# 11.9 Mathematics and Statistics

[www.mun.ca/math](http://www.mun.ca/math)

The following undergraduate programs are available in the Department:

1. [Applied Mathematics and Chemistry Joint Honours (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303996)
2. [Applied Mathematics and Computer Science Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303976)
3. [Applied Mathematics and Economics Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303981)
4. [Applied Mathematics and Physics Joint Honours (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303995)
5. [Applied Mathematics and Physics Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303980)
6. [Biology and Statistics Joint Honours (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.304006)
7. [Computer Science and Pure Mathematics Joint Honours (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.304002)
8. [Computer Science and Pure Mathematics Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303978)
9. [Computer Science and Statistics Joint Honours (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303984)
10. [Computer Science and Statistics Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303964)
11. [Economics and Pure Mathematics Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303974)
12. [Economics and Statistics Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303966)
13. [Economics (Co-operative) and Statistics Joint Major (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/1/#d.en.303965)
14. [Honours in Applied Mathematics (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304026)
15. [Honours in Pure Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304025)
16. [Honours in Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304022)
17. [Major in Applied Mathematics (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304032)
18. [Major in Pure Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304030)
19. [Major in Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304023)
20. [Minor in Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304031)
21. [Minor in Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#d.en.304021)
22. [Pure Mathematics and Statistics Joint Honours (B.Sc. only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/2/#d.en.303994)

Details of Joint Major and Joint Honours programs are given under [Joint Program Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/10/).

Mathematics and Statistics course descriptions are found at the end of the Faculty of Science section under [Course Descriptions, Mathematics and Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/).

#### [11.9.1 Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.1)

1. At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1005](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1031](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1052](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), the former 1080, the former 1081, [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), the former 1150 and 1151.
2. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for Mathematics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or Mathematics [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) and cannot receive credit for either course.
3. Students with credits in Mathematics or Statistics not listed in this Calendar must consult the Department for equivalency before taking any course listed under [Course Descriptions, Mathematics and Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/).
4. Placement in Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1005](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), and [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), shall be determined by the Department of Mathematics and Statistics on the basis of the student’s score on the Mathematics Placement Test (MPT), SAT Subject Test in Mathematics Level 1, or other acceptable criteria-based test.

#### [11.9.2 Faculty Advisors](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.2)

Normally, the Program Officer will be the advisor for each student who has undertaken a major in Applied or Pure Mathematics, and the Deputy Head (Statistics) will be the advisor for any student involved in a major in Statistics. Students should consult with their advisor at least once each semester to ensure that their choice of courses is appropriate.

Note:

The Department of Mathematics and Statistics will endeavour to give appropriate advice to students registered in its programs. However, the Department points out that it is the responsibility of the student to see that the student's academic program meets the University's Regulations in all respects. Students are referred to the [University Regulations (Undergraduate), Registration, Student Responsibility](https://www.mun.ca/university-calendar/university-regulations-undergraduate/6/5/#d.en.299595). The Department accepts no responsibility for any matter arising from an inappropriate and/or improperly recorded registration.

#### [11.9.3 Course Numbering System](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.3)

The subject area of all courses offered by the Department of Mathematics and Statistics is identified by the second digit of the course number:

Second Digit

0 – Common Core Mathematics courses

1 – Applied Mathematics courses

2 – Applied Mathematics and Pure Mathematics courses

3 – Pure Mathematics courses

4 – Pure Mathematics and Statistics courses

5 – Statistics courses

Unless otherwise specified, where a regulation makes reference to Mathematics courses, this shall include courses in any of the categories listed above.

Where a regulation makes reference to Applied Mathematics courses, this shall include all courses with second digit 1 or 2. Where a regulation makes reference to Pure Mathematics courses, this shall include all courses with second digit 2, 3 or 4. Where a regulation makes reference to Statistics courses, this shall include all courses with second digit 4 or 5.

#### [11.9.4 Major in Applied Mathematics (B.Sc. Only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.4)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the General Degree of Bachelor of Science, a student shall successfully complete the following requirements:

1. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3100](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3132](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3161](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4160](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4190](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
2. Three credit hours in courses numbered 3000 or higher that are offered by the Department of Mathematics and Statistics, excluding the former Mathematics 3330.
3. A computing course, early in your program. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is highly recommended.
4. A designated technical writing course offered by a Science department. Mathematics [2130](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended. The technical writing course is prerequisite to some 3000-level courses.
5. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/)) and [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
6. A statistics course. Statistics [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.

#### [11.9.5 Major in Pure Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.5)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the General Degree of Bachelor of Science or the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/) for the General Degree of Bachelor of Arts, as appropriate, a student shall successfully complete the following requirements:

1. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
2. One of Mathematics [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3210](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
3. One of Mathematics [3331](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3370](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
4. Twelve further credit hours in Pure Mathematics courses numbered 3000 or higher, excluding the former Mathematics 3260 and 3330, at least 6 credit hours of which must be in courses numbered 4000 or higher.
5. A computing course. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.
6. A designated technical writing course offered by a Science department. Mathematics [2130](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.
7. A statistics course. Statistics [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.

