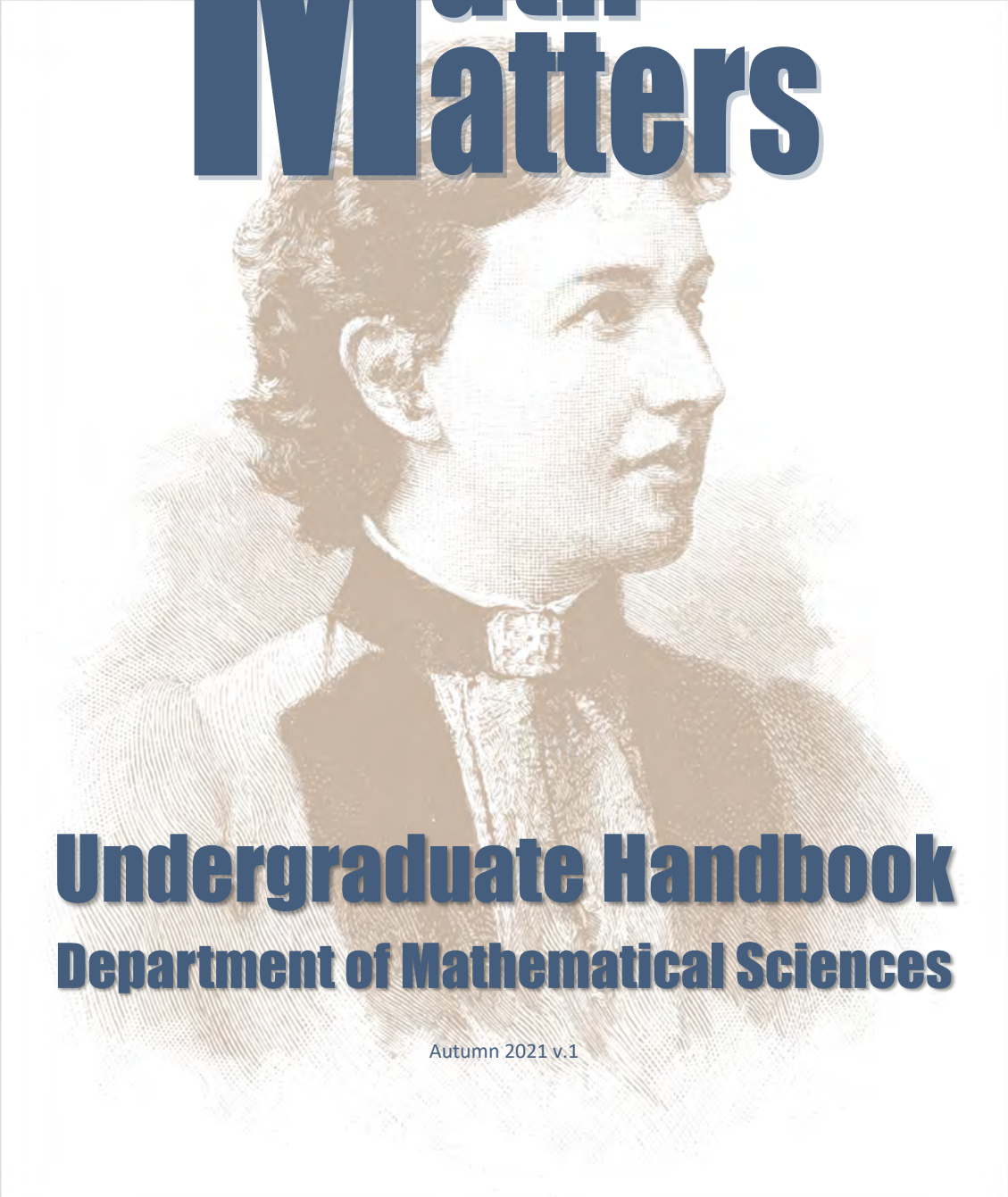



Math Matters




Undergraduate Handbook
Department of Mathematical Sciences

Autumn 2021 v.1

Contents



**DEPAUL
UNIVERSITY**



**Department of
Mathematical Sciences**

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Contents edited for format, and subject to change. The material contained herein is only advisory, and shall not constitute an official information source for the Department of Mathematical Sciences or for DePaul University. For official information, please visit www.depaul.edu.

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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 2019 rankings of the best jobs, among the top ten were: Data Scientist (#1), Statistician (#2), Mathematician (#8), Operations Research Analyst (#9), and Actuary (#10). Other highly-ranked jobs requiring a large amount of mathematical background included Software Developer (#11), Physicist (#19), Computer Systems Analyst (#22), Meteorologist (#24), Financial Analyst (#28), Biomedical Engineer (#29), Economist (#36), Petroleum Engineer (#37), and Accountant (#47). Other careers that depend deeply on mathematics:

Actuarial and Insurance

Actuary, Insurance Underwriter, Accountant, Investment Analyst, Benefits Specialist, Financial Planner, Banker

Health

Ecologist, Biomathematician, Biomedical Engineer

Computer & Information Sciences

Computer Programmer, Data Processor, Database Manager, Applications Programmer, Systems Analyst, Computer Applications Engineer, Control Systems Engineer, Numerical Analyst, Operations Analyst, Systems Engineer

Teaching/Academic Research

Teacher/Junior High/High School, College or University Professor

Statistics

Analytical Statistician, Theoretical Statistician, Demographer, Quality Control Analyst, Econometrician, Psychometrician, Biometrician

Business/Industry

Engineering Analyst, Financial Analyst, Statistician, Technical Writer, Communications Engineer, Fluid Dynamics Analyst, Consultant, Grant Proposal Writer, Product Developer, Market Researcher

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, a BA in Data 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. In the Loop, the tutoring lab is in Lewis Hall #1662. There they can get tutoring from math students who are often mathematics majors. On both campuses, students can come on a drop-in basis during the regular school year, starting in the second week of each quarter through the last week (not available during finals week). The Lab schedules are generally posted online and outside the door, and at go.depaul.edu/mathtutors. These spaces also make computing available through a limited number of networked PCs.

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 for 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 BS Actuarial Science program, or 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, a department faculty member will be assigned as your academic advisor sometime in the academic quarter following your declaration. The department advising committee sends email updates once per quarter with information for new and returning students. You can find information about your advisor through the BlueStar system on Campus Connect (campusconnect.depaul.edu). It is recommended that 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 <https://dehub.campusgroups.com/depasc/home/>, or write to depaulactuarialclub@gmail.com.

