biological Sciences
- MATH 158-3 Calculus for the Social Sciences II

plus both of

- MATH 232-3 Elementary Linear Algebra
- MATH 251-3 Calculus III

Statistics

Students must complete both of

- STAT 270-3 Introduction to Probability and Statistics
- STAT 280-3 Applied Probability Models

Computing Science

Students must complete one of

- CMPT 100-3 Software Packages and Programming
- CMPT 101-4 Introduction to Computer Programming
- CMPT 102-3 Introduction to Scientific Computer Programming

b) Upper Division Requirements

Mathematics and Computing Science

Students must complete

- MACM 316-3 Numerical Analysis I

Statistics

Students must complete all of

- STAT 330-3 Introduction to Statistical Inference
- STAT 350-3 Linear Models in Applied Statistics
- STAT 402-3 Generalized Linear and Nonlinear Modelling
- STAT 410-3 Statistical Analysis of Sample Surveys
- STAT 430-3 Statistical Design and Analysis of Experiments
- STAT 450-3 Statistical Theory

c) Students are also required to complete a minor in some discipline other than mathematics or statistics. The certificate in actuarial mathematics may also be used to fulfil this requirement.

d) Faculty of Science requirements stipulate that at least three other upper division courses be taken in mathematics, statistics, actuarial mathematics, or mathematics and computing science. Students should consult a departmental advisor before selecting these courses. STAT 340, 420 and 460 are recommended. Neither STAT 301 nor STAT 302 may be used to fulfil this requirement.

Honors Program

A bachelor of science with honors in statistics requires 132 credit hours. See general regulations in the *Faculty of Science* section for further breadth, upper division credit, and other requirements.

In addition to the requirements a), b) and c) for a major, candidates for an honors degree in statistics will be required to obtain credit for the following.

d) Additional Mathematics Requirements

Students must complete all of

- MATH 242-3 Introduction to Analysis
- MATH 320-3 Advanced Calculus of One Variable
- MATH 322-3 Complex Variables

plus one of

- MATH 332-3 Introduction to Applied Algebraic Systems
- MATH 339-3 Groups and Symmetry
- MATH 438-3 Linear Algebra

e) Additional Statistics Requirements

Students must complete both of

- STAT 420-3 Non-Parametric Statistics
- STAT 460-3 Decision Analysis and Bayesian Inference

f) Faculty of Science requirements stipulate that at least three other upper division courses be taken in statistics, mathematics, actuarial mathematics or mathematics and computing science. These courses should be chosen with the assistance of a statistics advisor. STAT 340 is recommended. Neither STAT 301 nor STAT 302 may be used to fulfil this requirement.

Minor Program

Candidates for a minor in statistics are subject to the general regulations of the faculty in which they are registered. In addition, students will be required by the Department of Mathematics and Statistics to obtain credit for the following courses.

Mathematics Requirements

Students must complete one of

- MATH 151-3 Calculus I
- MATH 154-3 Calculus I for the Biological Sciences
- MATH 157-3 Calculus for the Social Sciences I

plus one of

- MATH 152-3 Calculus II
- MATH 155-3 Calculus II for the Biological Sciences
- MATH 158-3 Calculus for the Social Sciences II

plus both of

- MATH 232-3 Elementary Linear Algebra
- MATH 251-3 Calculus III

Statistics Requirements

Students must complete

- STAT 270-3 Introduction to Probability and Statistics

and at least five of the following courses.

- ACMA 315-3 Credibility Theory and Loss Distributions
- ACMA 320-3 Actuarial Mathematics I

- ACMA 335-3 Risk Theory
- ACMA 445-3 Survival Models
- STAT 330-3 Introduction to Statistical Inference*
- STAT 340-3 Statistical Quality Control
- STAT 350-3 Linear Models in Applied Statistics*
- STAT 380-3 Introduction to Stochastic Processes
- STAT 402-3 Generalized Linear and Nonlinear Modelling
- STAT 410-3 Statistical Analysis of Sample Surveys
- STAT 420-3 Non-Parametric Statistics
- STAT 430-3 Statistical Design and Analysis of Experiments
- STAT 450-3 Statistical Theory
- STAT 460-3 Decision Analysis and Bayesian Inference
- *these core courses are recommended

STAT Courses

Back to the Undergraduate Studies section of the 1999/2000 Simon Fraser University Calendar

Appendix II

Graduate Program Requirements

Graduate Statistics: Proposed 2000/01 Calendar Entry

This calendar entry has been approved by the Faculty of Science graduate studies committee. It is anticipated that these regulations will be in place by September 2000. The current calendar entry is also attached.

M.Sc. Program Requirements:

The program is intended to give students instruction on a wide range of statistical techniques and also to provide experience in the practical application of statistics. The program should be of interest to students who wish to acquire statistical expertise in preparation for a career in either theoretical or applied statistics.
Students in the program will be required to

- complete at least 30 credit hours of course work in Statistics and related fields beyond courses taken for the bachelor's degree. Of these 30 hours, at least 24 are to be in graduate courses or graduate seminars, and the remaining six may be chosen from graduate courses or those 400 level undergraduate courses which may be taken for credit for the BSc in Statistics. Normally these courses will include STAT 801, 811 and 812 and at least four of STAT 802, 803, 804, 805, 806, 870, 890, 891.

- submit and defend successfully a project (as outlined in the Graduate General Regulations) based on some problem of statistical analysis. This problem will often arise out of the statistical consulting service.

Students with a good undergraduate background in statistics will normally complete the course work in 4 semesters. The project, including the defence, is expected to require 2 semesters or less.
Students with backgrounds in other disciplines, or with an inadequate background in statistics, may be required to take certain undergraduate courses in the department in addition to the above requirements.

Co-op education

Students in the M.Sc. program or the Ph.D. program have the opportunity to obtain work experience during their degrees by participating in the co-operative education program. Employment lasting one or two semesters with government agencies, companies or other organizations employing statisticians is arranged for qualified students. Such employment often provides the problem which forms the basis of the M.Sc. project.

Ph.D. Program Requirements

A candidate will generally obtain at least 30 credits beyond courses taken for the bachelor's degree. Of these, at least 22 will be graduate courses or seminars and the remaining 8 may be from graduate courses or those 400 level undergraduate courses which may be taken for credit for the BSc in Statistics. Students who hold an M.Sc. in statistics are deemed to have earned 18 of the 22 graduate hours and 4 of the 8 undergraduate or graduate hours required.

