Accreditation of Statisticians by the Statistical Society of Canada

Approved March 20, 2004, amended June 12, 2005, by the Board of Directors of the Statistical Society of Canada.

1. Introduction

The Statistical Society of Canada (SSC) offers two levels of accreditation, the Professional Statistician (P.Stat.) and the Associate Statistician (A.Stat.). These qualifications are intended to indicate to the broader statistical and non-statistical communities that the holder has achieved a certain level of professional competence in the understanding and application of statistical methods, and maintains a level of ethical practice. The SSC website and a brochure advertise the existence of accreditation to prospective applicants and employers.

A certificate of accreditation level and licensee number are issued to recipients of accredited status. The certificate indicates that the holder adheres to ethical practice, as defined by the SSC Code of Ethical Statistical Practice. The Code is available in a brochure downloadable from the SSC website. The accredited statistician may affix the received designation to his/her list of professional qualifications.

The qualification of A.Stat. is intended to indicate that the holder has completed a course of study equivalent to a major or honours degree in statistics, or in exceptional instances, has otherwise demonstrated an advanced understanding of statistical theory and its application. The qualification of P.Stat. is intended to indicate that the holder has the necessary academic qualifications and a minimum of six years of professional experience in the application of statistics.

SSC Accreditation is for practice in Canada, by a Statistician who is a Canadian citizen or a legal resident of Canada, or has an association with Canada as defined in section 2.4.

2. Implementation of accreditation

There will be two phases for the implementation of accreditation: an initial startup phase, where established professionals will be accredited to form a working group, and an ongoing phase. In the startup phase, a number of P.Stat. applicants will be considered in order to form the working group. The SSC Board will be requested to grant P.Stat. status to these individuals, on the recommendation of an Interim Accreditation Committee. The Initial Accreditation Committee and the Initial Accreditation Appeals Committee will then be formed from the working group. Other potential P.Stat. and A.Stat. applicants will be notified with a general SSC (g-ssc) list email circulation and a posting at the SSC website about the first dates for submission of applications.

2.1 How to apply

To apply for the P.Stat. or A.Stat. qualification, an applicant must complete the official application form available from the SSC website. The applicant must clearly demonstrate fulfillment of the necessary criteria. The applicant must also supply the names of two referees

who may be asked (as decided by the Accreditation Committee in its sole unfettered determination, not subject to appeal) to write letters of support directly to the Accreditation Committee. Applications will be accepted in either French or English.

Completed application forms must be sent electronically to the SSC, in accordance with the instructions provided with the forms at the time of submission. Applications may be submitted at any time, but the Accreditation Committee will normally bring forward recommendations to the SSC Board twice a year, on May 1st and October 1st. When the process is fully established, the corresponding submission deadlines will be February 1st and June 30th respectively, to ensure that applications received by these dates may be properly evaluated for the next Board meeting.

Each applicant will be required to pay an application administration fee as determined by the SSC. There will be no refund if the application is not successful. An applicant who is unsuccessful will receive written feedback from the Accreditation Committee, and may reapply, but no earlier than 12 months after Board consideration of the denied application. The applicant who is unsuccessful may appeal to the Accreditation Appeals Committee within 30 calendar days of the date of the notification letter.

2.2 The Accreditation Committee

The Accreditation Committee makes recommendations to the Board of the SSC about all aspects of accreditation, including each application received.

Normally, the Board will receive recommendations on applications twice a year, at the summer and fall Board meetings. Submissions are encouraged throughout the year. The final approval of the Board is expected to be a formality in the majority of cases. Only under exceptional circumstances will the Board review an individual recommendation. Materials submitted for an application will be kept confidential at all stages of the process.

2.2.1 Initial Accreditation Committee

The Initial Accreditation Committee will exist for a period of four years. The Initial Accreditation Committee will consist of a Chair and twelve P.Stat. members of the SSC, appointed at initiation by the SSC Board from the working group of first P.Stat. members. The slate will be recommended by the Interim Accreditation Committee, and will represent the interests of the Society, the statistical profession, and various areas of statistical expertise. In particular, the slate will represent major subject matter areas, SSC geographic regions, employer sectors (university, government, industry), and English/French language capability.

These first members of the Initial Accreditation Committee shall serve a two year term, with the possibility of one renewal. The intention is that approximately one half of the initial members will be replaced after two years, using the drawing of lots as required. The replacement members of the Initial Accreditation Committee will be elected, in the same manner as for the ongoing Accreditation Committee. A member of the Initial Accreditation Committee may stand for office in the first election of the ongoing Accreditation Committee if (s)he served for only the first, or last, two years of the Initial Committee.

Decisions of the Initial Accreditation Committee are made by majority vote, with the Chair voting only in the case of a tie. The Committee may determine its own procedures for reviewing applications, but in no case shall a recommendation be forwarded to the Board without having been reviewed by at least two members of the Committee.

In the year preceding the election for the Initial Accreditation Committee, the (Past- or Outgoing-) Chair of the Initial Accreditation Committee will serve on the SSC Elections Committee.

The Initial Accreditation Committee will submit a slate of candidates who are P.Stat. members to the(Past- or Outgoing-) Chair for inclusion in the annual SSC elections.

2.2.2 Ongoing Accreditation Committee

The Accreditation Committee consists of a Chair and twelve members of the SSC, chosen to represent the interests of the Society, the statistical profession, and various areas of statistical expertise. In particular, the Committee will represent major subject matter areas, SSC geographic regions, employer sectors (university, government, industry), and English/French language capability. The members must hold the P.Stat. designation, and will be elected by the P.Stat. members of the SSC during the annual SSC elections.

Elected members of the Accreditation Committee shall serve a two year term, with a maximum of one contiguous re-election. The intention is that approximately half of the members will be replaced every two years, with the drawing of lots as required. Decisions are made by majority vote, with the Chair voting only in the case of a tie. The Committee may determine its own procedures for reviewing applications, but in no case shall a recommendation be forwarded to the Board without having been reviewed by at least two members of the Committee.

