

# DEPARTMENT OF MATHEMATICS

## COLLEGE OF ARTS AND SCIENCES

### Faculty

**Bryan Dawson** (1998). Professor of Mathematics and Department Chair. B.S. and M.S., Pittsburg State University; Ph.D., University of North Texas.

**Richard Dehn** (1969). Associate Professor of Mathematics. B.S., University of Memphis; M.A.T., Purdue University; M.S., University of Arkansas, Additional study, University of Wisconsin, University of Arkansas, University of Missouri-Rolla.

**Chris Hail** (1995). Professor of Mathematics. B.S., Campbellsville College; M.A., Morehead State University; Ed.D., University of Kentucky.

**Dwayne Jennings** (1981). Associate Professor of Mathematics and Computer Science. B.S., Union University; M.S. (Mathematics) and M.S. (Computer Science), University of Memphis.

**Matt Lunsford** (1993). Professor of Mathematics. B.G.S., Louisiana Tech University; M.S., University of Nebraska; Ph.D., Tulane University.

**George Moss** (2009). Associate Professor of Mathematics and Assistant Dean of the College of Arts and Sciences. B.S., Auburn University; Ph.D., Virginia Polytechnic Institute and State University.

**Michelle Nielsen** (2010). Assistant Professor of Mathematics. B.A., Bethel University; M.S.; Ph.D., University of Minnesota.

**Troy Riggs** (1993, 2000). Professor of Mathematics. B.S., University of South Dakota; M.A., and Ph.D., University of Nebraska-Lincoln.

### Mission Statement

Union's mathematics program seeks to further students in their quest for increased understanding of Creation and the created order and to equip students to serve God, church and society through excellence in thinking and the use of mathematics. We do this through a curriculum that develops the student's ability to think logically, analytically, and abstractly; to pursue a body of knowledge whose basis is independent of both empirical observation and culture; and to learn humility and a sense of wonder at the complexity, beauty, and applicability of mathematics.

### Student Awards

A **Departmental Award** is given to the senior who places first in the Major Field Test for Mathematics as partial fulfillment of MAT 498.

The **Wolfram Research Inc. Award** is awarded to a freshman calculus student chosen by the Department of Mathematics based upon demonstrated outstanding achievement, enthusiasm, ingenuity, and creativity in mathematics.

### Curriculum

The department offers a major in mathematics and minors in mathematics, mathematics with emphasis in statistics, and actuarial science. Students majoring in mathematics may select from the following tracks: mathematics, teacher licensure in mathematics for secondary education (grades 7-12), or actuarial science. The offerings of the major provide a foundation for beginning graduate study in mathematics, for entry into mathematics-related work fields, and for teaching mathematics at the secondary level. Students majoring or minoring in mathematics begin their academic credit towards the major or minor with courses numbered MAT 205 or above. Students having a four-year high school mathematics program that included trigonometry should be able to begin the calculus sequence in their first semester.

#### I. Major in Mathematics—35 hours

- MAT 207, 208, 211, 212, 213, 315 and 498 are required.
- Select one: MAT 411, MAT 415.
- Select 9 hours from junior or senior MAT courses.
- Independent Study (MAT 495) or Departmental Special Study (MAT 395) may be used for 3 of the 9 hours required in C.
- Prerequisites: PHY 231, and CSC 115 or 255.

#### II. Major in Mathematics with Discipline-Specific Honors—36 hours

- MAT 207, 208, 211, 212, 213, 315\*—21 hours
- MAT 411\* and MAT 415\*—6 hours
- Upper Level MAT \*Elective hours—6 hours
- Three 300 or 400 level MAT courses from \* above taken under honors-contract, as approved by the department, to include 411 or 415 with at least two completed prior to the semester in which the honors project is completed—9 hours
- Independent Study (MAT 495) or Departmental Special Study (MAT 395) may be used for 3 of the 6 hours required in C.
- Attend at least 4 honors colloquia during each of the junior and senior years, as approved by the Director of the Honors Community.
- MAT 498—3 hours to include the honors project.
- Admissions Standards met and Progression Standards continue to be met throughout the program.
- Prerequisites: PHY 231, and CSC 115 or 255.

#### III. Teacher Licensure in Mathematics (Grades 7-12)

- Major requirements as shown above to include MAT 413.
- Professional Education: EDU 150, 250, 326, 422, 433; PSY 213, 318; SE 225.
- Completion of applicable portions of the Praxis II.
- For additional information, see the Assistant Dean for Teacher Education and Accreditation.