Candidates will normally pass a general examination covering a broad range of senior undergraduate material in statistics. A candidate ordinarily will not be allowed to take the general examination more than twice. The general examination must normally be completed within four full time semesters of initial enrollment in the Ph.D. program.

Students will be required to submit and successfully defend a thesis which will embody a significant contribution to statistical knowledge.

For further information and regulations, see Graduate General Regulations.

Graduate Courses in Statistics

STAT 602-3	Generalized Linear and Non-linear Modelling
STAT 650-5	Quantitative Analysis in Resource Management and Field Biology
STAT 801-4	Mathematical Statistics
STAT 802-4	Multivariate Analysis
STAT 803-4	Data Analysis
STAT 804-4	Time Series Analysis
STAT 805-4	Non-parametric Statistics and Discrete Data Analysis
STAT 806-4	Lifetime Data Analysis
STAT 811-2	Statistical Consulting I
STAT 812-2	Statistical Consulting II
STAT 870-4	Applied Probability Models
STAT 880-0	Practicum I
STAT 881-0	Practicum II
STAT 882-0	Practicum III
STAT 883-0	Practicum IV
STAT 890-4	Statistics: Selected Topics
STAT 891-2	Seminar
STAT 894-2	Reading
STAT 895-4	Reading
STAT 898-0	MSc Thesis/Project
STAT 899-0	PhD Thesis

Notes

- STAT 602 and 650 are service courses not for students in our department. We will maintain these courses.
- STAT 880-883 are numberings for semesters of participation in Co-op education.

Statistics Program

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http://www.math.sfu.ca

Director of Statistics

C.B. Dean BSc (Sask), MMath, PhD (Wat)

Graduate Program Chair

R.A. Lockhart BSc (Br Col), MA, PhD (Calif)

Faculty and Areas of Research

For a complete list of faculty, see the *Mathematics and Statistics* undergraduate section.

C.B. Dean - discrete and lifetime data, extra-Poisson variation

R.A. Lockhart - goodness-of-fit testing, inference on stochastic processes, large sample theory

R.D. Routledge - biometrics, estimating the sizes of animal populations

C. Schwarz - modelling of animal population dynamics, capture-recapture methods

R.R. Sitter - sample surveys, design of experiments, biostatistics

M.A. Stephens* - goodness-of-fit testing and directional data

T.B. Swartz - statistical computing, theory of inference

C. Villegas* - Bayesian inference

K.L. Weldon - cross sectional sampling, statistical consulting

*emeritus

This is one of the graduate programs offered by the Department of Mathematics and Statistics.

Admission

For admission requirements, see the *Graduate General Regulations* section.

Applicants normally submit scores in the aptitude section of the graduate record examinations of the Educational Testing Service. Applicants whose first language is not English normally submit

the test of English as a foreign language results.

Applicants with degrees in areas other than statistics are encouraged to apply provided they have some formal training in statistical theory and practice.

MSc Program Requirements

The program is intended to give students instruction on a wide range of statistical techniques and also to provide experience in the practical application of statistics. The program should be of interest to students who wish to acquire statistical expertise in preparation for a career in either theoretical or applied statistics.

Students in the program will be required to

- complete at least 30 credit hours of course work in Statistics and related fields beyond courses taken for the bachelor's degree. Of these 30 hours, at least 24 are to be in graduate courses or graduate seminars, and the remaining six may be chosen from graduate or undergraduate seminars or 400 level undergraduate courses. Normally these courses will include STAT 801, 811 and 812 and at least four of STAT 802, 803, 804, 805, 806, 870, 890, 891.
- complete satisfactorily STAT 811 and 812
- submit and defend successfully a project (as outlined in the *Graduate General Regulations*) based on some problem of statistical analysis. This problem will ordinarily arise out of the statistical consulting service.

Students with a good undergraduate background in statistics will normally complete the course work in four semesters. The project, including the defence, is expected to require two semesters or less.

Students with backgrounds in other disciplines, or with an inadequate background in statistics, may be required to take certain undergraduate courses in the department in addition to the above requirements.

Co-operative Education

Students in the MSc or PhD program may obtain work experience during their graduate studies by participating in the co-operative education program. Employment lasting one or two semesters with government agencies, companies or other organizations employing statisticians is arranged for qualified students. Such employment often provides the problem which forms the basis of the MSc project.

PhD Program Requirements

A candidate will generally obtain at least 28 credits beyond courses taken for the bachelor's degree. Of these, at least 16 will be graduate courses or seminars and the remaining 12 may be from graduate courses or seminars or 400 level undergraduate courses. Students who hold an MSc in statistics are deemed to have earned 12 of the 16 graduate hours and eight of the 12 undergraduate or graduate hours required. The course work in all cases will involve study in at least four different areas of statistics and probability.

Candidates normally pass a general examination covering a broad range of senior undergraduate statistics material. A candidate ordinarily is not allowed to take the general examination more than

twice. The general examination is normally completed within four full time semesters of initial enrolment in the PhD program.

Students submit and successfully defend a thesis which will embody a significant contribution to statistical knowledge.

For further information and regulations, see *Graduate General Regulations*.

STAT Graduate Courses

Back to the Graduate Studies section of the 1999/2000 Simon Fraser University Calendar

Appendix A

Research Profile of Faculty in the proposed Department of Statistics and Actuarial Science

Dr. Rob Balshaw, an adjunct professor, is a Senior Biostatistician with Synectics Health Corporation, a medical research group based on campus at the University of British Columbia. His work at Synectics has focussed on the design and analysis of observational, longitudinal medical studies, and on the analysis of pharmacokinetic data arising in clinical trials settings. Current work includes several large scale studies in psychiatric disorders, auto-immune disease, and oncology. Dr. Balshaw's research interests include methodologies for the analysis of longitudinal count data and approaches to the analysis of observational data. Drs. Balshaw and Dean are currently examining methods for the analysis of life history data. Recent work includes an examination of the use of cubic splines for the estimation of the intensity function in a panel data context.