#### [11.9.6 Major in Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.6)

As a component of the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the General Degree of Bachelor of Science or the [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/) for the General Degree of Bachelor of Arts, as appropriate, a student shall successfully complete the following requirements:

1. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), Statistics [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3520](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3521](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4530](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
2. Statistics [2500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/). Statistics [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.
3. Nine further credit hours in Statistics courses numbered 3000 or higher, at least 6 credit hours of which must be in courses numbered 4000 or higher excluding Statistics [4581](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
4. A computing course. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.
5. Mathematics [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) and [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) are recommended.

#### [11.9.7 Honours in Applied Mathematics (B.Sc. Only)](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.7)

See [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the Honours Degree of Bachelor of Science. A student shall successfully complete the following requirements:

1. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2130](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3100](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3132](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3161](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3210](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4160](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4180](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4190](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [419A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
2. At least one of Mathematics [4162](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [4170](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
3. Statistics [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
4. Nine further credit hours in courses numbered 3000 or higher that are offered by the Department of Mathematics and Statistics, excluding the former Mathematics 3330, at least 3 of which must be in courses numbered 4000 or higher.
5. A computing course early in the program is required. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.
6. Physics [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) (or [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/)), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).

#### [11.9.8 Honours in Pure Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.8)

See [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the Honours Degree of Bachelor of Science or [Bachelor of Arts (Honours) Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/4/) (as appropriate). A student shall successfully complete the following requirements:

1. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2130](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3210](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3331](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4310](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [439A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), Statistics [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
2. Either Mathematics [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [3370](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
3. Either Mathematics [4000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [4001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
4. Either Mathematics [4320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [4321](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
5. Twelve further credit hours in Pure Mathematics courses numbered 3000 or higher, excluding the former Mathematics 3330, at least 9 credit hours of which must be in courses numbered 4000 or higher.
6. A computing course early in the program is required. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.

#### [11.9.9 Honours in Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.9)

See [Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/4/) for the Honours Degree of Bachelor of Science or [Bachelor of Arts (Honours) Degree Regulations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-humanities-and-social-sciences/6/4/) (as appropriate). A student shall successfully complete the following requirements:

1. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), 3132, [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3210](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), Statistics [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3520](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [3521](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4530](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [4590](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [459A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
2. Statistics [2500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/). Statistics [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.
3. Eighteen further credit hours in Statistics courses including at least 12 credit hours in courses numbered 4000 or higher excluding Statistics [4581](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
4. A computing course. Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.
5. Mathematics [4000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) is recommended.

#### [11.9.10 Minor in Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.10)

A total of 24 credit hours in courses offered by the Department of Mathematics and Statistics is required of which only 6 credit hours shall be in courses at the 1000 level and at least 6 credit hours shall be in courses numbered 3000 or higher.

#### [11.9.11 Minor in Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/#11.9.11)

The courses required for a minor in Statistics are:

1. Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/); Statistics [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [2500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/), Statistics [2501](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) or [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).
2. Twelve further credit hours in Statistics courses numbered 3000 or higher excluding Statistics [4581](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/).

It is recommended that Mathematics [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) and Mathematics [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/11/9/) be taken since they are prerequisite to several further Statistics courses.

#### [13.9.1 Mathematics Courses](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#13.9.1)

Pure and applied Mathematics courses are designated by MATH. Where the 4 digit course number is the same, students can receive credit for only one course with subject names MATH, AMAT, PMAT, STAT.

##### [MATH 1000 Calculus I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304331)

is an introduction to differential calculus, including algebraic, trigonometric, exponential, logarithmic, inverse trigonometric and hyperbolic functions. Applications include kinematics, related rates problems, curve sketching and optimization.

CR: the former MATH 1081

LC: 4

PR: MATH [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [109B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics 1000, [1031](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1080, the former 1081, [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1150 and 1151

##### [MATH 1001 Calculus II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304359)

is an introduction to integral calculus, including Riemann sums and the Fundamental Theorem of Calculus, techniques of integration, improper integrals and first order differential equations. Applications include: area between curves, volumes of solids of revolution, probability functions and modelling with differential equations.

PR: MATH [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former MATH 1081

##### [MATH 1005 Calculus for Business](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304340)

is an introduction to differential calculus, including algebraic, exponential, and logarithmic functions. Applications include related rates and optimization in a business context and partial differentiation. This is a terminal course, not intended for those planning on taking further calculus courses. Business students who plan to take further calculus courses should complete MATH [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) instead of MATH 1005.

LC: 4

PR: MATH [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [109B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or a combination of placement test and high school Mathematics scores acceptable to the Department

UL: at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/),1005, [1031](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1080, the former 1081, [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1150 and 1151

##### [MATH 1031 Mathematical Problem Solving](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304358)

- inactive course.