In the year preceding an election for the Accreditation Committee, the (Past-, or Outgoing-) Chair of the Accreditation Committee will serve on the SSC Elections Committee. The Accreditation Committee will submit a slate of candidates who are P.Stat. members to the (Past- or Outgoing-) Chair for inclusion in the annual SSC elections.

2.2.3 Duties of the (Initial) Accreditation Committee

The Accreditation Committee is the primary body to make recommendations to the Board of the SSC about the accreditation process, and about applications for accreditation. The Committee is responsible to the Board, reporting to the Board twice a year, operating under the following terms of reference:

- to assess applications of individuals for the qualifications of A.Stat. and P.Stat. according to the requirements stated in Appendices A-D, and to make recommendations to the Board on such applications for accreditation;
- to review requests for accreditation by programs (see Appendices E,F) and make recommendations on these requests to the Board;
- to make recommendations to the Board about the accreditation process;
- to produce amendments to accreditation documentation, for consideration and approval

by the SSC Board;
- to provide information to individuals, universities, employers, associations and other interested bodies, as requested by the Board (especially through the maintenance of current accreditation documentation at the SSC website; see Appendix G for the brochure Accreditation of Professional Statisticians in Canada);
- to assist in the planning and provision of services to accredited members, especially in the areas of professional development and ethical statistical practice;
- to nominate slates of candidates who are P.Stat. members for election to the Accreditation Committee and the Accreditation Appeals Committee.

The Accreditation Committee shall furnish a written report at the Annual Meeting of the SSC describing the activities of the Committee in the preceding year.

2.2.4 Vacancies

If a member is convicted of a criminal offense, his/her duty shall be suspended immediately. A member of the (Initial) Accreditation Committee shall cease to hold office: a) if the member resigns the office by written notice to the Secretary of the SSC; b) if the member is determined by a competent authority to be of unsound mind; c) if the member has been convicted of a criminal offense; d) if the member becomes bankrupt or otherwise insolvent; e) on the member's death; f) if the member ceases to hold the P.Stat. designation for any reason. The SSC Board of Directors shall fill any vacancy by appointing a P.Stat. member in good standing to serve for the balance of the unexpired term.

2.3 Accreditation Appeals Committee

2.3.1 Initial Accreditation Appeals Committee

The Initial Accreditation Appeals Committee will exist for a period of four years. The Board of the SSC will appoint at initiation an Initial Accreditation Appeals Committee consisting of the Past-President of the SSC (or, as necessary for certain appeals, the SSC President-Elect or the SSC Public Relations Officer) and six other senior professional statisticians from the working group of first P.Stat. members of the SSC. The term of office for the six members of the Initial Appeals Committee (other than the Chair) will be two years, with the possibility of one renewal. The intention is that three of the members will be replaced after two years, using the drawing of lots as required. The replacement members will be elected, in the same manner as for the ongoing Accreditation Appeals Committee.

2.3.2 Ongoing Accreditation Appeals Committee

In the ongoing phase the Board of the SSC determines the Chair of the Accreditation Appeals Committee, normally the Past-President of the SSC (or, as necessary for certain appeals, the SSC President-Elect or the SSC Public Relations Officer). There will be six other P.Stat. members elected by the P.Stat. Members of the SSC. The term of office for the six members of the Accreditation Appeals Committee (other than the Chair) will be two years, with a maximum of one contiguous re-election. Three members will be replaced every two years, using the drawing of lots as required.

2.3.3 Duties of the (Initial) Accreditation Appeals Committee

The Accreditation Appeals Committee has the following responsibilities:

- to consider appeals by applicants denied a P.Stat. or A.Stat. designation;
- to consider appeals of loss of accredited status due to nonpayment of dues;
- to consider formal complaints against P.Stat. or A.Stat. members alleging professional misconduct, professional negligence, abuse or misuse of the professional designation privilege, or conduct in breach of professional ethics.

The Accreditation Appeals Committee is the arbiter for all appeals involving the accreditation process. The procedures of the Accreditation Appeals Committee are found in Appendix H. A panel consisting normally of the Chair and two members hears each case. Decisions are made by majority vote, with the Chair voting only in the case of a tie.

The Accreditation Appeals Committee shall furnish a written report at the Annual Meeting of the SSC. The report shall maintain the confidentiality of the members affected.

2.3.4 Vacancies

If a member is convicted of a criminal offense, his/her duty shall be suspended immediately. A member of the (Initial) Accreditation Committee shall cease to hold office: a) if the member resigns the office by written notice to the Secretary of the SSC; b) if the member is determined by a competent authority to be of unsound mind; c) if the member has been convicted of a criminal offense; d) if the member becomes bankrupt or otherwise insolvent; e) on the member's death; f) if the member ceases to hold the P.Stat. designation for any reason. The SSC Board of Directors shall fill any vacancy by appointing a P.Stat. member in good standing to serve for the balance of the unexpired term.

2.4 Evaluating the Applications

All decisions, guidelines, and bases of the SSC and its Committees are solely to be determined in their unfettered and absolute discretion, not subject to any external appeal or review of any kind.

An applicant must be a Canadian citizen or legally entitled to work in Canada, or an accredited member of an organization in his/her home country that is the equivalent to the SSC and shares reciprocal relationship with the SSC for the purposes of membership and recognition of professional standards.

The qualifications of A.Stat. and P.Stat. may not be held simultaneously.

The applicant is responsible for ensuring that the materials submitted are sufficient to assess the candidacy. The Accreditation Committee will assess each application on the basis of the information provided. The Committee reserves the right to require additional materials.

The Accreditation Committee and the Accreditation Appeals Committee may access an

applicant's application and PD reports, and documents are not available to anyone else, except by written consent of the member. These documents are stored confidentially at the SSC Office, SSC Office staff who handle accreditation documents will be required to sign a non-disclosure agreement. Although the SSC will use reasonable efforts to keep an applicant's details confidential at all times, the SSC makes no representation or warranty to this effect.

Applicants are advised:

- to ensure that they have permission from their employers for members of the Committee to review the material;
- to use the security features of PDF documents to encrypt sensitive information.