Math Club

The DePaul Math Club typically meets at noon each Friday during the academic year. The Club provides fun and interesting activities and programs to benefit students of mathematics at all levels. The club hosts talks by faculty and students on mathematical topics outside of regular course content, in addition to regular fun features like the Integration Bee and problem-solving sessions. Pizza is provided at most Friday DePaul Math Club meetings. For more information, email depaulmathclub@gmail.com.

DePaul ASA-STATCOM—Pro Bono Statistical Consulting

The DePaul ASA-STATCOM is a combined student chapter of ASA and STATCOM for anyone who is passionate about statistics. ASA (American Statistical Association) is the world's largest community of statisticians, and we are honored to have started a student chapter at DePaul in 2017. We provide career information in the statistical sciences, as well as encourage students to continue studying statistics. ASA student chapter activities include academic tutorials, talks from industry, job events. Chapter members can join the ASA for only \$25 per year.

Statistics in the Community (STATCOM), a student-run volunteer organization launched at DePaul University in 2008, offers students opportunities to polish up their professional skills through practical projects from local businesses and organizations. Students actively gain practical experience in large data sets, working with advisors who help them understand data management. The work is pro-bono but students are able to put it on their resume. For the most up-to-date information, visit <https://community.amstat.org/depaul-sc/home>, or write to asastatcom.depaul@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:

- AMS—American Mathematical Society—ams.org
- ASA—American Statistical Association—amstat.org
- AWM—Association for Women in Mathematics—awm-math.org
- MAA—Mathematical Association of America—maa.org
- NAM—National Association of Mathematicians—nam-math.org
- SACNAS—Society for the Advancement of Chicanos/Hispanics & Native Americans in Science—sacnas.org
- SIAM—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:

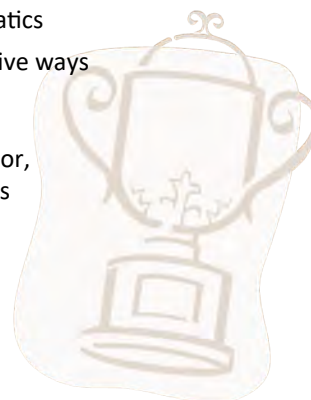
- Be a graduating senior with strong academic credentials in mathematics, education, computer science, commerce or music
- Demonstrate an interest in advancing the study of mathematics
- Demonstrate an interest in applying mathematics in innovative ways

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.



B.A./B.S. Mathematical Sciences Overview

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.

Requirement	BA Mathematics	BS Mathematics
Liberal Studies Requirements	80 hours	80 hours
Major Requirements	32-36 hours	48-52 hours
Major Concentration Requirements	24-28 hours	24-28 hours
Open Electives	48-56 hours	32-40 hours
Total hours required	192 hours	192 hours

B.A./B.S. Mathematical Sciences Major Requirements

Common Core

- **Choose one of the following Calculus sequences:**
 - ◇ Sequence One
 - * MAT 147-148-149 CALCULUS WITH INTEGRATED PRECALCULUS I-II-III
 - ◇ Sequence Two
 - * MAT 150-151-152 CALCULUS I-II-III
 - ◇ Sequence Three
 - * MAT 155-156 SUMMER CALCULUS I-II
 - ◇ Sequence Four
 - * MAT 160-161-162 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I-II-III
 - ◇ Sequence Five
 - * MAT 170-171 CALCULUS FOR LIFE SCIENCES I-II
 - * MAT 149, MAT 152 OR MAT 162
- 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
 - ◇ MAT 140-141 DISCRETE MATHEMATICS I-II
- CSC 241 INTRODUCTION TO COMPUTER SCIENCE I, or a more advanced course in any programming language.
- MAT 398 SENIOR CAPSTONE SEMINAR
- [BS only] Students must earn at least 16 quarter hours as 4 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.
- **Data Analysis Requirement (AQ 2019 and later), which can be satisfied via one of the following:**
 - ◇ AP Statistics credit (score of 3 or better)
 - ◇ Courses from a concentration. The following concentration areas will automatically satisfy the data analysis requirement: Actuarial Science, Financial Math, Quantitative Analysis & Operations Research, Statistics
 - ◇ One of the following electives: MAT 137, 242, 341, or 348, IT 223, PSY 240, BIO 206, ENV 260, or SOC 279
 - ◇ [BS only] An applied statistics or data analysis course taken as one of the four Natural or Computer Science courses required for the BS.

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 LOSS MODELS I
MAT 365 LOSS MODELS II
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 is recommended for the fall 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, 320, 340, 370, and 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.
- 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

	Autumn	Winter	Spring
Y3	351	352	353
	361	362	363
		341	
Y4	356	398	326
	357	341	359
	364	355	
	368	358	
	370		

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: LINEAR PROGRAMMING
 - MAT 388 OPERATIONS RESEARCH: 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.

- **Data Analysis Requirement**, which can be satisfied via one of the following:

- ◇ AP Statistics credit (score of 3 or better)
- ◇ One of the following electives: MAT 137, MAT 242, MAT 341, MAT 348, IT 223, PSY 240, BIO 206, ENV 260, or SOC 279
- ◇ An applied statistics or data analysis course taken as one of the four Natural or Computer Science courses required for the BS.

Course Scheduling

- Unless otherwise specified, assume Calculus I-II-III in Y1 and MAT 260-1-2 in Y2.
- MAT 215 is recommended for the fall 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, 320, 340, 370, and 372.
- MAT 216 is required for MAT 303, 310, 335 and 337.
- 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.

Key

Required
Choose One
Choose Three
Choose Two*
Choose One*

*Check Prerequisites

	Autumn	Winter	Spring
Y2	260	261	262
	215/140-1	215/140-1	215/140-1
		302	304
			303
Y3	335	302	304
	351	385	303
	370	352	337
	310	311	353
		340	
		336	
Y4		355	
	335	398	304
	351	302	303
	370	352	337
	310	311	353
		340	
		336	
	355		

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
- **Finance Minor requirements** [Students must meet the prerequisites of ACC 101, ECO 105, ECO 106 and MAT 137 (or a course in statistics) prior to some courses in the minor.]
 - 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 336 PRINCIPLES OF STOCK PICKING
 - FIN 340 INTERNATIONAL FINANCE
 - FIN 355 GLOBAL IPOs & VENTURE CAPITAL
 - FIN 360 IPOs & VENTURE CAPITAL
 - FIN 362 RISK MANAGEMENT
 - FIN 363 DERIVATIVES: PRICING & APPLICATIONS
 - FIN 366 FINANCIAL MODELING
 - FIN 380 CASES IN FINANCIAL DECISION MAKING [Capstone]
 - FIN 381 BEHAVIORAL FINANCE
 - FIN 393 FINANCE INTERNSHIP
 - FIN 394 APPLIED INTERNATIONAL PORTFOLIO MANAGEMENT [2 Credit Hours]
 - FIN 395 INVESTMENT SEMINAR [2 Credit Hours]
 - FIN 398 SPECIAL TOPICS
 - FIN 399 INDEPENDENT STUDY
 - RE 350 REAL ESTATE ANALYSIS [Cross-listed with FIN 350]

- **Open Electives**

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

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 is recommended for the fall 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, 320, 340, 370, and 372.
- MAT 216 is required for MAT 303, 310, 335 and 337.
- 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 One

	Autumn	Winter	Spring
Y2	260 215/140-1	261 215/140-	262 215/140-1 304
Y3	351	352 385	353 304
Y4		355 398 385	304

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. Students must also satisfy the department’s Data Analysis requirement.

