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Why Mathematics?

The mathematician’s patterns, like the painter’s or the poet’s, must be beautiful; the ideas, like the colours or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics. —G.H. Hardy

Mathematics, as a study of patterns—both practical and abstract—involves analytical thought, logical reasoning, problem solving skills, and precise communication. Because of its power and versatility, mathematics has been crowned “Queen of the Sciences.” There is no field of scientific inquiry that does not express itself through the language of mathematics. The kinds of analytics and logical thinking skills that one develops while studying mathematics are precisely the skills that recruiters look for in potential employees. Jobs involving significant mathematical background also consistently rank near the top of the list in annual career surveys. In CareerCast.com's 2016 rankings of the 200 best jobs, among the top ten were: (#1) Data Scientist, (#2) Statistician, (#6) Mathematician, and (#10) Actuary. Other highly-ranked jobs requiring a large amount of mathematical background included Software Engineer (#7), Computer Systems Analyst (#8), Biomedical Engineer (#14), Financial Analyst (#27), Economist (#24), Petroleum Engineer (#20), Meteorologist (#16), Physicist (#21), Pharmacist (#29), and Accountant (#33). Other careers that depend deeply on mathematics:

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<tr>
<th>Actuarial and Insurance</th>
<th>Teaching/Academic Research</th>
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<tr>
<td>Actuary, Insurance Underwriter, Accountant, Investment Analyst, Benefits Specialist, Financial Planner, Banker</td>
<td>Teacher/Junior High/High School, College or University Professor</td>
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<tr>
<td>Health</td>
<td>Statistics</td>
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<tr>
<td>Ecologist, Biomathematician, Biomedical Engineer</td>
<td>Analytical Statistician, Theoretical Statistician, Demographer, Quality Control Analyst, Econometrician, Psychometrician, Biometrician</td>
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<tr>
<td>Computer &amp; Information Sciences</td>
<td>Business/Industry</td>
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An undergraduate degree in mathematics provides an excellent foundation for those interested in pursuing advanced degrees in mathematics or other more specialized professions, some of which are listed above. Mathematics is also an outstanding pre-professional degree for students considering allied fields such as law, business administration, and medicine.

Mathematics at DePaul

The department offers a BA or BS in Mathematics, a BS in Actuarial Science, and a BS in Mathematics & Computer Science, as well as a minor in either Mathematics or Statistics. It also offers Combined Bachelor of Mathematical Sciences (BA/BS) and graduate degrees in Applied Mathematics (MS), Applied Statistics (MS), Pure Mathematics (MS), and Secondary Education Mathematical Sciences (MEd), all of which allow completion of a bachelor's degree and a graduate degree in five years.
Student Resources, Activities & Organizations

Mathematics Tutoring & Computer Labs

The department maintains two separate mathematics tutoring labs, one on each main campus, to offer free tutoring to undergraduates enrolled in a math class. On the Lincoln Park Campus the lab is located in SAC 521, in the heart of the Department of Mathematical Sciences. Tutoring is generally available on certain weekend days in O’Connell 300. In the Loop, the tutoring lab is in Lewis Hall #1662. On both campuses, students can come on a drop-in basis during the regular school year, any week of classes except finals week. There they can get tutoring from math students who are often mathematics majors. The Lab schedules are generally posted online and outside the door, and at go.depaul.edu/math. These spaces also make computing available through a limited number of networked PCs. In addition, the PC labs in O’Connell 300 (LPC) are generally available for student use when classes are not taking place there.

The website listed above also has extensive and current information on tutoring and practice materials, as well as announcements of current departmental events.

Student Employment—Tutoring & Grading

The Mathematics Labs listed above offer opportunities for students to engage in tutoring their fellow students as paid lab tutors.

There is also the opportunity for students who have completed Calculus to grade homework for various lower- and upper-level mathematics courses. Students are paid to work with faculty members to evaluate the homework papers their classes.

For more information or to sign up for either math tutoring or grading, please contact Nydia Rodriguez (nrodrigu@depaul.edu, 773-325-4878).

Internships

Students enrolled in the Actuarial Science, Statistics, or Financial Mathematics concentrations are heartily encouraged to participate in the department’s internship program, which facilitates internships at many local well-known companies such as Allstate, North American, Blue Cross Blue Shield, CNA, Capital One, and Zurich. Internship fairs are held periodically which give students an opportunity to meet with representative of these and other companies, and explore the possibilities for corporate internships.

Interested students should contact Desale Habtzghi (dhabtzgh@depaul.edu, 773.325.4054), or the Career Center (careercenter.depaul.edu, DPC: 312.362.8437, LPC: 773.325.7431).
**Student Research**

The faculty view research as an integral part of academic preparation at both the graduate and undergraduate levels. Consequently many on-campus research opportunities are provided for students. Research projects vary in nature and scope, and often take place during the summer and carry significant amounts of financial support. In the past, students have participated in research that has led to presentations at conferences and even publications in professional journals.

Further questions about student research should be sent to CSHResearch@depaul.edu. You may also explore research opportunities by either calling 773-325-8490 or emailing CSHAdvising@depaul.edu.

**Advising**

When you declare a major in Mathematics (no matter the concentration), you should then contact the Department Chair, Dr. Ahmed I. Zayed, at (773) 325-7808 or at azayed@depaul.edu, so that a department faculty member can be assigned as your academic advisor. If you do not know who your advisor is, check Campus Connect (campusconnect.depaul.edu). It is recommended that mathematics majors meet with a mathematics advisor at least twice a year.

**Putnam Competition**

The William Lowell Putnam Mathematical Competition is a highly prestigious (and legendarily difficult) mathematics examination administered each year by the Mathematical Association of America. The department holds an ongoing series of coaching sessions to help students prepare for the exam, and each year fields a team to represent DePaul.

**Student Accomplishments**

The department is very proud of the accomplishments of its students, whose recent achievements include:

**Student Publications**: Students in the department authored or coauthored four papers which have been published in peer-reviewed journals such as *DePaul Discoveries* and *College Mathematics Journal*.

**Conference and REU Participation**: Recent undergraduates have participated at conferences or REUs (Research Experiences for Undergraduates) at the University of Chicago, Carleton College, and Rose-Hulman Institute of Technology.

**Putnam Exam**: In the 2013 exam, Matthew McGrail was ranked 266 out of 4113 participants worldwide, a remarkable achievement.

**Graduate School**: After completing their undergraduate degree at DePaul University, students have recently gone on to pursue graduate work at City University of New York, Northwestern University, University of Chicago, University of Iowa, University of Nebraska, Lincoln; University of Nevada, Las Vegas; University of Rochester, and the University of Victoria.

**Employment**: As examples, some recent graduates have been hired at firms such as CNA, Allstate, and Amazon.com, while others have secured positions at organizations such as Math for America and Teaching for America.
Student Organizations

Actuarial Club

The DePaul Actuarial Science Club is an organization of undergraduate and graduate students at DePaul University who are interested in Actuarial Science. The club seeks to mentor interested students by:

- Inviting professionals to speak about the Actuarial industry.
- Helping students network with their peers and industry figureheads.
- Organizing study groups for the Society of Actuaries (SOA) exams.

For the most up-to-date information on the Actuarial Club, visit orgsanddepartments.orgsync.com/org/depasc/home, or write to depaulactuarialclub@gmail.com.

Math Club

The DePaul Math Club typically meets at lunchtime each Friday during the academic year, and provides fun and interesting activities and programs to benefit all students of mathematics. The club features talks by faculty and students on interesting mathematical topics outside of the typical course content, in addition to regular fun features such as an integration bee and problem-solving sessions. For the most up-to-date information on the Math Club, visit orgsync.com/39792/chapter, write to depaulmathclub@gmail.com, or contact Nick Ramsey (nramsey@depaul.edu).

STATCOM Chicago—Pro Bono Statistical Consulting

Statistics in the Community (STATCOM) is an organization of graduate statistics students that offers pro bono statistical consulting services to local businesses and organizations for the purpose of creating a culture of service while engaging students in consulting and leadership work. Founded at Purdue University in 2001, the STATCOM network now extends nationwide.

STATCOM Chicago was launched at DePaul University in 2008. Today the group serves clients in the Chicagoland area with the help of students from the Illinois Institute of Technology, the University of Illinois at Chicago, and Rosalind Franklin University.

For the most up-to-date information on STATCOM Chicago, visit orgsync.com/48609/chapter, or write to statcomchicagodepaul@gmail.com.

Memberships in Professional Organizations

Students are encouraged to take advantage of the opportunities offered by professional organizations that provide valuable resources such as job services, networking, and mathematical discussion groups. Special student rates are often available. These organizations include:

- American Mathematical Society—ams.org
- Mathematical Association of America—maa.org
- SACNAS—Society for the Advancement of Chicanos/Hispanics & Native Americans in Science—sacnas.org
- Society for Industrial & Applied Mathematics—siam.org
Scholarships

Student Scholarships

Several scholarships are available to undergraduate mathematics students at DePaul. These vary widely in monetary amounts and eligibility requirements, but those available to mathematics students include:

- Allstate Actuarial Scholarship (for actuarial students)
- Effron Family Scholarship for Pure Mathematics
- Richard K. Matthei Memorial Scholarship
- Rev. Charles F. Shelby Endowed Scholarship
- Briefs-Waters Memorial Endowed Scholarship
- The James & Mary Schaefer Liberal Arts & Sciences Endowed Scholarship

CSH Scholarships

Other scholarships for mathematics majors or for general science, are also made available through the Department of Mathematical Sciences or through the College of Science & Health. For more information, contact Yevgenia Kashina (ykashina@depaul.edu, 773-325-1351) or visit go.depaul.edu/math.

Student Awards

Walter A. Pranger Memorial Prize in Mathematical Sciences

The Walter A. Pranger Memorial Prize recognizes outstanding undergraduate scholarship in the mathematical sciences. The prize takes its name Dr. Walter A. Pranger, Professor of Mathematical Sciences at DePaul, honoring his 35-year commitment to excellence in teaching at DePaul University. The prize awards at least $500 annually to a graduating senior. To be eligible, a student must:

- Be a graduating senior with strong academic credentials in mathematics, education, computer science, commerce or music
- Demonstrate an interest in advancing the study of mathematics
- Demonstrate an interest in applying mathematics in innovative ways

Outstanding Mathematics Student

The Outstanding Student Award goes to an outstanding graduating senior, based on GPA in all mathematics classes taken here at DePaul, as well as other factors.

Actuarial Exam Reimbursement Award

For students who have passed an actuarial exam by SOA or CAS. Award is $100 per exam.
The Department of Mathematical Sciences offers courses in pure, applied mathematics and statistics to help students reach a wide variety of intellectual, academic, and career goals.

Many students come to the department to obtain the mathematical background needed to be successful in programs in the natural sciences, computer science, social sciences, and business. Such students may choose to supplement their major in their home department by obtaining a minor in mathematics.

Other students come to the department seeking a program leading to an undergraduate or graduate degree in one of the mathematical sciences. Undergraduate students majoring in mathematical sciences may choose one of seven areas of concentration:

- **Actuarial Science**—Prepares students to work for insurance or pension consulting firms, and government.
- **Applied and Computational Mathematics**—Prepares students for employment as quantitative analysts, computational scientists, and applied mathematicians, as well as continued study of applied or discrete mathematics at the graduate level.
- **Financial Mathematics**—This concentration is a Mathematics Major that is attached to a Finance Minor. It includes courses that are relevant to contemporary financial mathematical modeling, along with courses in Finance and their prerequisites.
- **Individualized Concentration**—Students may consult with a mathematics faculty advisor and the department chair to create an individualized program of study leading to a degree in mathematics.
- **Pure Mathematics**—Provides a broad mathematical exposure for students who are interested in studying and/or doing mathematical research at the graduate level.
- **Quantitative Analysis and Operations Research**—Provides students with the mathematical background to work in finance, computer applications, and production scheduling and forecasting.
- **Statistics**—Offers students a solid foundation in probability and statistics. Statisticians are employed by government, industry, marketing research companies, and consulting firms to design surveys and experiments and to analyze statistical data.