Dr. Charmaine Dean works with Children's Hospital and the Ministry of Health in their development of models for investigating spatial and temporal patterns in disease incidence and mortality over the province, including the development of innovative statistical methodology to do so. Assessing the spatial-temporal distribution of various kinds of mortality throughout the province is an important task at the ministry. Policy-makers use these distributions, presented in the form of maps, for allocating health funding. The new methodology Dr. Dean and her recent Ph.D. graduate, Dr. Ying MacNab, have developed focuses specifically on addressing the problem of producing meaningful statistics at the local health area level for small population groups. Identifying the distribution of rates over a region is a prediction problem, where random effects, representing area-specific effects, are to be estimated. These area-specific effects are correlated both spatially and temporally. In B.C. the data arise in a nested structure and she and Dr. MacNab have exploited this structure to develop inference for a proposed hierarchical model for the random effects. Primary applications at present are cancer and infant mortality. With a previous Spanish postdoctoral student, Dr. Ugarte, and her Spanish colleague Dr. Militino, Dr. Dean is involved in a project funded by Spain, to produce a mortality atlas for the province of Navarra in Spain.

Dr. Dean has also worked in the general area of the analysis of count data, and has produced several papers dealing with methods for handling a common and troublesome phenomenon in such analyses called 'overdispersion'. This arises when the empirical variance in the data exceeds the nominal variance under some presumed model. Dr. Dean has developed some simple yet effective methods for accommodating overdispersion in analyses of count data. Her recent work focuses on testing for variance components in Poisson mixture models using a modification of penalized quasi-likelihood techniques. She has investigated the loss in efficiency in the estimation of treatment effects in the analysis of counts versus actual event times in Poisson processes. This has implications for cost-effectiveness in the design of clinical trials.

Dr. Dean has also been involved in research projects through the Vancouver General Hospital, and the B.C. Institute for Child and Family Health. She is currently involved in AIDS research with Health Canada, and in the analysis of the results of a major provincial study on survival after cardiac surgery.

Dr. Jinko Graham's research is in the area of statistical genetics and genetic epidemiology. With Professors Åke Lernmark and Norman Breslow at the University of Washington,

she is a coinvestigator on a Swedish population-based case-control study of the genetic and environmental basis of type 1 diabetes, a complex genetic disease. The research is a team effort with the Swedish Childhood Diabetes Study Group, a well-known network of physicians and diabetes researchers based in hospitals across Sweden.

Disease associations within populations are a focus of the ongoing research in type 1 diabetes, and also of related work with Professor Elizabeth Thompson at the University of Washington, developing new methods of *disequilibrium fine-mapping.* In disequilibrium mapping, population associations are used to infer the genomic location of a disease mutation at finer resolution than is possible with traditional genetic linkage studies based on family data. Fine-mapping reduces the substantial costs associated with isolating and cloning a disease gene in a large candidate interval of the genome. The idea is that, on average, marker loci closer to the disease locus will have alleles which are more strongly associated with the disease than farther marker loci. Since genealogical relationships within a population lead to such associations, stochastic models of gene ancestry have proven useful.

Besides disequilibrium mapping, many other problems in population genetics can be phrased in terms of a latent ancestry connecting genes. For example, in work with Professor Bruce Weir at North Carolina State University and Dr. James Curran at the University of Waikato, Dr. Graham is developing improved estimators of forensic match probabilities for modern microsatellite DNA profiles. In forensic matching of the DNA of a suspect to a perpetrator, the more related the suspect and perpetrator are, the more likely that there will be a match. The microsatellite loci currently popular in forensic DNA profiling mutate in stepwise increments, and so the allelic state provides some information on the underlying ancestry. However, current estimators of match probabilities are based on a non-stepwise mutation model, and do not make use of this important information on relatedness.

An ancestral perspective is also useful in a research project with Professor Françoise Seillier-Moiseiwitsch at the University of North Carolina at Chapel Hill and Dr. Brad McNeney at Simon Fraser University. The group is using data on the genetic diversity of HIV populations within individuals to estimate the diversity of strains at the time of infection. The number of transmitted HIV quasispecies is of interest to scientists developing vaccine strategies.

Dr. Richard Lockhart is completing work with T. W. Anderson and M. A. Stephens on goodness-of-fit testing for standard time series models like AR(1) and MA(1) based on comparison of the cumulative spectral distribution and the empirical spectral distribution function. With Gemai Chen and M. A. Stephens he has recently developed asymptotic approximations for the usual likelihood objects in the Box-Cox transformation analysis in a framework which leads to asymptotic approximations which (unlike those of Bickel and Doksum) depend continuously on the parameter values. They have developed goodness-of-fit tests for the (false) null hypothesis of normal errors in these models, along the way trying to make clear the meaning of testing such a hypothesis. They intend to see if this sort of small sigma large n asymptotics applies usefully in other estimated transformation contexts.

One of his recent Ph.D. graduates, Ken Butler, developed goodness-of-link tests for logistic regression in his Ph.D. thesis and Dr. Lockhart expects to continue work in this area generally. Related work with John Spinelli and M. A. Stephens on assessing the Poisson assumption in Poisson regression models is almost complete.

Another of his recent Ph.D. students, Chandanie Perera, developed small sigma asymptotic analysis of a method (thermo-luminescence) of dating sedimentary deposits such as sand dunes. The problem requires further work particularly on a question of the following form. If the

regression of Y on X has a slope which does not depend on a further covariate W over a range $W_l \leq W \leq W_u$ where the limits W_l and W_u are unknown, how should this common slope be estimated and how do we attach a standard error to its estimate. The problem is further complicated because in the thermo-luminescence context the data sets for Y versus X are correlated at adjacent settings of W (and the regressions are not linear). In her thesis, Perera developed tests for normality when you have many small samples which may not have common means or variances. This work is incomplete and related to other work still underway with Gemai Chen in which they try to deal with goodness-of-fit tests after fitting a large number of parameters.

Dr. Lockhart is interested quite generally in the problem of model assessment, particularly in models with many parameters. He seeks tests which control overall error rates according to some clear protocol but which, having detected a model failure, can be decomposed into components which can be used to identify the particular sort of model failure.

Dr. Brad McNeney's research is in statistical issues related to public health. Much of his current work is concerned with the design of epidemiologic and clinical studies, and associated questions of data access such as security and privacy, extraction from large central registries, and distributed computing, particularly in health services or health outcomes settings. In collaboration with Professors Jon Wellner and Norman Breslow at the University of Washington, he is developing statistical methods for the cost-effective design of such studies. Recently, two-phase or response-selective design strategies have been proposed as economical. The case-control study in which cases are oversampled relative to their overall population frequency may be viewed as an example, and is known to be far more efficient than a cohort study when the disease is rare. More generally, the response and a set of inexpensive covariates can be measured on all subjects. Then, in a second phase, those with rare responses and/or exposures can be oversampled for a more informative and costly covariate, while a reduced fraction of individuals with common responses and exposures can be sampled. Thus, a subset of subjects will have data *missing by design* on the costly covariate. The work carries over naturally to more general missing-data problems in the statistical analysis of clinical trial data. With Professor A. (Butch) Tsiatis at North Carolina State University, Dr. McNeney is investigating efficient estimation and testing in semiparametric models with data that are missing by chance.

