SIMON FRASER UNIVERSITY

OFFICE OF THE VICE-PRESIDENT, ACADEMIC

MEMORANDUM

To: Senate

From: D. Gagan, Chair
             Senate Committee on Academic Planning

Subject: Department of Mathematics and Statistics -
             Curriculum Revisions
             (SCUS Reference: SCUS 97-20)
             (SCAP Reference: SCAP 97-48)

Date: September 16, 1997

Action undertaken by the Senate Committee on Undergraduate Studies and the Senate Committee on Academic Planning gives rise to the following motion:

Motion:

"That Senate approve and recommend approval to the Board of Governors as set forth in S.97 -65, the following changes in the Department of Mathematics and Statistics:

i)   Proposed B.Sc. Major and Honors Degree in Statistics
ii)   Proposed B.A. Major and Honors Degree in Statistics
iii)   Proposed Minor in Statistics through the Arts and Science Faculties"

For Information:

Acting under delegated authority the Senate Committee on Undergraduate Studies approved the following changes:

i)   Change in prerequisite for STAT 403
ii)   Title change for STAT 330 and 350
iii)   Change in number, description and prerequisite for STAT 440

The full report of curriculum revision is available in Secretariat Services for consultation by any Senator. Please contact Bobbie Grant, Senate Assistant at 291-3168 or e-mail bgrant@sfu.ca if you wish to review this material.

Proposal for Major, Honors, and Minor Programs in Statistics

This is a proposal to convert current options within the Mathematics undergraduate program umbrella into separately designated programs in Statistics. At the same time, we are proposing revisions to these programs aimed at improving their relevance to the provincial employment market and their accessibility to a broader range of students.

Rationale

The major impetus for this change is that students have expressed the importance of creating an official "Statistics" designation for the degree. The existing options provide the misleading designation, "Mathematics," on their transcript and diploma. We propose that this deficiency be removed by turning these options into fully separate programs. The programs are already running, but with a different name. The proposal will therefore create no significant new demands on faculty or support staff. Nor will it generate increased demands for space, computing, or library resources.

The existing options have a strong track record. Enrollments have been healthy, and students have been placed in many valuable co-op and post-degree positions. In addition, many of the stronger graduates have enrolled in post-graduate programs. The newly designated programs will build on this strength. Their goals are as follows:

The primary goal of the Major in Statistics is to train students who can contribute to the solution of applied statistical problems in industry, commerce, and government agencies. Graduates are expected to understand the difficulties and general strategies for handling the following components: problem identification, sampling and experimental design, data management, statistical analysis, report generation, and follow-up. Graduates should be well-versed in the more basic, commonly used techniques of sample surveys, experimental design, analysis of variance, and linear and generalized linear modelling. They should also have developed basic practical experience. Upon graduation, they should be fully prepared to work on well-defined components of major projects. With further practical experience, they should be able to assume leadership roles.

The programs are also designed so that stronger graduates, especially those completing an honors in Statistics, should be well-prepared for further graduate education in statistics and related disciplines.

The proposal calls for changes to three sections of the calendar. In order of appearance in the calendar, these are:

I. A new Faculty of Arts program entry (along with deletion of the existing options from the Mathematics entry)

II. A new Faculty of Science program entry (along with deletion of the existing options from the Mathematics entry)

III. Alterations to the course descriptions for three STAT courses.

Full calendar descriptions for this proposal follow. These are very similar to the existing descriptions for the options that they are to replace. Nonetheless, we are taking this opportunity also to make several minor improvements. These changes are described in detail in the following section.

Subsidiary Changes

(1) STAT 402, 410, and 430 have been added to the list of mandatory requirements for the major and honors programs. These courses develop core skills that are essential components of a modern statistician's tool kit.

(2) We are dropping MATH 242 and 252 from the requirements for a major in statistics. MATH 242 focusses on developing skills in formal mathematics. We are training the majority of our Statistics majors for work as applied statisticians. In this work, the formal, deductive reasoning of mathematics plays a less important role than the inductive reasoning of statistics. For this reason, we have removed MATH 242 from the list of mandatory courses for the Statistics Major. However, since formal mathematics plays a key role in developing new statistical techniques and theory, MATH 242 remains a required course in the Statistics Honors Program.