A thesis option is available to mathematics majors who wish to pursue an extended independent project related to a theoretical or applied focus of the program. Students would work under the guidance of a faculty mentor. At least 4 credits must be completed over one or two quarters prior to the thesis submission. Interested students are strongly encouraged to enroll in MAT 390 during their junior year.

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<th>Requirement</th>
<th>BA Mathematics</th>
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<td>Liberal Studies Requirements</td>
<td>80 hours</td>
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<td>Major Requirements</td>
<td>32-36 hours</td>
<td>48-52 hours</td>
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<td>Major Concentration Requirements</td>
<td>24-28 hours</td>
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<tr>
<td>Open Electives</td>
<td>48-56 hours</td>
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<td><strong>Total hours required</strong></td>
<td><strong>192 hours</strong></td>
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B.A./B.S. Mathematical Sciences
Major Requirements

Common Core

- Choose one of the following Calculus sequences:
  - Sequence One
    * MAT 150 CALCULUS I
    * MAT 151 CALCULUS II
    * MAT 152 CALCULUS III
  - Sequence Two
    * MAT 147 CALCULUS WITH INTEGRATED PRECALCULUS I
    * MAT 148 CALCULUS WITH INTEGRATED PRECALCULUS II
    * MAT 149 CALCULUS WITH INTEGRATED PRECALCULUS III
  - Sequence Three
    * MAT 160 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I
    * MAT 161 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS II
    * MAT 162 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS III
  - Sequence Four
    * MAT 170 CALCULUS FOR LIFE SCIENCES I
    * MAT 171 CALCULUS FOR LIFE SCIENCES II
    * MAT 149, MAT 152 OR MAT 162
  - Sequence Five
    * MAT 155 SUMMER CALCULUS I
    * MAT 156 SUMMER CALCULUS II

- MAT 260 MULTIVARIABLE CALCULUS I
- MAT 261 MULTIVARIABLE CALCULUS II
- MAT 262 LINEAR ALGEBRA
- One of the following options
  - MAT 215 INTRODUCTION TO MATHEMATICAL REASONING
  - Discrete Mathematics Sequence
    * MAT 140 DISCRETE MATHEMATICS I
    * MAT 141 DISCRETE MATHEMATICS II

- CSC 241 INTRODUCTION TO COMPUTER SCIENCE I, or a more advanced course in any programming language.

- (B.S. only) Students must earn at least 16 quarter hours as four courses in the natural or computer sciences, or in GEO 241, GEO 243, or GEO 345.

Concentration Requirements

Students must also complete the requirements from one of the following concentrations: Pure Mathematics; Statistics; Actuarial Science; Financial Mathematics; Quantitative Analysis and Operations Research; Applied and Computational Mathematics; or Individualized.

If the student chooses to declare more than one Mathematical Sciences concentration, then the student must complete the requirements for each concentration, and take at least three additional 300-level courses overall. For example, a student earning two concentrations would have taken at least nine 300-level courses, and a student earning three concentrations would have taken at least twelve 300-level courses.
Actuarial Science Concentration

Actuarial Science uses mathematics, statistics and financial theory to study uncertain future events, especially those that relate to risk management and insurance programs. This concentration prepares students to work for insurance or pension consulting firms, and government.

Course Requirements

- **Required Courses**
  - MAT 351 PROBABILITY AND STATISTICS I
  - MAT 352 PROBABILITY AND STATISTICS II
  - MAT 353 PROBABILITY AND STATISTICS III
  - MAT 361 THEORY OF INTEREST
  - MAT 362 LIFE CONTINGENCIES I
  - MAT 363 LIFE CONTINGENCIES II

- **Open Electives**
  
  Open elective credit also is required to meet the minimum graduation requirement of 192 hours.

**Recommended Mathematics Courses**

- MAT 341 STATISTICAL METHODS USING SAS
- MAT 355 STOCHASTIC PROCESSES
- MAT 356 APPLIED REGRESSION ANALYSIS
- MAT 358 APPLIED TIME SERIES AND FORECASTING
- MAT 359 SIMULATION MODELS AND MONTE CARLO METHOD
- MAT 364 STOCHASTIC RISK MODELS
- MAT 367 CREDIBILITY THEORY
- MAT 368 MATHEMATICS FOR FINANCE

**Additional Recommended Courses**

- ACC 101 INTRODUCTION TO ACCOUNTING I
- ECO 105 PRINCIPLES OF MICROECONOMICS
- ECO 106 PRINCIPLES OF MACROECONOMICS
- FIN 310 INTRODUCTION TO FINANCE
- FIN 311 CORPORATE FINANCE
- FIN 317 PRINCIPLES OF CORPORATE FINANCE FOR ACTUARIES (requires permission from Finance Dept)
- FIN 320 MONEY AND BANKING
- FIN 330 INVESTMENTS: THEORY & PRACTICE
- FIN 335 PORTFOLIO MANAGEMENT
- FIN 362 RISK MANAGEMENT
- FIN 363 DERIVATIVES: PRICING & APPLICATIONS
Course Scheduling

- Unless otherwise specified, assume Calculus I-II-III in Y1 and MAT 260-1-2 in Y2.
- MAT 215 can be taken in any quarter of Y2.
- MAT 140 and 141 are typically offered each quarter and may be taken in Y1 or Y2.
- MAT 140-141/215 is required for MAT 301, 302, 303, 310, 320, 335, 337, 340, 370, 372.
- CSC 241 is offered every quarter.
- JYEL Courses in the department are MAT 397 (Autumn-Winter) and MAT 390 (Spring).
- Thesis writers should take MAT 396 during the Autumn and/or Winter of Y4.
- Students who want to take MAT 368 need to take MAT 352 and MAT 361 first.
- FIN 310 requires ACC 101-102 and ECO 105-106, and MAT 135-137.
- It is recommended that MAT 361 be taken in the sophomore year.

Sample Track

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Key

- Required
- Electives
Applied & Computational Mathematics Concentration

The concentration in Applied and Computational Mathematics is intended for any student who enjoys mathematics, problem solving, and applications to solving practical problems in business, government, and science. The concentration is especially intended for students seeking a career as quantitative analysts, computational scientists, and applied mathematicians, and for those thinking of continuing the study of applied or discrete mathematics at the graduate level.

Course Requirements

• **CSC 242 INTRODUCTION TO COMPUTER SCIENCE II** or another approved computer science course.

• Three courses chosen from the following list:
  - MAT 302 COMBINATORICS
  - MAT 304 DIFFERENTIAL EQUATIONS
  - MAT 384 MATHEMATICAL MODELING
  - MAT 385 NUMERICAL ANALYSIS I

• Two additional courses chosen from among the above and the following list:
  - MAT 335 REAL ANALYSIS I
  - MAT 351 PROBABILITY AND STATISTICS I
  - MAT 352 PROBABILITY AND STATISTICS II
  - MAT 370 ADVANCED LINEAR ALGEBRA
  - MAT 381 FOURIER ANALYSIS AND SPECIAL FUNCTIONS
  - MAT 386 NUMERICAL ANALYSIS II

• One additional course chosen from among the above and the following list:
  - MAT 303 THEORY OF NUMBERS
  - MAT 310 ABSTRACT ALGEBRA I
  - MAT 311 ABSTRACT ALGEBRA II
  - MAT 330 METHODS OF COMPUTATION AND THEORETICAL PHYSICS I
  - MAT 331 METHODS OF COMPUTATION AND THEORETICAL PHYSICS II
  - MAT 336 REAL ANALYSIS II
  - MAT 337 COMPLEX ANALYSIS
  - MAT 340 TOPOLOGY
  - MAT 341 STATISTICAL METHODS USING SAS
  - MAT 353 PROBABILITY AND STATISTICS III
  - MAT 355 STOCHASTIC PROCESSES
  - MAT 387 OPERATIONS RESEARCH I: LINEAR PROGRAMMING
  - MAT 388 OPERATIONS RESEARCH II: OPTIMIZATION THEORY
Students interested in graduate study in applied mathematics are encouraged to take MAT 335-336, 370, 385-386.

- **Open Electives**

  Open elective credit also is required to meet the minimum graduation requirement of 192 hours.

### Course Scheduling

- Unless otherwise specified, assume Calculus I-II-III in Y1 and MAT 260-1-2 in Y2.
- MAT 215 can be taken in any quarter of Y2.
- MAT 140 and 141 are typically offered each quarter and may be taken in Y1 or Y2.
- MAT 140-141/215 is required for MAT 301, 302, 303, 310, 320, 335, 337, 340, 370, 372.
- CSC 241 is offered every quarter.
- MAT 385 has a programming prerequisite.
- JYEL Courses in the department are MAT 397 (Autumn-Winter) and MAT 390 (Spring).
- Thesis writers should take MAT 396 during the Autumn and/or Winter of Y4.
- MAT 381, 387, and 388 are also options, but they are not offered with enough regularity to list by quarter. If one of these is not offered in a given year, a student may request an independent study.
- MAT 330 and 331 are offered as PHY 300 and 301, respectively.

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<th>Year</th>
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**Key**

- Required
- Choose One
- Choose Three
- Choose Two*
- Choose One*

*Check Prerequisites
Financial Mathematics Concentration

This concentration is a Mathematics Major that is attached to a Finance Minor. It includes courses that are relevant to contemporary financial mathematical modeling, along with courses in Finance and their prerequisites. The Finance Minor is designed to complement the mathematics coursework.

Course Requirements

- In addition to completing a Finance Minor, the following mathematics courses are required:
  - MAT 304 DIFFERENTIAL EQUATIONS or MAT 385 NUMERICAL ANALYSIS I
  - MAT 351 PROBABILITY AND STATISTICS I
  - MAT 352 PROBABILITY AND STATISTICS II
  - MAT 353 PROBABILITY AND STATISTICS III
  - MAT 355 STOCHASTIC PROCESSES
  - MAT 368 MATHEMATICS FOR FINANCE

- Open Electives

  Open elective credit also is required to meet the minimum graduation requirement of 192 hours.

- Finance Minor requirements

  - ACC 101 INTRODUCTION TO ACCOUNTING I
  - ACC 102 INTRODUCTION TO ACCOUNTING II
  - ECO 105 PRINCIPLES OF MICROECONOMICS
  - ECO 106 PRINCIPLES OF MACROECONOMICS
  - FIN 202 QUANTITATIVE REASONING
  - FIN 310 INTRODUCTION TO FINANCE
  - FIN 311 CORPORATE FINANCE
  - FIN 320 MONEY AND BANKING
  - FIN 330 INVESTMENTS: THEORY & PRACTICE

- Two electives chosen from the following list:

  - FIN 313 INVESTMENT BANKING
  - FIN 323 COMMERCIAL BANKING
  - FIN 333 FINANCIAL STATEMENTS ANALYSIS
  - FIN 335 PORTFOLIO MANAGEMENT
  - FIN 340 INTERNATIONAL FINANCE
  - FIN 362 RISK MANAGEMENT
  - FIN 363 DERIVATIVES: PRICING & APPLICATIONS
  - FIN 380 CASES IN FINANCIAL DECISION MAKING
  - FIN 393 FINANCE INTERNSHIP
  - FIN 395 INVESTMENT SEMINAR
  - FIN 398 SPECIAL TOPICS
  - FIN 399 INDEPENDENT STUDY
Additional Recommended Courses

- MAT 341 STATISTICAL METHODS USING SAS
- MAT 370 ADVANCED LINEAR ALGEBRA
- MAT 358 APPLIED TIME SERIES AND FORECASTING
- MAT 356 APPLIED REGRESSION ANALYSIS

Course Scheduling

- Unless otherwise specified, assume Calculus I-II-III in Y1 and MAT 260-1-2 in Y2.
- MAT 215 can be taken in any quarter of Y2.
- MAT 140 and 141 are typically offered each quarter and may be taken in Y1 or Y2.
- MAT 140-141/215 is required for MAT 301, 302, 303, 310, 320, 335, 337, 340, 370, 372.
- CSC 241 is offered every quarter.
- MAT 385 has a programming prerequisite.
- JYEL Courses in the department are MAT 397 (Autumn-Winter) and MAT 390 (Spring).
- Thesis writers should take MAT 396 during the Autumn and/or Winter of Y4.