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

- MAT 216 FOUNDATIONS OF ADVANCED MATHEMATICS
- **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 304 DIFFERENTIAL EQUATIONS
 - 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 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.
- **Data Analysis Requirement**, which can be satisfied via one of the following:
 - ◇ AP Statistics credit (score of 3 or better)
 - ◇ One of the following electives: MAT 137, MAT 242, MAT 341, MAT 348, IT 223, PSY 240, BIO 206, ENV 260, or SOC 279
 - ◇ [BS only] An applied statistics or data analysis course taken as one of the four Natural or Computer Science courses required for the BS.

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 is recommended for the fall quarter of Y2.
- MAT 140-141/215 is required for MAT 301, 302, 320, 340, 370, and 372.
- MAT 216 is required for MAT 303, 310, 335 and 337.
- 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.

	Autumn	Winter	Spring
Y2	260	261	262
	215	215	215
		216	
		301	303
		302	304
Y3	310	301	303
	335	302	304
	320	321	312
	370	340	337
		348	
		311	
		336	
Y4	320	398	303
	351	301	304
	370	302	312
		321	337
		340	353
		348	
		352	
		385	
		311	
		336	

Key

Required
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: LINEAR PROGRAMMING
 MAT 388 OPERATIONS RESEARCH: 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 TOPICS IN OPERATIONS RESEARCH
 CSC 389 THEORY OF COMPUTATION

	Autumn	Winter	Spring
Y2	260	261	262
	215/140-1	215/140-1	215/140-1
Y3	351	352	353
		*387	*388
Y4	356	398	*388
		358	
		*387	

Course Scheduling

- Unless otherwise specified, assume Calculus I-II-III in Y1 and MAT 260-1-2 in Y2.
- MAT 140 and 141 are typically offered each quarter and may be taken in Y1 or Y2.
- MAT 215 is recommended for the fall quarter of Y2.
- MAT 140-141/215 is required for MAT 301, 302, 320, 340, 370, and 372.
- MAT 216 is required for MAT 303, 310, 335 and 337.
- 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

**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.

	Autumn	Winter	Spring
Y2	260	261	262
	215/140-1	215/140-1	215/140-1
Y3	351	352	353
		385	
		341	
		348	
Y4	356	398	326
	370	358	359
	357	385	
	364	328	
		341	
	348		
	355		

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 help you prepare for the actuarial exams offered by the Society of Actuaries and the Casualty Actuarial Society. These courses include Probability and Statistics I & II (P Exam), Theory of Interest (FM Exam), Mathematics for Finance (IFM Exam), Loss Models I & II (STAM Exam), Life Contingencies I & II (LTAM Exam), and Applied Regression Analysis and Applied Time Series & Forecasting (SRM Exam). We also offer 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

Requirement	BS Actuarial Science
Liberal Studies Requirements	80 hours
Major Requirements	100 hours
Open Electives	12 hours
Total hours required	192 hours

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

<https://dehub.campusgroups.com/depasc/home/>.

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
- BLW 201 LEGAL & ETHICAL ASPECTS IN THE BUSINESS ENVIRONMENT
- ECO 105 PRINCIPLES OF MICROECONOMICS
- ECO 106 PRINCIPLES OF MACROECONOMICS
- MAT 150 CALCULUS I
- MAT 151 CALCULUS II
- MAT 152 CALCULUS III
- MAT 260 MULTIVARIABLE CALCULUS I
- MAT 262 LINEAR ALGEBRA
- MAT 351 PROBABILITY AND STATISTICS I
- MAT 352 PROBABILITY AND STATISTICS II [Covers topics relevant to the P Exam]
- MAT 353 PROBABILITY AND STATISTICS III
- MAT 361 THEORY OF INTEREST [Covers topics relevant to the FM Exam]
- MAT 368 MATHEMATICS FOR FINANCE [Covers topics relevant to the IFM Exam]
- FIN 310 INTRODUCTION TO FINANCE [Covers topics relevant to the FM Exam]
- FIN 365 PRINCIPLES OF RISK & INSURANCE
- ICS 392 SENIOR SEMINAR [Liberal Studies Program Capstone]

Data Analysis Requirements

- CSC 241 INTRODUCTION TO COMPUTER SCIENCE I
- MAT 341 STATISTICAL METHODS USING SAS

Actuarial Mathematics Major Electives—Select ONE of the following two-course sequences

- MAT 362-3 LIFE CONTINGENCIES I-II [Covers topics relevant to the LTAM Exam]
- MAT 364-5 LOSS MODELS I-II [Covers topics relevant to the STAM Exam]

Actuarial Statistics Major Electives—Select THREE of the following

- ◇ MAT 350 BAYESIAN STATISTICS
- ◇ MAT 355 STOCHASTIC PROCESSES
- ◇ MAT 356 APPLIED REGRESSION ANALYSIS [With MAT 358, covers topics relevant to the SRM Exam]
- ◇ MAT 358 APPLIED TIME SERIES AND FORECASTING [With MAT 356, covers topics relevant to the SRM Exam]
- ◇ MAT 359 SIMULATION MODELS AND MONTE CARLO METHOD
- ◇ MAT 360 GENERALIZED LINEAR MODELS
- ◇ DSC 323 DATA ANALYSIS AND REGRESSION [formerly CSC 324]
- ◇ DSC 324 ADVANCED DATA ANALYSIS [formerly CSC 334]
- ◇ DSC 341 FOUNDATIONS OF DATA SCIENCE [formerly CSC 367]

