Accreditation of Programs offered by Institutions

2016-08-15

1. Background and Overview

The Statistical Society of Canada has embarked on a program of accreditation of Statisticians in Canada. There are two levels of accreditation. The Professional Statistician (P.Stat.) designation indicates a high level of education and professional proficiency. The Associate Statistician (A.Stat.) designation is for Statisticians who are working towards the P.Stat. designation. The qualifications of A.Stat. and P.Stat. may not be held simultaneously.

The A.Stat. designation indicates that the holder has completed a course of study showing ability and aptitude in statistics (e.g., an undergraduate degree in Statistics), or, in exceptional instances, has otherwise demonstrated an advanced understanding of statistical theory and its application. An A.Stat. designation would be regarded as the entry level requirement for a Statistician practicing in Canada under the direction/mentorship of a P.Stat. (Professional Statistician), or other suitably qualified individuals.

The educational qualifications for an A.Stat. designation are outlined in Appendices A and F of the document entitled *Accreditation of Statisticians by the Statistical Society of Canada*.

There will be many sources of applicants for the A.Stat. designation, and the Accreditation Committee would like to ensure that:

- consistent standards are applied across Canada;
- transparent standards are available so applicants are clear on expectations;
- consistent standards are used for all types of applicants regardless of education route;
- respondent burden should be minimized;
- Accreditation Committee burden should be minimized;

The majority of A.Stat. applicants are expected to be recent undergraduates from statistics programs from Canadian institutions and this proposal is aimed at streamlining applications from this large cohort.

Two models were examined.

- Accreditation of Programs: Under this model, each Department that offers an undergraduate degree in Statistics would submit their entire program to receive accredited status and completing of the degree requirements by a student would be an indication of fulfillment of the educational requirements. Because of differing program requirements across the country, it would be difficult to ensure

consistency across Canada. As well, many students do not complete degree requirements in a consistent fashion across Canada, and many students may not fit exactly within the narrow confines of an accredited program. Institutions that did not offer a full degree program in statistics would be unable to participate.

- Accreditation of Courses: Under this model, a suite of courses would be accredited from each Department. The suite of courses would have common elements to those at other Universities across Canada. Students could complete degree requirements in many different ways and still receive recognition of achievement. Departments with smaller programs could still participate and their students would receive partial credit towards their educational requirements for A.Stat.

The Accreditation Committee felt that the advantages of the latter model, accreditation of courses, were compelling.

The list of courses required to fulfill the educational requirements of the A.Stat. are presented later in this document.

Departments who wish to participate in accreditation will determine which of their institution's courses would be used to fulfill the requirements. For each course that is proposed, copies of the course outlines (and if possible a final exam) will be submitted to the Accreditation Committee. These will be submitted in a single application to the Accreditation Committee.

The Accreditation Committee will review the material. Successful Departments can then use this check list to guide students on the requirements for the A.Stat. and can add entries to their course catalogues identifying such courses.

A complete list of institutions with their lists of accredited courses will be posted on the SSC website for reference by students. Once a suite of courses is accredited, Departments are encouraged to provide to students the list of accredited courses. The following wording may be inserted in academic calendars for accredited educational programs.

> The Statistical Society of Canada has accredited certain courses as partially satisfying the requirements for the Associate Statistician (A.Stat.) designation. Please contact the Department for details. Further information on the Professional Statistician (P.Stat.) and Associate Statistician (A.Stat.) designation is available at http://www.ssc.ca.

A.Stat. applicants from an accredited program will complete a form showing which accredited courses have been taken, the grade level obtained, and a copy of their transcript. It will not be necessary for the student to submit any further documentation on any accredited course. Applicants who use non-accredited courses to fulfill the educational requirements of the A.Stat. will be required to submit course outlines and other supporting documentation.

Applicants from smaller programs may not be able to complete all of the A.Stat. educational requirements from a single institution, but can combine courses from several institutions.

For most undergraduates and masters of statistics programs, the respondent review burden will be minimized. Ph.D. applicants will be deemed to have met educational requirements through formal training. Fulfillment of the A.Stat. educational requirements via degree program(s) will not confer automatic A.Stat. designation. An applicant will need to successfully complete an accreditation application to demonstrate in addition written communication skills with a one-page summary of background and to supply the names of two referees who will be contacted about the applicant's oral communication skills.

Departmental responsibilities for their students are minimized in that there is no need to sign off on any application as the transcript from the institution will be sufficient. Awarding of the A.Stat. designation is by the SSC, not by the Department. This removes much of the potential for a conflict between the Department and the student.

The proposal below has been presented at meetings of program chairs of Departments at the last several SSC annual meetings, and an email request for comment was also sent to all departments across Canada. There appears to be general agreement with the proposal as it stands. In the remainder of the document, the various elements of this proposal will be expanded.