##### [MATH 1050 Finite Mathematics I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.312492)

covers topics which include sets, logic, permutations, combinations and elementary probability.

CR: MATH [1052](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and MATH [1053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

LC: 4

PR: a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1031](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), 1050, [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1052](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1080, the former 1081, [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1150 and 1151. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

##### [MATH 1051 Finite Mathematics II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.312493)

covers topics which include elementary matrices, linear programming, elementary number theory, mathematical systems, and geometry.

CR: MATH [1052](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and MATH [1053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

LC: 4

PR: a combination of placement test and high school mathematics scores acceptable to the department or the former MATH 103F

UL: At most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1031](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), 1051, [1052](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1053](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1080, the former 1081, [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1150 and 1151. Students who have already obtained 6 or more credit hours in Mathematics or Statistics courses numbered 2000 or above should not register for this course, and cannot receive credit for it.

##### [MATH 1090 Algebra and Trigonometry](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304301)

provides students with the essential prerequisite elements for the study of an introductory course in calculus. Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.

CR: if previously successfully completed or currently registered for MATH [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1080, or the former 1081

LC: 4

PR: a combination of placement test and high school Mathematics scores acceptable to the Department, or the former MATH 103F

UL: at most 9 credit hours in Mathematics will be given for courses successfully completed from the following list subject to normal credit restrictions: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1031](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1080, the former 1081, 1090, [109A/B](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1150 and 1151

##### [MATH 109A and 109B Introductory Algebra and Trigonometry](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304382)

is a two-semester course which provides students with the essential prerequisite elements for the study of an introductory course in calculus, at a slower pace than MATH [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/). Topics include algebra, functions and their graphs, exponential and logarithmic functions, trigonometry, polynomials, and rational functions.

CR: if previously successfully completed or currently registered for MATH [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [1090](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 1080, or the former 1081

LC: 4

PR: a combination of placement test and high school Mathematics scores acceptable to the Department

##### [MATH 2000 Calculus III](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304338)

is an introduction to infinite sequences and series, and to the differential and integral calculus of multivariate functions. Topics include tests for the convergence of infinite series, power series, Taylor and Maclaurin series, complex numbers including Euler's formula, partial differentiation, and double integrals in Cartesian and polar coordinates.

PR: MATH [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 2050 Linear Algebra I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304294)

includes the topics: Euclidean n-space, vector operations in 2- and 3-space, complex numbers, linear transformations on n-space, matrices, determinants, and systems of linear equations.

PR: A combination of placement test and high school Mathematics scores acceptable to the Department or 3 credit hours in first year Mathematics courses

##### [MATH 2051 Linear Algebra II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304328)

includes the topics: real and complex vector spaces, basis, dimension, change of basis, eigenvectors, inner products, and diagonalization of Hermitian matrices.

PR: MATH [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 2075 Introduction to the History of Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304351)

- inactive course.

##### [MATH 2090 Mathematics of Finance](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304299)

covers the topics: simple and compound interest and discount, forces of interest and discount, equations of value, annuities and perpetuities, amortization schedules and sinking funds, bonds and other securities, contingent payments.

PR: MATH [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 2091 Introduction to Actuarial Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304319)

- inactive course.

##### [MATH 2130 Technical Writing in Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304376)

is a project oriented course combining mathematical investigation and technical writing. By using computer programming, graphical and typesetting tools, students will explore mathematical concepts and will produce technical reports of professional quality. The latter will combine elements of writing and graphics to convey technical ideas in a clear and concise manner.

PR: admission to Applied or Pure Mathematics major and MATH [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and (Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), or Engineering [1020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/); or permission of the Head of Department)

##### [MATH 2260 Ordinary Differential Equations I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304321)

introduces first and second order differential equations, systems of first order differential equations and Laplace transforms. These will be studied with both analytic techniques as well as using a computer algebra system to generate symbolic and numerical solutions. Applications include oscillatory motion and population and epidemic models.

CR: the former MATH 3260

PR: MATH [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 2320 Discrete Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304337)

covers basic concepts of mathematical reasoning: logic and quantifiers, methods of proof, sets and set operations, functions and relations, equivalence relations and partial orders, countable and uncountable sets. These concepts will be illustrated through the congruence and divisibility of integers, induction and recursion, principles of counting, permutations and combinations, the Binomial Theorem, and elementary probability.

CR: the former Computer Science 2740, Electrical and Computer Engineering 4110, the former Engineering 3422, the former Engineering 4424

PR: MATH [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 2330 Euclidean Geometry](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304293)

is an introduction to Euclidean geometry of the plane. It covers the geometry of triangles and circles, including results such as the Euler line, the nine-point circle and Ceva’s theorem. It also includes straight-edge and compass constructions, isometries of the plane, the three reflections theorem, and inversions on circles.

CR: the former MATH 3330

PR: MATH [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3000 Real Analysis I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304370)

covers the structure of the real numbers, sequences and limits, compactness, continuity, uniform continuity, differentiation, and the Mean Value Theorem.