### Key

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<tr>
<th></th>
<th>Required</th>
<th>Choose One</th>
<th>Choose One</th>
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</thead>
</table>

Individualized Mathematics Concentration

Students may consult with a mathematics faculty advisor and the department chair to create an individualized program of study leading to a degree in mathematics.
Pure Mathematics Concentration

This concentration provides a broad mathematical exposure for students who are interested in studying and/or doing mathematical research at the graduate level.

Course Requirements

- Three courses to be chosen from the following list
  
  MAT 310 ABSTRACT ALGEBRA I
  MAT 311 ABSTRACT ALGEBRA II
  MAT 335 REAL ANALYSIS I
  MAT 336 REAL ANALYSIS II

- Three additional mathematics courses from the following list
  
  MAT 301 HISTORY OF MATHEMATICS
  MAT 302 COMBINATORICS
  MAT 303 THEORY OF NUMBERS
  MAT 311 ABSTRACT ALGEBRA II
  MAT 312 ABSTRACT ALGEBRA III
  MAT 320 GEOMETRY I
  MAT 321 GEOMETRY II
  MAT 336 REAL ANALYSIS II
  MAT 337 COMPLEX ANALYSIS
  MAT 304 DIFFERENTIAL EQUATIONS
  MAT 340 TOPOLOGY
  MAT 348 APPLIED STATISTICAL METHODS
  MAT 351 PROBABILITY AND STATISTICS I
  MAT 352 PROBABILITY AND STATISTICS II
  MAT 353 PROBABILITY AND STATISTICS III
  MAT 370 ADVANCED LINEAR ALGEBRA
  MAT 372 LOGIC AND SET THEORY
  MAT 385 NUMERICAL ANALYSIS I
  MAT 386 NUMERICAL ANALYSIS II (CROSS-LISTED WITH MAT 486 & CSC 386/486)

- Open Electives
  
  Open elective credit also is required to meet the minimum graduation requirement of 192 hours.

Recommended Course Selections

For students interested in graduate study in mathematics:

MAT 310 ABSTRACT ALGEBRA I
MAT 311 ABSTRACT ALGEBRA II
MAT 312 ABSTRACT ALGEBRA III
MAT 335 REAL ANALYSIS I
MAT 336 REAL ANALYSIS II
MAT 337 COMPLEX ANALYSIS
For students interested in graduate study in economics, finance, or statistics:

MAT 351 PROBABILITY AND STATISTICS I
MAT 352 PROBABILITY AND STATISTICS II
MAT 353 PROBABILITY AND STATISTICS III
A&S 491 ADMINISTRATIVE THEORY AND BEHAVIOR
MAT 336 REAL ANALYSIS II

Course Scheduling

- Unless otherwise specified, assume Calculus I-II-III in Y1 and MAT 260-1-2 in Y2.
- MAT 215 can be taken in any quarter of Y2.
- MAT 140 and 141 are typically offered each quarter and may be taken in Y1 or Y2.
- MAT 140-141/215 is required for MAT 301, 302, 303, 310, 320, 335, 337, 340, 370, 372.
- CSC 241 is offered every quarter.
- MAT 385 has a programming prerequisite.
- JYEL Courses in the department are MAT 397 (Autumn-Winter) and MAT 390 (Spring).
- Thesis writers should take MAT 396 during the Autumn and/or Winter of Y4.

Key

- Required
- Choose One
- Choose Three*
- Choose One

*Check Prerequisites
Quantitative Analysis and Operations Research Concentration

This concentration provides students with the mathematical background to work in finance, computer applications, and production scheduling and forecasting.

Course Requirements

- **Required Courses**
  - MAT 351 PROBABILITY AND STATISTICS I
  - MAT 352 PROBABILITY AND STATISTICS II
  - MAT 353 PROBABILITY AND STATISTICS III

- **Three courses from the following list**
  - MAT 356 APPLIED REGRESSION ANALYSIS
  - MAT 358 APPLIED TIME SERIES AND FORECASTING
  - MAT 387 OPERATIONS RESEARCH I: LINEAR PROGRAMMING
  - MAT 388 OPERATIONS RESEARCH II: OPTIMIZATION THEORY

- **Open Electives**
  Open elective credit also is required to meet the minimum graduation requirement of 192 hours.

Additional Recommended Courses

- MAT 370 ADVANCED LINEAR ALGEBRA
- MAT 384 MATHEMATICAL MODELING
- MAT 385 NUMERICAL ANALYSIS I
- MAT 386 NUMERICAL ANALYSIS II
- MAT 389 OPERATIONS RESEARCH III
- CSC 389 THEORY OF COMPUTATION

Course Scheduling

- Unless otherwise specified, assume Calculus I-II-III in Y1 and MAT 260-1-2 in Y2.
- MAT 215 can be taken in any quarter of Y2.
- MAT 140 and 141 are typically offered each quarter and may be taken in Y1 or Y2.
- MAT 140-141/215 is required for MAT 301, 302, 303, 310, 320, 335, 337, 340, 370, 372.
- CSC 241 is offered every quarter.
- MAT 385 has a programming prerequisite.
- JYEL Courses in the department are MAT 397 (Autumn-Winter) and MAT 390 (Spring).
- Thesis writers should take MAT 396 during the Autumn and/or Winter of Y4.

<table>
<thead>
<tr>
<th>Course</th>
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<td>MAT 388</td>
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</tbody>
</table>

**Key**

- Required
- Choose One
- Choose Three
- *Occasional
Statistics Concentration

This concentration offers students a solid foundation in probability and statistics. Statisticians are employed by government, industry, marketing research companies, and consulting firms to design surveys and experiments and to analyze statistical data.

Course Requirements

- Required Courses
  - MAT 351 PROBABILITY AND STATISTICS I
  - MAT 352 PROBABILITY AND STATISTICS II
  - MAT 353 PROBABILITY AND STATISTICS III
  - MAT 341 STATISTICAL METHODS USING SAS
  - MAT 356 APPLIED REGRESSION ANALYSIS
  - MAT 326 SAMPLE SURVEY METHODS or MAT 328 DESIGN OF EXPERIMENTS

- Open Electives

Open elective credit also is required to meet the minimum graduation requirement of 192 hours.

Additional Recommended Courses

- MAT 354 MULTIVARIATE STATISTICS
- MAT 355 STOCHASTIC PROCESSES
- MAT 357 NONPARAMETRIC STATISTICS
- MAT 358 APPLIED TIME SERIES AND FORECASTING
- MAT 335 REAL ANALYSIS I
- MAT 336 REAL ANALYSIS II
- MAT 370 ADVANCED LINEAR ALGEBRA
- MAT 385 NUMERICAL ANALYSIS I
- MAT 386 NUMERICAL ANALYSIS II

Students interested in graduate study in mathematical statistics are encouraged to take the following:

- MAT 335 REAL ANALYSIS I
- MAT 336 REAL ANALYSIS II

Course Scheduling

- MAT 348 only requires Calculus II, so it can be taken any time after Y1, but we recommend taking it in Y3 or Y4.
- All other notes are the same as those listed on previous page.

### Key

- **Required**
- **Choose One**
- **Choose Three**
- **Electives**
B.S. Actuarial Science
Overview

The Actuarial Science program will prepare you to analyze the financial consequences of risk and uncertainty. You will use mathematics, statistics and financial theory to study uncertain future events, especially those that relate to risk management and insurance programs. More specifically, you will learn to:

- Apply the laws of probability and statistics to solve actuarial problems.
- Understand the theory of interest and its applications to the pricing of securities.
- Calculate the financial costs and benefits of insurance for various individuals.
- Design, implement and monitor life contingency models.
- Describe risk management frameworks and identify how specific risks can be quantified.

Curriculum

We offer courses that will prepare you to pass actuarial exams offered by the Society of Actuaries and the Casualty Actuarial Society, as well as courses that will allow you to satisfy other requirements in the actuarial credentialing process.

Faculty

Our actuarial faculty consists of dedicated teachers, industry experts and accomplished academicians. For short bios and contact information, visit depaul.edu.

Alumni

Students graduating with an Actuarial Science degree usually work in:

- Insurance and reinsurance companies
- Consulting firms
- Professional, scientific, and technical services
- Management of companies and enterprises
- Funds, trusts, and other financial vehicles
- Government

One of our strengths is the extensive network of DePaul graduates with successful careers in the industry, both in Chicago and across the nation. Read about their experience and career paths at depaul.edu.

Resources & Actuarial Club

DePaul has a very active Actuarial Science Club, which promotes the study of actuarial science and the pursuit of actuarial careers by DePaul students. Current information can be accessed through go.depaul.edu/math.
B.S. Actuarial Science

Major Requirements

Common Core

- ACC 101 INTRODUCTION TO ACCOUNTING I
- ACC 102 INTRODUCTION TO ACCOUNTING II
- ECO 105 PRINCIPLES OF MICROECONOMICS
- ECO 106 PRINCIPLES OF MACROECONOMICS
- MAT 150 CALCULUS I
- MAT 151 CALCULUS II
- MAT 152 CALCULUS III
- BLW 201 LEGAL & ETHICAL ASPECTS IN THE BUSINESS ENVIRONMENT
- MAT 260 MULTIVARIABLE CALCULUS I
- MAT 262 LINEAR ALGEBRA
- MAT 351 PROBABILITY AND STATISTICS I
- MAT 352 PROBABILITY AND STATISTICS II
- MAT 353 PROBABILITY AND STATISTICS III
- MAT 361 THEORY OF INTEREST
- MAT 362 LIFE CONTINGENCIES I
- MAT 363 LIFE CONTINGENCIES II
- FIN 317 PRINCIPLES OF CORPORATE FINANCE FOR ACTUARIES
- FIN 320 MONEY AND BANKING
- FIN 362 RISK MANAGEMENT
- FIN 365 PRINCIPLES OF RISK & INSURANCE
- FIN 369 ACTUARIAL SCIENCE CAPSTONE COURSE
- ICS 392 SENIOR SEMINAR (Liberal Studies Program Capstone)

Math Requirements

- CSC 241 INTRODUCTION TO COMPUTER SCIENCE I
- MAT 341 STATISTICAL METHODS USING SAS
- MAT 356 APPLIED REGRESSION ANALYSIS
- MAT 358 APPLIED TIME SERIES AND FORECASTING
- MAT 368 MATHEMATICS FOR FINANCE
- One of the following options
  ◊ MAT 359 SIMULATION MODELS AND MONTE CARLO METHOD
  ◊ or MAT 364 STOCHASTIC RISK MODELS
B.S. Mathematics & Computer Science
Overview

The B.S. in Math and Computer Science is a joint degree between the College of Computing and Digital Media and the Department of Mathematics. It provides challenging opportunities to exceptional students with an interest in the highly theoretical nexus of math and computer science. Mathematics is a key element to the theory and practice of computer science and technology:

- Number theory forms the basis for encryption algorithms for messages sent over the Internet.
- Facts from projective geometry and multivariable calculus underlie the computer algorithms that control computer animation.
- Properties of abstract groups are instrumental in correcting transmission errors that occur when information is sent from one computer to another.
- Graph theory and combinatorics are used to create algorithms for Internet search engines and analyze Internet routing protocols.