An applicant may nominate up to two members of the Committee who should not see the material, because of confidentiality, conflict of interest, or other reasons.
Members of the Accreditation Committee (or Accreditation Appeals Committee) may declare an inability to review particular applications because of conflict of interest, or other reasons (see section 2.7).

Members of either Committee who review material will sign a nondisclosure agreement in relation to the documents they will review. The reviews will be kept confidential; they will be stored securely. In the case of an overall negative recommendation, the Chair will prepare an edited anonymous version of the reviews which will be given to the applicant as part of the feedback provided in the case of an overall negative recommendation. Such feedback may also be requested by the applicant in the case of a positive recommendation. The Chair's version of a negative review will be kept indefinitely with the application. No one on the Committee(s) other than the reviewers and the Chair will see the reviews, and if there is an appeal to the Board, Board members will sign a nondisclosure agreement.

Note: An applicant may request further confidentiality. In the event that confidentiality requires further safeguards, as determined by the SSC in its sole determination, one or more of the following additional measures may be adopted.

Special Review options:

1. Sensitive materials may be de-sensitized by the replacement of specific numbers with x, y, z, etc.
2. Formal letters of confidentiality may be exchanged.
3. The review of primary written documentation may be replaced by an oral teleconference review, at the expense of the applicant. In such a case, the applicant would submit written testimony from two individuals with an intimate knowledge of his/her work. The two Accreditation Committee reviewers will perform independent teleconference interviews of the applicant and the two referees.

Special consideration will be given to accredited/chartered/certified statisticians from other jurisdictions; common elements between programs will be accepted on a par.

2.4.1 Qualifications for an Associate Statistician (A.Stat.)

An A.Stat. should have the equivalent of at least a major or honours degree in Statistics, or in exceptional instances, have otherwise demonstrated an advanced understanding of statistical theory and its application. A guiding principle is that an effective statistician at any level displays a combination of skills that include but are not exclusively statistical/mathematical. Educational requirements generally require background in the areas outlined in Appendix A; graduates from accredited programs (Appendix E) are deemed to have satisfied the qualifications for an A.Stat.

Applicants should provide evidence of their qualifications in statistics subjects. The evidence can be in the form of a certified academic transcript, with additional information if necessary (e.g., details of individual subjects). Alternatively, a notarized copy of a degree can be provided. The documentation should be submitted in the form of scanned electronic copies, included with the application. A verification of the copies should be provided, supplied by a recognized authority, e.g., a Head of a Department of Statistics.

A successful A.Stat. recipient must be a member of the SSC within 4 months of certification being awarded. A recent A.Stat. recipient is required to establish a mentorship relationship with a P.Stat. advisor, for on-the-job professional interactions. The mentor may work for the same employer, or work in the same application area. An A.Stat. recipient in a remote geographic region may choose a relationship with someone relatively nearby geographically, or with someone further away but in the same area of application.

2.4.2 Qualifications for a Professional Statistician (P.Stat.)

Accreditation as a Professional Statistician (P.Stat.) is based on a combination of formal education in statistics (Appendix A), relevant practical experience (Appendix B), and a demonstration of ethical professional competence (Appendices B-D).

At the time of application for P.Stat. accreditation, a candidate must be a member of the SSC. The candidate must be actively involved in the practice of statistics currently, or have been actively involved in the past.

Holders of the P.Stat. qualification must meet the following requirements:

- educational requirements as outlined for the A.Stat., or a first author publication in a refereed statistical or methodological journal;
- at least six years practical experience in applying statistics at a substantial level together with acceptable evidence of knowledge, competence, and contributions to the subject and its applications; and
- evidence of broad professional experience after attaining the A.Stat. level of qualification.

The Accreditation Committee will be prepared to consider any relevant practical experience. (See Appendix B.) The following list describes the types of experience that would be considered, and is intended to be indicative rather than exhaustive:

- time spent on professional activities (consulting, collaboration, or work with practitioners in a substantial area of application) while performing graduate training; this experience may count for up to three years towards the required six years;
- leading statistical projects requiring a significant amount ofstatistical analysis or modelling;
- undertaking statistical analysis of data and reporting on the results;
- having responsibility for the interpretation and presentation of statistical information;
- designing statistical databases and reporting systems;
- teaching statistics based on practice; work/consulting/collaboration and any resulting teaching of statistics for a field of application;
- statistical consultancy;
- carrying out and implementing research to develop new methods to solve significant applied statistical problems;
- taking responsibility for the design and analysis of statistically based surveys;
- managing a statistics section with work in one or more of the above areas;
- carrying out work generally recognized as having made a significant contribution to the good practice of statistics.

In addition to listing the range of professional statistical experience, candidates must provide evidence of professional competence. Candidates are required to nominate two referees from whom letters may be requested by the Accreditation Committee. Both referees should be in a position to comment on the candidate's work from firsthand knowledge. Preferably, at least one referee should be a statistician with seniority. The Committee may request that the applicant nominate additional referees. If referees are clients (using the word "clients" in the broadest sense of covering all possible recipients of a statistician's work) or professional colleagues who are not statisticians, they may be asked to describe their grounds for assessing the candidate's work. Further documentation may be required in some cases.

The Committee recognizes that it is much easier to assess the competency of an individual who is solely responsible for (statistical) quality. Competency within statistical teams will be more difficult to assess, and applicants should ensure that such teamwork competency is adequately documented.

Claims of experience should be supportable by documented evidence. Candidates must submit copies of at least two pieces of written work. These may be (in-house) technical reports, publications [in (refereed) journals], or extracts from other work, that provide evidence of professional competence and its diversity. Appendix B explains in greater detail how the reviewers will evaluate experience.

Professional Statisticians are required to comply with the SSC Code of Ethical Statistical Practice (Appendix D). The American Statistical Association Code of Ethics adopted in August 1999 provides a full description of ethical conduct for statisticians, and is a useful reference, especially for any work involving a US jurisdiction. The guidelines are available on the web at: http://www.amstat.org/profession/index.cfm?fuseaction=ethicalstatistics . The Ethics Committee that wrote these guidelines also has a web site with some case studies at: http://www.tcnj.edu/~ethcstat/ .

