



THE UNIVERSITY OF BRITISH COLUMBIA

DEPARTMENT OF MATHEMATICS

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UNDERGRADUATE PROGRAM DESCRIPTION BOOKLET

The Department of Mathematics offers programs leading to Undergraduate degrees in three faculties:

- BA** Minor, Major, Double Major, Mathematics/Economics Major, Honours, Combined Honours, Mathematics/Music Honours. Co-operative Education Program options are also available.
- BSc** Minor, Major, Double Major, Combined Major, Mathematics/Economics Major, Mathematical Sciences Major, Honours, Combined Honours. A dual-degree BSc/BEd program and Co-operative Education Program options are also available.
- BASc** Minor in Honours Mathematics

CAREER OPPORTUNITIES

Our Majors programs (BA or BSc) offer substantial flexibility in Math course selection as well as plenty of elective room. Careers in finance, software development, actuarial science, high-school education, and many other areas are possible with these degrees.

The Honours degree (BA or BSc) leads to the same career options after graduation but is also the usual route for students intending to proceed to graduate school in Mathematics (to MSc and PhD degrees). Graduate-level training is necessary for some career paths. It is necessary to have a PhD degree in order to obtain an academic position at a university, for example. An Honours degree, with appropriate courses in analysis, discrete mathematics, probability, and statistics, is an appropriate route to graduate programs in Commerce, especially Management Science (Operations Research).

Currently, a Mathematics degree is one of the best entry routes to BEd programs. Students in a Major program intending to enter the BEd program should consider taking courses in geometry, number theory, probability, statistics, and mathematics history, such as MATH 302, 303, 308, 309, 312, 313, 342, 414, 446, and STAT 200. There is a dual-degree program in Mathematics and Education (BSc/BEd). Admission to this program requires application in the fall of second year. The Department of Mathematics runs outreach programs for BC students in Grades 6-12 and welcomes participation from Mathematics undergraduates interested in teaching as a potential career.

The business world has employed many Mathematics graduates, especially in the actuarial field, investment, and banking. For such employment, it is worthwhile to take courses in Statistics, in particular STAT 200, 305, 306, and 404. Students interested in the actuarial field should contact Dr. Joel Friedman in our department. Note that one can take a Major in Mathematics with a Minor in Commerce (BA or BSc degree) as well as a Mathematics/Economics Major (BA or BSc degree).

One area with employment opportunities is the software industry – systems analysis, software engineering, computer programming, and management information systems. Mathematics students interested in this path should consider taking Computer Science courses such as CPSC 110, 210, 221, and 310.

For career information, students are encouraged to look at *Jobs Rated 2014* available at www.careercast.com, which lists the following among the ten best American jobs (out of 200): mathematician (#1!), statistician, actuary, software engineer, and computer systems analyst. See also the American Mathematical Society website, www.ams.org/profession/career-info/career-index. For all career choices, good communication skills in both oral and written English are essential.

PROGRAMS OF STUDY

BA PROGRAM

There is no Physics or Chemistry requirement for students pursuing the BA program, but students need to satisfy a Computing requirement. This can be fulfilled by taking CPSC 110/210, or CPSC 110 and MATH 210. Arts students must also satisfy Literature and Language requirements. The BA program has other special requirements, including a first-year writing course and a fourth-year research-intensive course (fulfilled by one of MATH 441, 444, 445, 448, or 462). There are credit restrictions for a BA, limiting the number of non-Arts courses. (Math courses count as Science courses.) It is often possible to obtain permission from the Arts Faculty for exceptions to the Arts credit requirement.

Currently, about one-third of all Mathematics Majors are registered in Arts. The Honours program in Arts requires the completion of 120 specified credits with an average of at least 68%. One may take a Mathematics Minor (18 credits of courses in Mathematics numbered 300 or higher) along with another Arts Major. One could also take a Major in Mathematics and a Minor in another Arts or Science subject or Commerce. A Double Major program is available in Arts.

There is also a special Mathematics/Economics Major. Entry into this program is done by Economics.