CR: the former MATH 2001

LH: 1.5

PR: MATH [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3001 Real Analysis II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304380)

examines Infinite series of constants, sequences and series of functions, uniform convergence and its consequences, power series, Taylor series, Weierstrass Approximation Theorem.

CR: the former MATH 3201

LH: 1

PR: MATH [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3100 Introduction to Dynamical Systems](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304302)

examines flows, stability, phase plane analysis, limit cycles, bifurcations, chaos, attractors, maps, fractals. Applications throughout.

CR: the former AMAT 3190

PR: MATH [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) (or the former MATH 3260)

##### [MATH 3111 Applied Complex Analysis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304346)

examines mapping by elementary functions, conformal mapping, applications of conformal mapping, Schwartz-Christoffel transformation, Poisson integral formula, poles and zeros, Laplace transforms and stability of systems, analytic continuation.

PR: MATH [3210](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3132 Numerical Analysis I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304308)

includes a discussion of round-off error, the solution of linear systems, iterative methods for nonlinear equations, interpolation and polynomial approximation, least squares approximation, fast Fourier transform, numerical differentiation and integration, and numerical methods for initial value problems.

CR: Computer Science [3731](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

LH: 1.5

PR: MATH [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), MATH [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), and a computing course (Computer Science [1510](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) is recommended)

##### [MATH 3161 Ordinary Differential Equations II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304306)

examines power series solutions, method of Frobenius, Bessel functions, Legendre polynomials and others from classical Physics, systems of linear first order equations, fundamental matrix solution, existence and uniqueness of solutions, and advanced topics in ordinary differential equations.

PR: MATH [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) (or the former MATH 3260) and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3202 Vector Calculus](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304310)

deals with functions of several variables, Lagrange multipliers, vector valued functions, directional derivatives, gradient, divergence, curl, transformations, Jacobians, inverse and implicit function theorems, multiple integration including change of variables using polar, cylindrical and spherical co-ordinates, Green's theorem, Stokes' theorem, divergence theorem, line integrals, arc length.

CR: Physics [3810](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

PR: MATH [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3210 Introduction to Complex Analysis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304347)

examines complex numbers, analytic functions of a complex variable, differentiation of complex functions and the Cauchy-Riemann equations, complex integration, Cauchy's theorem, Taylor and Laurent series, residue theory and applications.

PR: MATH [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3240 Applied Graph Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304317)

examines algorithms and complexity, definitions and basic properties of graphs, Eulerian and Hamiltonian chains, shortest path problems, graph colouring, planarity, trees, network flows, with emphasis on applications including scheduling problems, tournaments, and facilities design.

CR: the former Computer Science 2741

PR: MATH [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3300 Set Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304329)

is an introduction to Mathematical Logic, functions, equivalence relations, equipotence of sets, finite and infinite sets, countable and uncountable sets, Cantor's Theorem, Schroeder-Bernstein Theorem, ordered sets, introduction to cardinal and ordinal numbers, logical paradoxes, the axiom of choice.

PR: MATH [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3303 Introductory Geometric Topology](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304343)

covers graphs and the four colour problem, orientable and non-orientable surfaces, triangulation, Euler characteristic, classification and colouring of compact surfaces, basic point-set topology, the fundamental group, including the fundamental groups of surfaces, knots, and the Wirtinger presentation of the knot group.

PR: MATH [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3320 Abstract Algebra](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304379)

is an introduction to groups and group homomorphisms including cyclic groups, cosets, Lagrange's theorem, normal subgroups and quotient groups, introduction to rings and ring homomorphisms including ideals, prime and maximal ideals, quotient rings, integral domains and fields.

PR: MATH [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3321 Applied Algebra](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304316)

- inactive course.

##### [MATH 3331 Projective Geometry](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304339)

includes course topics: projective space, the principle of duality, mappings in projective space, conics and quadrics.

PR: MATH [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3340 Introductory Combinatorics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304305)

includes topics: distributions, the binomial and multinomial theorems, Stirling numbers, recurrence relations, generating functions and the inclusion-exclusion principle. Emphasis will be on applications.

PR: MATH [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 3370 Introductory Number Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304353)

examines perfect numbers and primes, divisibility, Euclidean algorithm, greatest common divisors, primes and the unique factorization theorem, congruences, cryptography (secrecy systems), Euler-Fermat theorems, power residues, primitive roots, arithmetic functions, Diophantine equations, topics above in the setting of the Gaussian integers.

PR: MATH [2320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4000 Lebesgue Integration](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304368)

includes a review of the Riemann integral, functions of bounded variation, null sets and Lebesgue measure, the Cantor set, measurable sets and functions, the Lebesgue integral in R1 and R2, Fatou's lemma, Monotone and Dominated Convergence Theorems, Fubini's Theorem, an introduction to Lebesgue-Stieltjes measure and integration.