This program is intended to appeal to academically talented students. It is designed to prepare them for graduate study in various areas of computer science such as theoretical computer science, graphics, data analysis, artificial intelligence, and computational methods and in areas in applied mathematics such as numerical analysis or discrete mathematics. The program is also designed to prepare students to compete for the more theoretical complex jobs found in computer software development.

Students in the program will explore a broad range of fields including:

- Theory of computation
- Computational mathematics
- Artificial intelligence
- Data analysis
- Graphics
- Computer vision

It is highly recommended that students concentrate on one or two areas for their advanced classes to achieve depth, but they are not required to do so. Faculty advisors are available to assist students in their selection.

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<td>Liberal Studies Requirements</td>
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<td><strong>Total hours required</strong></td>
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</table>
B.S. Mathematics & Computer Science
Major Requirements

Course Requirements

- CSC 241 INTRODUCTION TO COMPUTER SCIENCE I
- CSC 242 INTRODUCTION TO COMPUTER SCIENCE II
- CSC 300 DATA STRUCTURES IN JAVA I
- CSC 301 DATA STRUCTURES IN JAVA II
- CSC 321 DESIGN AND ANALYSIS OF ALGORITHMS
- CSC 373 COMPUTER SYSTEMS I
- CSC 374 COMPUTER SYSTEMS II
- CSC 394 SOFTWARE PROJECTS (Capstone)
  or GPH 395 COMPUTER GRAPHICS SENIOR PROJECT (Capstone)
  or MAT 398 SENIOR CAPSTONE SEMINAR (Capstone)
- MAT 140 DISCRETE MATHEMATICS I
- MAT 141 DISCRETE MATHEMATICS II
- Choose one of the following Calculus sequences:
  ◦ Sequence One
    * MAT 150 CALCULUS I
    * MAT 151 CALCULUS II
    * MAT 152 CALCULUS III
  ◦ Sequence Two
    * MAT 147 CALCULUS WITH INTEGRATED PRECALCULUS I
    * MAT 148 CALCULUS WITH INTEGRATED PRECALCULUS II
    * MAT 149 CALCULUS WITH INTEGRATED PRECALCULUS III
  ◦ Sequence Three
    * MAT 160 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I
    * MAT 161 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS II
    * MAT 162 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS III
  ◦ Sequence Four
    * MAT 170 CALCULUS FOR LIFE SCIENCES I
    * MAT 171 CALCULUS FOR LIFE SCIENCES II
    * MAT 149, MAT 152 OR MAT 162
  ◦ Sequence Five
    * MAT 155 SUMMER CALCULUS I
    * MAT 156 SUMMER CALCULUS II
- MAT 260 MULTIVARIABLE CALCULUS I
- MAT 262 LINEAR ALGEBRA
- 3 CDM Major Electives
- 3 MAT Major Electives
- 1 CDM or MAT Major Elective

Continued...
Major Electives

Students must take 7 Major Field electives chosen from the grouped list below. Of these, 3 must be CDM courses and 3 must be MAT courses, and 1 could be either a CDM or MAT course.

Students must earn a grade of C- or higher in all major elective courses.

It is recommended that students concentrate on one or two areas for their advanced classes to achieve depth, but they are not required to do so. Students are strongly encouraged to discuss course selection with an advisor. Students may wish to arrange with a professor to take an independent study or a research experience (MAT 399 or CSC 399 or IT 300) in order to explore a subject more deeply than is possible in a scheduled course.

Theory of Computation

The courses in the theory area explore the mathematical and logical foundations of computer science.

- MAT 302 COMBINATORICS
- MAT 303 THEORY OF NUMBERS
- MAT 304 DIFFERENTIAL EQUATIONS
- MAT 351 PROBABILITY AND STATISTICS I
- MAT 310 ABSTRACT ALGEBRA I
- MAT 311 ABSTRACT ALGEBRA II
- MAT 312 ABSTRACT ALGEBRA III
- MAT 335 REAL ANALYSIS I
- MAT 372 LOGIC AND SET THEORY
- CSC 235 PROBLEM SOLVING
- CSC 327 PROBLEM SOLVING FOR CONTESTS
- CSC 333 CRYPTOLOGY
- CSC 344 AUTOMATA THEORY AND FORMAL GRAMMARS
- CSC 347 CONCEPTS OF PROGRAMMING LANGUAGES
- CSC 348 INTRODUCTION TO COMPILER DESIGN
- CSC 358 SYMBOLIC PROGRAMMING
- CSC 387 OPERATIONS RESEARCH I: LINEAR PROGRAMMING or MAT 387 OPERATIONS RESEARCH I: LINEAR PROGRAMMING
- CSC 389 THEORY OF COMPUTATION

Computational Methods

The computational methods area investigates quantitative and computational methods in computer science.

- CSC 331 SCIENTIFIC COMPUTING
- MAT 385 NUMERICAL ANALYSIS I
- MAT 386 NUMERICAL ANALYSIS II
- MAT 330 METHODS OF COMPUTATION AND THEORETICAL PHYSICS I
- MAT 331 METHODS OF COMPUTATION AND THEORETICAL PHYSICS II
- MAT 384 MATHEMATICAL MODELING

Artificial Intelligence

For students with an interest in the computational relations between syntax and semantics.

- CSC 380 FOUNDATIONS OF ARTIFICIAL INTELLIGENCE
- CSC 357 EXPERT SYSTEMS
- CSC 358 SYMBOLIC PROGRAMMING
Data Analysis
For students who are interested in statistical and computational analysis of data. Many of the courses in this area require the student to take MAT 351-353.

- CSC 328 DATA ANALYSIS FOR EXPERIMENTERS
- CSC 334 ADVANCED DATA ANALYSIS
  or MAT 354 MULTIVARIATE STATISTICS
- CSC 367 INTRODUCTION TO DATA MINING
- MAT 261 MULTIVARIABLE CALCULUS II
- MAT 351 PROBABILITY AND STATISTICS I
- MAT 352 PROBABILITY AND STATISTICS II
- MAT 353 PROBABILITY AND STATISTICS III
- MAT 355 STOCHASTIC PROCESSES
- MAT 357 NONPARAMETRIC STATISTICS
- MAT 370 ADVANCED LINEAR ALGEBRA
- MAT 356 APPLIED REGRESSION ANALYSIS
- MAT 358 APPLIED TIME SERIES AND FORECASTING
- MAT 359 SIMULATION MODELS AND MONTE CARLO METHOD

Graphics
The graphics courses are intended for students who want to study the technical and mathematical foundations of computer graphics and animation.

- MAT 337 COMPLEX ANALYSIS
- MAT 261 MULTIVARIABLE CALCULUS II
- MAT 385 NUMERICAL ANALYSIS I
- GPH 211 PERCEPTUAL PRINCIPLES FOR DIGITAL ENVIRONMENTS I
- GPH 212 PERCEPTUAL PRINCIPLES FOR DIGITAL ENVIRONMENTS II
- GPH 325 SURVEY OF COMPUTER GRAPHICS
- GPH 329 COMPUTER GRAPHICS DEVELOPMENT II
- GPH 336 SMOOTH SURFACE MODELING FOR GRAPHICS AND ANIMATION
- GPH 372 PRINCIPLES OF COMPUTER ANIMATION

Computer Vision
Computer vision studies the mathematical and algorithmic underpinnings of image analysis and image processing.

- MAT 261 MULTIVARIABLE CALCULUS II
- MAT 335 REAL ANALYSIS I
- MAT 385 NUMERICAL ANALYSIS I
- MAT 370 ADVANCED LINEAR ALGEBRA
- MAT 384 MATHEMATICAL MODELING
- CSC 381 INTRODUCTION TO DIGITAL Image PROCESSING
- CSC 382 APPLIED IMAGE ANALYSIS

Research
- CSC 395 RESEARCH COLLOQUIUM
- CSC 399 INDEPENDENT STUDY
- MAT 390 MATHEMATICS READING AND RESEARCH
- MAT 396 SENIOR THESIS RESEARCH

- Open Electives
  Open elective credit also is required to meet the minimum graduation requirement of 192 hours.

- Degree Requirements
  Students in this degree must meet the following requirements:
  - Complete a minimum of 192 credit hours (generally 48 courses)
  - Earn a grade of C- or higher in WRD 103, WRD 104, and all Major and Minor courses
  - Earn a grade of D or higher in all other Liberal Studies and Open Elective courses
  - Maintain a cumulative GPA of 2.0 or higher
B.S. Mathematics & Computer Science
Advising Guide

Additional Course information

- **CSC 241/242 sequence:** The intro programming sequence (CSC 241/CSC 242) should be taken by Math-CS majors in the freshman year, i.e. as soon as possible. Incoming freshmen must make sure to take CSC 241 by the winter quarter; otherwise they will need to wait a full year to start their programming sequence. Students who have previous programming should not be placed into CSC 242, see next item on CSC 243.

- **CSC 243 vs CSC 241/242:** Students who have previous programming experience, but not the equivalent of two quarters of programming, should be placed into CSC 243, which combines the material of CSC 241/242 into a single quarter, but assumes that the students have previous programming experience. Students with extensive previous programming experience should have CSC 241/242 replaced by other courses, and be placed into CSC 300, the first Java/Data Structures course.

- **MAT 130 and CSC 241:** MAT130 is a prerequisite for CSC241. Students who place into MAT130 must take MAT130 in the fall so that they can start the programming sequence in the winter. However, the first course in the calculus sequence may not start in winter quarter, so students needing prerequisite math courses may need to delay the start of calculus until year 2. Because of the number of advanced math courses required in this degree, this may prolong the completion of the degree unless courses are made up over the summer.

- **MAT 140/141 vs MAT 215:** If a student took MAT 215, this should be applied to MAT 140, but the student should still take MAT 141.

Software & Hardware Recommendations

Following are the same recommendations given to BS-CS students:

The CS and SE programs are designed to be platform independent so a Window, Linux, or Mac machine will do. It is helpful for CS students to own a computer, and the likely choice is a laptop. One thing freshmen should keep in mind is that cheaper, low end machines may not be powerful enough to run the software built 4 years from now when they are seniors. They also tend to be less stable. So a machine that is mid-level to high-end is preferable.

Resources

- Computer Science Society: [http://css.cdm.depaul.edu/](http://css.cdm.depaul.edu/)
- The Association for Computing Machinery (ACM: [http://acm.org](http://acm.org)) is the largest educational and scientific computing society. Students are encouraged to get involved.
- Support for women at CDM: [http://www.cdm.depaul.edu/Current%20Students/Pages/WomeninIT.aspx](http://www.cdm.depaul.edu/Current%20Students/Pages/WomeninIT.aspx)
- Tutoring in math is offered by the department of Mathematical Sciences in the College of Science and Health. Visit their web site at [go.depaul.edu/math](http://go.depaul.edu/math) for more information.
Recommended First-Year Schedule

<table>
<thead>
<tr>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
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<tbody>
<tr>
<td>LSP 110 Discover; or LSP 111 Explore Chicago</td>
<td>Arts &amp; Literature course</td>
<td>LSP 112 Focal Point Seminar</td>
</tr>
<tr>
<td>WRD 103 Composition and Rhetoric I</td>
<td>WRD 104 Composition and Rhetoric II</td>
<td>Self, Society &amp; the Modern World course</td>
</tr>
<tr>
<td>CSC 241 Introduction to Computer Science I</td>
<td>CSC 242 Introduction to Computer Science II</td>
<td>CSC 300 Data Structures in Java I</td>
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<tr>
<td>MAT 150 Calculus I*</td>
<td>MAT 151 Calculus II*</td>
<td>MAT 152 Calculus III*</td>
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*Note that there are four other calculus sequences to choose from (the MAT 147 sequence, the 155 sequence, the MAT 160 sequence, and the MAT 170 sequence). It may be likely that students in this major opt for one of those sequences.*

Minors

- CDM offers a minor in Computer Science that consists of 7 courses.
- Refer to the “Academics” section of the CDM web site for more information about minors in CDM.
- The College of Science and Health offers minors in Mathematics and Statistics.
- Refer to the University Catalog for more information about minors in CSH.
- Notice that MAT 130 is a prerequisite for CSC 241. Unless students place in MAT 140, they need to take MAT 130 before starting the CS minor.