BSc PROGRAM

Students intending to pursue an Honours program are strongly urged to take MATH 120, 121, 223, 226, and 227. This eases the transition to the third year of the Honours program. The Honours program in Science requires the completion of 132 credits. One may take a Mathematics Minor (18 credits of courses in Mathematics numbered 300 or higher) along with another Science Major. One could also take a Major in Mathematics and a Minor in another Science or Arts subject or Commerce. A Double Major program is available in Science. There is also a special Mathematics/Economics Major, and a Combined Major in Computer Science and Mathematics.

BASc PROGRAM (Minor in Honours Mathematics)

In this Minor, one must take a number of advanced mathematics courses, in addition to those required by the program. By carefully picking electives and taking some summer courses, it is possible to complete this program within four years. It is advantageous to obtain Advanced Placement credit (Calculus AB or BC) or Challenge credit for MATH 100 and/or MATH 101 prior to entering UBC.

If a student intends to pursue a degree program in Mathematics, it is important to see a Mathematics Advisor or the Undergraduate Chair. Contact information is on our website (www.math.ubc.ca) under the “Undergraduates” tab.

COMMENTS ON SOME SPECIFIC MATHEMATICS COURSES

Detailed information (including prerequisites) for all UBC Mathematics courses is available in the UBC Calendar. Some additional comments are given below.

MATH 001 and MATH 002: These are non-credit pre-calculus courses offered by UBC Continuing Studies for students who are inadequately prepared to take MATH 180 or MATH 184, which have a prerequisite of at least 80% in Pre-Calculus 12.

MATH 003 and MATH 004: These are non-credit calculus courses, at the high-school level, offered by UBC Continuing Studies.

MATH 100: Prior to entering UBC, students who have taken a high-school calculus course may write the UBC-SFU-UVIC-UNBC Calculus Challenge Exam. Students who obtain a grade of 4 or 5 in the AP Calculus AB exam can obtain credit for MATH 100. A grade of 4 or 5 in the AP Calculus BC exam leads to credit for MATH 100 and MATH 101.

MATH 100 (or 180 or 184) and MATH 101: This is the first-year calculus stream designed for Engineering and Physical Sciences students who have taken a high-school calculus course. Those without such a course should take MATH 180 or MATH 184 in the first term.

MATH 102 (or 180 or 184) and MATH 103:	This is the first-year calculus stream designed for Life Sciences students who have taken a high-school calculus course. Those without such a course should take MATH 180 or MATH 184 in the first term.
MATH 104 (or 184 or 180) and MATH 105:	This is the first-year calculus stream designed for Commerce and Social Sciences students who have taken a high-school calculus course. Those without such a course should take MATH 184 or MATH 180 in the first term.
MATH 110	This is a full-year alternative to MATH 180 or MATH 184, for students with insufficient high-school preparation.
MATH 120 and MATH 121:	These are 4-credit Honours versions of the courses MATH 100 and 101, or MATH 102 and 103, or MATH 104 and 105. Prerequisite: a high-school calculus course and a grade of 95% or better in Pre-Calculus 12. To register, contact the Undergraduate Chair.
MATH 210:	This is a mathematical way to satisfy the second half of the Computing requirement for a degree.
MATH 217:	This accelerated course, which contains material from MATH 200 and MATH 317, is intended for students in Honours Physics and Engineering Physics.
MATH 221:	This course is open to students who have passed MATH 101 or 103 or 105 or 121, or obtained at least 64% in MATH 100 (180) or 102 or 104 (184) or 120, or have advanced credit for MATH 100.
MATH 230:	This is a 3-credit course useful for entry into the BEd Elementary Program. Prerequisite: Principles of Mathematics 11.
MATH 302:	This course is equivalent to STAT 302.
MATH 305:	This new course in complex variables is similar to MATH 300 but contains a greater emphasis on applications.
MATH 308-312:	Note the prerequisite of MATH 220 or MATH 226 or CPSC 121.
MATH 318:	This is an accelerated course that contains material from MATH 302 and MATH 303.
MATH 331:	This is an Honours course in problem solving.
MATH 335:	This is a 4-credit course open to Arts and unclassified students intending to enter the BEd Elementary Program without previous credit for any other Mathematics course.
MATH 342:	Note the prerequisite of MATH 220 or MATH 226 or CPSC 121.