Dr. McNeney also has research interests in statistical issues related to HIV vaccine development. Given the scale of the public health problem HIV poses in the developing world, the need for effective vaccines is clear. In a project with Professor Françoise Seillier-Moiseiwitsch at the University of North Carolina, and Dr. Jinko Graham at Simon Fraser University, he is developing statistical methods for assessment of the number and diversity of HIV quasispecies transmitted to an individual based on HIV envelope sequences collected over time from newly infected individuals. The larger the number of transmitted quasispecies, the more difficult the task of developing an effective vaccine.

The goal of **Dr. Rick Routledge's** research program is to develop statistical methodology of particular value to population biologists and resource managers. This work requires that he uses, and make contributions to, newly evolving statistical theory, and that he keeps abreast of modern developments in population biology and related instrumentation. Examples of the technical methodology that Dr. Routledge works with include saddlepoint approximations, exact p-value calculations, spline-fitting, and split-beam echosounding.

Dr. Routledge's work has been incorporated into undergraduate courses and texts in population biology, and has contributed to high-profile public debates on resource management

issues. Spin-off work in estimating human populations has also contributed to debates over street prostitution, the issuance of local arrest warrants, needle exchanges for intravenous drug users, and health care for aboriginal populations.

A major focus of his recent research has been in fish management. This began with a collaborative project with the Pacific Salmon Commission, in which he and his graduate student developed geometric probability arguments to improve the process for estimating the numbers of adult sockeye salmon migrating up the Fraser River. This work led to his appointment to the Fraser River Sockeye Public Review Board, a ministerial inquiry into so-called missing fish in the Fraser River in 1994. He is now co-supervising (with J. O'Hara-Hines at the University of Waterloo) a Ph.D. student who is investigating estimation formulas for use with newly evolving split-beam echosounding technology.

Fisheries data typically contain large measurement errors. One of his M.Sc. students recently looked at applying the SIMEX method for generating bias adjustment to a nonlinear regression model commonly used in fish stock recruitment. Furthermore, the escalating conservation crisis for coho salmon has prompted Dr. Routledge and a senior coho biologist in the Department of Fisheries and Oceans to study models for predicting extinction probabilities for small, isolated fish stocks.

Other components of his research program include studying the properties of saddlepoint approximations and the mid-p-value, developing new change-point methodology for specific problems arising in physiological threshold phenomena, developing new diversity estimation techniques for use in implementing forest practices codes, and refining mark-recapture techniques for fish and wildlife estimation problems.

Dr. Carl Schwarz studies the dynamics of animal populations and a variety of ecological problems. His research is motivated by real problems encountered by ecologists. Much of his research involves capture-recapture experiments. In these experiments animals are captured, tagged, released and then subsequently recaptured. The pattern of captures and recaptures enables the researcher to estimate survival rates and the number of animals present in the population.

One of his immediate research objectives is to extend a method called the stratified-Petersen estimator which is often used in salmon escapement studies to take account of certain assumptions which are not valid in practice. The estimate of escapement in the Nass river in northern B.C. uses fish wheels to capture, tag, and release fish. Recaptures take place upriver at the Meziadin Dam where all returning salmon must pass through a single fish way. Unfortunately, due to the large volume, it is not possible to examine all the fish, and sub-samples are taken- but, it is not possible to read all of the individual tags. Dr. Schwarz is developing methods to deal with the observed, but unread tag numbers in order to obtain estimates of the number of salmon that originally passed the fish wheels.

He is also investigating the effect of tag reading errors. In a study on Sable island, seals were individually branded as pups and subsequent surveys have used spotting scopes to record the brand numbers of adult seals that have returned to breed. Based upon the observed capture histories, it appears that a substantial number of the brand readings are in error. Surprisingly, no previous work has been done on the effects of tag misread errors upon estimates of survival, catch-ability, and abundance in capture-recapture studies.

Students under Dr. Schwarz's supervision have worked in a number of areas motivated by real world problems. Some recent projects include methods for creel surveys when gear loses efficiency; estimating the number of razor clams on beaches in Haida Gwaii; estimating oyster

densities in the Klahoose First Nation's waters; estimating breeding probabilites for grey seals; and comparing methods of estimating timber volumes for the Ministry of Forests.

Dr. Randy Sitter's research contributions have been primarily in two rather unrelated areas: analysis of complex survey data; and the design of experiments with a specific focus on industrial applications.

In complex surveys, often the sampling design induces a structure to the data which is not independent and identically distributed. Though techniques for variance estimation and confidence intervals do exist, they are often cumbersome to implement, or do not extend to complex designs. It is desirable to have resampling methods which re-utilize the existing estimation system repeatedly, using computing power to avoid theoretical work, that can be applied to such data. Dr. Sitter has made a number of contributions to the development of such resampling methods in this setting. At present he and one of his recently graduated Ph.D. students (C. Wu, now a faculty member at U. Waterloo) are considering development of such methods for cross-classified sampling as is used to estimate the Retail Price Index in the United Kingdom, as well as other countries. This work was motivated by a long-term consulting project which the SCS together with Dr. Sitter have had with the Office of National Statistics in the U.K. More recently, Dr. Sitter has developed (with J. Chen and with C. Wu) empirical likelihood methodology to incorporate complicated auxiliary information into complex survey designs. It is shown that, under stratified multi-stage and other complex designs and that when estimating the total of y when the auxiliary variable x has known mean, the method is asymptotically equivalent to the commonly used generalized regression estimator. Initial investigations suggest better small sample performance and robustness to deviations from a linear relation.

Dr. Sitter has also made contributions to optimal design and combinatorical design. Motivated by applications in the pharmaceutical industry, he developed (with C.F.J. Wu and a M.Sc. student, B. Forbes) a simple two-stage approach to the optimal design of binary response studies. Simulations suggest inferences based on such a procedure are better than a one-stage approach. In the process, many useful theoretical results were established in both one- and two-stage optimal designs in this and more complicated non-linear modeling situations. In many industrial settings, unreplicated fractional factorial (FF) designs are used to investigate the possible importance (in terms of quality) of a large number of factors using only a small number of experimental runs. A common way to choose the best such design is by ranking the design using aberration as a measure, where smaller aberration essentially implies a design is more able to consider interaction effects. Dr. Sitter has extended the notion of aberration to blocked FF designs and obtained minimum aberrations (MA) designs for this common experimental setting (with J. Chen and M. Feder). Together with another of his recently graduated Ph.D. students (D. Bingham, now a faculty member at U. Michigan) he has obtained theoretical results and developed algorithms for obtaining such MA designs in the case of split plot structures and robust parameter experiments.