Policies specific to this degree

This is a joint degree that is offered between CDM and the College of Science and Health. Students from either college may declare this major.
Combined Bachelor’s/Master’s Degrees
Overview

The Department of Mathematical Sciences offers four combined degree options to undergraduate Mathematical Sciences majors who have achieved a high level of academic success and who are interested in earning both a Bachelor’s degree and a Master’s degree in an accelerated period. Most students complete the combined degree program in a total of about five years.

Program Offerings

- **Combined degree in Applied Mathematics (MS)**, with graduate concentrations in
  - Actuarial Science
  - Applied and Computational Mathematics
  - Mathematical Finance
  - Statistics

- **Combined degree in Applied Statistics (MS)**, with graduate concentrations in
  - Biostatistics
  - Data Science
  - General Applied Statistics

- **Combined degree in Pure Mathematics (MS)**

- **Combined degree in Secondary Education Mathematics (MEd)**

Students may apply for entry into a combined degree program during their junior year of study, and if accepted, can then take up to three graduate courses during their senior year. Those three courses then count toward both the Bachelor’s degree and the Master’s degree.

Students in a combined degree program must apply for undergraduate degree conferral in anticipation of their fourth year of undergraduate study. Once students earn their undergraduate degree from DePaul, they then matriculate as a graduate student and complete the remaining required courses for their Master’s degree.

Typical Graduate Course Load for Combined Degree Program Students

- **Fourth/Senior year**
  - Autumn: One graduate course
  - Winter: One graduate course
  - Spring: One graduate course (student completes undergraduate degree requirements and matriculates as a graduate student for Autumn Quarter)

- **Fifth/Graduate year**
  - Autumn: Three graduate courses
  - Winter: Three graduate courses
  - Spring: Three graduate courses
Double Demon Discount

Alumni from any of DePaul’s colleges who are admitted into a graduate degree program in the College of Science and Health automatically qualify for the Double Demon Discount. Combined degree program students are also eligible. This scholarship covers 25% of the tuition for a Master’s degree in the College of Science and Health. Both full-time and part-time students are eligible. No scholarship application is required; all alumni admitted to these programs qualify. For more information, contact the Office of Graduate Admission at GradDePaul@depaul.edu or (773) 325-7315.

The Double Demon Discount cannot be used in conjunction with other DePaul Scholarships, waivers, or awards. DePaul University employees are eligible for other employee tuition benefits through the university, and hence are not eligible for the Double Demon Discount.

Combined Degree in Applied Mathematics (MS)

The tools of Applied Mathematics are applicable wherever quantitative data is used for strategic decision-making. The combined degree program in Applied Mathematics is designed to provide undergraduate students with the quantitative background they need in order to apply those tools in their chosen career. The program also provides a solid foundation for students interested in pursuing a PhD-level graduate work in applied mathematics.

Combined Degree Program Admission Criteria

Students applying for admission to the combined degree program in Applied Mathematics should have already completed the following undergraduate coursework:

- One year of single-variable calculus (e.g., MAT 150-151-152, or equivalent)
- Two quarters of multivariable calculus (MAT 260 and MAT 261)
- One quarter of linear algebra (MAT 262)
- A course in logic and proofs (MAT 215 or both MAT 140 and MAT 141)
- At least one quarter of statistics (e.g., MAT 351 or MAT 348)
- At least one quarter of computer programming (e.g., Python, Java, C++)

Students who are interested in applying to the combined degree program in Applied Mathematics but who do not meet these requirements should consult with the Applied Mathematics Graduate Program Director Desale Habtzghi (dhabtzgh@depaul.edu).

Application Instructions

Students may apply for admission into the combined degree program in Applied Mathematics during their junior year of study. To apply, students should submit the following materials to the Office of Graduate Admissions (graddepaul@depaul.edu):

- CSH Combined Program Application form
- Official copy of undergraduate transcript

Interested students are strongly encouraged to consult with the Applied Mathematics Graduate Program Director Desale Habtzghi prior to submitting their application.
Combined Degree in Applied Statistics (MS)

The ability to research, analyze, and interpret data to reduce risk and increase success is invaluable across industries. The combined degree program in Applied Statistics is designed to help undergraduate students hone their data-analytic skills, and to help them explore how to tackle problems of statistical design, analysis, and control.

This program provides students with a strong quantitative background for careers in business, industry, or government. It also provides a solid foundation for students interested in pursuing PhD-level work in Applied Statistics.

Combined Degree Program Admission Criteria

Students applying for admission into the combined degree program in Applied Statistics should have already completed the following undergraduate coursework:

- One year of single-variable calculus (e.g., MAT 150-151-152, or equivalent)
- Two quarters of multivariable calculus (MAT 260 and MAT 261)
- One quarter of linear algebra (MAT 262)
- A course in logic and proofs (MAT 215 or both MAT 140 and MAT 141)
- At least one quarter of statistics (MAT 351 or MAT 348)
- At least one quarter of computer programming (e.g., Python, Java, C++)

Students who are interested in applying to the combined degree program in Applied Statistics but who do not meet these requirements should consult with the Applied Statistics Graduate Program Director Desale Habtzghi (dhabtzgh@depaul.edu).

Application Instructions

Students may apply for admission into the combined degree program in Applied Statistics during their junior year of study. To apply, students should submit the following materials to the Office of Graduate Admissions (graddepaul@depaul.edu):

- CSH Combined Degree Program Application form
- Official copy of undergraduate transcript

Interested students are strongly encouraged to consult with the Applied Statistics Graduate Program Director Desale Habtzghi prior to submitting their application.
Combined Degree in Pure Mathematics (MS)

The combined degree program in Pure Mathematics is designed to provide undergraduate Mathematical Sciences majors with rigorous training in Pure Mathematics as well as a solid foundation for pursuing PhD-level graduate work in mathematics or for teaching mathematics at the community college level. Additional information about the graduate program in Pure Mathematics can be found on the program webpage.

Combined Degree Program Admission Criteria

Students applying for admission to the combined degree program in Pure Mathematics should have already completed the following undergraduate coursework:

♦  One year of single-variable calculus (e.g., MAT 150-151-152, or equivalent)
♦  Two quarters of multivariable calculus (MAT 260 and MAT 261)
♦  One quarter of linear algebra (MAT 262)
♦  A course in logic and proofs (MAT 215 or both MAT 140 and MAT 141)

In addition, students who plan to apply to the combined degree program in Pure Mathematics are strongly advised to complete at least one of the following course sequences during their junior year to ensure they meet the prerequisites for graduate coursework during their senior year:

♦  MAT 310 & MAT 311 (Abstract Algebra I & II)
♦  MAT 335 & MAT 336 (Real Analysis I & II)

Students who are interested in applying to the combined degree program in Pure Mathematics but who are not concurrently enrolled in either Abstract Algebra or Real Analysis, or who have not yet completed MAT 261 or MAT 262, should consult with the Pure Mathematics Graduate Program Director Yevgenia Kashina (ykashina@depaul.edu).

Application Instructions

Students may apply for admission into the combined degree program in Pure Mathematics during their junior year of study. To apply, students should submit the following materials to the Office of Graduate Admissions (graddepaul@depaul.edu):

♦  CSH Combined Program Application form
♦  Official copy of undergraduate transcript

Interested students are strongly encouraged to consult with the Pure Mathematics Graduate Program Director Yevgenia Kashina prior to submitting their application.
Combined Degrees Continued...

Combined Degree in Secondary Education Mathematics (MEd)

The TEACH: Secondary Education Mathematics program combines a College of Science and Health (CSH) undergraduate Mathematical Sciences degree with a graduate-level College of Education (COE) Master's in Education degree. Students graduate with either a BA or BS in Mathematical Sciences and an MEd in Education with a Professional Educator License and math endorsement in Secondary Education Mathematics (grades 9-12 or 6-12) in the State of Illinois.

This combined degree program of the College of Science and Health and the College of Education was collaboratively developed and is governed and taught by faculty from both units. The program features the integration of disciplinary content with educational foundations and pedagogical content knowledge. The Junior Year Experiential Learning course, Senior Capstone course, and the three double-counted undergraduate/graduate courses offer students a seamless transition from undergraduate to graduate studies and from major-field coursework to teacher-preparation coursework. The 5th-year Master’s level coursework builds on students’ undergraduate experiences through a series of integrated courses that include consistent and long-term field experiences culminating in a student-teaching experience during the Spring of students’ fifth year.

Criteria for admission to the TEACH Program

During Junior Year

- Junior standing (88 or more credit hours)
- Declared, relevant CSH major
- Completion of at least 16 credit hours here at DePaul
- Completion of TCH 320 (JYEL course)
- Overall gpa of 3.0

Application process

- Submit a completed COE application form
- Submit DePaul University unofficial transcripts
- Submit two letters of recommendation (at least one from a faculty member in disciplinary major)
- Submit a 750-word essay on teaching interests and goals

A subcommittee of the Program’s Coordinating Committee with expertise in the student’s undergraduate disciplinary major reviews all applications. Upon acceptance to the Program, students will be notified via email and letter and assigned a CSH disciplinary advisor and COE academic advisor.

Admission to the TEACH Program does not constitute admission to the 5th Year Master’s level coursework.
Criteria for admission to 5th year Master’s year

Upon completion of undergraduate major program

- Completion of undergraduate degree audit
- Completion of TCH sequence and capstone coursework (during Senior Year)
- Completion of ISBE Basic Skills Test or Test of Academic Proficiency (TAP) (during Senior Year or earlier)
- Completion of COE Technology skills assessment (EDU 025) (during Senior Year or earlier)
- Maintenance of a 3.0 GPA

Course Requirements

All students need to have sufficient knowledge of the subject they will be teaching. Illinois State Board of Education requires a minimum of 48 quarter hours (32 semester hours) in the content area subject. Typically these requirements are met concurrently with the completion of the CSH undergraduate degree program. Prior to admission to the 5th Year Master’s Year, students must meet with their CSH academic advisor to complete an undergraduate degree audit that will include an official written content area evaluation. Any areas of deficiency must be completed prior to beginning student teaching.

Content Area Requirements for Secondary Mathematics Education:

All coursework in the content area must earn a grade of C or better and a minimum of 18 quarter hours (12 semester hours) must be coursework at an undergraduate upper level or graduate level.

- Calculus I
- Calculus II
- Calculus III
- Intro to Math Reasoning or Discrete Math I and Discrete Math II
- Multivariable Calculus I
- Multivariable Calculus II
- Linear Algebra
- Programming Language
- Abstract Algebra I
- Theory of Numbers |or Abstract Algebra II
- Geometry I
- Geometry II or Real Analysis I
- Probability & Statistics
- History of Mathematics

Junior Year Coursework: 4 undergraduate quarter hours required

- TCH 320 EXPLORING TEACHING IN THE URBAN HIGH SCHOOL (fulfills undergraduate Junior Year Experiential Course requirement)
Senior Year Coursework: 4 quarter hours required

- TCH 390 CAPSTONE: INTEGRATING EDUCATION & DISCIPLINARY FOUNDATIONS (fulfills undergraduate Capstone requirement; major area may require a separate Capstone course)

Undergraduate/Graduate Double-Counted Courses: 12 undergraduate/graduate quarter hours required, grade of C or better required.