2. Educational requirement for A.Stat.

The A.Stat. designation is intended to indicate that the holder has completed a course of study showing ability and aptitude in statistics (e.g., an undergraduate degree in Statistics), or in exceptional instances, has otherwise demonstrated an advanced understanding of statistical theory and its application. An A.Stat. designation would be regarded as the entry level requirements for a Statistician practicing in Canada under the direction of a P.Stat. or other suitably qualified individual. It is expected that most holders of A.Stat. would work towards obtaining their P.Stat. designation.

Because of the varying programs across Canada, the Accreditation Committee prepared guidelines for formal instruction with a set of course requirements for a professional statistician.

The suite of courses has been broken into a number of areas corresponding to mathematical prerequisites; statistical methodology; computer skills; communication skills; and substantive knowledge in an application area.

Within each area, a number of modules have been identified. It is envisioned that

approximately 16-18 courses would be necessary to fulfill the requirements for the A.Stat. designation of which approximately half would be in Statistics with the remainder providing the mathematical, computation, communication, and breadth requirements. A course is defined as approximately 30 hours of instruction, e.g., a standard thirteen-week course that meets three times a week for 50 minutes. While not every course may cover every topic, it is envisioned that approximately 80% of a module should be covered in a course.

Some students may not graduate with both experimental design and survey sampling courses. Although only one of these courses is required, the committee recommends that both be taken.

Each university will have a minimum standard, a minimum grade for each course. The Accreditation Committee recommends a minimum grade greater than a passing level, e.g., B- (70%), be indicated as suitable level for A.Stat. Compensating indicators of achievement will be reviewed in applications on a case by case basis.

Some courses may be graded on a pass/fail basis. The Accreditation Committee may find one or two such courses acceptable, but is unlikely to accept substantial numbers of such courses.

The textbooks listed are exemplary only to indicate the expected level of instruction, and do not constitute an endorsement by the SSC nor are Departments obligated to use these textbooks.

2.1 Mathematical modules – approximately 3 courses

(a) Calculus I
(b) Calculus II
These modules should cover the standard topics in differentiation, single variable integration, and multivariable integration. These are to a great extent standard topics offered in introductory calculus courses and so little detail is provided here.

(c) Linear Algebra
This module should cover matrix manipulations, vector spaces, singular values, eigenvalues and eigenvectors. These topics are to a great extent standard topics in an introductory linear algebra course.

2.2 Statistical and probability modules

Note that some of these courses may require additional introductory courses in statistics and probability which are usually not counted towards completion of the A.Stat. designation requirements.

The following modules can usually be covered in approximately 7 courses. The first four

modules are core, i.e. all applicants for the A.Stat. designation should have completed the first two topics and at least one of the second two, while the last set of modules is elective.

2.2.1 Mathematical statistics modules – approximately 1 course - required

(a) Distributional theory (moments, transformations, moment generating functions)
(b) Basic distributions (normal, t, chi-square, F, exponential, weibull, uniform, etc)
(c) Relationships among basic distributions
(d) Basic theory of estimation; sufficiency; method of moments; maximum likelihood estimation; basic Bayes estimation; confidence intervals; credible intervals; prediction intervals
(e) Basic theory of hypothesis testing; likelihood ratio tests; chi-square tests;
(f) Basic probability theory; convergence types

These modules should cover the majority of the topics in books such a Hogg and Craig (Introduction to Mathematical Statistics) or Mood, Bose, and Graybill (Introduction to the Theory of Statistics)

2.2.2 Linear Regression module – approximately 1 course – required

(a) Single variable regression
(b) Multiple regression using matrix notation; diagnostics
(c) Model selection; forwards, backwards, stepwise, Cp, AIC, etc.

This is a standard course in regression methods as covered in Kutner, Nachtsheim, Neter and Li (Applied Linear Models) or Kleinbaum, Kupper, and Muller (Applied Regression Analysis and Other Multivariable Methods), or Draper and Smith (Applied Regression Analysis), etc.

2.2.3 Design and analysis of experiments module – approximately 1 course - recommended but not required, but at least one of experimental design or survey sampling must be present

(a) Completely randomized designs
(b) Complete block designs
(c) Latin squares
(d) Incomplete block designs
(e) Split-plot designs
(r) Fractional factorial designs
(g) Response surface designs

These topics should also discuss sample size determination and power determination. There should be practice in both DESIGN and ANALYSIS of

experiments. These are standard topics covered in books such as Montgomery (Design and Analysis of Experiments) or Kuehl, (Statistical Principles of Research Design and Analysis), or Hicks and Turner (Fundamental Concepts in the Design of Experiments), etc.