B.A. Data Science Overview

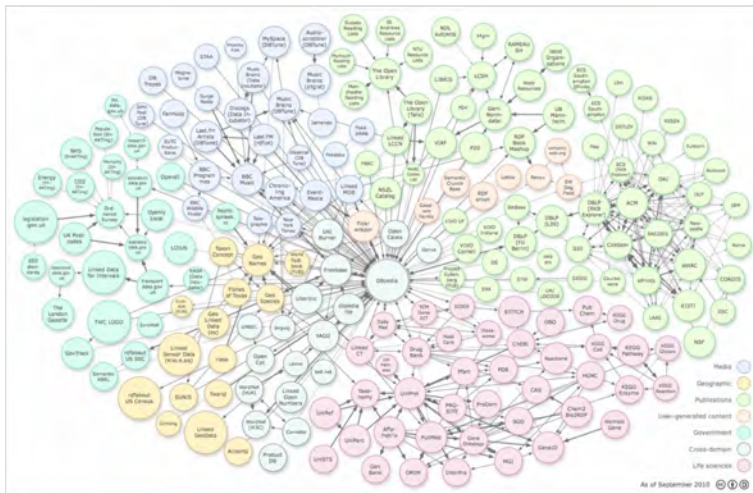
The Bachelor of Arts in Data Science is designed to meet the growing demand for data scientists or data analysts. The increasing availability of digital information is changing the way businesses and organizations operate. More and more companies are in need of data science professionals with deep analytical and technical skills who can analyze massive amounts of data and extract information from complex data sources.

Data science is an excellent choice for any student who has an interest or aptitude in the mathematical and computer sciences and who aspires to have an impactful and rewarding career, regardless of industry or job title. Students pursuing the Bachelor of Arts in Data Science will be advised to get contextualized experience by combining their degree with a minor or a second major in a different area of study. Fluency in data science and analytics will enable graduates with a dual focus to position themselves as the future leaders in their respective fields.

Curriculum

DePaul offers a Bachelor of Arts degree through the Mathematical Sciences Department in the College of Science and Health, and a Bachelor of Science degree in in the College of Computing and Digital Media. The two programs share a common core of courses that students take during the first two years. The common core focuses on the fundamental skills of data science including programming, data management, statistical inference and data mining. After the second year, the two degrees diverge in their emphasis and level of specialization.

Requirement	BS Actuarial Science
Liberal Studies Requirements	76 hours
Major Requirements	76-80 hours
Open Electives	36-40 hours
Total hours required	192 hours



B.A. Data Science Major Requirements

Common Core

- **Either both:**

CSC 241 INTRODUCTION TO COMPUTER SCIENCE I
CSC 242 INTRODUCTION TO COMPUTER SCIENCE II

Or just:

CSC 243 PYTHON FOR PROGRAMMERS

- **All of the following:**

CSC 300 DATA STRUCTURES I
CSC 301 DATA STRUCTURES II
CSC 321 DESIGN AND ANALYSIS OF ALGORITHMS
DSC 323 DATA ANALYSIS AND REGRESSION (FORMERLY CSC 324)
DSC 324 ADVANCED DATA ANALYSIS (FORMERLY CSC 334)
CSC 355 DATABASE SYSTEMS
DSC 341 FOUNDATIONS OF DATA SCIENCE (FORMERLY CSC 367)
IT 223 DATA ANALYSIS
MAT 140 DISCRETE MATHEMATICS I
MAT 150 CALCULUS I
MAT 151 CALCULUS II
MAT 152 CALCULUS III
MAT 220 APPLIED LINEAR ALGEBRA
MAT 260 MULTIVARIABLE CALCULUS I
MAT 349 APPLIED PROBABILITY
MAT 350 BAYESIAN STATISTICS
MAT 360 GENERALIZED LINEAR MODELS
MAT 384 MATHEMATICAL MODELING

- **Open Electives**

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



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
- ◆ Computer vision
- ◆ Research

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.

Requirement	BA Mathematics
Liberal Studies Requirements	80 hours
Major Requirements	56 hours
Major Concentration Requirements	28 hours
Open Electives	28 hours
Total hours required	192 hours

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
- **One of the following:**
 - ◊ CSC 394 SOFTWARE PROJECTS (Capstone)
 - ◊ GPH 395 COMPUTER GRAPHICS SENIOR PROJECT (Capstone)
 - ◊ 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 147-148-149 CALCULUS WITH INTEGRATED PRECALCULUS I-II-III
 - ◊ Sequence Two
 - * MAT 150-151-152 CALCULUS I-II-III
 - ◊ Sequence Three
 - * MAT 155-156 SUMMER CALCULUS I-II
 - ◊ Sequence Four
 - * MAT 160-161-162 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I-II-III
 - ◊ Sequence Five
 - * MAT 170-171 CALCULUS FOR LIFE SCIENCES I-II
 - * MAT 149, MAT 152 OR MAT 162
- MAT 260 MULTIVARIABLE CALCULUS I
- MAT 262 LINEAR ALGEBRA
- **3 CDM Major Electives**
- **3 MAT Major Electives**
- **1 CDM or MAT Major Elective**

Continued...

B.S. Mathematics & Computer Science (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-minus 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 310 ABSTRACT ALGEBRA I
MAT 335 REAL ANALYSIS I
MAT 336 REAL ANALYSIS II
MAT 351 PROBABILITY AND STATISTICS I
MAT 370 ADVANCED LINEAR ALGEBRA
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
MAT 387 OPERATIONS RESEARCH: LINEAR PROGRAMMING
CSC 389 THEORY OF COMPUTATION

Computational Methods

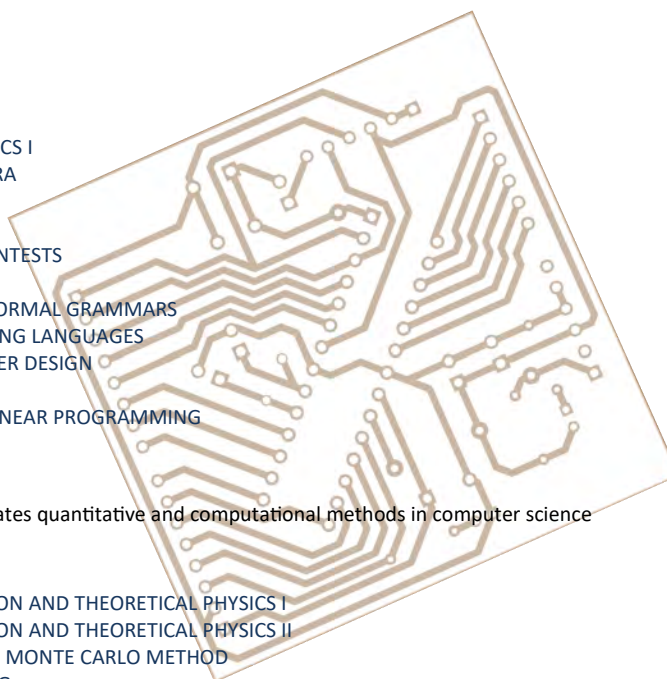
The computational methods area investigates quantitative and computational methods in computer science