- TCH 401 TEACHING AS A PROFESSION IN SECONDARY SCHOOL
- TCH 413 THE NATURE OF MATHEMATICS
- TCH 423 INQUIRY & APPLICATION IN DEVELOPING SECONDARY MATHEMATICS PEDAGOGY

5th Year Master’s Year Coursework, excluding Student Teaching: 32 graduate quarter hours required, grade of C or better required.

- SCG 406 HUMAN DEVELOPMENT AND LEARNING: SECONDARY
- LSI 446 PSYCHOLOGY AND EDUCATION OF THE EXCEPTIONAL CHILD
- BBE 501 TEACHING ADOLESCENT ENGLISH LANGUAGE LEARNERS AND DIALECT SPEAKERS ACROSS THE CURRICULUM
- TCH 453 RESEARCH METHODS & DISCIPLINARY INQUIRY: MATHEMATICS (Taken in conjunction with TCH 483)
- TCH 473 TEACHING MATHEMATICS IN THE HIGH SCHOOL 1
- TCH 483 TEACHING MATHEMATICS IN THE HIGH SCHOOL 2
- TCH 495 ASSESSMENT ISSUES IN SECONDARY EDUCATION
- T&L 525 READING, WRITING, AND COMMUNICATING ACROSS THE CURRICULUM

Student Teaching: 8 graduate quarter hours required

Registration in student teaching requires completion of all requirements and procedures listed in the college core section. EDU 95 indicates to the Illinois State Board of Education that all field experience hours are complete. It is a non-credit, non-tuition course.

- TCH 590 STUDENT TEACHING (6 credit hours, grade of B- or better required)
- TCH 591 STUDENT TEACHING SEMINAR (2 credit hours)
- EDU 95 CLINICAL EXPERIENCE WITH CHILDREN AND YOUTH (non-credit, non-tuition, PA grade required)
Licensure Tests

All individuals licensed by the Illinois State Board of Education (ISBE) are required to complete licensure tests specific to their teaching license. Secondary Education Math students must complete the following tests:

♦ Test of Academic Proficiency (TAP) (test #400) - assesses knowledge of reading comprehension, language arts, writing, and math. Test is required to qualify for Advanced Standing. *Check with your advisor about qualifying for a waiver with acceptable ACT or SAT test scores.

♦ Mathematics Content Area Test (test #115) – assesses knowledge of processes and applications of mathematics. Test is required before Student Teaching (deadlines apply).

♦ EdTPA - assessment conducted during the student teaching experience including video clips of instruction, lesson plans, student work samples, analysis of student learning and reflective commentaries. Students will submit an electronic portfolio to an outside agency for independent evaluation and a fee will be imposed by that agency as part of the assessment.

Field Experiences

Each student seeking licensure from the College of Education/Professional Education Unit must complete supervised field experiences in appropriate settings in conjunction with education courses. The field experiences must include a variety of grade levels, multicultural experiences, and a minimum of 15 hours in special education settings. All field experiences must be completed prior to final approval for student teaching. Students should enter field experience hours into the FEDS system upon completion of each course with field experience requirements. For details on requirements, expectations, documentation, & courses in your program that require hours, visit the College of Education website.
Minor in Mathematics
Course Requirements

A minor in Mathematics can be developed to complement a major program in any major, with a focus on pure and applied mathematical theory.

- Choose one of the following Calculus sequences:
  - **Sequence One**
    - MAT 150 CALCULUS I
    - MAT 151 CALCULUS II
    - MAT 152 CALCULUS III
  - **Sequence Two**
    - MAT 147 CALCULUS WITH INTEGRATED PRECALCULUS I
    - MAT 148 CALCULUS WITH INTEGRATED PRECALCULUS II
    - MAT 149 CALCULUS WITH INTEGRATED PRECALCULUS III
  - **Sequence Three**
    - MAT 160 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I
    - MAT 161 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS II
    - MAT 162 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS III
  - **Sequence Four**
    - MAT 170 CALCULUS FOR LIFE SCIENCES I
    - MAT 171 CALCULUS FOR LIFE SCIENCES II
    - MAT 149, MAT 152 OR MAT 162
  - **Sequence Five**
    - MAT 155 SUMMER CALCULUS I
    - MAT 156 SUMMER CALCULUS II

- One of the following options
  - MAT 215 INTRODUCTION TO MATHEMATICAL REASONING
  - Discrete Mathematics Sequence
    - MAT 140 DISCRETE MATHEMATICS I
    - MAT 141 DISCRETE MATHEMATICS II

- Two additional mathematics courses chosen from the 200 or 300-level courses which are admissible for credit as part of the common core or as part of one of the concentrations in mathematics.

Business students who have an exceptionally strong background in calculus, including calculus of trig functions, may be permitted by the chair to substitute MAT 135 BUSINESS CALCULUS I and MAT 136 BUSINESS CALCULUS II for MAT 150 CALCULUS I.

Students cannot earn a minor in the same academic program as their major.
Minor in Statistics
Course Requirements

The Statistics minor is designed for students who wish to apply advanced statistical skills to a career in engineering, physics, business, or biological science. Students will learn statistical computation, theory, and analysis.

A total of six courses are required based upon the below outline.

- Choose one of the following Calculus sequences:
  - Sequence One
    * MAT 150 CALCULUS I
    * MAT 151 CALCULUS II
    * MAT 152 CALCULUS III
  - Sequence Two
    * MAT 147 CALCULUS WITH INTEGRATED PRECALCULUS I
    * MAT 148 CALCULUS WITH INTEGRATED PRECALCULUS II
    * MAT 149 CALCULUS WITH INTEGRATED PRECALCULUS III
  - Sequence Three
    * MAT 160 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I
    * MAT 161 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS II
    * MAT 162 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS III
  - Sequence Four
    * MAT 170 CALCULUS FOR LIFE SCIENCES I
    * MAT 171 CALCULUS FOR LIFE SCIENCES II
    * MAT 149, MAT 152 OR MAT 162
  - Sequence Five
    * MAT 155 SUMMER CALCULUS I
    * MAT 156 SUMMER CALCULUS II

- MAT 348 APPLIED STATISTICAL METHODS
- MAT 349 APPLIED STATISTICAL METHODS II
- One course from the following list
  MAT 326 SAMPLE SURVEY METHODS
  MAT 328 DESIGN OF EXPERIMENTS
  MAT 356 APPLIED REGRESSION ANALYSIS
  MAT 357 NONPARAMETRIC STATISTICS

Business students who have an exceptionally strong background in calculus, including calculus of trig functions, may be permitted by the chair to substitute MAT 135 BUSINESS CALCULUS I and MAT 136 BUSINESS CALCULUS II for MAT 150 CALCULUS I. NOTE: In case a particular course is not offered for an extended time, certain individual substitutions can be made in consultation with an academic advisor.

Students cannot earn a minor in the same academic program as their major.
Course Descriptions

MAT 100 INTRODUCTION TO QUANTITATIVE REASONING
An introduction to the algebra needed for quantitative reasoning with a focus on functions and modeling. This course emphasizes the applications of elementary algebra and the use of functions to model and analyze real-world situations. Topics include functions from graphical, tabular, and symbolic points of view and models using linear, quadratic, power, exponential, and logarithmic functions. Graphing technology is used extensively. This course is prerequisite to LSP 120 and is intended for students continuing on to LSP 120. This course is not recommended for students whose plan of study includes calculus. Prerequisite: MAT 094 or placement.

MAT 101 INTERMEDIATE ALGEBRA
Functions, factoring, rational expressions, roots, radicals, quadratic equations, quadratic inequalities. Course meets for an additional 1 hour lab session each week for enrichment and problem solving. Prerequisite: MAT 095.

MAT 110 FOUNDATIONS OF MATHEMATICS FOR ELEMENTARY SCHOOL TEACHERS I
This course gives students a deeper understanding of the foundations of elementary mathematics. Topics include problem solving, number systems, the decimal system, the number line, rounding, fractions, percentages, addition and subtraction. MAT 101 or LSP 120 or equivalents or placement by test is a prerequisite for this class.

MAT 111 FOUNDATIONS OF MATHEMATICS FOR ELEMENTARY SCHOOL TEACHERS II
This course gives students a deeper understanding of the foundations of elementary mathematics. Topics include problem solving, fractions, percentages, addition, subtraction, multiplication, and division. Prerequisite: MAT 110.

MAT 112 GAMBLING AND GAMES, PROBABILITY AND STATISTICS
Students with very little mathematical background and little or no computing background will be given a brief introduction to the use of Microsoft Excel for mathematical purposes. This will be followed by a brief discussion of chance, gambling, and probability. Several popular games (such as lotteries, roulette, craps, and poker) will be considered both from a theoretical point of view and by means of very simple computer simulation. At the end, we will discuss briefly topics from game theory such as zero-sum games and game with cooperation. Prerequisite: MAT 094 or placement.

MAT 115 MATHEMATICS FOR ELEMENTARY SCHOOL TEACHERS III
Continuation of Math 110-111. Prerequisite: MAT 111.

MAT 130 PRECALCULUS
Functions and their graphs, exponential and logarithmic functions, inverse functions, polynomial and rational functions. Prerequisite: MAT 101 or placement by test.

MAT 131 TRIGONOMETRY
Trigonometric functions, inverse trigonometric functions, trigonometric identities, laws of sines and cosines, polar coordinates and complex plane. MAT 130 or equivalents or placement by test is a prerequisite for this class.

MAT 135 BUSINESS CALCULUS I
Differential calculus of one or more variables with business applications. Prerequisite: A grade of C-minus or better in MAT 130 or equivalent.

MAT 136 BUSINESS CALCULUS II
Integral calculus, matrix algebra, and probability theory with business applications. A grade of C-minus or better in MAT 135 or equivalent is a prerequisite for this class.

MAT 137 BUSINESS STATISTICS
Basic concepts of statistics and applications; data analysis with the use of Excel; theoretical distributions; sampling distributions; problems of estimation; hypothesis testing; problems of sampling; linear regression and correlation. Prerequisite: A grade of C-minus or better in MAT 130.

MAT 140 DISCRETE MATHEMATICS I
Combinatorics, graph theory, propositional logic, singly-quantified statements, operational knowledge of set theory, functions, number systems, methods of direct and indirect proof. MAT 130 or above or equivalents or placement by test is a prerequisite for this class.

MAT 141 DISCRETE MATHEMATICS II
Methods of direct and indirect proof, set theoretic proofs, sequences, mathematical induction, recursion, multiply-quantified statements, relations and functions, complexity. MAT 140 is a prerequisite for this class.

MAT 147 CALCULUS W/ INTEGRATED PRECALCULUS I
Limits, continuity, the derivative, rules of differentiation, derivatives of trigonometric and logarithmic functions and their inverses, and applications, with precalculus review included for each topic. The full MAT 147-8-9 sequence covers all the material of MAT 150-1-2 plus additional precalculus material. (6 quarter hours) Prerequisite: MAT 130 or equivalents, or placement by test.

MAT 148 CALCULUS W/ INTEGRATED PRECALCULUS II
Extrema, curve sketching, related rates, definite and indefinite integrals, applications of the integral, with precalculus review included for each topic. (6 quarter hours) Prerequisite: MAT 147 or MAT 150 or MAT 155 or MAT 160 or MAT 170.

MAT 149 CALCULUS W/ INTEGRATED PRECALCULUS III
Techniques of integration, L'Hopital's rule, improper integrals, Taylor polynomials, series and sequences, first-order differential equations, with precalculus review included for each topic. (6 quarter hours) Prerequisite: MAT 148 or MAT 151 or MAT 161 or MAT 171.
**MAT 150 CALCULUS I**
Limits, continuity, the derivative, rules of differentiation, derivatives of trigonometric and logarithmic functions and their inverses, applications of the derivative, extrema, curve sketching, and optimization. This course meets for an additional 1-hour lab session each week for enrichment and problem solving. Prerequisite: MAT 131 or placement by test.