Dr. John Spinelli is a Senior Biostatistician at the British Columbia Cancer Agency and a Research Advisor to the British Columbia Cardiac Registries. He has been involved in design and analysis of a multitude of research studies at the BC Cancer Agency, St. Paul's Hospital, Vancouver General Hospital and the Ministry of Health. His current projects include risk factors for childhood leukemia, sun exposure as a risk factor for lymphoma, assessing the outcome after coronary interventions (surgery/angioplasty), mortality while waiting for cardiac surgery, early discharge after narcotic overdose and estimating the cost of smoking in British Columbia.

With Dr. Stephens and Dr. Lockhart he is working on problems in goodness-of-fit, particularly for regression models. Current work involves tests of fit for the binomial distribution and binomial regression. A recent project involves the development of tests of fit for grouped continuous data.

With Dr. Dean and Melody Ghahramani, he is working on the development of statistical models for simultaneous modeling of short and long-term mortality after cardiac surgery.

Dr. Michael Stephens, Professor Emeritus, remains very active in research receiving numerous invitations to speak and collaborate both nationally and internationally. He continues to supervise students. He is currently working on a number of projects in goodness-of-fit including: testing time series models with T.W. Anderson and Richard Lockhart, testing Poisson regression models, tests for specific distributions with V. Choulakian and P. Puig, general results for functions of expected values of order statistics with his recent Ph.D. student H. Coronel-Brizio and general consistency results for the Shapiro-Wilk goodness-of-fit statistic.

Dr. Tim Swartz's research interests lie in the field of statistical computing. Most of his work attempts to take advantage of the power of modern computing machinery by developing computationally intensive algorithms to solve statistical problems. A particular area where he has devoted a lot of attention is the integration problem which arises in Bayesian applications as well as other fields in the physical sciences. With M. Evans of the University of Toronto, he is near completion of a research level text on integration that will be published in the Oxford Statistical Science Series.

Dr. Swartz also has interests in certain areas of applied statistics. He has written a series of papers that develop empirical voting indices and is near completion of some modelling work concerning final offer arbitration. He also has written papers involving statistics in sport.

Dr. Larry Weldon's primary area of research is the foundations of statistics - a re-evaluation of the important tools and concepts that are necessary for statisticians and others to use statistical theory effectively. His years of experience with consulting in the health, social and life sciences has broadened his view of the discipline of statistics. He has written two textbooks in statistics which reflect this research, and emphasize logic and conceptual understanding rather than the traditional mathematics of statistics. He is currently writing a book addressing the new role of probability modeling. He has worked for several years on how to revise statistical education in the light of modern technology, and his experience with a statistical education project in Indonesia has been a model for developing his ideas. Dr. Weldon is also interested in the use of applied probability models for studying complex systems, and graphical methods for data analysis and for describing simulation outcomes.

Dr. Julia Wirch's research is in Actuarial Science. Her current work investigates capital adequacy risk measures for insurance asset portfolios. The development of quantitative, objective methods for the determination of the risk factor distributions and risk measurement techniques used in solvency testing and margin calculations is of increasing importance as the risks of insurance companies become more complex.

With Dr. Mary Hardy at the University of Waterloo, Dr. Wirch examined risk measures currently used for insurance regulation, and investigated distortion risk measures which led her to construct the coherent beta risk measure. The coherent beta risk measure satisfies the notion of second order stochastic dominance, an important economic ordering property pertaining to risk aversion, which is not satisfied by the risk measures used in practice.

The significance of this research is in its application to risk management. In financial risk management, the use of coherent risk measures with consistent ordering properties will improve the information available to managers, regulators and shareholders of financial institutions. Two issues adding to the risk of insurers are the increased used of embedded options in insurance contracts and the increased use of derivative securities in insurance fund management. These instruments are often more volatile than traditional insurance products with respect to risk factors. This research has shown how the coherent beta risk measure can be applied to measure the risk in these embedded options.

Dr. Wirch also has research interests in multivariate risk distributions and the application of copulas to obtain marginal distributions. Insurance asset portfolios are often allocated among funds which may be controlled by different fund managers. Determining the risk in each fund is often as important as determining the risk of the total portfolio. A similar decomposition can be done using multiple risk factors such as the interest rate and exchange rate.

Currently, Dr. Wirch is investigating the generalization of static capital requirements to dynamic capital requirements using a characterization of dynamic risk measures developed by Tan Wang (1996).

Appendix B

The Statistical Consulting Service

The Statistical Consulting Service (SCS) is a consulting unit within the Statistics Group at Simon Fraser University formed in 1980 to promote more effective links between academic statisticians and applied researchers. The SCS provides expert statistical advice to individuals involved in data-based research projects, promotes links between the statistical education program at SFU and individuals involved in data-based research, and improves the quality of both data-based research and the teaching of graduate students in statistics.

The SCS has access to a variety of modern computing facilities and software. It has a full-time Director, who is a qualified statistical consultant. All statistical faculty in the Department of Mathematics & Statistics at SFU contribute to the SCS; their combined experience includes a full spectrum of statistical application areas as well as a broad coverage of statistical techniques. SCS staff have contacts to other university resources that can be arranged on a contractual basis.

Typical SCS projects include design of experiments or surveys, sample size determination, suggestion of appropriate software for statistical analysis, provision of advice on graphical data summaries, determination of appropriate inferential techniques, evaluation of study protocols in grant applications, quality assurance and reliability techniques and the offering of short courses. Itemized below are examples of completed projects.

- Modeling the distribution of pulp fibre length.
- Designed experiments in the pulp and paper industry.
- Estimation of variability in the Consumer Price Index.
- Study of ventilation in humans during exercise.
- Effects of mild anesthesia on the thermoregulatory response during cold exposure in humans.
- Career profile of women scientists in B.C.
- Parental decision-making for student recruitment into early French immersion.
- Sediment discharge regimes of B.C. rivers.
- Comparison of diets for salmon nutrition.
- Mark-recapture method of estimating size of a criminal population from police records.
- Analysis of DNA damage in bladder cells.