CSC 331 SCIENTIFIC COMPUTING
MAT 304 DIFFERENTIAL EQUATIONS
MAT 330 METHODS OF COMPUTATION AND THEORETICAL PHYSICS I
MAT 331 METHODS OF COMPUTATION AND THEORETICAL PHYSICS II
MAT 359 SIMULATION MODELS AND MONTE CARLO METHOD
MAT 384 MATHEMATICAL MODELING
MAT 385 NUMERICAL ANALYSIS I
MAT 386 NUMERICAL ANALYSIS II

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



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 370 ADVANCED LINEAR ALGEBRA
MAT 381 FOURIER ANALYSIS AND SPECIAL FUNCTIONS
MAT 384 MATHEMATICAL MODELING
MAT 387 OPERATIONS RESEARCH: LINEAR PROGRAMMING
MAT 388 OPERATIONS RESEARCH: OPTIMIZATION THEORY
CSC 381 INTRODUCTION TO DIGITAL IMAGE PROCESSING
CSC 382 APPLIED IMAGE ANALYSIS

Data Science

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.

DSC 324 ADVANCED DATA ANALYSIS (FORMERLY CSC 334)
or MAT 354 MULTIVARIATE STATISTICS
DSC 341 FOUNDATIONS OF DATA SCIENCE (FORMERLY CSC 367)
DSC 333 INTRODUCTION TO BIG DATA PROCESSING
DSC 345 MACHINE LEARNING
DSC 365 DATA VISUALIZATION (FORMERLY DSC 350)
MAT 341 STATISTICAL METHODS USING SAS
MAT 349 APPLIED PROBABILITY
or MAT 351 PROBABILITY AND STATISTICS I
MAT 352 PROBABILITY AND STATISTICS II
MAT 353 PROBABILITY AND STATISTICS III
MAT 354 MULTIVARIATE STATISTICS
MAT 355 STOCHASTIC PROCESSES
MAT 356 APPLIED REGRESSION ANALYSIS
or DSC 323 DATA ANALYSIS AND REGRESSION (FORMERLY CSC 324)
MAT 357 NONPARAMETRIC STATISTICS
MAT 358 APPLIED TIME SERIES AND FORECASTING
MAT 359 SIMULATION MODELS AND MONTE CARLO METHOD
MAT 360 GENERALIZED LINEAR MODELS

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-minus 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

- Please find the CSC 241 advising guide at <http://facweb.cdm.depaul.edu/asettle/csc241AdvisingGuide.pdf>.
- Computer Science Society: <http://css.cdm.depaul.edu/>
- The Association for Computing Machinery (ACM: <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>
- 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 for more information.

Recommended First-Year Schedule

Fall	Winter	Spring
LSP 110 Discover; or LSP 111 Explore Chicago	Arts & Literature course	LSP 112 Focal Point Seminar
WRD 103 Composition and Rhetoric I	WRD 104 Composition and Rhetoric II	Self, Society & the Modern World course
CSC 241 Introduction to Computer Science I	CSC 242 Introduction to Computer Science II	CSC 300 Data Structures in Java I
MAT 150 Calculus I*	MAT 151 Calculus II*	MAT 152 Calculus III*

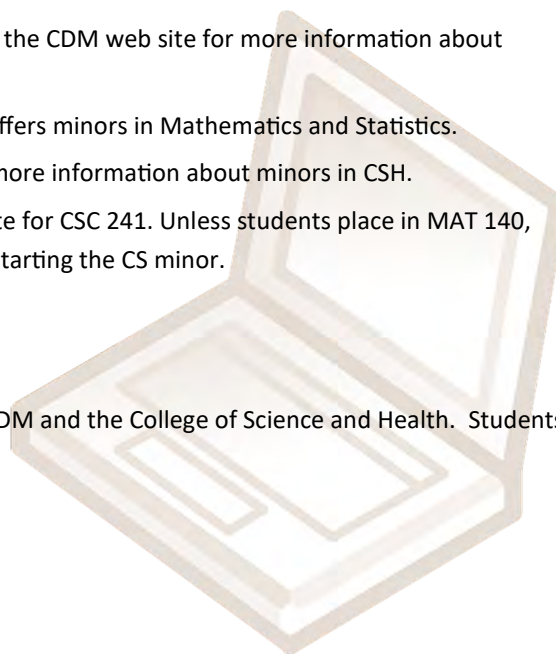
** Note that there are four other calculus sequences to choose from (the MAT 147 sequence, the 155 sequence, the MAT 160 sequence, and the MAT 170 sequence). It may be likely that students in this major opt for one of those sequences.*

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 successfully completed (with a C-minus or better) the following undergraduate coursework:

- ◆ One year of single-variable calculus (MAT 150-151-152, or equivalent)
- ◆ One quarter of multivariable calculus (MAT 260, or equivalent)
- ◆ One quarter of linear algebra (MAT 262, or equivalent)
- ◆ 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, Ilie Ugarcovici (iugarcov@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, Ilie Ugarcovici (iugarcov@depaul.edu), prior to submitting their application.

Combined Degrees (Continued)

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 successfully completed (with a C-minus or better) the following undergraduate coursework:

- ◆ One year of single-variable calculus (MAT 150-151-152, or equivalent)
- ◆ One quarter of multivariable calculus (MAT 260, or equivalent)
- ◆ One quarter of linear algebra (MAT 262, or equivalent)
- ◆ 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 (dhabtzgh@depaul.edu), 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 (ykashina@depaul.edu), 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 Program

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)

Continued...

Combined Degrees (Continued)

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:**
 - ◇ MAT 147-148-149 CALCULUS WITH INTEGRATED PRECALCULUS I-II-III
 - ◇ MAT 150-151-152 CALCULUS I-II-III
 - ◇ MAT 155-156 SUMMER CALCULUS I-II
 - ◇ MAT 160-161-162 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I-II-III
 - ◇ MAT 170-171 CALCULUS FOR LIFE SCIENCES I-II and (MAT 149, MAT 152 OR MAT 162)
- MAT 260 MULTIVARIABLE CALCULUS I
- **Choose one of the following courses:**
 - MAT 262 LINEAR ALGEBRA
 - MAT 220 APPLIED LINEAR ALGEBRA
- **Choose one of the following courses:**
 - MAT 215 INTRODUCTION TO MATHEMATICAL REASONING
 - MAT 304 DIFFERENTIAL EQUATIONS
 - MAT 351 PROBABILITY & STATISTICS I
 - MAT 348 APPLIED STATISTICAL METHODS
 - MAT 384 MATHEMATICAL MODELING
 - MAT 385 NUMERICAL ANALYSIS I

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.