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2.5 Maintenance of Accredited Qualification

The first year accreditation dues for each P.Stat. applicant reviewed and accepted during the set-up of the Initial Accreditation Committees will be collected immediately following notification of successful application. In general, the first year accreditation dues for A.Stat. and P.Stat. members accredited at the June Board Meeting will be 1/2 of that year's annual dues, collected immediately following notification of a successful application; the dues for those accredited at an October Board Meeting will be waived for that year. Accreditation dues for subsequent years will be billed with the annual SSC membership forms.

Members maintain their accreditation qualification with the payment of annual SSC membership fees and the annual accreditation dues to the SSC; submission of the form with past and current fields of expertise and practice, and the form with the past year's record of professional development (PD); and the maintenance of ethical professional competency and practice. Members may affix their accreditation designation to their list of qualifications as long as they maintain their qualification.

The information collected annually about an individual's past and new areas of expertise and practice will be kept in a database posted on the SSC website, updateable by the webmaster. The database will be used for networking. It will be used for strategic planning of course offerings, and assessment of strengths and gaps in the expertise available in Canada. The individual PD information will be stored in a secure location, and accessed only by Accreditation Committee program planners.

With the maintenance of the qualification indicated above, the P.Stat. designation is expected to be for life. It is expected that members maintain their P.Stat. competencies in chosen area(s) of statistical practice. Such competence is a fundamental ethical requirement of professional practice. For the practitioner, the need to maintain competence will provide motivation and opportunities for meeting and networking with other practitioners. Appendix C provides details on professional development.

If a membership is called into question (see Appendix H), the member will be expected to demonstrate maintenance of P.Stat. competencies. Guidelines are provided in Appendix C to assist members in understanding this facet of accreditation. Members should maintain their own records, particularly those on professional development, should they be needed to demonstrate maintenance of competence. The SSC Accreditation Committee will store the annual filings indefinitely.

Accredited qualification is rescinded on cessation of membership in the SSC. An accredited member may choose to terminate accreditation by written notice to the Accreditation Committee, or by not paying annual accreditation dues. Accreditation terminated by the member may be reinstated at the discretion of the Accreditation Appeals Committee; the Committee will take into account temporary interruptions, e.g. absence from Canada, parental leave, illness, etc.

2.6 Disciplinary Issues and Enforcement of Certification Standards

When the SSC receives a formal complaint against an accredited member, the procedures of the Accreditation Appeals Committee (AAC) will apply (Appendix H). The member shall be notified of the complaint. The AAC shall then conduct a preliminary investigation, where deemed necessary as solely determined by the SSC, and possibly a formal hearing. The AAC will decide whether the member should be exonerated, advised about ethical practice, or warned about ethical practice, or whether it should be recommended that accreditation be revoked. If the AAC determines that accreditation should be revoked, it will convey its recommendation to the Board of the SSC. The accredited member may appeal a decision of the AAC to the Board of the SSC within 30 days from the date of the written decision by the AAC.

Accreditation may be revoked by the Board of the SSC if, in the sole opinion of the AAC, an accredited statistician

- has refused or neglected to comply with the provisions of the SSC membership rules, or
- has willfully acted in a manner prejudicial to the interests of the SSC or the statistical profession, including noncompliance with the Code of Ethics, or
- has supplied misleading information in an application for accreditation or maintenance.

2.7 Conflicts of Interest

A member of the Accreditation Committee (AC) or Accreditation Appeals Committee (AAC) who has a conflict of interest with respect to an applicant or case shall declare that conflict of interest, and be absent from deliberations on the applicant or case. Conflicts of interest include (but are not limited to)the following examples:

- the Committee member and applicant or member in the case know one another from the same workplace;
- the Committee member has supervised the applicant or member in the case in a graduate program;
- the Committee member has written a letter of reference for the applicant or member in the previous six years.

A person who has served on the AC shall not sit on the AAC for at least two years after leaving the AC.

An AC or AAC member who has reviewed or participated in a decision about an applicant or case may not be involved in a subsequent appeal of the decision within a five year period of the initial decision.

3. Public information about accreditation

3.1 Registry of accredited statisticians

The SSC maintains a public registry (e.g. a web page) of accredited statisticians. Inclusion in this registry does not represent an endorsement by the SSC. The type of information contained in the listing shall be approved by the Board, but includes the member's name, the level of

accreditation, a postal contact, an email address, an optional link to a personal web page, and up to three areas of past and three areas of current expertise, identified by the member. If a member's accreditation lapses or is revoked, the member's information shall be removed from the public listing within 90 days.

3.2 Member's usage of trademark

An accredited member may indicate the level of accreditation (A.Stat. or P.Stat.) obtained. The member may not state that the designation is an endorsement by the SSC. If a member's accreditation lapses or is revoked, the member must cease usage of the trademark within 90 days.

4. Interpretation

Should a conflict arise between the English and the French version of any accreditation documentation, the Board of Directors shall interpret the documentation in its sole determination.

5. Dissolution of Accreditation Committees

The Board of the SSC may, upon three months notice, dissolve the Accreditation Committee or the Accreditation Appeals Committee.

Appendix A: Educational Guidelines for Accrediting Statisticians

These Educational Guidelines will serve as the non-binding basis for awarding the A.Stat. (Associate Statistician) designation. They are also part of the requirements for receiving the P.Stat. (Professional Statistician) designation.

An A.Stat. should have the equivalent of at least a major or honours degree in Statistics, or in exceptional instances, have otherwise demonstrated an advanced understanding of statistical theory and its application (see Appendix B). Substantial work in developing curriculum guidelines for such programs is underway in the American Statistical Association. Their general guidelines for an undergraduate program in statistics are available on their web site and presented in Appendix F.

In particular: "Effective statisticians at any level display a combination of skills that are not exclusively mathematical. Programs should provide some background in these areas:

- Statistical: Graduates should have training and experience in statistical reasoning, in designing studies (including practical aspects), in exploratory analysis of data by graphical and other means, and in a variety of formal inference procedures.
- Mathematical: Undergraduate major programs should include study of probability and statistical theory along with the prerequisite mathematics, especially calculus and linear algebra.
- Computational: Working with data requires more than basic computing skills. Programs should require familiarity with a standard statistical software package and should encourage study of data management and algorithmic problem solving.

