

## SCIE 4900 Medical Sciences Honours Research & thesis

CREDIT HOURS: 6

The course is required of, and restricted to, students in the Medical Sciences Honours program. Students conduct a research project in the laboratory or research site of an approved faculty member and attend weekly meetings of the class. Students have the flexibility to undertake their research in a department of their choice, subject to the approval of the Honours committee. Class participation, an interim report, a written thesis, an a presentation at the Annual Medical Sciences symposium are required for completion.

NOTES: Credit can only be given for this course if X and Y are completed in consecutive terms and partial credit cannot be given for a single term.

PREREQUISITES: An approved research project supervisor (as determined by the Medical Sciences Honours Committee) and minimum average GPA of 3.3 calculated from the following core courses: BIOL 2020.03, BIOL 2030.03, PHYL 2041.03, PHYL 2044.03, MICI 2100.03, BIOC 2300.03, SOSA 2503.03, PHIL 2810.03, PHAC 3001.03, MICI 3115.03, ANAT 3010.03, PATH 3000.03, CHEM 2401.03 and CHEM 2402.03. At the time of application, you are unlikely to have completed all of the listed core courses; therefore you GPA of the completed courses at the time of application must be equal to or greater than 3.3 (B+ average). A GPA of at least 3.3 is also required for all core courses at the time of graduation.

# Statistics

Location:

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## Introduction

It doesn't matter if you want to design computer games, study the safety of nuclear power plants, analyze the stock market or conduct political polls: scientists of all kinds work with numbers to measure and explore the world. That's where statistics comes in. Statistics is the study of the collection, organization, analysis, interpretation and presentation of data. Extracting knowledge from data helps us plan for the future and improve our quality of life.

The Dalhousie Statistics program is the only program in the Maritimes that offers a full range of undergraduate and graduate programs. Our undergraduate courses are also approved by the accreditation committee of the Statistics Society of Canada, so that our graduates can apply for the Associate Statistician designation.

Statistics makes a great undergraduate degree with wide applicability and is an essential component of any program in the sciences or social sciences.

## Degree Programs

The Department of Mathematics and Statistics offers the following degree programs in Statistics

- BSc or BA (120 credit hour) Honours (Concentrated)\*
- BSc or BA (120 credit hour) Combined Honours\*
- BSc or BA (120 credit hour) Major\*
- BSc or BA (120 credit hour) Double Major\*
- BSc or BA (90 credit hour) Minor in Statistics
- Minor in Statistics

\* May be combined with Minor programs from other disciplines

Departmental requirements for each degree program can be seen by following the links in the menu to the right.

In addition to departmental requirements, students must satisfy the requirements outlined in the [Academic Regulations](#) and the [College of Arts and Science Degree Requirements](#) sections. Students are advised that a number of requirements differ for the BA and BSc degrees.

A student is governed by the academic regulations in place at the time of initial enrolment, as long as the degree is completed within the time permitted (10 years). Subsequent changes in regulations shall apply only if the student so elects. Students applying the old academic regulations should consult the calendar of the appropriate year.

Students should plan their programs of study carefully and are strongly encouraged to do so in consultation with a Statistics undergraduate academic advisor.

## Staff

### Dean

Moore, C., BA (Hons), PhD (Cambridge), Professor (Psychology)

### Chair of the Department

Janssen, J. C., MSc (Eindhoven), PhD (Lehigh)

### Director of Division

Dowd, M., PhD (Dalhousie)

### Faculty Advisor

Smith, B., MSc (Calgary), PhD (Berkeley), Honours and Undergraduate Advisor, Statistics

Kenney, T., BA (Hons), MMath, PhD (Cambridge), Honours and Undergraduate Advisor, Actuarial Science

### Professor Emeritus

Field, C. A., MSc, PhD (Northwestern)

Hamilton, D. C., MA, PhD (Queen's)

### Professors

Bielewski, J., MA, PhD (Texas A & M), jointly with Biology

Dowd, M., PhD (Dalhousie)