CR: the former Pure Mathematics 4400

PR: MATH [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4001 Functional Analysis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304344)

includes metric and normed spaces, completeness, examples of Banach spaces and complete metric spaces, bounded linear operators and their spectra, bounded linear functionals and conjugate spaces, the fundamental theorems for Banach spaces including the Hahn–Banach Theorem, topology including weak and weak\* topologies, introduction to Hilbert spaces.

CR: the former Pure Mathematics 4302

PR: MATH [3001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4100 Applied Functional Analysis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304332)

- inactive course.

##### [MATH 4102 Stochastic Methods in Applied Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304363)

- inactive course.

##### [MATH 4130 Introduction to General Relativity](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304324)

studies both the mathematical structure and physical content of Einstein’s theory of gravity. Topics include the geometric formulation of special relativity, curved spacetimes, metrics, geodesics, causal structure, gravity as spacetime curvature, the weak-field limit, geometry outside a spherical star, Schwarzschild and Kerr black holes, Robertson-Walker cosmologies, gravitational waves, an instruction to tensor calculus, Einstein’s equations, and the stress-energy tensor.

CO: MATH [4230](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

EQ: Physics [4220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

PR: MATH [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and one of Physics [3220](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or MATH [4230](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or permission of the Head of Department.

##### [MATH 4131 Numerical Linear Algebra](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304381)

- inactive course.

##### [MATH 4132 Introduction to Optimization](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304312)

- inactive course.

##### [MATH 4133 Numerical Optimization](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304364)

is numerical methods for functions of one variable, for functions of several variables including unrestricted search, sequential uniform search, irregular search, non-gradient methods, gradient methods with and without constraints, geometric programming, selection of other topics from dynamic programming, integer programming, etc., solution of applied problems by numerical optimization.

PR: MATH [3132](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4140 Introduction to Mathematical Control Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304367)

- inactive course.

##### [MATH 4160 Partial Differential Equations I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304366)

covers two point boundary value problems, Fourier series, Sturm-Liouville theory, canonical forms, classification and solution of linear second order partial differential equations in two independent variables, separation of variable, integral transform methods.

PR: MATH [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) (or the former MATH 3260) and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4161 Integral Equations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304298)

- inactive course.

##### [MATH 4162 Numerical Methods for Differential Equations](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304326)

covers numerical solution of initial value problems for ordinary differential equations by single and multi-step methods, Runge-Kutta, and predictor-corrector; numerical solution of boundary value problems for ordinary differential equations by shooting methods, finite differences and spectral methods; numerical solution of partial differential equations by the method of lines, finite differences, finite volumes and finite elements.

PR: MATH [3132](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and [4160](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4170 Partial Differential Equations II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304361)

covers first order equations, Cauchy problems, Cauchy-Kowalewska theorem, second order equations, canonical forms, wave equations in higher dimensions, method of spherical means, Duhamel's principle, potential equation, Dirichlet and Neuman problem, Green's function and fundamental solution, potential theory, heat equation, Riemann's method of integration, method of plane and Riemann waves for systems of PDEs of the first order.

PR: MATH [4160](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4180 Introduction to Fluid Dynamics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304374)

covers basic observations, mass conservation, vorticity, stress, hydrostatics, rate of strain, momentum conservation (Navier-Stokes equation), simple viscous and inviscid flows, Reynolds number, boundary layers, Bernoulli's and Kelvin's theorems, potential flows, water waves, thermodynamics.

CR: ONAE [4020](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

EQ: Physics [4205](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

PR: MATH [2260](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) (or the former MATH 3260) and [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4190 Mathematical Modelling](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304375)

is intended to develop students' skills in mathematical modelling and competence in oral and written presentations. Case studies in modelling will be analysed. Students will develop a mathematical model and present it in both oral and report form.

CR: MATH [4191](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

PR: MATH [3100](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [3161](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [4160](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), and a technical writing course offered by a Science department (MATH [2130](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) is recommended).

##### [MATH 419A and 419B Applied Mathematics Honours Project](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304348)

is a two-semester course that requires the student, with supervision by a member of the Department, to prepare a dissertation in an area of Applied Mathematics. In addition to a written project, a one hour presentation will be given by the student at the end of the second semester.

CH: 6

CR: the former AMAT 4199

PR: registration in an Honours or Joint Honours program in Applied Mathematics.

##### [MATH 4230 Differential Geometry](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304362)

covers both classical and modern differential geometry. It begins with the classical theory of curves and surfaces, including the Frenet-Serret relations, the fundamental theorem of space curves, curves on surfaces, the metric, the extrinsic curvature operator and Gaussian curvature. The modern section studies differentiable manifolds, tangent vectors as directional derivatives, one-forms and other tensors, the metric tensor, geodesics, connections and parallel transport, Riemann curvature and the Gauss-Codazzi equations.

PR: MATH [3202](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4240 Differential and Integral Calculus on Manifolds](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304369)

- inactive course.