MATH 252 stresses concepts that are rarely used in statistical work, and has therefore been dropped from the list of required courses for both programs.

(3) The upper division auxiliary concentration has been changed to a requirement for a minor in some discipline outside of Mathematics and Statistics. We continue to believe in the importance of advanced training in a discipline to which statistics can be applied. We want our graduates to know enough about an area of potential use to be able to work through real applications, not contrived, textbook problems. For practical reasons, we have changed the former requirement for an auxiliary concentration (to be approved by an advisor in our department). It makes more sense for economists, e.g., to determine the components of an advanced auxiliary concentration in economics than for us to attempt this task. The proposed change to a requirement for a minor will achieve this end. We have also removed proscriptions against using computer science as an auxiliary concentration.

(4) We have removed a loophole in the regulations regarding the use of STAT 301 and 302 (two courses designed for students majoring in other disciplines) to fulfill the faculty requirements for 30 upper division credits in the major or honors program. We have deliberately not proscribed the use of STAT 403 for this purpose, as we anticipate that this new course will develop valuable practical skills in statistics majors as well as students from other programs.

(5) To the honors program course requirements, we have added "MATH 332 (or 339)". These newly-created courses now serve as alternative prerequisites for MATH 438, which will continue to be a required course in the program.

(6) In the honors program, we have reduced the required number of upper-division hours in MATH, STAT, ACMA, and MACM courses from 60 to a more manageable 51. This is more in line with general honors degree requirements in both faculties (50 in Arts, 48 in Science).

(7) We have corrected an outdated reference to ACMA course listings in the Faculty of Arts description of the minor. (Extensive revisions to ACMA courses were not incorporated.) The entries for the two faculties are now identical. We are therefore proposing a minor saving of calendar space by listing the minor program only once, in the Faculty of Science section, with the Faculty of Arts entry reduced to a cross reference.

(8) We are proposing changes to three specific courses, STAT 330, 350, and 440, as explained later in the proposal.

(9) The lower-division computing course requirement has been changed from one of CMPT 101, 102, or 103 to one of CMPT 100, 101, or 102. CMPT 103 is no longer offered, and CMPT 100 prepares students more effectively to take full advantage of modern statistical software packages.

(10) The lists of course requirements have been revised so as to make them conform to standard Calendar formatting.

Further Important Improvements not Included in this Package

In preparing this proposal, we have avoided making any recommendations that would further tax the university's limited resources. This course of action, though necessary in the present climate of restraint, has not been taken lightly. Our review has identified the following key initiatives that we cannot undertake at this time.

(1) We would like to mount a new undergraduate course in data management and the advanced use of statistical computer packages. These skills are in high demand, and we anticipate strong enrollment for such a practical course.

(2) We would like to mount a regularly scheduled course at the advanced-undergraduate/graduate level in modern statistical computation. Of a more specialized nature, this course would train students in this rapidly evolving, highly applicable area of expertise.

(3) We need to develop infrastructure for facilitating practical work in experimental design and sample surveys. An experimental lab facility would permit us to construct more sophisticated and effective opportunities for students to develop memorable experiences in these key aspects of applied statistical work. This facility would, e.g., provide a unique opportunity for students to explore the value of, and practical difficulties associated with, randomization in sample surveys, adaptive sampling schemes, blocking in experiments, and fractional factorial layouts.

(4) We need to develop better communication skills in our students. At the very least, we need to make more persistent demands in existing courses for oral and written presentations. The importance of communication skills is almost universally stressed by employers. We anticipate that the achievement of high standards in this area will become an even greater challenge in the future as increasing numbers of students arrive for whom English is a second language. Nonetheless, such an initiative would impose a substantial commitment of extra faculty and teaching-assistant resources.

Each of these initiatives represents a substantial improvement to the quality of our programs. We shall be looking for opportunities to develop them in the future.