COURSE SELECTION IN THE MAJORS PROGRAM

Major students sometimes wonder which third- and fourth-year Mathematics courses to include in their degree. In practice, typical choices come from the following:

MATH 300	Introduction to Complex Variables
MATH 302	Introduction to Probability
MATH 303	Introduction to Stochastic Processes
MATH 307	Applied Linear Algebra
MATH 308	Euclidean Geometry
MATH 309	Topics in Geometry
MATH 310	Abstract Linear Algebra
MATH 312	Introduction to Number Theory
MATH 313	Topics in Number Theory
MATH 316	Elementary Differential Equations II
MATH 317	Calculus IV
MATH 340	Introduction to Linear Programming
MATH 342	Algebra, Coding Theory, and Cryptography
MATH 345	Applied Nonlinear Dynamics and Chaos
MATH 360	Mathematical Modeling in Science
MATH 361	Introduction to Mathematical Biology
MATH 400	Applied Partial Differential Equations
MATH 414	Mathematical Demonstrations
MATH 441	Mathematical Modeling: Discrete Optimization Problems
MATH 442	Optimization in Graphs and Networks
MATH 444	Mathematical Research and Writing
MATH 445	Mathematical Modeling: Applications in the Natural and Social Sciences
MATH 446	Topics in the History of Mathematics I
MATH 448	Directed Studies in Mathematics
MATH 462	Projects in Mathematical Biology

For reasons of breadth, it is a good idea to include MATH 302, 307, 308, 312, and 340, and then to take follow-up courses as interests dictate. Major students, especially those considering graduate school in the Mathematical Sciences, are also encouraged to take some of the courses required in the Honours program, such as MATH 300, 320, 321, and 322. Another suggestion is to take some higher-level elective courses in an area of application, such as Economics, Computer Science, or Statistics.

COURSE SELECTION IN THE HONOURS PROGRAM

Students planning on an Honours or Combined Honours degree are advised to take the Honours version of first- and second-year courses, specifically MATH 120 (Honours Differential Calculus), 121 (Honours Integral Calculus), 223 (Linear Algebra), 226 (Advanced Calculus I), and 227 (Advanced Calculus II). For each of these courses, the syllabus in the regular and the Honours versions is similar enough so that the regular course with a sufficiently high grade will

be accepted as a prerequisite for a subsequent Honours course. However, in general, the Honours versions cover the material in greater depth, offer more challenging problems, and anticipate concepts that are important in upper-level courses. Note that an Honours student who takes MATH 200 or MATH 253 instead of MATH 226 must also take MATH 220 (Mathematical Proof).

The core third-year courses are MATH 300 (Introduction to Complex Variables), 320 (Real Variables I), 321 (Real Variables II), and 322 (Introduction to Algebra). Almost all fourth-year courses have these courses as prerequisites. A highly recommended course, MATH 331 (Problem Solving), may be profitably taken in second, third or fourth year. The prerequisites are MATH 223 (152, 221) and MATH 226 (200). The remaining upper-level courses are organized into the areas of analysis, algebra, geometry and topology, applied mathematics, and a course in graph theory. See the UBC Calendar for detailed descriptions. Some higher-level courses are not offered every year. Advanced students are encouraged to take 500-level (introductory graduate) courses. Note that the Math Honours program (not Combined Honours) allows some Math Major courses

OTHER INFORMATION

ADVISING

All undergraduates are expected and strongly encouraged to see their respective Undergraduate Advisor at least once each academic year during the first term, preferably before the end of October. Check at the main Mathematics Office (Room 121 in the Mathematics Building) or on our department's website to obtain the current advisor for your year and program. There are also Actuarial, Putnam, Co-op and School Workshop Advisors, as well as an advisor for students enrolled in programs other than Mathematics.

APPEAL PROCEDURES

A student who wishes to protest a mark in a midterm or homework assignment should initially approach the instructor concerned. Only if the problem cannot be resolved in this fashion should the student approach the Undergraduate Chair. Students must not, on their own initiative, approach a second instructor.

After the final exam period, students can complete a Viewing of a Final Examination form (available in the Math Office or online) and then meet with their instructor to discuss the exam. If a student then wishes to have the final exam officially re-marked, they must go to Enrolment Services to complete a Review of Assigned Standing form and pay a fee, which is only refunded if the exam mark is raised.