##### [MATH 4250 Reinforcement Learning](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304300)

considers a mathematical framework in which an agent (such as a person or a robot) learns which actions to take in an environment in order to maximize a specific reward signal. The course provides an introduction to reinforcement learning, including tabular solution methods, dynamic programming, Monte Carlo methods, temporal-difference learning, planning methods and approximate solution methods.

PR: MATH [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), MATH [3132](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), Statistics [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4252 Quantum Information and Computing](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304355)

covers postulates of quantum mechanics, matrix theory, density matrices, qubits, qubit registers, entanglement, quantum gates, superdense coding, quantum teleportation, quantum algorithms, open systems, decoherence, physical realization of quantum computers.

EQ: Physics [4852](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

PR: MATH [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or Physics [3820](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4280-4289 Special Topics in Pure and Applied Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304303)

will have the topics to be studied announced by the Department. Consult the Department for a list of titles and information regarding availability.

PR: permission of the Head of the Department

##### [MATH 4300 General Topology](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304372)

is an introduction to point-set topology, centering on the notions of the topological space and the continuous function. Topological properties such as Hausdorff, compactness, connectedness, normality, regularity and path-connectedness are examined, as are Urysohn’s metrization theorem and the Tychonoff theorem.

PR: MATH [3300](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4301 Algebraic Topology](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304313)

- inactive course.

##### [MATH 4310 Complex Function Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304309)

examines topology of C, analytic functions, Cauchy's theorem with proof, Cauchy integral formula, singularities, argument principle, Rouche's theorem, maximum modulus principle, Schwarz's lemma, harmonic functions, Poisson integral formula, analytic continuation, entire functions, gamma function, Riemann-Zeta function, conformal mapping.

PR: MATH [3210](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4320 Ring Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304342)

examines factorization in integral domains, structure of finitely generated modules over a principal ideal domain with application to Abelian groups, nilpotent ideals and idempotents, chain conditions, the Wedderburn-Artin theorem.

PR: MATH [3320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4321 Group Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304323)

examines permutation groups, Sylow theorems, normal series, solvable groups, solvability of polynomials by radicals, introduction to group representations.

PR: MATH [3320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4331 Galois Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304322)

covers irreducible polynomials, field extensions, Galois groups, and the solution of equations by radicals.

PR: MATH [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and MATH [3320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4340 Combinatorial Analysis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304371)

continues most of the topics started in [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) with further work on distributions, recurrence relations and generating functions. Generating functions are used to solve recurrence relations in two variables. Also included is a study of Polya's theorem with applications.

PR: MATH [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4341 Combinatorial Designs](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304341)

includes the study of finite fields, Latin squares, finite projective planes and balanced incomplete block designs.

PR: MATH [3320](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3340](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4370 Number Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304297)

is continued fractions, an introduction to Diophantine approximations, selected Diophantine equations, the Dirichlet product of arithmetic functions, the quadratic reciprocity law, and factorization in quadratic domains.

PR: MATH [3370](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [MATH 4375 History of Mathematics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304334)

- inactive course.

##### [MATH 439A and 439B Pure Mathematics Honours Project](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304311)

is a two-semester course that requires the student, with supervision by a member of the Department, to prepare a dissertation in an area of Pure Mathematics. Although original research by the student will not normally be expected, the student must show an ability and interest to learn and organize material independently. A one-hour presentation will be given by the student at the end of the second semester.

CH: 6

CR: the former MATH 4399

PR: registration in an Honours or Joint Honours program in Pure Mathematics

#### [13.9.2 Statistics Courses](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#13.9.2)

In accordance with Senate's Policy Regarding Inactive Courses, the course descriptions for courses which have not been offered in the previous three academic years and which are not scheduled to be offered in the current academic year have been removed from the following listing. For information about any of these inactive courses, please contact the Head of the Department.

Statistics courses are designated by STAT. Where the 4 digit course number is the same, students can receive credit for only one course with subject names MATH, AMAT, PMAT, STAT.

##### [STAT 1500 Introduction to Data Science](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.320502)

aims to teach fundamentals of data science. Emphasis will be placed on data visualization, data wrangling and summarizing data, statistical estimation and testing, regression modeling, supervised and unsupervised statistical learning. Standard data science software will be used to demonstrate the techniques.

PR: 3 credit hours in Mathematics or Statistics courses, or a combination of placement test and high school Mathematics scores acceptable to the Department

##### [STAT 1510 Statistical Thinking and Concepts](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304352)

examines the basic statistical issues encountered in everyday life, such as data collection (both primary and secondary), ethical issues, planning and conducting statistically-designed experiments, understanding the measurement process, data summarization, measures of central tendency and dispersion, basic concepts of probability, discrete probability models, understanding sampling distributions, the central limit theorem based on simulations (without proof), linear regression, concepts of confidence intervals and testing of hypotheses. Statistical software will be used to demonstrate each technique.