Appendix C

Students who completed the M.Sc. between 93–1 and 99–3

Year	Semester	Name	Supervisor	Present Occupation
1993	1	Waweru	Lockhart	Statistician, Government of Kenya
	1	Mwangi	Eaves	Statistician, Government of Kenya
	2	Deng	Dean	Ph.D. Computer Science
	2	Zhong	Weldon	Ph.D. Engineering
1994	1	Grunwald	Eaves	U.S. College Statistics Instructor
	1	Yu	Weldon	*Lost to follow-up*
	1	Zhan	Dean	Ph.D. Statistics Waterloo
	2	Kristiansen	Dean	Statistician, ICBC
	3	Hu	Lockhart	*Lost to follow-up*
1995	1	Cheng	Schwarz	Ph.D., Computer Science
	1	Carpenter	Dean	Self-Owned Business
	1	Ma	Eaves	CIBC, Toronto
	2	Rae	Dean	Biostatistician, St. Paul's Hospital
1996	1	Rajwani	Schwarz	Statistician, ICBC
	2	Sun	Schwarz	Sessional Lecturer
	3	Sutherland	Schwarz	Statistician, Health Canada
1997	1	Brownell	Routledge	Statistician, US Marketing Firm
	2	Lui	Swartz	Lecturer, Coquitlam College, Sessional
	2	Kalbfleisch	Sitter	Statistician, Capital One Market Research, VA
1998	1	Taylor	Schwarz	Statistician, UBC
	2	Han	Routledge	Anderson Consulting
	2	Ghahramani	Dean	Statistician, A.T. &T
	2	Thompson	Dean	Biostatistician, U.S. National Cancer Institute
1999	2	Paltiel	Schwarz	UBC Statistics Consulting Laboratory
	2	Zhang	Weldon	Ph.D., Computer Science
	3	Macleod	Schwarz	Anderson Consulting

Students who completed the Ph.D. between 93–1 and 99–2

Year	Semester	Name	Supervisor	Present Occupation
1994	1	Spinelli	Stephens	Faculty, UBC
	1	Coronel-Brizio	Stephens	Faculty, Mexico
1995	2	Banneheka	Routledge	Faculty, Sri Lanka
	2	Tsao	Routledge	Faculty, UVic
1996	2	Perera	Lockhart	Faculty, Sri Lanka
1997	2	Butler	Lockhart	Postdoctoral Fellow
	3	Balshaw	Dean	Biostatistician, Synectics Health Corporation, UBC
1999	1	Bingham	Sitter	Faculty, U Michigan
	2	MacNab	Dean	Faculty, UBC
	2	Wu	Sitter	Faculty, UWaterloo

Appendix D

Graduate Students' Coop Employment

Year	Semester	Student	Employer
1995	3	Jason Sutherland	Health Canada, Ottawa
1996	1	Peter Lui	BC Ministry of Forests, Victoria
	1	Karim Rajwani	Fed. Dept. of Fisheries & Oceans, Nanaimo
	1	Jason Sutherland	Health Canada, Ottawa
	2	Stephanie Brownell	Health Canada, Ottawa
	2	Melody Ghahramani	St. Paul's Hospital, Vancouver
	2	Charles Paltiel	Statistics Canada, Ottawa
	3	Myra Andrews	Statistics Canada, Ottawa
	3	Stephanie Brownell	Health Canada, Ottawa
	3	Hillary Han	Imperial Oil, Calgary
	3	Peter Lui	BC Ministry of Forests, Victoria
1997	1	Hillary Han	Imperial Oil, Calgary
	1	Heidi Kalbfleisch	BC Cancer Agency, Vancouver
	2	Melody Ghahramani	St. Paul's Hospital, Vancouver
	2	Darby Thompson	Health Canada, Ottawa
	3	Heidi Kalbfleisch	Statistics Canada, Ottawa
	3	Darby Thompson	Health Canada, Ottawa
1998	2	Ellen Chan	Statistics Canada, Ottawa
	2	Colin MacLeod	Statistics Canada, Ottawa
	2	Charles Paltiel	Statistics Canada, Ottawa
	2	Greg Pond	Fed. Dept. of Fisheries & Oceans, Nanaimo
	2	Ruihua Yin	Health Canada, Ottawa
	3	Greg Pond	BC Ministry of Forests, Victoria
1999	1	May Lee	BC Ministry of Forests, Victoria
	2	Milena Simic	Health Canada, Ottawa
	2	Wanlin Wei	BC Ministry of Forests, Victoria
	3	Milena Simic	Health Canada, Ottawa
	3	Alex Zhao	Technical University of BC, Surrey

Appendix E

Letters from Doctoral Graduates

The University of Michigan

DEPARTMENT OF STATISTICS
4062 FRIEZE BUILDING

105 SOUTH STATE STREET
ANN ARBOR, MICHIGAN 48109-1285
USA

DEPARTMENTAL OFFICE: (734) 763-3519
FAX: (734) 763-4676

To whom it may concern,

My name is Derek Bingham and I am an Assistant Professor in the Department of Statistics at the University of Michigan, and I was a graduate student in SFU's Department of Mathematics and Statistics from 1995-1999. I am writing with regards to the proposal for the creation of the Department of Statistics at Simon Fraser University. In particular, I am writing to offer my support for this venture and to congratulate the University for recognizing Statistics as a discipline that is unique and different from Mathematics.

In my opinion, there is a perception among statistics faculty at large, and among the students that they advise, that graduate education in statistics is better in a statistics department rather than a joint mathematics and statistics department. While the idea that graduate education in statistics is actually better in a statistics department is arguable, the perception that it is better is evident. By forming a separate department, the Statistics faculty will be able to attract more of the best graduate students.

The new Statistics Department at Simon Fraser will also help attract new high calibre faculty members. As someone who was recently going through the interview process, I can say that the faculty positions in statistics departments were more attractive to me than those in joint departments because I would be judged (e.g., the tenure process) by individuals in statistics only. In a joint department, there exists the possibility that you will be reviewed by members of the faculty who are essentially in a different discipline and may not be able to accurately assess your impact on the field. My feeling is that this opinion is widely held by young researchers in statistics.

Lastly, I should say a few words about the Statistics group at SFU. As a graduate student, I spent alot of time with the Statistics faculty in one capacity or another. Their dedication to their students and to their work was always impressive. The most notable aspect of the group, to me, is the integrity of its members.

In short, forming a new Department of Statistics at Simon Fraser will, in my opinion, allow a good program become even better. I feel that this will allow the University to attract even more high calibre graduate students and faculty members in the area of statistics.