In general, mathematics students cannot earn a minor in the same academic program as their major. A minor in Mathematics, however, can be earned if the student's major is

- BS Actuarial Science
- BA Data Science
- BA/BS Mathematics with a concentration in Statistics.

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.

- **Choose one of the following Calculus sequences:**
 - ◇ MAT 147-148 CALCULUS WITH INTEGRATED PRECALCULUS I-II
 - ◇ MAT 150-151 CALCULUS I-II
 - ◇ MAT 155-156 SUMMER CALCULUS I-II
 - ◇ MAT 160-161 CALCULUS FOR MATHEMATICS AND SCIENCE MAJORS I-II
 - ◇ MAT 170-171 CALCULUS FOR LIFE SCIENCES I-II
- **Choose one of the following courses:**
 - MAT 341 STATISTICAL METHODS USING SAS
 - MAT 348 APPLIED STATISTICAL METHODS
- **Choose one of the following courses:**
 - MAT 349 APPLIED PROBABILITY
 - MAT 351 PROBABILITY AND STATISTICS I
- **Choose two courses from the following list:**
 - MAT 326 SAMPLE SURVEY METHODS
 - MAT 328 DESIGN OF EXPERIMENTS
 - MAT 350 BAYESIAN STATISTICS
 - MAT 356 APPLIED REGRESSION ANALYSIS
 - MAT 357 NONPARAMETRIC STATISTICS
 - MAT 358 APPLIED TIME SERIES & FORECASTING
 - MAT 399 (Internship course)

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.

In general, mathematics students cannot earn a minor in the same academic program as their major. A minor in Statistics, however, can be earned if the student's major is one of the following:

- BS Actuarial Science
- BS Mathematics & Computer Science
- BA/BS Mathematics, with a concentration in Actuarial Science, Applied Computational Mathematics, Financial Mathematics, Pure Mathematics, or Individualized Concentration (with prior approval of the department chair)

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 equivalent 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 equivalent 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'Hôpital'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.

*Red = Core Course
*Green = Statistics Course

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'Hôpital'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. Prerequisite: MAT 149 or MAT 152 or MAT 156 or MAT 162 or MAT 172.

MAT 216 FOUNDATIONS OF ADVANCED MATHEMATICS

Introduction to abstract mathematics: Congruences, modular arithmetic, the Euclidean algorithm, proofs involving manipulation of inequalities and estimation, sequences and their limits. Prerequisite: MAT 215 (or MAT 141).

MAT 220 APPLIED LINEAR ALGEBRA

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 216, 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

Theories, methods, and materials for teaching and learning mathematics in secondary schools. Cross-listed with SEC 309. Prerequisite: SE 364.

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 216), 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, or instructor permission.

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.

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. Prerequisite: MAT 130 or placement by test.

MAT 324 DATA ANALYSIS & STATISTICAL SOFTWARE II

Advanced features and applications of the statistical package used in MAT 323. Prerequisite: C-minus or better in MAT 323, or instructor permission.

*Red = Core Course
*Green = Statistics Course

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. 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 216).

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 215 (or MAT 141) and MAT 335, or instructor permission.

MAT 341 STATISTICAL METHODS USING SAS

The SAS programming language. Data exploration, description and presentation, with emphasis on writing statistical reports. 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, or instructor permission.

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 349 APPLIED PROBABILITY

Probability theory, probability distributions, mathematical expectation, functions of random variables, sampling distributions, estimation, tests of hypotheses, simulation. Focus on applications. Prerequisite: C-minus or better in MAT 341 or MAT 348 or CSC 324 or DSC 323.

MAT 350 BAYESIAN STATISTICS

Comparison of Bayesian and frequentist methods, conditional probability, Bayes theorem, conjugate distributions, computational methods, hands-on Bayesian data analysis using appropriate software, interpretation and presentation of analysis results. Students will learn to use software packages including OpenBUGS. The free software program R will be utilized for data analysis. Prerequisite: MAT 349 (or MAT 351).

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 instructor consent.

MAT 355 STOCHASTIC PROCESSES

Discrete Markov chains and random walks, birth and death processes, Poisson processes, queuing systems, and renewal processes. Cross-listed with MAT 455. Prerequisite: MAT 353 and (MAT 220 or MAT 262).

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 MAT 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) or MAT 356.

MAT 359 SIMULATION MODELS & 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 360 GENERALIZED LINEAR MODELS

Applications of generalized linear models. Topics include generalized linear models for non-normal continuous response, models for binary and multinomial response data, models for count data, and analysis of variance and covariance. The class of generalized linear models contains the models most commonly used in statistical practice. Prerequisites: (CSC 324 or DSC 323 or MAT 341) and (MAT 349 or MAT 351).

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 LOSS MODELS I

Severity and frequency models, aggregate models, coverage modifications, risk measures, construction and selection of parametric models. (Cross-listed with MAT 464.) Prerequisite: MAT 353.

MAT 365 LOSS MODELS II

Bayesian credibility, Buhlmann credibility, insurance and reinsurance coverages, pricing and reserving. (Cross-listed with MAT 465.) Prerequisite: MAT 364.

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 algorithm and applications to digital filtering, 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 220 or 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/better in MAT 385, or permission.

**MAT 387 OPERATIONS RESEARCH:
LINEAR PROGRAMMING**

Linear programming, integer programming and LP relaxation, the duality theorem, simplex algorithm, interior point methods, applications to industrial engineering. Students should take an introductory computer programming course before taking this course. (CROSS-LISTED AS MAT 487.) Prerequisites: MAT 260 and MAT 262.

**MAT 388 OPERATIONS RESEARCH:
OPTIMIZATION THEORY**

Convex optimization, quadratic optimization problems, Lagrange multipliers and generalization to inequality constraints, alternating direction method of multipliers (ADMM), unconstrained minimization, applications to industrial engineering including machine learning. Students should take an introductory computer programming course before taking this course. (CROSS-LISTED AS MAT 488.) Prerequisites: MAT 260 and MAT 262.