CO: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

CR: cannot receive credit for STAT 1510 if completed with, or subsequent to, STAT [2500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former 2510

##### [STAT 2410 Introduction to Probability Theory](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304373)

covers combinatorial analysis, axioms of probability, conditional probability, independence, random variables, distribution function, mathematical expectation, Chebyshev’s inequality, joint distribution of two random variables, binomial and related distributions, Poisson, gamma, beta, normal, student t and F distributions, functions of random variables, convergence in probability, convergence in distribution, central limit theorem.

CR: STAT [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

OR: one 90 minute tutorial period per week

PR: MATH [2000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 2500 Statistics for Business and Arts Students](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304360)

covers descriptive statistics (including histograms, stem-and-leaf plots and box plots), elementary probability, random variables, the binomial distribution, the normal distribution, sampling distribution, estimation and hypothesis testing including both one and two sample tests, paired comparisons, correlation and regression, related applications.

CR: STAT [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former 2510, Psychology [2910](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [2925](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and the former 2900

LH: one 90 minute lab per week. Statistical computer package will be used in the laboratory, but no prior computing experience is assumed

PR: 3 credit hours in Mathematics or Statistics courses, or a combination of placement test and high school Mathematics scores acceptable to the Department

##### [STAT 2501 Further Statistics for Business and Arts Students](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304330)

covers power calculation and sample size determination, analysis of variance, multiple regression, nonparametric statistics, time series analysis, introduction to sampling techniques.

CR: STAT [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), Psychology [2911](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [2950](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), and the former 2901

LH: one 90 minute lab per week. Statistical computer package will be used in the laboratory.

PR: STAT [2500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former 2510

##### [STAT 2550 Statistics for Science Students](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304336)

is an introduction to basic statistics methods with an emphasis on applications to the sciences. Material includes descriptive statistics, elementary probability, binomial distribution, Poisson distribution, normal distribution, sampling distribution, estimation and hypothesis testing (both one and two sample cases), chi-square test, one way analysis of variance, correlation and simple linear regression.

CR: Engineering [4421](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), STAT [2500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), the former STAT 2510, Psychology [2910](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), Psychology [2925](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), and the former Psychology 2900

LH: one 90 minute lab per week. Statistical computer package will be used in the laboratory, but no prior computing experience is assumed.

PR: Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former 1081

##### [STAT 2560 Further Statistics for Science Students](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304315)

covers estimation and hypothesis testing in the two-sample and paired sample cases, one way and two way analysis of variance, simple and multiple linear regression, chi-square tests, non-parametric tests including sign test, Wilcoxon signed rank test and Wilcoxon rank test.

CR: STAT [2501](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), Psychology [2911](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [2950](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), and the former 2901

EQ: the former STAT 2511

LH: one 90 minute lab per week. Statistical computer packages will be used in the laboratory, but no prior computing experienced is assumed.

PR: STAT [2500](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), Mathematics [1000](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 3411 Statistical Inference I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304335)

examines sampling distributions, order statistics, confidence interval, hypotheses testing, chi-square tests, maximum likelihood estimation, maximum likelihood estimation, Rao-Cramér inequality and efficiency, maximum likelihood tests, sufficiency, completeness and uniqueness, exponential class of distributions, likelihood ratio test and Neyman-Pearson lemma.

OR: one and a half hour tutorial period weekly

PR: STAT [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 3520 Experimental Design I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304350)

is an introduction to basic concepts in experimental design, including principles of experimentation; single factor designs such as completely randomized designs; randomized block designs; Latin square designs; Graeco Latin square designs; multiple comparison tests; analysis of covariance; balanced incomplete block designs; factorial designs; fixed, random and mixed effects models.

CR: Psychology [3900](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and [3950](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

PR: Mathematics [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and either STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or both Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and one of STAT [2501](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former 2511

##### [STAT 3521 Regression](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304378)

covers inferences in linear regression analysis including estimation, confidence and prediction intervals, hypotheses testing and simultaneous inference; matrix approach to regression analysis, multiple linear regression, multicollinearity, model building and selection, polynomial regression, qualitative predictor variables.

PR: Mathematics [2050](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and either STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or both Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and one of STAT [2501](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former 2511

##### [STAT 3540 Time Series I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304327)

is an introduction to basic concepts of time series analysis such as stationarity and nonstationarity, components of time series, transformation of nonstationary series using regression, decomposition methods and differencing, autocovariance and autocorrelation functions, moving average (MA), autoregressive (AR), and ARMA representation of stationary time series including stationarity and invertibility conditions; partial autocorrelation function; properties of MA(q), AR(p) and ARMA(p, q) models, model identification, parameter estimation, model diagnostics and selection, forecasting, integrated ARMA process. Applications to real time series.