2.2.4. Survey sampling module – approximately 1 course – recommended but not required, but at least one of experimental design or survey sampling must be present

(a) Simple random samples
(b) Systematic samples
(c) Cluster samples
(d) Two stage sample
(e) Sampling Weights

These topics should cover stratification; ratio and regression estimation; domain estimation; estimates of means, total, proportions, and ratios. These are standard topics in books such as Lohr (Survey Sampling.), Cochran (Sampling Techniques) or Thompson (Sampling), or Levy and Lemeshow (Sampling of Populations: Methods and Applications).

2.2.5. Other statistics modules – approximately 3 courses

The applicant should complete an additional 3 courses that can incorporate a wide variety of topics. One of survey sampling or experimental design may be replaced by an elective, but three additional courses are still required. Some of the potential topics are listed below – this list is exemplary rather than exhaustive – Departments can use other topics with approval from the Accreditation Committee. These are NOT the topic for the substantive area in Section 2.5.

(a) Generalized linear models
Logistic regression; log-linear models; contingency tables

(b) Modern computational methods
Bootstrapping; jackknifing, and other resampling methods

(c) Computational Bayesian methods

(d) Generalized estimating equations

(e) Survival analysis

(f) Data mining

(g) Statistical consulting

(h) Time series

(i) Multivariate methods

(j) Non-parametric methods

(k) Quality control

(l) Data analysis/capstone course
In this course students should take an integrative approach to data analysis using such topics as visualization, model building, model validation, etc.

(m) Econometrics

(n) Actuarial Science courses

(o) Categorical data analysis

(p) Stochastic processes

2.3 Computer skills - (approximately 2 courses)

Students should be able to use the standard productivity tools, be able to use common statistical packages, and should also be able to program non-standard analyses. Many programs integrate these topics through out the undergraduate experience without formal courses in productivity tools or statistical packages.

(a) Productivity tools – word processors; spreadsheets; drawing programs; web usage

(b) Statistical packages
Students should have experience in at least one of S-Plus, R, SAS, SPSS, etc.

(c) Formal computer language
Students should have a basic understanding of programming at the base level using a language such as FORTRAN, C, Basic, Matlab, S-Plus, R, or similar languages.

2.4 Communication Skills – approximately 1 course

(a) Written communication

In some programs, student may take specialized courses in these areas. In other courses, these skills may be integrated into the program over a broad array of courses. For example, some courses in a program may be designated as writing intensive courses. The student should receive substantial feedback to help develop their communication skills.

Some departments may choose not to accredit courses in this area and require students to demonstrate their abilities by submission of written reports directly to the Accreditation Committee with their A.Stat. application.

(b) Oral communication
The A.Stat. applicant's references will be contacted for information about the applicants' oral communication skills and departments do not have to submit courses for accreditation in this area.

2.5 Substantive Area – approximately 3 courses

The student should develop expertise in a substantive area other than statistics.

In many programs, this would be obtained by a three course minor in another area, by two 2-course minors. or by any set of related three courses. Most minors are acceptable except those whose application content may be minimal. Minors in applicable mathematics (e.g. operations research, applied mathematics) and actuarial science are acceptable.

It is envisioned that students may be able to substitute work experience for some or all of these requirements when the final application form for A.Stat. are complete (e.g. a co-op term may be a suitable substitute).

2.6 Example of a Course List

An example of a course list for the fictional University of Canada appears on the following two pages. A blank Word form is available on the SSC website and is to be completed and enclosed with the application for approval or renewal of an educational program.

University of Canada
Department of Statistics

Accredited courses that may be used towards the A.Stat. designation

<table>
<tr><th>Module</th><th colspan="2">Course</th></tr>
<tr><td colspan="3">Mathematics Modules</td></tr>
<tr><td>1. Calculus I</td><td colspan="2">{MATH 101-3 Calculus I OR
MATH 102-3 Enriched Calculus} AND
MATH 103-3 Calculus II</td></tr>
<tr><td>2. Calculus II</td><td colspan="2">MATH 201-3 Calculus III</td></tr>
<tr><td>3. Linear Algebra</td><td colspan="2">MATH 221-3 Linear Algebra AND
MATH 321-3 Advanced Linear Algebra</td></tr>
<tr><td colspan="3">Statistics and probability modules</td></tr>
<tr><td>4. Mathematical Statistics</td><td colspan="2">STAT 301-3 Mathematical Statistics I AND
STAT 302-3 Mathematical Statistics II</td></tr>
<tr><td>5. Linear Regression</td><td colspan="2">STAT 401-3 Linear Models</td></tr>
<tr><td>6. Design of Experiments</td><td>STAT 402-3 Experimental Design and Analysis</td><td rowspan="2">(If only one of STAT 402/403 is taken, the other must be replaced by a course from the list below.)</td></tr>
<tr><td>7. Survey Sampling</td><td>STAT 403-3 Survey Sampling Design and Analysis</td></tr>
<tr><td>8. Electives</td><td colspan="2">Select three from
STAT 411-3 Nonparametric Statistics
STAT 421-3 Methods for Multivariate Data
STAT 431-3 Time Series Analysis
STAT 441-3 Lifetime and Survival Analysis
STAT 451-3 Computational Bayesian Methods
STAT 461-3 Applied Probability Models</td></tr>
</table>