Sincerely,

D. Bingham

Derek Bingham

47.

From gchen@coxbox.math.uregina.ca Fri Jan 14 07:33:14 2000
Date: Fri, 14 Jan 2000 09:33:12 -0600 (CST)
From: Gemai Chen <gchen@math.uregina.ca>
Subject: Re: Separate Department of Statistics
To: lockhart@cs.sfu.ca
X-Status: $$$$
X-UID:

Dear Richard:

I was very glad to hear that you and your colleagues at SFU are working on the creation of a Statistics Department.

As a former student, as a person who has had experience in both studying and working in a Statistics department as well as in a Math and Stats department, I feel certain that what you are doing is good for the statistics discipline to grow, good for the mathematicians to stay more focused on their job, and undoubtedly good for the future of SFU.

Statistics is NOT a sub-discipline of Mathematics. Statisticians use unique principles to guide their work and utilize whatever tools available (including math tools) to get the job done. Recent changes in science and society have expected all statisticians to relate their work to fruitful applications; the number of theorem-proof statisticians, who looked most like mathematicians, is shrinking dramatically. A Statistics Department will provide the most natural environment for the above to happen, and students will find it much easier to choose a discipline which has led many to challenging, enjoyable and financially rewarding jobs.

Best wishes!

Gemai

Dr. Gemai Chen Associate Professor

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Regina, Saskatchewan S4S 0A2 Canada

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6 February 2000
Dr. Ying MacNab

Professor Charmaine Dean
Director of Statistics
Department of Mathematics and Statistics
Simon Fraser University
Burnaby, BC, Canada, V5A 1S6

Dear Professor Dean,

Thank you for informing me that the statisticians at SFU have put forward a proposal for the establishment of a Department of Statistics at Simon Fraser University. I am writing to you to express my support for this important initiative. I also wish to congratulate the University for taking such a significant step forward. By building a Department of Statistics, the teaching, the development, and the application of statistical science can be fully explored.

It was about sixty years ago in 1940 when Professor Harold Hotelling published his historical essay *The Teaching of Statistics*, and later in 1949, his essay on *The place of Statistics in University.* Later, in 1988, both essays were reprinted by the IMS in Statistical Science (Vol 3, No. 1) with in-depth discussion by distinguished discussants, many of them prominent statisticians. Now statistics has been widely recognized as a distinct and fundamental discipline, a science of rapid development and wide application. The number of institutions with Department of Statistics has increased and such a move has proven to be successful and rewarding. Those universities where a Department of Statistics/Biostatistics is firmly established are able to attract students of the highest caliber. Studyinging in a Department of Statistics is particularly important for those who wish to pursue higher degrees in statistics.

The members of the Statistics Group work actively in the field of statistics and have put together a sound program of statistical teaching. I believe that the establishment of a Department of Statistics will bring good prospects for the University and provide an environment where statisticians can be more

49.

focused on their teaching and research work and the future departmental chair can work with fellow statisticians to refine and extend the current programs.

I wish you all the best and success in this endeavour.

Sincerely yours,

Ying MacNab

Changbao Wu, Assistant Professor

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==========

My name is Changbao Wu. I finished my Ph.D. studies in Statistics at Simon Fraser last August and took an Assistant Professorship in the Department of Statistics and Actuarial Science at University of Waterloo immediately after that.

Last Spring, during my job interviews, I had a chance to visit some statistics departments in Canadian universities (UBC, Western Ontario, Waterloo, Manitoba and Carleton) and some others in the United States as well. It was only after those detailed investigations I realized that how solid the statistics program at SFU is. The undergraduate and graduate programs are solid, the faculty members are strong and active.

However, the fact that the statistics program is within the combined Math and Stat department has a tremendous negative impact on this group. Students who consider universities for graduate studies usually believe that the program should be small and weak. As a matter of fact, I almost abandoned the idea of pursuing a Ph.D. at SFU. It puts the program at an unfavorable position for getting best students. It also has an unseenable impact on its graduates when they start looking for jobs. During my four years at SFU, I felt that there were too many struggles in battling for computing power, conflicts for other resources and spaces, delays in decision-making process. The combined department will hurt the Math program less than it does for other programs, unless the department is to be renamed as the Department of Statistics and Mathematical Science.

As a Ph.D. graduate of SFU who benefitted very much from the statistics program, I strongly support the move toward a separate department of statistics. A top statistics department among Canadian universities will be there.

Appendix F: Space-Sharing with Mathematics

A. Space typically used solely for the Statistics and Actuarial Programs.

1. 15 regular offices in the main Math-Stat corridor: 10 for regular faculty; 1 for the Statistics Lab Co-ordinator; 1 for the Director of the Statistical Consulting Service; and 3 for Emeritus professors, sessionals, adjuncts, and visitors.
2. 1 small office, SCB 9651 shared by 3 statistics Ph.D. students.
3. The Statistics Workshop

B. Space currently shared between Mathematics, Statistics and Actuarial Science.

1. 5 regular offices in the main Math-Stat corridor: 1 for the Departmental Assistant; 1 for the Graduate Secretary; 1 for the Chair's Secretary; 1 for the Co-op Coordinator; 1 for the computer technician.
2. 1 larger office for the Chair.
3. 1 storage room.
4. 1 large departmental office, currently occupied by a receptionist and 2 secretaries, but has room for another secretary, with attached photocopy/fax/storage room.
5. 1 Departmental Library.
6. 1 small room with a sink, fridge and microwave; note that the department does not have a common room - this room can just about hold four people standing closely together.
7. 1 large shared graduate student office, K 9501, in which currently 25 students share 20 desks; of these 17 are statistics graduate students. This room also serves as a graduate computer room housing 5 SUN workstations.
8. 1 resource room, K 9509 for seminars, departmental meetings and colloquia.
9. The WCAT Laboratory, K 9514.
10. 1 graduate student computing room opposite to the WCAT Laboratory, K 9512.
11. 1 printer/computer room, TLX 10515.
12. 1 meeting room, TLX 10501.