PR: either STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or both Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and one of STAT [2501](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former 2511

##### [STAT 3570 Reliability and Quality Control](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304304)

covers an introduction to reliability, parallel and series systems, standard parametric models, estimation of reliability, quality management systems, introduction to statistical process control, simple quality control tools, process control charts for variables and attributes, process capability, cumulative sum chart, exponentially weighted moving average chart, acceptance sampling plans, measurement system analysis, continuous improvement and six sigma methodology.

PR: either STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or both Mathematics [1001](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and one of STAT [2501](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or the former 2511

##### [STAT 3585 Computational Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304357)

is an introduction to modern computational statistics, using a programming language which implements S. Emphasis will be placed on the development of algorithms and programs for generating random numbers, numerical techniques and programs for graphical exploratory data analysis, implementing specialized statistical procedures, Monte Carlo simulation and resampling.

PR: STAT [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), STAT [2560](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4402 Stochastic Processes](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304325)

covers the Poisson process, renewal theory, Markov chains, and some continuous state models including Brownian motion. Applications are considered in queuing, reliability, and inventory theory. Emphasis is on model building and probabilistic reasoning.

CR: Mathematics [4102](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

PR: STAT [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4410 Statistical Inference II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304365)

covers decision theory, uniformly minimum variance estimators, sufficiency and completeness, likelihood theory and maximum likelihood estimation, other estimation methods including best linear unbiased estimation, estimating equations and Bayesian estimation, hypothesis testing and interval estimation, and applications of statistical inference methods under regression models and analysis of variance models.

PR: Mathematics [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4504 Biostatistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.320503)

provides an overview of statistical principles and methods in epidemiology. Emphasis will be placed on study designs, measures of risk and disease-exposure association, inference for measures of association, confounding, causal inference, analysis of binary responses, count, and time-to-event.

PR: STAT [2550](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4520 Experimental Design II](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304314)

is an introduction to factorial experiments including mixed effects models, unbalanced data in factorial designs, two level and three level factorial experiments, blocking and confounding in factorial designs, fractional factorial experiments, unreplicated factorial experiments, response surface designs, robust parameter designs, nested and split plot designs.

PR: STAT [3520](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4530 Survey Sampling](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304333)

covers basic concepts, simple random sampling, unequal probability sampling and the Horvitz-Thompson principle, sufficiency, design and modelling in sampling, ratio and regression estimators, stratified and cluster sampling, methods for elusive and/or hard- to-detect populations.

PR: STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4540 Time Series](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304356)

examines the analysis of time series in the time domain and is an introduction to frequency domain analysis. Topics covered include integrated ARMA processes, seasonal time series models, intervention analysis and outlier detection, transfer function models, time series regression and GARCH models, vector time series models, state space models and the Kalman Filter. Spectral decomposition of a time series is introduced. Emphasis is on applications and examples with a statistical software package.

PR: STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) and [3540](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4550 Non-parametric Statistics](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304318)

covers inferences concerning location based on one sample, paired samples or two samples, inferences concerning scale parameters, goodness-of-fit tests, association analysis, tests for randomness.

PR: one of STAT [3520](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3521](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4560 Continuous Multivariate Analysis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304295)

examines the multivariate normal distribution and its marginal and conditional distributions, distributions of non-singular and singular linear combinations, outline of the Wishart distribution and its application, in particular, to Hotelling’s T-squared statistic for the mean vector, connection between likelihood ratio and Hotelling’s T- squared statistics, a selection of techniques chosen from among MANOVA, multivariate regression, principal components, factor analysis, discrimination and classification, clustering.

PR: Mathematics [2051](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), STAT [2410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3410](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), and one of STAT [3411](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [3520](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), or [3521](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4561 Categorical Data Analysis](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304354)

is an analysis of cross-classified categorical data with or without explanatory variables, chi-square test, measures of association, multidimensional contingency tables, hypotheses of partial and conditional independence, log-linear models for Poisson, multinomial and product-multinomial sampling schemes, concept of ordinal categorical models, logit models, likelihood estimation, selection of suitable log-linear and logit models.

PR: STAT [3520](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3521](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 4581 Quantitative Methods in Biology](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304345)

- inactive course.

##### [STAT 4590 Statistical Analysis of Data I](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304349)

examines the statistical analysis of real life univariate data using computational and statistical methods including descriptive statistics, chi-square tests, non-parametric tests, analysis of variance, linear, logistic and log-linear regressions. Other statistical techniques such as integrated autoregressive moving average modelling and forecasting or quality control methods may be introduced depending on the nature of the data.

LH: one 90 minute lab per week

PR: one of STAT [3520](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/), [3521](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/) or [3540](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/)

##### [STAT 459A and 459B Statistics Honours Project](https://www.mun.ca/university-calendar/st-johns-campus/faculty-of-science/13/9/#d.en.304320)

is a two-semester course that requires the student, with supervision by a member of the Department, to prepare a dissertation in an area of Statistics. In addition to a written project, a presentation will be given by the student at the end of the second semester.

CH: 6

CR: the former STAT 4599

PR: registration in an Honours or Joint Honours program in Statistics