**MAT 151 CALCULUS II**
Definite and indefinite integrals, the Fundamental Theorem of Calculus, applications of the integral, techniques of integration. This course meets for an additional 1-hour lab session each week for enrichment and problem solving. Prerequisite: MAT 150 or MAT 155 or MAT 160 or MAT 170.

**MAT 152 CALCULUS III**
L'Hôpital's rule, improper integrals, sequences and series, Taylor polynomials. This course meets for an additional 1-hour lab session each week for enrichment and problem solving. Prerequisite: MAT 151 or MAT 161 or MAT 171.

**MAT 155 SUMMER CALCULUS I**
Limits, continuity, the derivative, rules of differentiation, derivatives of trigonometric and logarithmic functions and their inverses, applications of the derivative, extrema, curve sketching, and optimization. Definite and indefinite integrals, the Fundamental Theorem of Calculus, applications of the integral. 6 Credit hours. Summer session only. Prerequisite: MAT 131 or placement by Mathematics Diagnostic Test.

**MAT 156 SUMMER CALCULUS II**
Further applications of the integral, techniques of integration. L'Hôpital's rule, improper integrals, sequences and series, Taylor polynomials. 6 Credit hours. Summer session only. Prerequisite: MAT 148 or MAT 151 or MAT 155 or MAT 161 or MAT 171.

**MAT 160 CALCULUS FOR MATH AND SCIENCE MAJORS I**
Limits, continuity, the derivative, rules of differentiation, derivatives of trigonometric and logarithmic functions and their inverses, applications of the derivative, extrema, curve sketching, and optimization. This course meets for an additional 1.5-hour lab session each week for enrichment and problem solving. (5 quarter hours) Prerequisite: MAT 131 or placement by test.

**MAT 161 CALCULUS FOR MATH AND SCIENCE MAJORS II**
Definite and indefinite integrals, the Fundamental Theorem of Calculus, applications of the integral, techniques of integration. This course meets for an additional 1.5-hour lab session each week for enrichment and problem solving. (5 quarter hours) Prerequisite: MAT 150 or MAT 155 or MAT 160 or MAT 170.

**MAT 162 CALCULUS FOR MATH AND SCIENCE MAJORS III**
L'Hôpital's rule, improper integrals, sequences and series, Taylor polynomials. This course meets for an additional 1.5-hour lab session each week for enrichment and problem solving. (5 quarter hours) Prerequisite: MAT 151 or MAT 161 or MAT 171.

**MAT 170 CALCULUS FOR LIFE SCIENCES I**
The course covers the following topics using examples from the sciences: Functions as models, logarithmic scale graphing, exponential growth and decay, difference equations and limits of sequences, geometric series, functions and limits, trigonometric functions and their limits, continuity, limits at infinity, the derivative, differentiation rules, derivatives of trigonometric and exponential functions, related rates, derivatives of inverse and logarithm functions. Course meets for an additional lab session each week during which time students will work on applied mathematics projects based on the topics covered in the course. Students majoring in the sciences should consult with their major department to decide between the 160 and 170 sequences. (5 quarter hours) MAT 131 or placement by test is a prerequisite for this class.

**MAT 171 CALCULUS FOR LIFE SCIENCES II**
The course covers the following topics using examples from the sciences: Applications of the derivative including approximation and local linearity, differentials, extrema and the Mean Value Theorem, monotonicity and concavity, extrema, inflection points, graphing, L'Hospital's Rule, optimization, and the Newton-Raphson method, antiderivatives, the definite integral, Riemann sums, the Fundamental Theorem of Calculus, area, cumulative change, average value of a function, and techniques of integration: substitution rule and integration by parts. Course meets for an additional lab session each week during which time students will work on applied mathematics projects based on the topics covered in the course. Course meets for an additional lab session each week during which time students will work on applied mathematics projects based on the topics covered in the course. (5 quarter hours) Prerequisite: MAT 150 or MAT 155 or MAT 160 or MAT 170.

**MAT 172 CALCULUS III WITH DIFFERENTIAL EQUATIONS**
This course is designed for students in the life sciences and covers some topics from MAT 152, differential equations and an introduction to the Calculus of functions of several variables. Specific topics are as follows. Numerical integration, partial fraction expansions, Taylor approximations of a function, differential equations, separation of variables, slope fields, Euler's existence theorem, polygonal approximations to solutions of differential equations, the logistic equation and allometric growth models, equilibria of differential equations and their stability, applications of stability theory, functions of several variables, partial derivatives, directional derivative and the gradient. Course meets for an additional lab session each week during which time students will work on applied mathematics projects based on the topics covered in the course. (5 quarter hours) Prerequisite: MAT 151 or MAT 161 or MAT 171.

**MAT 207 HISTORY OF PROBABILITY AND STATISTICS**
History Of Probability And Statistics.
MAT 215 INTRODUCTION TO MATHEMATICAL REASONING
An introduction to basic concepts and techniques used in higher mathematics courses: set theory, equivalence relations, functions, cardinality, techniques of proof in mathematics. The emphasis is on problem solving and proof construction by students. The department recommends that students take this course no later than the spring quarter of the sophomore year. Prerequisite: MAT 149 or MAT 152 or MAT 156 or MAT 162 or MAT 172.

MAT 220 APPLIED LINEAR ALGEBRA
"(Primarily for non-mathematics majors.) Systems of linear equations, matrices and matrix algebra, determinants, diagonalization and matrix factorization with MATLAB/Maple, with applications to linear programming and graph theory. Prerequisite: MAT 141 or MAT 148 or MAT 151 or MAT 155 or MAT 161 or MAT 171.

MAT 242 ELEMENTS OF STATISTICS
Descriptive statistics, elements of probability, the binomial and normal probability models; large and small sample hypothesis testing, correlation and regression analysis. Use of computer packages. This course does not count toward mathematics major credit. Cross-listed with SOC 279. Prerequisites: (MAT 095 and MAT 100) or MAT 101 or placement.

MAT 260 MULTIVARIABLE CALCULUS I
Vectors, dot and cross products, parameterizations of lines and planes in space, functions of several independent variables, partial derivatives, tangent planes and linear approximations, the chain rule, directional derivatives and the gradient vector, extreme values, Lagrange multipliers, double integrals and their applications. Prerequisite: MAT 149 or MAT 152 or MAT 156 or MAT 162 or MAT 172.

MAT 261 MULTIVARIABLE CALCULUS II
Surface areas, triple integrals, vector functions and space curves, derivatives of vector functions, arc length and curvature, vector fields, line integrals, Green's Theorem, parametric surfaces, surface integrals, curl and divergence, Stokes's Theorem, the Divergence Theorem. Prerequisite: MAT 260.

MAT 262 LINEAR ALGEBRA
Systems of linear equations and matrices; vectors in n-space; vector spaces: linear combinations, linear independence, basis; linear transformations, change of basis, eigenvalues and eigenvectors. Prerequisite MAT 260.

MAT 301 HISTORY OF MATHEMATICS
History of mathematics with problem solving. Prerequisite: C-minus or better in MAT 141 or MAT 215, or instructor permission.

MAT 302 COMBINATORICS
Methods of counting and enumeration of mathematical structures. Topics include generating functions, recurrence relations, inclusion relations, and graphical methods. Prerequisite: C-minus or better in MAT 141 or MAT 215.

MAT 303 THEORY OF NUMBERS
A study of properties of integers: divisibility; Euclid's Algorithm; congruences and modular arithmetic; Euler's Theorem; Diophantine equations; distribution of primes; RSA cryptography. Prerequisite: C-minus or better in MAT 141 or MAT 215, or instructor permission.

MAT 304 DIFFERENTIAL EQUATIONS
Linear equations, systems with constant coefficients, series solutions, Laplace transforms, and applications. Formerly MAT 338. Prerequisite: MAT 260.

MAT 309 TEACHING AND LEARNING SECONDARY SCHOOL MATHEMATICS

MAT 310 ABSTRACT ALGEBRA I
The first quarter of a 3-quarter sequence. Topics in the sequence include the integers; abstract groups, rings, and fields; polynomial rings; isomorphism theorems; extension fields; and an introduction to Galois theory. MAT 303 is highly recommended. Prerequisites: MAT 262 and (C-minus or better in MAT 141 or MAT 215), or instructor permission.

MAT 311 ABSTRACT ALGEBRA II
A continuation of topics from MAT 310: Groups, rings, fields, polynomial rings, isomorphism theorems, extension fields, and an introduction to Galois theory. Prerequisite: C-minus or better in MAT 310, or instructor permission.

MAT 312 ABSTRACT ALGEBRA III
A continuation of topics from MAT 311: Groups, rings, fields, polynomial rings, isomorphism theorems, extension fields, and an introduction to Galois theory. Prerequisite: C-minus or better in MAT 311, or instructor permission.

MAT 320 GEOMETRY I
Incidence and separation properties of planes; congruences; the parallel postulate; area theory; ruler and compass construction. Prerequisite: C-minus or better in MAT 141 or MAT 215.

MAT 321 GEOMETRY II
Introduction to solid geometry and non-euclidean geometry (hyperbolic and spherical models); other special topics. Prerequisite: C-minus or better in MAT 320, or instructor permission.

MAT 323 DATA ANALYSIS & STATISTICAL SOFTWARE I
Computing with a statistical package. Introduction to data analysis, elementary statistical inference, regression and correlation. This course does not count toward mathematics major credit. (CROSS-LISTED AS IT 223). Prerequisite: MAT 130 or placement by test.

*Red = Core Course
*Green = Statistics Course
MAT 324 DATA ANALYSIS & STATISTICAL SOFTWARE II
Advanced features and applications of the statistical package used in 323. (CROSS-LISTED WITH CSC 324). Prerequisite: C-minus or better in MAT 323, or instructor permission.

MAT 326 SAMPLE SURVEY METHODS
Simple random, stratified, systematic and cluster sampling. Multistage and area sampling. Random-response and capture-release models. Prerequisite: MAT 349 or MAT 353.

MAT 328 DESIGN OF EXPERIMENTS
Linear models and quadratic forms. Single, two and several-factor experiments, incomplete designs, confounding and fractional factorial experiments. Response surfaces and partially balanced incomplete block designs. Prerequisite: MAT 349 or MAT 353.

MAT 330 METHODS OF COMPUTATION AND THEORETICAL PHYSICS I
Computational and theoretical methods in ordinary differential equations, complex numbers, systems of equations, phase plane analysis, and bifurcations. Applications to damped, driven oscillators, and to electronics.

MAT 331 METHODS OF COMPUTATION AND THEORETICAL PHYSICS II
Computational and theoretical methods in ordinary differential equations, complex numbers, systems of equations, phase plane analysis, and bifurcations. Applications to damped, driven oscillators, and to electronics. Lab Fee. Prerequisite: MAT 261.

MAT 335 REAL ANALYSIS I
Real number system, completeness, supremum, and infimum, sequences and their limits, lim inf, lim sup, limits of functions, continuity. Prerequisites: (MAT 149 or MAT 152 or MAT 156 or MAT 162) and (C-minus/better in MAT 141 or MAT 215).

MAT 336 REAL ANALYSIS II
Properties of continuous functions, uniform continuity, sequences of functions, differentiation, integration. To follow 335 in the Winter Quarter. Prerequisite: C-minus or better in MAT 335, or instructor permission.

MAT 337 COMPLEX ANALYSIS
Complex functions; complex differentiation and integration; series and sequences of complex functions. Prerequisite: MAT 215 and MAT 261 and MAT 335, or instructor permission.

MAT 340 TOPOLOGY
An introduction to point-set topology: metric spaces, topological spaces, continuity, connectedness, and compactness. Prerequisites: C-minus or better in MAT 335, or instructor permission.