The renovations required for the reallocation procedure require a modest amount of resources to separate the space between the two new units and at the same time gain a small amount of more useful space. This would be combined with a space- and resource-sharing proposal between the two units and a plan by the university to make available additional space for both units as soon as such is available. Our proposal is for the new Department of Statistics and Actuarial Science to occupy the east end of the main corridor of the current department. This would include:

I. Space for the Statistics and Actuarial Science Program.

1. 15 regular offices allocated as above under item 1 of part A.
2. 1 regular office for a Chair.
3. 1 regular office for a Departmental Assistant.
4. The space currently occupied by the Departmental Library renovated to be the new Statistics and Actuarial Science Departmental office. In doing this renovation a small amount of space could be absorbed into one of the adjacent offices to create a slightly larger office for the Chair.
5. 1 regular office renovated to house the statistics library, and to act also as a coffee/meeting room.
6. The Statistics Workshop.
7. The small office, SCB 9651, to be shared by finishing Ph.D. students.
8. The graduate student shared office, K 9501. A co-operative effort between the two new units will ensure that office-space is made available to all graduate students.

II. Space shared with Mathematics.

1. 2 regular offices in the main Math-Stat corridor for personnel who will work for both new units: 1 for the Co-op Coordinator; 1 for the computing technician.
2. the resource room, K 9509 for seminars, departmental meetings and colloquia.
3. The WCAT Laboratory, K 9514.
4. the graduate student computing room opposite to the WCAT Laboratory, K 9512.
5. the printer/computer room, TLX 10515.
6. the meeting room, TLX 10501.

The above proposal should be justified in terms of its fairness to the Department of Mathematics. In part I, the 15 regular offices in item 1 are already typically used by statistics and actuarial science. The offices for the Chair and Departmental Assistant would be offset by a decrease of one secretarial office in the current department. This office and space for a mathematics departmental library could be recovered by renovations to the current departmental office. The adjacent coffee room and storage room could also be renovated to create more usable space for mathematics, perhaps a common room. This would make sense since presumably the new Department of Mathematics would have only 4 instead of 6 support staff and the present office would be far too large for the smaller unit. If done in an intelligent manner, space could be gained since at present the current departmental office has space for one more secretary than it currently holds. The separate storage room next to the small coffee room might be incorporated as the new smaller department would not need as much storage.

The current shared space which will not be shared by the two units includes the current library, main office, Chair's office, Departmental Assistant's office, graduate secretary's office,

Chair's secretary's office, storage room and small coffee room. The proposal here is equivalent to viewing that, of this space, statistics and actuarial science retains the current library, and three offices, one for a Chair, one for a Departmental Assistant and one other as a library/meeting room, while mathematics retains the rest. In terms of square footage, the new department then obtains one-third of this current shared space.

The above proposal does not solve the current lack of space. If such an approach is adopted, both departments will still be underspaced. For example, even ignoring the expected growth, the new Department of Statistics and Actuarial Science should really have more space for conducting experiments in the Workshop, office space for graduate students and visitors, a meeting room separate from the coffee room, a larger room for the Statistical Consulting Office for client meetings, another office for visitors, an additional computer/printer room and a small departmental library. These do not represent costs of separating the two units, but rather represent current additional space requirements which exist within the Department of Mathematics and Statistics. Similar space requirements could be listed for the Department of Mathematics. We suggest that space for the two units be allocated from the space which will be vacated when departments and faculty are shifted to the new applied sciences building.

Renovations to construct a Main Office for Statistics and Actuarial Science

We propose that the General Office for the new department be located in the present Department of Mathematics and Statistics Library, Room K10542/10544, with offices for the Department Chair and Departmental Assistant located on either side of this office. There would be doors connecting these adjacent offices to the general office.

The General Office would house one full-time and one part-time support staff persons. To optimize the use of the available space, the existing wall between the room and the corridor would be changed into a counter with a sliding grill. Blinds would be added to the windows, and a small storage room for confidential materials would be created in the southeast corner of the office.

We are recommending that all furniture be movable for two reasons. First, we view this as an interim solution for accommodating the new department. Second, we need flexibility while we learn how to utilize the space most effectively.

We wish to point out several undesirable features of this proposed arrangement. The entire south side of this floor can be oppressively hot in the summertime, and K10542/10544 is probably the hottest room of all. In addition, the large conduits seriously impinge on the amount of usable space in this room. Furthermore, the hall outside the proposed general office is narrow and cramped. Finally, the room contains doors that at present open onto an unusable roof area which contains numerous exhaust vents. We urge the university to give high priority to proposals and requests (some of them long-standing) to

1. improve the airflow on the south side of the entire floor,
2. remove the large conduits from K10542/10544,
3. create an attractive, healthy roof-top area, similar to ones in the Multipurpose Complex, and
4. find a more appropriate, long-term home for the new Department of Statistics.

Approximate immediate costs (as discussed with Erik Grafstrom, Manager, Minor Projects, Facilities Management) are as follows:

Item	Approx. Costs
Counter and Grill	$15,000
Communicating Doors	$9,000
Shelving	$10,000
Mailslots	$10,000
Blinds	$15,000
Furniture	$10,000
Confid. Storage	$8,000
Computers, Printer, Fax	$8000
Contingencies	$10,000
Total	$95,000

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Appendix G

Budget

Salary and Operating Expenses

- Chair's stipend.
- Salaries for existing faculty, instructor–statistics laboratory, consulting director. These are currently in place.
- Salaries for a Departmental Assistant, one full-time and one half-time secretary.
- The remainder of the position for David Eaves, a retired Statistics faculty member. We propose that this be reallocated to the new department for use in establishing a permanent Director of the SCS, in keeping with the plans of the ALRP of Mathematics and Statistics.
- Sessional budget. This will include teaching relief for the Chair and one course per year for one other faculty member, as well as sessionals usually required for mounting our programs. The sessional budget will be generated through the normal criteria for allocation of fall-out and overhead-return funding.
- Teaching Assistant budget. We propose that the teaching assistant budget for statistics and actuarial science be taken initially from the budget for the whole department. This will be discussed with the Dean and the Mathematics Chair.
- Non-salary Operating Budget. Supplies, maintenance. We propose that (i) $20K allocated to the SCS and currently in the department's operating budget be moved to the operating budget for the new department, (ii) one-third of the remainder of the operating budget, outside of funds used specifically for the SCS and the CECM, be allocated to the initial operating budget of statistics and actuarial science.

Capital Expenses

- Renovations to the departmental library/Chair's office, former joint general office, new coffee/meeting room.
- Upgrade to undergraduate computing facility. Annual upgrades will be funded through the operating budget.
- Computer and office furniture for Departmental Assistant. Note that office furniture for the secretaries would be transfered from current available furniture for the department's secretaries.
- Photocopier/facsimile/printer for the main office.
- Refrigerator, microwave, kettle, tables and chairs for meeting room.

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