- Nonmathematical: Graduates should be expected to write clearly, to speak fluently, and to have developed skills in collaboration and teamwork and in organizing and managing projects.....
- Substantive area: Because statistics is a methodological discipline, statistics programs should include some depth in an area of application."

The Accreditation Committee recommends that applicants who are not from accredited programs (Appendix E) review the list of core topics below. In creating this list, the Committee is mindful of the observation by Moore (2001, P.5) that with "diminished expectations: we cannot teach a wide audience what we might like to 'cover'. Niss warned against the 'dreaded disease syllabitis' that assesses a course or programme by the length of list of topics". Bryce *et al.* (2001) and Ritter *et al.* (2001) also discuss the undergraduate curriculum for a degree in Statistics.

Some of the topics appear to be graduate level material (e.g., survival analysis, data mining, or neural nets). The decision to include them required careful thought. The Committee agrees with Ritter et al. (2001) "that no student could have studied all the topics....nor could realistic undergraduate programs be constructed to cover every topic....what most employers want are bright individuals who have a good core knowledge of statistics, good computing capability, and good people skills." At the same time, the Committee is mindful of another comment by Moore (2001), who states that "no undergraduate programme is intended to train professional statisticians. For better or worse, statisticians are defined as having at least a master's degree or equivalent experience. Holders of a bachelor's degree may eventually reach this status via on the job training and practical experience, but their degree does not equip them for professional practice." Too many employers think that an honours degree will do as long as the person can run a statistical package without supervision by higher level personnel.

1. Mathematical Background
   - single and multivariable calculus (integration and differentiation)
   - linear algebra
   - matrix algebra
   - linear systems of equations
   - eigenvalues/eigenvectors, singular value decomposition

2. Statistical Background
   - probability theory and stochastic processes
   - distributional theory (e.g., relationships among the standard distributions)
   - estimation and hypothesis testing theory
   - foundations (sufficiency, etc...)
   - methods of moments
   - maximum likelihood
   - general estimating equations
   - bayesian methods
   - core methodology
   - data visualization and exploration
   - single/multiple/logistic regression

- chi square and generalized linear models
- design and analysis of experiments
- single and multifactor designs
- crd, rcb, split plot, repeated measures, fractionation
- design and analysis of surveys
- srs, cluster, multistage sampling designs
- variance reduction: stratification, ratio, regression
- bootstrapping and jackknifing

3. Computational skills
- basic programming skills with procedural languages
- using statistical packages effectively
- databases and data management
- simulation and modelling
- data transfers between different formats (e.g., Excel > SAS > ACCESS)

4. Communication skills
- effective technical writing and presentations
- teamwork and collaboration

5. Specialization (depending upon area of expertise). Some examples are:

Industry/Manufacturing/Engineering
- quality/process control, time series, reliability
- neural nets

Medical
- survival analysis, categorical data analysis
- generalized estimating equations

Business and Management
- multivariate analysis, time series, quality/process control
- data mining

Government
- multivariate analysis, privacy issues, advanced survey sampling

Biology/Ecology
- capture/recapture, Taylor's power law
- principal components, multivariate analysis methods
- randomization tests

Social Sciences
- factor analysis, principal components, survey instrument design

Bryce, G.R, Gould, R., Notz, W.L., and Peck, R.L. (2001). Curriculum Guidelines for Bachelor of Science Degrees in Statistical Science, *American Statistician,* 55, 7-13.

Moore, D.S. (2001). Undergraduate Programs and the Future of Academic Statistics, *American Statistician,* 55, 1-6.

Ritter, M.A., Starbuck, R.R. and Hogg, R.V. (2001). Advice from Prospective Employers on Training BS Statisticians, *American Statistician,* 7, 14-18.

Appendix B: Defining Professional Statistical Experience

What is professional statistical experience? Most agree that a professional statistician designation encompasses a number of duties and responsibilities that differ from those expected of a recent graduate or a junior statistician. Simply stated, the professional statistician should demonstrate greater practical knowledge, experience, and expertise, and should be able to take greater responsibility for all aspects of statistical work. While the specific details for accreditation will depend on the particular job, the following aspects are central to the work of professional statisticians.

The activities that follow have been classified into two broad groupings: core experiences (denoted by "core"), which are essential for all professional statisticians; and specialized experiences, which may be more common in certain disciplines (all others listed).

A P.Stat. should have experience in all of the core group and at least two of the specialized group as appropriate.

1. Knowledge of Statistical Theory

Core knowledge relates to the theoretical aspects of the practice of statistics, normally covered in a college or university statistics degree, but it also includes statistical and contextual knowledge acquired in the workplace. Publication in the statistical literature represents knowledge at a high level and could be used instead of university transcripts to document competency in theoretical knowledge.

2. Application of Statistical Knowledge

The knowledge of statistics is applied in a wide variety of contexts, which necessitates a sound understanding of standard practices, regulatory affairs, and practice of specific skills in the work context. Developing these skills is usually done under guidance or through collaboration; skill is obtained through the application of statistics to provide solutions to businesses, industries, and governments. As a result of this combined knowledge, statisticians are expected to be competent in some of the following activities.

A Data management

- (Core) Experience in data collection and management of data sets; understanding of

database design and maintenance procedures, error control; experience in cleansing of data, data extraction and validation, and archiving of data sets for later use and study.

B Analysis of data based on theory or established computer based methodology

- (Core) Facility in use of computers and software packages in the analysis and dissemination of results; ability to use effectively software packages and utilities to analyze data; and ability to assess the suitability of software products and systems for project purposes.
- (Core) Ability to adapt and apply statistical theory to practical problems, and to select the most appropriate combination of statistical methods within the constraints of the problem at hand; ability to analyze thoroughly the statistical issues of a problem, establish scenarios and select the most appropriate option by comparing strengths and limitations.
- Ability to apply statistical principles and computer technology to plan and design studies with special requirements including operational, financial, and resource constraints; ability to develop designs that are robust against extraneous sources of variation, specify model structures, experimental and observational units, and specify procedures for model development, including correlation structure.
- Ability to develop statistical criteria for design and analysis.