COMPUTER LAB FACILITIES

The Mathematics Undergraduate Computer Lab is located in Room 310 in the Leonard S. Klinck (LSK) Building. Students can use any of the 42 Windows workstations and a printer networked to the Mathematics Unix servers. Users have access to various installed software to do course work, such as mathematical packages (Maple, Matlab, R), browsers and information readers (Firefox, email readers), editors and word processing (Open Office, TeX), and programming tools (GCC compilers, Java toolkit). In addition, Rooms 121 in LSK and 1042/1046 in the Earth Sciences Building (ESB) are available to Mathematics and Statistics undergraduates with lab accounts. Room 121 in LSK consists of 70 CAIL terminals which have Windows and Unix login with access to the same servers as in the Mathematics Undergraduate Computer Lab, as well as to additional software from several Windows 2008 servers (Jumpin, Microsoft Office, Lindo and Lingo, Scientific Notepad). Rooms 1042 and 1046 in ESB each have 20 Mac workstations. Two printers are available, with a strictly enforced quota of 35 pages per course. **The labs are open Monday to Friday from 8:00 am to 5:00 pm**, provided they have not been reserved by an instructor. All labs are closed on weekends and holidays.

CO-OPERATIVE EDUCATION PROGRAMS

Second- and third-year students can apply to pursue a Co-operative Education Program in Mathematics which involves work placements in addition to regular study. For information concerning the Co-op Education Program in Science, contact the Science Co-operative Education Office, Room 170, Chemistry and Physics Building, 6221 University Boulevard (604-822-9677). For information concerning the Co-op Education Program in Arts, contact the Arts Co-operative Education Office, Room C121, Buchanan Building, 1866 Main Mall (604-822-1529).

MATH CLUB (www.facebook.com/ubcmathclub)

All Mathematics undergraduates are strongly encouraged to join the Math Club located in Mathematics Annex 1119. The Math Club plays the role of a social centre for Mathematics students. It organizes lectures, study sessions, mentoring, and social functions, and it has a library, telephone, refrigerator, cheap food and pop, etc. The membership fee is nominal. Just prior to the December and April examination periods, the Math Club sells copies of previous final exams and solutions for most first- and second-year and some third-year Math courses.

MATH LEARNING CENTRE (MLC) (www.math.ubc.ca/~MLC)

The Math Learning Centre is a space for undergraduate students to study Math together, with support from Math Tutors who are graduate students in the Math Department. It is located in Rooms 301 and 302 in the Leonard S. Klinck (LSK) Building, and is open weekdays during the term and on a special schedule during the exam period. For a detailed description of the MLC, its schedule, announcements, and all other MLC-related information, visit the new website (noted above). There is no charge for the services MLC provides.

MATHEMATICS LIBRARY

All Mathematics undergraduates are strongly encouraged to make full use of the Mathematics Library, located in the Irving K. Barber Learning Centre (Level 4, North Wing). The online resources of books and journals are substantial.

PUTNAM COMPETITION (www.math.ubc.ca/~gerg/index.shtml?putnam)

Students are strongly encouraged to participate in the prestigious undergraduate Putnam Mathematics Competition. UBC has consistently ranked high in this North American competition for many years. There are special Lawrence Roberts Putnam Awards for UBC students who finish in the top 200. Registration is free and can be done on the department's Putnam webpage. That page also contains answers to frequently asked questions, as well as scheduling information for practice sessions and contact information for further questions.

REGISTRATION PROBLEMS (www.math.ubc.ca/Ugrad/ugradRegistration.shtml)

If you encounter any registration problems, please contact the main Mathematics Office (Room 121 in the Mathematics Building) (604-822-2666).

SUPPLEMENTAL EXAMINATIONS

Supplemental Examinations and Examinations for "Higher Standing" are unavailable in any Mathematics course.

TRANSFER CREDITS

Students with questions concerning transfer credits from other institutions or other faculties should contact Dr. Lior Silberman (lior@math.ubc.ca / 604-827-3031).

Notices of interest to undergraduates are posted on the bulletin board located in the hallway outside the main Mathematics Office (Room 121 in the Mathematics Building).