Gu, H., MSc (Peking), PhD (Hong Kong)

Mills-Flemming, J., MSc (TUNS), PhD (Dalhousie), Graduate Advisor Statistics

Smith, B., MSc (Calgary), PhD (Berkeley)

Susko, E., PhD (Waterloo)

Thompson, K., MSc (Manchester), PhD (Liverpool) (CRC Chair), jointly with Oceanography

Zhao, Y., MSc (Western Kentucky), PhD (UBC), cross appointment with Management

### Associate Professors

Beiko, R., PhD (Ottawa), cross appointment with Computer Science

Herbinger, C., MSc (Paris), PhD (Dalhousie), jointly with Biology

### Assistant Professors

Kenney, T., BA (Hons), MMath, PhD (Cambridge), cross appointment with Mathematics

### Lecturer

Sarhan, A., PhD (Ghansk)

### Postdoctoral Fellow

Auger-Methe, M., PhD (Edmonton)

Aeberhard, W., PhD (Geneva, Switzerland)

### Adjunct Professors

Gupta, R. P., PhD (Delhi) Dalhousie

Millar, M., PhD (Dalhousie) MSVU

Sneddon, G., PhD (Dalhousie) MSVU

Wang, X., PhD (Waterloo) St. FX

### Statistical Consultant

Wang, H., PhD (Ottawa)

Please refer to the entry for the [Department of Mathematics and Statistics](#) for a full listing of the members of the Department and information on other programs offered by the Department.

## BSc or BA (120 credit hour) Concentrated Honours in Statistics

Students who want a challenging program resulting in comprehensive knowledge of both theoretical and applied Statistics may want to enroll in an Honours program. Students interested in eventually pursuing graduate studies are particularly encouraged to consider Honours. Honours students must write a research-based Honours thesis. The research thesis and the Honours Qualifying Examination requirement are satisfied through completion of STAT 4950.03.

### **Admission to Honours**

Students must apply for admission to Honours programs. Students considering Honours in Statistics should consult with a Statistics Honours Advisor early in their studies.

### **Departmental requirements**

In addition to fulfilling the requirements outlined in the [Academic Regulations](#) and [College of Arts and Science Degree Requirements](#) sections, students in a BSc or BA Concentrated Honours program in Statistics must complete the following courses:

#### **1000 level**

- MATH 1000.03: Differential and Integral Calculus I/MATH 1010.03: Differential and Integral Calculus II or MATH 1215.03: Life Sciences Calculus/MATH 1010.03: Differential and Integral Calculus II
- STAT 1060.03: Introductory Statistics for Science and Health Sciences<sup>1</sup>
- CSCI 1100.03: Computer Science I/CSCI 1101.03: Computer Science II<sup>2</sup>

#### **2000 level**

- MATH 2001.03: Intermediate Calculus I
- MATH 2002.03: Intermediate Calculus II
- MATH 2030.03: Matrix Theory and Linear Algebra I
- MATH 2040.03: Matrix Theory and Linear Algebra II or MATH 2135.03: Linear Algebra
- STAT 2060.03: Introduction to Probability and Statistics
- STAT 2080.03: Statistical Methods for Data Analysis and Inference<sup>3</sup>
- At least two additional statistics<sup>4</sup> courses at or above the 2000 level (6 credit hours)

#### **3000 level**

- STAT 3340.03: Regression and Analysis of Variance
- STAT 3350.03: Design of Experiments
- STAT 3360.03: Probability
- STAT 3380.03: Sample Survey Methods
- STAT 3460.03: Intermediate Statistical Theory
- At least two mathematics<sup>5</sup> courses at the 3000 level (6 credit hours)

#### **4000 level**

- STAT 4066.03: Advanced Statistical Theory I
- One of STAT 4350.03: Applied Multivariate Analysis, STAT 4390.03: Time Series Analysis and STAT 4620.03: Data Analysis
- STAT 4950.03: Honours Research Project

<sup>1</sup>The requirement to take STAT 1060.03: Introductory Statistics for Science and Health Sciences may be waived for students entering the program in their second year.