C Expediting solutions to problems

- Ability to adapt statistical theory to practical problems and to further the area of specialization; ability to make practical use of existing theoretical developments, for example, by operationalizing or automating them, so as to extend state-of-the-art statistical procedures to new frontiers.
- Ability to identify areas in statistical programs which would benefit from the application of new techniques or methods; ability to initiate, complete and report on research and/or development projects leading to new or improved methods; ability to acknowledge and report when work leads to a dead end.
- Ability to validate models, through significance testing, resampling, and simulations.
- Ability to develop or adapt methodologies for solving problems; nimbleness in problem solving.

D Project management

- (Core) Ability to conduct research/work and to prepare meaningful summaries to assist in accurate decision making.
- (Core) Ability to understand local culture rapidly and to work within its constraints.
- Ability to develop protocols for experiments or trials, including control procedures; ability to make decisions on what measurements should be taken, their value, and their scale.
- Knowledge of when and how to terminate an unsuccessful trial, and how not to be involved in a trial that does not meet acceptable statistical standards.

3. Directing Statistical Knowledge-based Solutions

- (Core) Ability to determine the client or research needs and to direct the statistical approaches required to meet them; ability to act independently, with well-developed analytical skills and judgment to assess a problem and determine solutions.
- (Core) Ability to specify the objectives, scope, requirements, and limitations of the statistical contributions of a study.
- (Core) Demonstrated command of a specific subject and its state-of-the-art statistical practices within one's organization and outside.
- (Core) Knowledge of the role of the statistics group in relation to the organization, and its products and services.
- Ability to lead a team effectively: 1) coordinate work, taking into account knowledge, abilities, interests, and developmental needs of staff; 2) determine priorities with clients and staff; 3) prepare work plans, monitor progress and, if necessary, redirect activities.
- Ability to take responsibility for the work of others by leading and motivating staff to meet objectives, promoting teamwork and initiative and, when necessary, resolving crises.
- Ability to apply basic principles of project management, and deal with several projects simultaneously.
- For consultancy, ability to define and formulate problems and statistical specifications.

4. Communications Skills

This section relates to communication within the profession and outside, to clients and to the public, and addresses both oral and written skills: reporting the statistical details for other statisticians to follow, conveying subject matter content and general statistical concepts to subject specialists, and conveying essential statistical concepts and results to a general readership.

- (Core) Ability to communicate effectively, orally and in writing: ability to convey ideas to achieve understanding and acceptance; to give information effectively and influence others; to express ideas accurately and effectively; to understand information, questions, and instructions; to be clear, direct, easily understood, concise, to the point, logical, informative, and complete; and to use appropriate vocabulary, flow, and delivery.
- (Core) Ability to explain statistical concepts, methods, and their benefits to non-statisticians, to clients and members of the general public.
- At the expert level, as an editor, or a member of an editorial board, ability to take responsibility for setting standards for reporting statistical information.

5. Leadership and Managerial Skills

The activities referred to in this section include the administrative supervision of staff; representing the statistical group to upper management and external clients/agencies; promoting the use of statistics; managing resources; and securing funds.

- (Core) Ability to promote the value of statistics to an organization, management, clients, and subject-matter colleagues, industry, and business.

- Assumption of responsibility for supervising professional statisticians and mentoring new graduate statisticians.
- Ability to coach and lead team(s) with mutual exchange to obtain a feasible strategy for a business case.
- Demonstrated supervisory responsibilities and capacity to handle and resolve crises, should they occur.
- Ability to prepare and lead workshops.
- Experience as a strategist with a bottom-line impact on the organization, such as helping the organization to gain a competitive advantage.
- Experience in recruiting resources for projects.
- For statistical consultancy, ability to define problems and statistical specifications; to establish contracts, costs, and fees; to market services and build a client base; to demonstrate good interpersonal skills; to balance cost, time, and quality; to establish schedules and manage projects.
- In management, ability to write (research) proposals and (grant) applications for funding; to budget (research) projects; to demonstrate solid decision-making and risk assessment.

6. Personal Suitability

- (Core) Ability to work with clients, fellow researchers, colleagues, and staff.
- (Core) Ability to develop and maintain effective working relationships.
- (Core) Adherence to a code of ethics and good statistical practices.
- (Core) Effective representation of an organization and the statistical profession.
- (Core) Honest and proper conduct at all times, in accordance with generally accepted standards: being trustworthy, dependable, mature, adaptable, and flexible; demonstrating integrity and sound judgment.
- Seeking to be influential, innovative, an originator, proactive, self-motivated, independent, complete, and comprehensive.

The above Professional Experience Guidelines will serve as a non-binding basis for awarding the Professional Statistician (P.Stat.) qualification.

Appendix C: Guidelines for Professional Development

Members maintain their accreditation qualification with the payment of the annual fee to the SSC; submission of the form with past and current fields of expertise and practice, and the form with the past year's record of professional development (PD); and the maintenance of ethical professional competency and practice.

The information collected annually about an individual's past and new areas of expertise and practice will be kept in a database posted on the SSC website, updateable by the webmaster. The database will be used for networking. It will be used for strategic planning of course offerings, and assessment of strengths and gaps in the expertise available in Canada. The individual PD information will be stored in a secure location, and accessed only by Accreditation Committee program planners.

With the maintenance of the qualification indicated above, the P.Stat. designation is expected to be for life. It is expected that members maintain their P.Stat. competencies in chosen area(s) of statistical practice. Such competence is a fundamental ethical requirement of professional practice. For the practitioner, the need to maintain competence and the availability of the database will provide motivation and opportunities for meeting and networking with other practitioners.

Individual practitioners will take responsibility for deciding what activities are most timely and relevant for maintaining their competence. Thus, there will be no official list of activities that qualify and no regular review of performance.