MAT 389 TOPICS IN OPERATIONS RESEARCH

Advanced topics in operations research and optimization theory. Prerequisite: A grade of 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

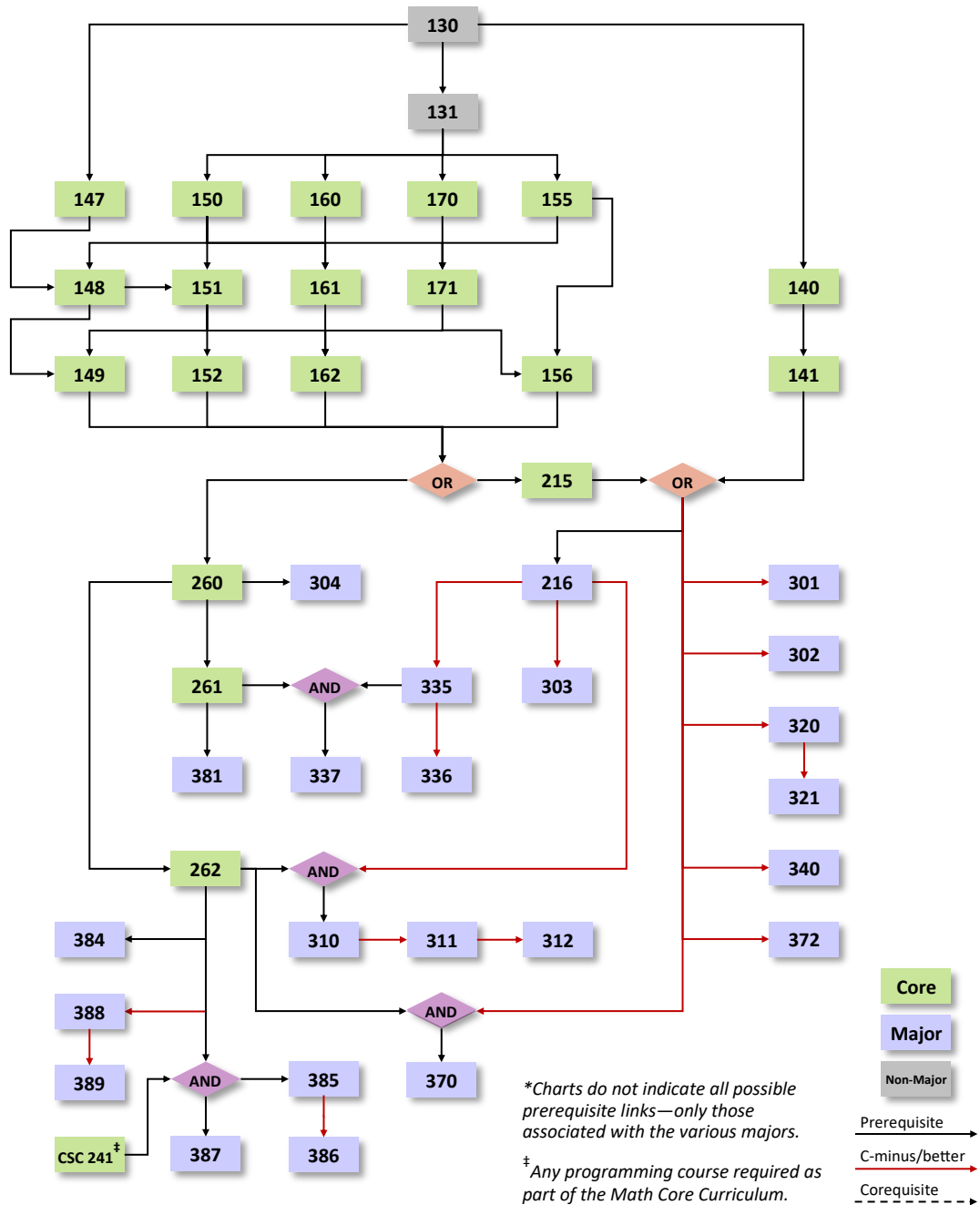
Topics vary from year to year. This course does not count toward the mathematical major or minor credit. Prerequisites: MAT 215 (or MAT 140 and 141) and MAT 262, or instructor permission.

MAT 399 INDEPENDENT STUDY

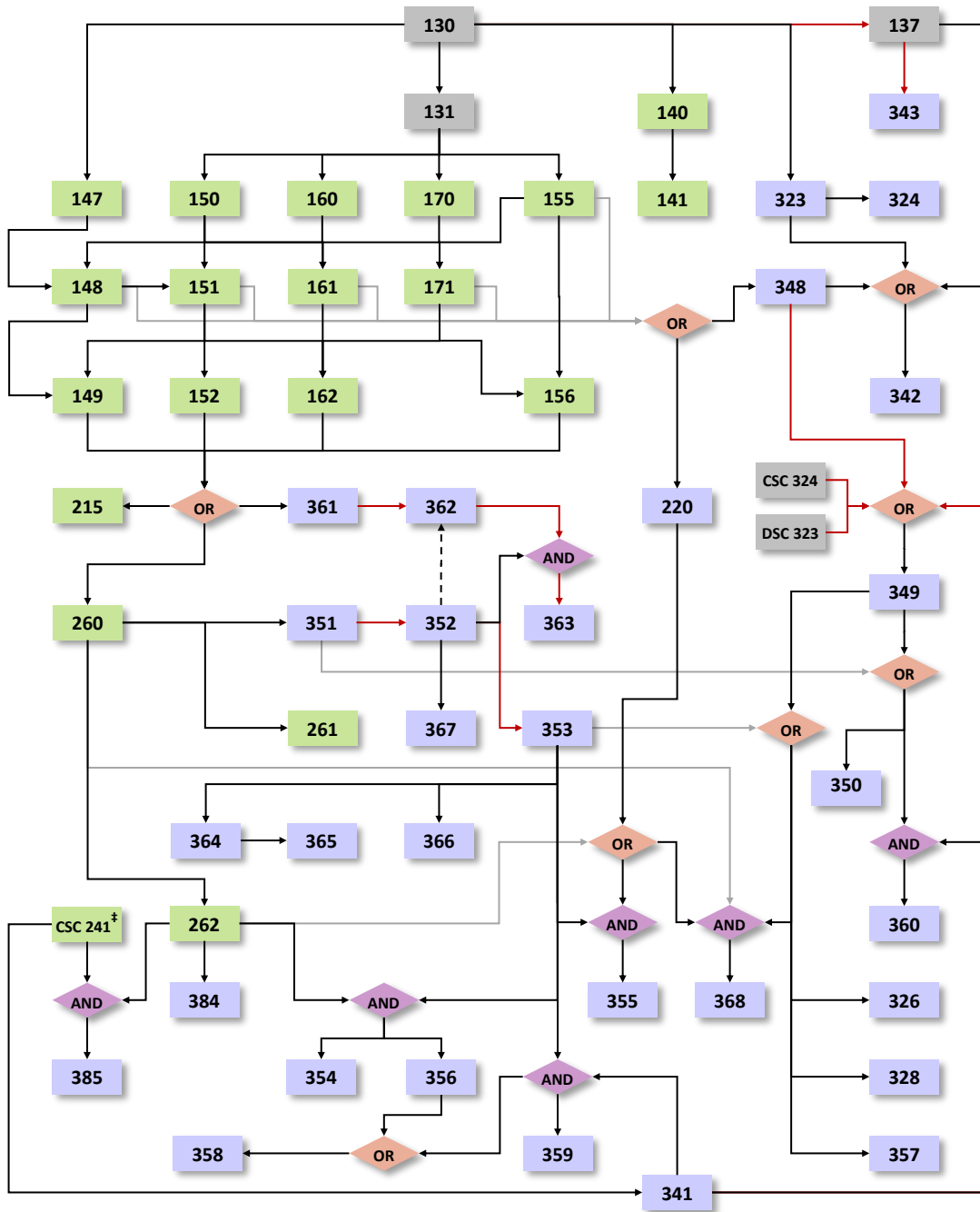
Variable credit.