<sup>2</sup>Math 3210 or STAT 2450 may be taken in place of CSCI 1101.

<sup>3</sup>Some students may take STAT 2080.03 in the first year of their degree program.

<sup>4</sup>Statistics courses are any courses listed or cross-listed as STAT. The following math courses also count as credit hours in statistics:

- MATH 2001.03: Intermediate Calculus I
- MATH 2002.03: Intermediate Calculus II
- MATH 2030.03: Matrix Theory and Linear Algebra I
- MATH 2040.03: Matrix Theory and Linear Algebra II

<sup>5</sup>The 3000 level mathematics courses can be chosen from the following list, and count toward the required credit hours in statistics:

- MATH 3045: Curves and Surfaces
- MATH 3080: Introduction to Complex Variables
- MATH 3120: Differential Equations
- MATH 3140: Introduction to Wavelets
- MATH 3210: Introduction to Numerical Analysis
- MATH 3260: Applied Differential Equations
- MATH 3300: Optimization
- MATH 3330: Applied Graph Theory
- MATH 3400: Classical Game Theory
- MATH 3500X/Y.06: Intermediate Analysis
- MATH 3501: Intermediate Analysis I
- MATH 3502: Intermediate Analysis II
- MATH 3900: Financial Mathematics

## **BSc or BA (120 credit hour) Combined Honours in Statistics and another subject**

Students who wish to study Statistics in conjunction with another subject may wish to pursue a Combined Honours degree program. The other subject may be any discipline from the Faculty of Science, the Faculty of Arts and Social Sciences, the Faculty of Computer Science, or the College of Sustainability. Statistics may be the primary subject (defined as the subject with the larger number of credits at the second year or above), or the secondary subject.

Students planning to enroll in a Combined Honours program should consult with academic advisors from both programs early in their studies. Students must have their program of study approved by Academic Advisors in both subject areas. Students must complete a research thesis and an Honours Qualifying Examination in one of the two subject areas, a requirement normally completed in the primary subject area. For Statistics, this requirement is satisfied through STAT 4950.03.

### ***Departmental requirements***

Students in a BSc or BA Combined Honours program in Statistics and another subject must fulfill the requirements outlined in the [Academic Regulations](#) and [College of Arts and Science Degree Requirements](#) sections.

- Courses must include:
- MATH 2001.03: Intermediate Calculus I
- MATH 2030.03: Matrix Theory and Linear Algebra I
- STAT 2060.03: Introduction to Probability and Statistics
- STAT 2080.03: Statistical Methods for Data Analysis and Inference
- STAT 3340.03: Regression and Analysis of Variance
- STAT 3360.03: Probability
- STAT 3460.03: Intermediate Statistical Theory
- At least one STAT course at the 4000 level
- At least two additional Statistics<sup>4</sup> courses (6 credit hours) at or above the 2000 level

If Statistics is the primary subject, students will also complete

- STAT 4950.03: Honours Research Project

<sup>4</sup>Statistics courses are any courses listed or cross-listed as STAT. The following can also be counted towards statistics credit hours:



- MATH 2002.03: Intermediate Calculus II
- MATH 2040.03: Matrix Theory and Linear Algebra II

## BSc or BA (120 credit hour) Major in Statistics

The 120 credit hour Major is suited to students who want to focus on Statistics, but wish to have a program that is somewhat less constrained than the Honours program.