In the case of an A.Stat. designate, a filing of PD information will be mandatory for the granting of the P.Stat. designation.

Guidelines1. A professional development activity should be relevant to the educational requirements of an area of statistical practice (e.g., biostatistics, financial statistics, industrial statistics, sample survey statistics). The practitioner will ordinarily decide if the activity is relevant. Such decisions will often be subject to an employer's approval, and an A.Stat. may wish to seek the advice of a mentor.

2. Professional development (PD) will usually be of two types: formal and informal. Formal activities will include attendance at organized events such as meetings, seminars, and other programs with relevant content. Some examples are:

- sessions or workshops at annual meetings of the SSC or other(inter)national statistical societies;
- sessions or workshops at meetings, seminars, and other programs with subject matter content in the practitioner's area of application;
- seminars, courses, workshops, and meetings held by regional statistical associations (e.g., Ottawa, Manitoba, Montreal, Southern Ontario, ASSQ, TABA);
- courses sponsored by statistical software manufacturers;
- employer sponsored in-house training programs.

Informal activities include all others that contribute to continuing professional development such as private reading, study, or research in the area of practice. In the case of an A.Stat., time spent in communication with a mentor who is a P.Stat. qualifies as an informal professional development activity.

3. Practitioners' areas of practice may change over time as professional interests and activities change. However, it is the practitioners' responsibility to ensure appropriate expertise in at least one major area of statistical practice. In cases of change, it is particularly important to maintain appropriate documentation of how professional levels of competence have been developed and maintained in the new area. If in doubt, the practitioner is encouraged to contact the Accreditation Committee for additional guidance.

4. It is suggested that a practitioner maintain a personal record of attendance at formal activities as well as a log of informal activities. Members are asked to submit annually the current fields of expertise and practice, and past year's record of PD. If a membership is called into question, the member will be expected to demonstrate maintenance of their P.Stat. competencies. It is suggested that professional development records be maintained to demonstrate a maintenance of competence, should the need ever arise.

Appendix D: The Statistical Society of Canada Code of Ethical Statistical Practice

http://www.ssc.ca/main/about/accreditation/ethics_e.pdf

Appendix E: Accrediting Educational Programs

Institutions (universities, colleges, and others) will submit “programs" for consideration by the Accreditation Committee, and approval by the Board of the SSC. Students who successfully complete accredited programs with a specified level of performance would automatically receive the A.Stat. designation.

The package brought for approval will include detailed course outlines, sample assignments, sample examinations, and a written statement on how the program meets the educational guidelines. For an initial submission, there should be an indication of the length of time that the program has been operative. Accredited programs will be reviewed every five years.

Programs proposed for accreditation should follow the American Statistical Association guidelines on undergraduate programs in statistical science, as given in Appendix F.

Appendix F: American Statistical Association

Curriculum Guidelines for Undergraduate Programs in Statistical Science (quotes are used below in the skills needed area to indicate minor modifications from: http://www.amstat.org/education/index.cfm?fuseaction=Curriculum_Guidelines).

The American Statistical Association endorses the value of undergraduate programs in statistical science, both for statistical science majors and for students in other majors seeking a minor or concentration. This document provides guidelines for development of curricula for such programs.

Principles

Undergraduate programs in statistics are intended to equip students with quantitative skills that they can employ and build on in flexible ways. Some students will plan graduate work in statistics or other fields, while others will seek employment after their first degree. Programs should be sufficiently flexible to accommodate varying goals. Undergraduate programs are not intended to train professional statisticians, though some graduates may reach this level through

work experience and/or further study.

Institutions vary greatly in the type and intensity of programs they are able to offer. The ASA believes that almost all institutions can provide a level of statistical education that is useful to both students and employers. We encourage flexibility in adapting these guidelines to institutional constraints. In many cases, statistics minors or concentrations for quantitatively oriented students in fields such as biology, business, and behavioral and social science may be more feasible than a full statistics major.

Undergraduate statistics programs should emphasize concepts and tools for working with data and provide experience in designing data collection and in analyzing real data that go beyond the content of a first course in statistical methods. The detailed statistical content may vary, and may be accompanied by varying levels of study in computing, mathematics, and a field of application.

Though statistics requires mathematics for the development of its underlying theory, statistics is distinct from mathematics and uses many nonmathematical skills; thus, the curriculum must be more than a sequence of mathematics courses. It is essential that faculty trained in statistics and experienced in working with data be involved in developing statistics programs and in teaching or supervising courses required by the programs.

Skills Needed

Effective statisticians at any level display a combination of skills that are not exclusively mathematical. Programs should provide some background in these areas:

- Statistical Graduates should have training and experience in statistical reasoning, in designing studies (including practical aspects), in exploratory analysis of data by graphical and other means, and in a variety of formal inference procedures "at both univariate and multivariate levels".
- Mathematical Undergraduate major programs should include study of probability and statistical theory along with the prerequisite mathematics, especially calculus and linear algebra. Programs for non-majors may require less study of mathematics. Programs preparing for graduate work may require additional mathematics.
- Computational Working with data requires more than basic computing skills. Programs should require familiarity with a standard statistical software package and should encourage study of data management and algorithmic problem-solving.
- Nonmathematical Graduates should be expected to write clearly, to speak fluently, and to have developed skills in collaboration and teamwork and in organizing and managing projects. Academic programs often fail to offer adequate preparation in these areas.
- Substantive area Because statistics is a methodological discipline, statistics programs should include some depth in an area of application "and integration of statistical principles in an applied context".

Curriculum Topics for Undergraduate Degrees in Statistical Science

The approach to teaching the following topics should:

- Emphasize real data and authentic applications.
- Present data in a context that is both meaningful to students and indicative of the science behind the data.
- Include experience with statistical computing.
- Encourage synthesis of theory, methods, and applications.
- Offer frequent opportunities to develop communication skills.

Statistical Topics:

- Statistical theory (e.g., distributions of random variables, point and interval estimation, hypothesis testing, Bayesian methods).
- Graphical data analysis methods.
- Statistical modelling (e.g., simple, multiple, and logistic regression; categorical data; diagnostics; data mining).
- Design of studies (e.g., random assignment, replication, blocking, analysis of variance, fixed and random effects, diagnostics in experiments; random sampling, stratification in sample surveys; data exploration in observational studies).