*Red = Core Course
*Green = Statistics Course

Prerequisite Chart (Mathematics Concentrations*)



Prerequisite Chart (Actuarial Science & Statistics*)



Course Scheduling

AQ	WQ	SQ	Course Title
110			Mathematics for Elementary School Teachers I
	111		Mathematics for Elementary School Teachers II
130	130	130	Precalculus
131	131	131	Trigonometry
135	135	135	Business Calculus I
136	136	136	Business Calculus II
137	137	137	Business Statistics
140	140	140	Discrete Mathematics I
141	141	141	Discrete Mathematics II
147			Calculus with Integrated Precalculus I
	148		Calculus with Integrated Precalculus II
		149	Calculus with Integrated Precalculus III
150	150	150	Calculus I
151	151	151	Calculus II
152	152	152	Calculus III
215	215	215	Introduction to Mathematical Reasoning
	216	216	Foundations of Advanced Mathematics
		220	Applied Linear Algebra
242/SOC 279	242/SOC 279	242/SOC 279	Elements of Statistics
260	260	260	Multivariable Calculus I
	261	261	Multivariable Calculus II
262	262	262	Linear Algebra
	301		History of Mathematics
	302		Combinatorics
		303	Number Theory
		304	Differential Equations
309			Teaching & Learning Secondary School Mathematics
310			Abstract Algebra I
	311		Abstract Algebra II
		312/472	Abstract Algebra III
320			Geometry I
	321		Geometry II
		326/526 ¹	Sample Survey Methods
	328/528		Design of Experiments
335			Real Analysis I
	336		Real Analysis II
		337/437	Complex Analysis
	340/434		Topology

AQ	WQ	SQ	Course Title
	341/448	341/448	Statistical Methods Using SAS
	348		Applied Statistical Methods
		349	Applied Probability
350/427			Bayesian Statistics
351		351	Probability & Statistics I
352	352		Probability & Statistics II
		353	Probability & Statistics III
	355/455		Stochastic Processes
356/456			Applied Regression Analysis
357/457			Nonparametric Statistics
	358/512		Applied Time Series & Forecasting
		359/459	Simulation Models & Monte Carlo Method
	360		Generalized Linear Models
361			Theory of Interest
	362		Life Contingencies I
		363	Life Contingencies II
	364/464		Loss Models I
		365	Loss Models II
367	367	367	Credibility Theory
368/468			Mathematics For Finance
370/470			Advanced Linear Algebra
372	372	372	Logic & Set Theory
381 ²			Fourier Analysis & Special Functions
384/484			Mathematical Modeling
	385/485		Numerical Analysis I
		386/486	Numerical Analysis II
	387		Operations Research: Linear Programming
		388	Operations Research: Optimization Theory
390	390	390	Mathematics Reading & Research
395	395	395	Topics in Mathematics
396	396	396	Senior Thesis Research
397			Mathematical Pedagogy: Theory & Practice
	398		Senior Capstone

Key

Day Only
Day & Night
Night Only
As Needed

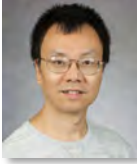
*The chart represents typical offerings, not an implied guarantee.
Courses not appearing have not been offered since WQ 2015.*

¹Odd Calendar Years (2021 + 2k)

²Even Calendar Years (2020 + 2k)

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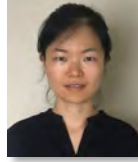
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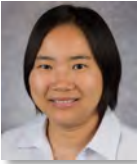
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Academic Calendar 2021-2022

Autumn Quarter

Wednesday September 8, 2021	BEGIN AQ2021 ALL CLASSES
Tuesday November 16, 2021	End AQ2021 Day & Evening Classes
Wednesday November 17, 2021	Begin AQ2021 Day & Evening Final Exams
Tuesday November 23, 2021	END AQ2021

Winter Quarter

Monday January 3, 2022	Begin WQ2022 Classes
Sunday March 13, 2022	End WQ2022 Day & Evening Classes
Monday March 14, 2022	Begin WQ2022 Day & Evening Final Exams
Sunday March 20, 2022	END WQ2022
Monday March 21, 2022	Begin Spring Break
Friday March 25, 2022	End Spring Break

Spring Quarter

Saturday March 26, 2022	Begin SQ2022 Classes
Friday June 3, 2022	End SQ2022 Day & Evening Classes
Saturday June 4, 2022	Begin SQ2022 Day & Evening Final Exams
Friday June 10, 2022	END SQ2022

Summer Session 1 (5-week term)

Monday June 13, 2022	Begin Summer Session I 2022 classes
Sunday July 17, 2022	END SUMMER SESSION I 2022

Summer Session 2 (5-week term)

Monday July 18, 2022	Begin Summer Session II 2022 classes
Sunday August 21, 2022	END SUMMER SESSION II 2022

Summer Term (10-week term)

Monday June 13, 2022	BEGIN SUMMER 2022 TERM
Sunday August 21, 2022	END SUMMER 2022 TERM

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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Math Club

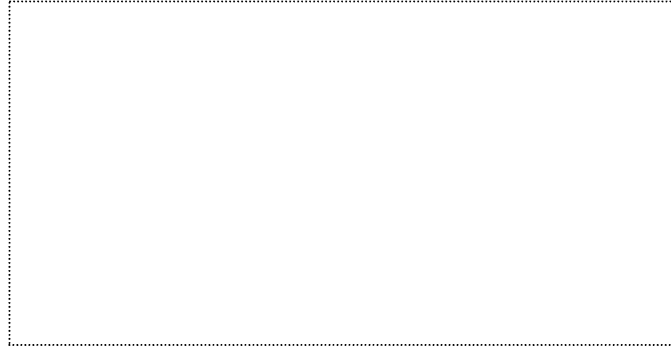
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About the front cover: Portrait of Sofia Vasilyevna Kovalevskaya (1850-1891),
engraved by R. G. Tietze, after a Russian print from a photograph. [Public domain]

9.29.2021