### Departmental requirements

In addition to fulfilling the requirements outlined in the [Academic Regulations](#) and [College of Arts and Science Degree Requirements](#) sections, students in a BSc or BA Major program in Statistics must complete the following courses:

#### 1000 level

- MATH 1000.03: Differential and Integral Calculus I/MATH 1010.03: Differential and Integral Calculus II or MATH 1215.03: Life Sciences Calculus/MATH 1010.03: Differential and Integral Calculus II
- STAT 1060.03: Introductory Statistics for Science and Health Sciences<sup>1</sup>
- CSCI 1100.03: Computer Science I/CSCI 1101.03: Computer Science II<sup>2</sup>

#### 2000 level

- MATH 2001.03: Intermediate Calculus I
- MATH 2002.03: Intermediate Calculus II
- MATH 2030.03: Matrix Theory and Linear Algebra I
- MATH 2040.03: Matrix Theory and Linear Algebra II or MATH 2135.03: Linear Algebra
- STAT 2060.03: Introduction to Probability and Statistics
- STAT 2080.03: Statistical Methods for Data Analysis and Inference<sup>3</sup>

#### 3000 level

- STAT 3340.03: Regression and Analysis of Variance
- STAT 3360.03: Probability
- STAT 3380.03: Sample Survey Methods or STAT 3350.03: Design of Experiments
- STAT 3460.03: Intermediate Statistical Theory
- At least 2 additional Statistics<sup>4</sup> courses (6 credit hours) at or above the 3000 level, including at least one course (3 credit hours) at the 4000 level

<sup>1</sup>The requirement to take STAT 1060.03: Introductory Statistics for Science and Health Sciences may be waived for students entering the program in their second year.

<sup>2</sup>Math 3210 or STAT 2450 may be taken in place of CSCI 1101.

<sup>3</sup>Some students may take STAT 2080.03 in the first year of their degree program.

<sup>4</sup>Statistics courses are any courses listed or cross-listed as STAT. The following are also counted as statistics credit hours:

- MATH 2001.03: Intermediate Calculus I
- MATH 2002.04: Intermediate Calculus II
- MATH 2030.03: Matrix Theory and Linear Algebra I
- MATH 2040.03: Matrix Theory and Linear Algebra II

## BSc or BA (120 credit hour) Double Major in Statistics and another subject

The Double Major degree program allows students to combine a study of Statistics with another subject. The other subject may be any discipline from the Faculty of Science, the Faculty of Arts and Social Sciences, the Faculty of Computer Science or the College of Sustainability. Statistics may be the primary subject (defined as the subject with the larger number of credits), or the secondary subject. If the primary subject area is from the Faculty of Arts and Social Sciences, the degree granted will be a BA.

It is recommended that students enrolled in a Double Major program consult with advisors in both subject areas.

### **Departmental requirements**

Students in a BSc or BA Double Major in Statistics and another subject must fulfill the requirements outlined in the [Academic Regulations](#) and [College of Arts and Science Degree Requirements](#) sections.

- Courses must include:
- MATH 2001.03: Intermediate Calculus I
- MATH 2030.03: Matrix Theory and Linear Algebra I
- STAT 2060.03: Introduction to Probability and Statistics
- STAT 2080.03: Statistical Methods for Data Analysis and Inference
- STAT 3340.03: Regression and Analysis of Variance
- STAT 3360.03: Probability
- STAT 3460.03: Intermediate Statistical Theory
- At least 3 additional statistics courses<sup>4</sup> at or above the 2000 level (9 credit hours)

<sup>4</sup>Statistics courses are any courses listed or cross-listed as STAT. The following can also be counted towards statistics credit hours:

- MATH 2002.03: Intermediate Calculus II
- MATH 2040.03: Matrix Theory and Linear Algebra II

## **BSc or BA (90 credit hour) Minor in Statistics**

The 90 credit hour Minor in Statistics is appropriate for students who want to study some Statistics but do not wish to complete the conventional four-year program. The degree is best suited for students who want a general science degree with some specialization in Statistics. A 90 credit hour degree program is not suitable for students who wish to pursue graduate studies. With additional study, the degree may be upgraded to a 120 credit hour Major or Honours degree at a later date.

A 90 credit hour BSc or BA in Statistics is usually the preferred option for students who wish to combine studies in Statistics with a degree in Engineering (see [BSc/BEng or BA/BEng Concurrent Program](#)).