Mathematical Topics:

- Calculus (integration and differentiation) through multivariable calculus.
- Applied linear algebra (emphasis on matrix manipulations, linear transformations, projections in Euclidean space, eigenvalue/eigenvector decomposition and singular value decomposition).

Probability:

- Emphasis on connections between concepts and their applications in statistics.

Computational Topics:

- Programming concepts; database concepts and technology.
- Professional statistical software appropriate to a variety of tasks.

Non-mathematical Topics:

- Effective technical writing and presentations.
- Teamwork and collaboration.
- Planning for data collection.
- Data management.

Electives:

There are many electives that might be included in a statistics major. Since resources will vary

among institutions, the identification of what will be offered is left to the discretion of individual units.

Practice:

When possible, the undergraduate experience should include an internship, a senior-level "capstone" course, a consulting experience of some kind, or a combination of these. These and other opportunities to practice statistics should be included in a variety of venues in an undergraduate program.

Appendix G: Accreditation of Professional Statisticians in Canada

http://www.ssc.ca/main/about/accreditation/accreditation_e.pdf

Appendix H: Procedures of the Accreditation Appeals Committee

The Accreditation Appeals Committee (AAC) has the following responsibilities:(a) Considering appeals by applicants denied a P.Stat. or A.Stat. designation.(b) Considering appeals of loss of accredited status due to nonpayment of dues.(c) Considering a formal complaint against a P.Stat. or A.Stat. alleging professional misconduct, professional negligence, abuse or misuse of the professional designation privilege, or conduct in breach of professional ethics.

All appeals or complaints must be in writing and must contain specific particulars about the decision being appealed and/or the alleged infraction.

Process:

Preliminary Investigation: When an appeal of type (a) or (b) is received, the Chair of the AAC will notify the Chair of the Accreditation Committee, provide a copy of the appeal, and then conduct a preliminary investigation. The Chair of the AAC may decide either

1. To return the appeal to the Accreditation Committee within 14calendar days of receiving the appeal. If the Accreditation Committee confirms its original decision, the Chair of the AAC will inform the appellant of the confirmation of the original decision (providing the appellant with the opportunity to withdraw the appeal, with a signed declaration of withdrawal). If there is no withdrawal, then a formal hearing will be convened as outlined below.

or

2. To convene a formal hearing (see details below).

When a complaint of type (c) is received, the Chair of the AAC will first notify the complained, provide a copy of the complaint, and then conduct a preliminary investigation. The Chair of the AAC, or another member of the AAC chosen by the Chair, will attempt an informal resolution. During the informal resolution process, the Chair of the AAC, or the chosen member of the

AAC, will serve not as an advocate for either side, but rather as a mediator in trying to resolve the complaint. The result of the informal resolution may be a withdrawal of the complaint, or a decision by the complained to relinquish accreditation status. Whatever the resolution, both parties should sign to agreement on the resolution of the complaint. If an informal resolution cannot be reached, a formal hearing will be convened. The member of the AAC who attempted mediation may not serve on the appeals panel for the formal hearing.

Formal Hearing:

The hearing will be heard by a panel of three members of the AAC, none of whom has a conflict of interest, or has attempted mediation in the case: the Chair of the AAC (or substitute), who will chair the panel, and two other members of the AAC, chosen by the Chair of the AAC. Within seven days of the decision to convene a hearing, the [appellant, for (a) and (b); and both the complained and complainant, for (c)] will be notified of the composition of the hearing panel. Within 14 days of the decision to convene a hearing the appellant/(complained, or complainant) will notify the President of the SSC of specifics of any apprehension of bias in the panel. The President of the SSC may choose other members of the AAC to replace any, or all, of the panel's members.

A formal hearing will be convened within 35 calendar days of the decision to convene such a hearing; the appellant/(complained and complainant) will be notified of the date and time of such a hearing. Any party interested in the proceeding (as solely determined by the SSC, but for illustrative purposes only, is likely to include the appellant, and/or appellant's representative; the complainant; a witness of the complaint; and the complained, and/or the complained's representative) must prepare a written submission and ensure that the Chair of the hearing panel receives it at least seven days prior to the hearing. The Chair of the hearing panel will ensure that the members of the panel and all parties involved in the case receive all written documentation at least three days prior to the hearing.

The hearing may be conducted in person or by teleconference. The hearing for cases of types (a) and (b) will usually be held by teleconference, while those of type (c) will usually beheld in person. There should be unanimous consent for the mode of a hearing by the hearing panel and all parties with a declared interest in the appeal or complaint. If unanimous consent cannot be reached, the panel has the final authority. All members of the hearing panel must be present. If a party with a declared interest does not attend the appeal, the hearing panel may proceed in that party's absence. All parties with a declared interest may make oral presentations. The appellant and the complained may call and cross-examine witnesses, and put forward explanation and defence.

The hearing panel will consider all written documentation, the written submissions, and the oral arguments. At the conclusion of the hearing, the hearing panel will have 7 calendar days to make a decision.

In cases of type (a), the denial of accreditation status may be confirmed or the credential of A.Stat. or P.Stat. may be recommended to the Board.

In cases of type (b), a member's designation may be lost, or the designation may be reinstated after payment of the appropriate fees.

In cases of type (c), the complaint may be dismissed (the complained exonerated), the complained may be advised about sound ethical practice, the complained may be warned about sound ethical practice, or it may be recommended to the Board of the SSC that the complained member's designation of A.Stat. or P.Stat. be revoked. The record of any advisements, warnings, or revocation of designation will remain on a member's file for at most 5 years.

The decision of the hearing panel will be communicated in writing to all interested parties.

A member may appeal in writing the decision of the hearing panel to the Board of the SSC within 30 calendar days of the written decision. The Board will review the documentation submitted to the hearing panel in coming to a final decision.

Note: All notifications will be sent by registered mail or express post or other means that has a confirmation of receipt upon delivery.