Proposed Entry for the Faculty of Arts Section

Statistics Program

K10512 Shrum Science Centre. (604) 291-3331/3332 Tel, (604) 291-4947 Fax,
http://www.math.sfu.ca Internet

Professors Emeriti
M.A. Stephens BSc (Bristol), AM (Harv), PhD (Tor)
C. Villegas Ing Ind (Uruguay)

Associated Faculty within Department of Mathematics and Statistics
C.B. Dean, Mathematics and Statistics
D.M. Eaves, Mathematics and Statistics
R.A. Lockhart, Mathematics and Statistics
G. Parker, Mathematics and Statistics
R.D. Routledge, Mathematics and Statistics
C. Schwarz, Mathematics and Statistics
R.R. Sitter, Mathematics and Statistics
T.B. Swartz, Mathematics and Statistics
K.L. Weldon, Mathematics and Statistics

Laboratory Instructor
X.Q. Chen BMath (Sichuan), MSc (S Fraser)

Advisor
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(604) 291-4849

The Department of Mathematics and Statistics offers a program of study within the Faculty of Arts leading to the degree of Bachelor of Arts with a major or honors in Statistics. Students interested in a Bachelor of Science degree in Statistics should refer to the *Faculty of Science*.

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.

General Requirements

Students planning to complete a Bachelor of Arts with a major or honors in Statistics must satisfy the Faculty of Arts requirements.

Major

A Bachelor of Arts with a major in Statistics requires completion of 120 semester hours, of which at least 65 semester hours must be taken within the Faculty of Arts and the Department of Mathematics and Statistics. See general regulations in the *Faculty of Arts* section, for further breadth, upper division credit, and other requirements.

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

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 FORTRAN for Science Students

Upper Division Requirements

Mathematics and Computing Science

Students must complete
MACM 316-3 Numerical Analysis I

Probability and 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

Students are also required to complete a minor in another discipline other than mathematics or statistics. The Certificate in Actuarial Mathematics may be used to fulfill this requirement.

Faculty of Arts requirements stipulate that at least three other upper division courses be taken in Mathematics, Statistics, Actuarial Mathematics, or Mathematics/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 fulfill this requirement.

Honors

A Bachelor of Arts with honors in Statistics requires 132 semester hours, of which at least 65 must be taken within the Faculty of Arts and Department of Mathematics and Statistics. See general regulations in the *Faculty of Arts* section for further breadth, upper division credit, and other requirements.

Furthermore, in addition to the above requirements for a major, candidates for an honors degree in Statistics will be required to obtain credit for the following:

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

plus both of
MATH 426-3 Introduction to Lebesgue Theory
MATH 438-3 Linear Algebra

Additional Statistics Requirements

Students must complete both of
STAT 420-3 Non-Parametric Statistics
STAT 460-3 Decision Analysis and Bayesian Inference

Minor

Requirements for students completing a minor program in Statistics are listed under *Department of Mathematics and Statistics, Faculty of Science.*

Extended Minor Program

According to general faculty regulations, an extended minor program must contain the lower division requirements for a major program, plus the upper division requirements for a minor program. For a statistics extended minor, this entails completion of all the course requirements for a minor plus STAT 280 and one of CMPT 100 or 101 or 102. At least seven upper division hours counted toward this requirement must be taken at Simon Fraser University.

Proposed Entry for the Faculty of Science Section

Statistics Program

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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*. 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.

General Requirements

Students planning to complete a Bachelor of Science with a major or honors in Statistics must satisfy the Faculty of Science upper division credit, breadth, and grade point average requirements.

Major

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

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 FORTRAN for Science Students

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

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 fulfill this requirement.

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 fulfill this requirement.

Honors

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

Furthermore, in addition to the above requirements for a major, candidates for an honors degree in Statistics will be required to obtain credit for the following:

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

plus both of
MATH 426-3 Introduction to Lebesgue Theory
MATH 438-3 Linear Algebra

Additional Statistics Requirements

Students must complete both of
STAT 420-3 Non-Parametric Statistics
STAT 460-3 Decision Analysis and Bayesian Inference

Minor

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

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
STAT 270-3 Introduction to Probability and Statistics

and obtain credit for at least 5 of the following courses
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
ACMA 315-3 Credibility Theory and Loss Distributions
ACMA 320-3 Actuarial Mathematics I
ACMA 335-3 Risk Theory
ACMA 345-3 Survival Models

(Students are encouraged to include the core courses, STAT 330 and 350.)