Computer Skills	
9. Computer skills I	CPSC 101-3 Computer Programming I OR CPSC 111-3 Introduction to Computer Systems and Programming
10. Computer skills II	CPSC 112-3 Computer Programming II OR STAT 351-3 Computational Statistical Methods
Communication Skills	
11. Communication skills	ENGL 170-3 Writing and Communication Skills OR ENGL 270-3 Expository Writing
Substantive Area	
12. Course 1	A three-course minor in another area, or two two-course minors, or by any set of related three courses. Most minors are acceptable except those whose application content may be minimal. Minors in applicable mathematics (*e.g.* operational research, applied mathematics) and actuarial science are acceptable.
13. Course 2	
14. Course 3	

Date of Expiration: 8 August 2026.

3. Applying for Accredited Status for Educational Programs

The application must be submitted to the Chair of the Accreditation Committee of the SSC electronically as a PDF file with a separate Word form listing the courses at accreditation@ssc.ca.

3.1 Demonstration of internal support

An application for accreditation of courses or programs is usually sponsored by a Department. The application should have the demonstrated support of at least three faculty within the Department (e.g., cosigning the application), and the support of the more senior administration (e.g., the Dean should also cosign the application). As there is little or no financial costs to accreditation, lack of support by members internal to the Department, or more senior administration, would not be desirable.

3.2 Documentation required

The application for accreditation of courses should consist of a single PDF document with:

a) a covering letter;
b) copy of letter of support from Department and Dean;
c) a checklist showing which courses will be used for which module and the proposed minimum level of achievement expected;
d) copies of course outlines and final exams (if possible);

and the list of courses in separate WORD form.

The education requirements for the A.Stat. designation have been grouped into modules. A module may or may not be equivalent to a particular course offered by a Department. The Department will ensure that their documentation makes it clear which module is covered by which course.

For each module (particularly for the statistical and probability modules), a copy of the official detailed course outline showing topics covered in the course and the textbook used, and a sample final exam (if possible) should be submitted. Some of the courses may not be taught by the sponsoring department, e.g., calculus and linear algebra, computing, or communication skills. In these cases, the Department should review these courses on a regular basis to ensure that they meet the needs of the department.

Departments are requested to set the standards for using a course towards accreditation HIGHER than the minimum standard for a pass at their institution, e.g. a minimum of B- (70%) in each course. The reason for a minimum standard higher than

university minimum is because it does not serve the Statistical Society of Canada well to have students with bare pass representing statisticians across Canada. Applications will be reviewed on a case by case basis, with compensating indicators of achievement being assessed.

As noted earlier, departments may not have a formal course in written communication skills. Alternate mechanisms are available such as final term papers, co-op reports, etc that are reviewed by the department as part of the student's degree program.

The course requirements for a substantive area outside of statistics can also be met in a variety of ways. For many degree programs, this would correspond to a minor. Most minors are acceptable (e.g. minors in operations research, combinatorics, actuarial science, arts, business, engineering, etc would be acceptable). Other alternatives include a co-op work term in lieu of a course, two 2-course minors, work experience in a job that has a substantial statistical component, i.e. roughly four months of work will substitute for one course in a substantive area. A student could also meet this requirement based on work experience after degree completion, say a minimum of a year at a work place in a job that has a substantial statistical component. In these cases, it will be the applicant's responsibility to provide documentation on their A.Stat. application.

3.3 Length of accreditation

Successfully accredited suites of courses shall maintain their status for five years from the date that accreditation was awarded by the SSC.

At the end of the five-year period, a new application should be submitted in full. The resubmission will help Departments avoid drift in the courses and its standards and to update their program as courses change over time.

Suites of courses need not be accredited in lock-step, i.e. application for courses may be submitted at any time, but departments are encouraged to accredit and re-accredit courses together.

3.4 Revoking of accredited status

The Board of the SSC (upon recommendation from the Accreditation Committee) may revoke accredited status at any time. Normally, the Department involved would be invited to make a submission to the Board before such a decision is made.