See the [Minor in Statistics](#) section of this Calendar.

## **Minor in Statistics**

This minor is available to students registered in a 120 credit hour Bachelor of Applied Computer Science, Bachelor of Arts, Bachelor of Commerce, Bachelor of Community Design, Bachelor of Computer Science, Bachelor of Informatics, Bachelor of Management, Bachelor of Music, Bachelor of Science or Bachelor of Science (Medical Sciences) program.

A BSc or BA (90 credit hour) degree program with a minor in Statistics is also available.

### **Requirements**

A minimum of 18 to a maximum of 36 credit hours in Statistics, which must include:

- MATH 2030.03: Matrix Theory and Linear Algebra
- STAT 2060.03: Introduction to Probability and Statistics
- STAT 2080.03: Statistical Methods for Data Analysis and Inference
- STAT 3340.03: Regression and Analysis of Variance
- At least one additional statistics<sup>1</sup> course (3 credit hours) at the 2000 level or above
- At least one additional statistics course (3 credit hours) at the 3000 level or above

<sup>1</sup>Statistics courses are any courses listed or cross-listed as STAT. The following can also be counted as statistics credit hours:

- MATH 2001.03: Intermediate Calculus
- MATH 2002.03: Intermediate Calculus II
- MATH 2040.03: Matrix Theory and Linear Algebra II

Contact [Statistics](#) for more information.

# Co-op, Minors, Certificates and Engineering Concurrent Programs for Students

## Minors available to students in Statistics

Minor programs allow students to develop subject specialties in addition to their Major or Honours subjects. Minors in other subjects are normally added to 120 credit hour BSc or BA programs.

Students in a BSc or BA (120 credit hour) program in Statistics may choose to include a Minor selected from the [list of approved Minors](#). Courses counted toward a Major or Honours subject cannot be used to fulfill the requirements of a Minor program.

## Certificates

In combination with a BSc or BA in Statistics, students may obtain one or more Certificates. A Certificate indicates that a student has achieved a certain level of proficiency in a given area or subspecialty. Courses counted toward a Major, Honours or Minor subject may also be used to fulfill the requirements of a Certificate. Students must apply to the Certificate Coordinator to be considered for a Certificate. Certificates are awarded upon graduation and are noted on the student's academic transcript.

A complete list of [Faculty of Science Certificates](#) and requirements can be found at the beginning of the [Faculty of Science](#) section. Students may also work toward obtaining Certificates offered by other Faculties; some of these are listed in the [College of Arts and Science Degree Requirements](#) section.

Certificates of particular interest to student enrolled in a BSc or BA in Statistics include:

- [Certificate in Actuarial and Financial Mathematics](#)
- [Certificate in Applied and Computational Mathematics](#)

## BSc/BEng or BA/BEng Concurrent Program

Students interested in combining their interest in Program with a degree in Engineering may choose a BSc/BEng or BA/BEng Concurrent Program, normally completed in a 5 year period. Over the first three years, students complete the requirements for a 90 credit hour BSc or BA degree in Statistics and a Diploma of Engineering (the first two years of engineering studies). Two more years of engineering studies are then required to obtain a BEng. Interested students should see an undergraduate advisor from Statistics and from the Faculty of Engineering in their first year of study.

Required Statistics courses for a BSc/BEng or BA/BEng program in Statistics

- A minimum of 18 credit hours in Statistics courses at the 2000 level or higher, which must include STAT 2060.03, STAT 2080.03, STAT 3340.03 and at least one other STAT course<sup>4</sup> at or above the 3000 level

<sup>4</sup>Statistics courses are any courses listed or cross-listed as STAT. The following can also be counted towards statistics credit hours:

- MATH 2001.03
- MATH 2002.03
- MATH 2030.03
- MATH 2040.03

## Courses

Below you will find descriptions for courses offered in this field of study. You will find a general overview of the topics covered and any prerequisite course or grade requirements, credit value and exclusions.