MAT 341 STATISTICAL METHODS USING SAS
The SAS programming language. Data exploration, description and presentation. Inference based on continuous and categorical data. Analysis of variance models and regression procedures including logistic regression. Cross-listed with MAT 448. Prerequisite: Successful completion of the programming course required as part of the Math Core Curriculum.

MAT 342 ELEMENTS OF STATISTICS II
Multiple regression, correlation, analysis of variance, time series, and sampling. Course content and emphases will vary with students' needs and backgrounds. Prerequisite: MAT 137 or MAT 323 or MAT 348.

MAT 343 BUSINESS STATISTICS II
Multiple regression, correlation, analysis of variance, time series and sampling. Statistical theory applied to business. Use of statistical computing packages. Course content will vary with the needs and desires of individual students. (FORMERLY BMS 342). Prerequisite: C-minus or better in MAT 137, or instructor permission.

MAT 348 APPLIED STATISTICAL METHODS
Introduction to statistical software (which will be used throughout the course). Descriptive statistics; elementary probability theory; discrete and continuous probability models; principles of statistical inference; Simple linear regression and correlation analysis. Prerequisite: MAT 148 or MAT 151 or MAT 155 or MAT 161 or MAT 171.

MAT 351 PROBABILITY AND STATISTICS I
Probability spaces, combinatorial probability methods, discrete and continuous random variables and distributions, moment generating functions, development and applications of the classical discrete and continuous distributions. Prerequisite: MAT 260.

MAT 352 PROBABILITY AND STATISTICS II
Joint probability distributions and correlation; law of large numbers and the central limit theorem; sampling distributions and theory of estimation. Prerequisite: C-minus or better in MAT 351, or instructor permission.

MAT 353 PROBABILITY AND STATISTICS III
Principles of hypothesis testing; most powerful tests and likelihood ratio tests; linear regression; one-way analysis of variance; categorical data analysis, nonparametric statistics. Prerequisite: C-minus or better in MAT 352, or instructor permission.

MAT 354 MULTIVARIATE STATISTICS
The multivariate normal distribution. Hypothesis tests on means and variances including the multivariate linear model. Classification using the linear discriminant function. Principal components and factor analysis. (CROSS-LISTED WITH MAT 454.) Prerequisites: MAT 262 and MAT 353, or consent of instructor.
MAT 355  STOCHASTIC PROCESSES

MAT 356  APPLIED REGRESSION ANALYSIS
Simple linear, multiple, polynomial and general regression models. Selection of best regression equation and examination of residuals for homoscedasticity and other diagnostics. Use of statistical software. Cross-listed with MAT 456. Prerequisites: MAT 262 and MAT 353.

MAT 357  NONPARAMETRIC STATISTICS
Inference concerning location and scale parameters, goodness of fit tests, association analysis and tests of randomness using distribution free procedures. Bootstrap techniques. Smoothing methodologies. Cross-listed with MAT 457. Prerequisite: MAT 349 or 353.

MAT 358  APPLIED TIME SERIES AND FORECASTING
Development of the Box-Jenkins methodology for the identification, estimation, and fitting of ARIMA, and transfer-function stochastic models for the purpose of analyzing and forecasting stationary, non-stationary, and seasonal time series data. The course emphasizes practical time-series data analysis using computer packages and includes applications to economic, business, and industrial forecasting. Cross-listed with MAT 512. Prerequisites: MAT 341 and MAT 353.

MAT 359  SIMULATION MODELS AND MONTE CARLO METHOD
Techniques of computer simulation of the classical univariate and multivariate probability distribution models, and such random processes as random walk, Markov chains, and queues. Cross-listed with MAT 459. Prerequisites: MAT 341 and MAT 353.

MAT 361  THEORY OF INTEREST
Theory and applications of compound interest to annuities, amortization schedules, sinking funds, bonds, and yield rates. Prerequisite: MAT 149 or MAT 152 or MAT 156 or MAT 162.

MAT 362  LIFE CONTINGENCIES I
Basic Contingencies: The theory and applications of contingency mathematics in life and health insurance, annuities, and pensions from both a probabilistic and a deterministic viewpoint. Topics include survival distribution and life tables, life insurance, and life annuities. Prerequisite: C-minus or better in MAT 361, or instructor permission. Co-requisite: MAT 352.

MAT 363  LIFE CONTINGENCIES II
Advanced Contingencies: A continuation of Mathematics 362. Topics include net premiums, net premiums reserves, multiple life functions, multiple decrement models, and valuation theory for pension plans. Prerequisite: MAT 352 and a grade of C-minus or better in MAT 362, or instructor permission.

MAT 364  STOCHASTIC RISK MODELS
Distributional quantities, distribution properties and classification, frequency and severity models, aggregate loss and ruin models. Cross-listed with MAT 464. Prerequisite: MAT 353.

MAT 365  STOCHASTIC SURVIVAL MODELS
Construction of parametric and nonparametric models, model validation and selection, credibility theory, simulation techniques. Cross-listed with MAT 465. Prerequisite: MAT 353.

MAT 366  MATHEMATICAL DEMOGRAPHY
Introduction to demography; mortality table construction and methods of population and demographic analysis. Prerequisite: MAT 353.

MAT 367  CREDIBILITY THEORY
Credibility theory and loss distributions with applications to casualty insurance classification and finance. Cross-Listed as MAT 467. Prerequisite: MAT 352.

MAT 368  MATHEMATICS FOR FINANCE
The course covers the mathematics of financial derivatives, investment strategies, arbitrage, put-call parity, binomial models for European options and interest rates, Black-Scholes formula, hedging, lognormal models for asset prices, exotic options, valuation using Monte-Carlo, and embedded options in annuity products. Prerequisite: (MAT 220 or MAT 262) and MAT 260 and (MAT 349 or MAT 353).

MAT 370  ADVANCED LINEAR ALGEBRA
Vector spaces, basis and dimension; matrix representation of linear transformations and change of basis; diagonalization of linear operators; inner product spaces; diagonalization of symmetric linear operators, principal-axis theorem, and applications. Cross-listed MAT 470. Prerequisites: MAT 262 and (C-minus or better in MAT 141 or MAT 215).

MAT 372  LOGIC AND SET THEORY
Topics in axiomatic set theory, formal logic, and computability theory. Prerequisite: C-minus or better in MAT 141 or MAT 215.

MAT 381  FOURIER ANALYSIS AND SPECIAL FUNCTIONS
The course covers the basic principles of discrete and continuous Fourier analysis and some of its applications currently used in scientific modeling. Students will use the computer to implement the computational algorithms developed in the course. Some of the topics covered will include Fourier transforms and their application to signal and image processing, discrete Fourier series, the fast Fourier transform to implement the computational algorithms developed in, and the Radon transforms and its applications to tomography. Prerequisite: MAT 262.

MAT 384  MATHEMATICAL MODELING
Modeling of real world problems using mathematical methods. Includes a theory of modeling and a study of specific models, selected from deterministic, stochastic, continuous, and discrete models. Cross-listed with MAT 484. Prerequisite: MAT 262.
MAT 385  NUMERICAL ANALYSIS I  
Use of a digital computer for numerical computation. Error analysis, Gaussian elimination and Gauss-Seidel method, solution of non-linear equations, function evaluation, cubic splines, approximation of integrals and derivatives, Monte Carlo methods. Cross-listed with MAT 485. Prerequisites: MAT 262, and a programming course required as part of the Math Core Curriculum, or consent of instructor.

MAT 386  NUMERICAL ANALYSIS II  
Theory and algorithms for efficient computation, including the Fast Fourier transform, numerical solution of non-linear systems of equations. Minimization of functions of several variables. Sparse systems of equations and corresponding eigenvalue problems. (CROSS-LISTED WITH MAT 486 & CSC 386/486). Prerequisite: C-minus or better in MAT 385, or instructor permission.

MAT 387  OPERATIONS RESEARCH I: LINEAR PROGRAMMING  
The Linear Programming problem and its dual; the simplex method; transportation and warehouse problems; computer algorithms and applications to various fields. (CROSS-LISTED AS MAT 487). Prerequisites: MAT 262 and (any introductory programming course).

MAT 388  OPERATIONS RESEARCH II: OPTIMIZATION THEORY  
Integer programming; non-linear programming; dynamic programming; queuing theory; game theory. Student should take an introductory computer programming course prior to taking this course. (CROSS-LISTED AS MAT 488). Prerequisites: MAT 260 and MAT 262.

MAT 389  OPERATIONS RESEARCH III  
Advanced Topics. Prerequisite: C-minus or better in MAT 388, or instructor permission.

MAT 390  MATHEMATICS READING AND RESEARCH  
The course provides students with a hands-on experience about research in mathematical sciences. Students attend seminars and research colloquia, and actively participate at discussions about the topics presented. Students reflect on the connections between various areas of modern mathematics, the challenges of structuring and solving problems, and the personal experience of doing mathematics. As a final project, each student prepares and presents a mathematical expository paper describing a current area of research, emphasizing its relevance to mathematics in general and its connections to real world problems. This course may be used to satisfy the junior-year experiential learning (JYEL) requirement.

MAT 391  STUDIES IN DEMOGRAPHY  
The course introduces students to the study by statistical methods of human populations in terms of type of data sources, population composition, growth, fertility, mortality, morbidity, health, migration, and urbanization. In addition, the course has a major component that emphasizes the study of current characteristics of the populations of developing countries in comparison with some developed countries including the United States of America. Students are required to present and submit a research project with comparative analysis of demographic statistics obtained on several developing and developed countries.

MAT 395  TOPICS IN MATHEMATICS  
Consult course schedule for current offerings. Course may be repeated for credit when title and content change. Variable credit allowed.

MAT 396  SENIOR THESIS RESEARCH  
A thesis option is available to mathematics majors who wish to pursue an extended independent project related to a theoretical or applied focus of the program. Students would work under the guidance of a faculty mentor. A total of 4 credits must be completed over the one or two quarters prior to the thesis submission. Interested students are strongly encouraged to enroll in MAT 390 during their junior year. (2 quarter hours)

MAT 397  MATHEMATICAL PEDAGOGY: THEORY & PRACTICE  
Introduction to current theories and practices in college mathematics instruction; helps undergraduate mathematics majors develop a deeper understanding of fundamental mathematical concepts and an awareness of how people learn mathematical ideas, and prepares them to work as consultants in mathematics instruction. Mathematical tutoring practicum is required. Four credit hour course offered over a two quarter span during the autumn and winter quarters only. See instructor for further information. This course maybe used to satisfy the junior experiential learning requirement, but it does not count toward mathematics major or minor credit. Cross-listed with MAT 697.

MAT 398  SENIOR CAPSTONE SEMINAR  
Topics vary from year to year. This course does not count toward the mathematical major or minor credit. Prerequisites: MAT 215 (or MAT 140 and 141) and MAT 262, or instructor permission.

MAT 399  INDEPENDENT STUDY  
Variable credit.
Prerequisite Chart (Mathematics Concentrations*)

*Charts do not indicate all possible prerequisite links—only those associated with concentrations in the major.

‡ Any programming course required as part of the Math Core Curriculum.
Prerequisite Chart (Actuarial & Statistics Concentrations*)
## Course Scheduling

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**Key**

- **Day Only**
- **Day & Night**
- **Night Only**

*The chart represents typical offerings, not an implied guarantee. Courses not appearing have not been offered since WQ 2014.*

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On one side, mathematics is obviously the language of science. On the other hand, the practitioners of mathematics very often don’t see it as just the language of science. They see it as something else, something of great beauty. As people might look at pictures or listen to a Bach cantata, a mathematician can look at a great theorem and see order and symmetry and patterns that are very aesthetically pleasing. When it’s convenient for us, we think of our field as one of the arts; when it’s convenient for us we think of our field as one of the sciences....Mathematics is a wonderful product of the human mind, the most impressive product of the human mind...

Gerald Alexanderson, Mathematical Association of America Past President
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