The first digit of the course indicates the general level. Those in the 1000 series are introductory degree level. Courses at the 2000, 3000, 4000 series are typically available to students in the second, third, and fourth year. Courses numbered at the 5000 level or above are graduate level. Courses listed at the 0100 or 0200 series are technology level courses. Courses below the 0100 level are generally non credit courses.

Some courses are listed as exclusionary to one another. This means that students may not obtain credit for both courses as designated.



Not all courses are offered each year. Please consult the current [timetable](#) for this year's offering. For further information please contact the department, or visit the department's website.

## Course Descriptions

### Course Notes

Certain courses have been approved for use in fulfilling the educational requirements of the Associate Statistician (A.Stat.) designation of the Statistical Society of Canada (SSC). See the Department or the SSC website (<http://ssc.ca/en/accreditation/apply/suggested-courses-use-towards-astat-designation>) for details.

Credit may not be obtained twice for the same course even if the numbers have been changed.

## Statistics

### STAT 1060 Introductory Statistics for Science and Health Sciences

CREDIT HOURS: 3

This course gives an introduction to the basic concepts of statistics through extensive use of examples. The topics include experimental design, descriptive statistics, simple linear regression and the basics of statistical inference. Students will learn to use the statistical package MINITAB. NOTE: Students who have already taken university level Calculus should consider taking STAT 2060.03 instead of STAT 1060.03.

NOTES: Students will not receive credit for taking STAT 1060.03 after receiving credit for STAT 2060.03.

PREREQUISITES: Academic or advanced Grade 12 Mathematics (or pre-calculus) or equivalent

CROSSLISTED: MATH 1060.03

EXCLUSIONS: COMM 2501.03, MGMT 2501.03, DISP

FORMAT: Lecture | Tutorial

### STAT 2060 Introduction to Probability and Statistics

CREDIT HOURS: 3

Rigorous introduction to probability and statistical theory. Topics covered include elementary probability, random variables, distributions, estimation and hypothesis testing. Estimation and testing are introduced using maximum likelihood and the generalized likelihood ratio. Natural sequels for this course are STAT 2080.03 and 3360.03

PREREQUISITES: MATH 1000.03 or MATH 1215.03 or MATH 1550 OR MATH 1500X/Y

CROSSLISTED: MATH 2060.03, ECON 2260.03

EXCLUSIONS: ENGM 2032.03

FORMAT: Lecture

### STAT 2080 Statistical Methods for Data Analysis and Inference

CREDIT HOURS: 3

The usual sequel to STAT 1060.03 or STAT 2060.03. This course introduces a number of techniques for data analysis and inference commonly used in the experimental sciences. Topics covered include model building in linear models, multiple regression, analysis of variance, factorial designs, analysis of covariance using the general techniques for linear models and two and three way tables along with logistic regression. A natural sequel for this course is STAT 3340.03.

PREREQUISITES: STAT 1060.03 or STAT 2060.03 or DISP

CROSSLISTED: MATH 2080.03, ECON 2280.03

EXCLUSIONS: COMM 2502.03, MGMT 2502.03, PSYO 2501.03

FORMAT: Lecture

### STAT 2300 Introduction to Mathematical Modelling I

CREDIT HOURS: 3

See course description for MATH 2300.03 in the Mathematics section of this calendar.

### STAT 2450 Introduction to Data Mining with R

CREDIT HOURS: 3

This course provided as introduction to data mining and R programming, suited for science students. Data mining methods include a vast set of tools developed in different areas for identifying the patterns in data. Students will learn programming methods for manipulating and exploring data through learning the basic ideas of some clustering, regression and classification methods. No prior programming knowledge is assumed.

PREREQUISITES: MATH 1000.03 and either (STAT 1060.03 or MATH 1060.03) or (STAT 2060.03 or MATH 2060.03)

FORMAT: Lecture

### STAT 2600 Theory of Interest

CREDIT HOURS: 3

See course description for MATH 2600.03 in the Mathematics section of this calendar.