#### IV. Minor in Mathematics—21 hours

- MAT 211 and 212
- Select one: MAT 205, 207, 208, 213; CSC 115, 255
- 6 hours of upper-level MAT courses.
- The remaining must be 205 or higher.

**V. Minor in Mathematics with an Emphasis in Statistics—20 or 21 hours**

- A. MAT 211 and 212, 208, 305, and 405
- B. One of: MAT 213, 314, 315; CSC 115 or 255.

**VI. Minor in Actuarial Science as earned with a Math Major—19 hours**

- A. Prerequisites (applicable to major): MAT 211, 212, 213, 305, 315, 401, 402.
- B. ACC 211, 212; ECO 211, 212; FIN 320.
- C. ECO 411 or 412.
- D. MAT 400.

**VII. Minor in Actuarial Science as earned with a Business Major and BSBA—21 hours**

- A. Prerequisites (applicable to other requirements): ACC 211, 212; ECO 211, 212; FIN 320; ECO 411 or 412; MAT 208, 211; CSC 115 or 255. Note: In the BSBA core MAT 208 substitutes for MAT 114, and CSC 115 or 255 for 105.
- B. MAT 212, 213, 305, 315.
- C. MAT 400, 401, 402.

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## Admissions and Progression in the Major in Mathematics with Discipline-Specific Honors

Admission to the Program requires completion of at least 15 hours through Union University or transfer to include MAT 207 and MAT 213 with a minimum GPA of 3.50 both in all coursework and specifically in mathematics as well. Transfer students must complete at least one semester at Union University prior to application to include at least one course applicable to the major. Application is made during or immediately following the second semester of the sophomore year, or for a transfer student not at Union during the sophomore year, immediately following the first semester of the junior.

At least three full semesters, preferably four, must remain before graduation when application is made. The student makes application to the Office of the Director of the Honors Community but must be preceded by an appointment with the Chair of the Department of Mathematics.

To remain in the program the student must maintain the 3.50 minimum GPA both overall and in Mathematics, complete each honors contract course with a grade of B or better, and complete the requirements of the honors thesis in a timely manner as outlined below.

The honors contract for upper-level courses other than MAT 498 shall consist of work that helps the student develop skills in proving theorems and promotes understanding deeper than that required of other students. Possibilities include, but are not limited to, Option (1) completion of a collection of 20 proofs that are more difficult or probe the material more deeply than is required of other students, or Option (2) reading, understanding, and presenting a previously-published paper in the content area of the course. The department reserves the right to require an honors student to complete an honors contract of each type during the junior year. For each honors contract course, the student must:

- Come to agreement with the instructor of the course regarding the nature of the contract prior to the beginning of the course. Students are advised to contact the instructor prior to the end of the previous Fall or Spring Semester.
- Obtain the Department Chair's approval of the honors contract.

- Complete the required paperwork with the Office of the Director of the Honors Community prior to the first day of classes for the semester.

A student may petition the Department of Mathematics in writing to have his/her case reviewed for exception. The petition is submitted to the Chair and will be reviewed by a committee of three mathematics faculty.

No later than the beginning of classes for the 2nd semester prior to graduation (typically the beginning of the senior year), the student shall have chosen a project advisor and, in consultation with that advisor, a specific topic of study. The project advisor will guide the student through the timetable required to meet internal and external requirements for project development and completion. The requirements for the Honors Project/Thesis will be detailed in the student's syllabus for MAT 498 (3 hours).

A student failing to make sufficient progress in the honors thesis to meet the required timetable or is of insufficient quality shall be dismissed from departmental honors. Such determination is made concurrently with the thesis advisor, the department chair, and at least one additional faculty member. Assuming an honors contract course under Option (2) above has been satisfactorily completed, the student's enrollment in the 3-hr option of MAT 498 will be converted to the 2-hour option and a committee consisting of the department chair, the Option 2 honors contract course instructor, the honors thesis advisor, the instructor of MAT 498, and if necessary additional faculty (to have the minimum 3 members) will consider whether the Option (2) honors contract presentation is sufficient to meet the requirement of the MAT 498 project for non-honors students so the student's graduation will not be delayed.

Graduation with Discipline-Specific Honors in Mathematics requires the student must:

- Complete degree requirements with a minimum 3.50 mathematics GPA ,
- Complete each honors contract course with a grade of B or better,
- Present the project at the Union University Scholarship Symposium,
- Apply to present the project at an off-campus meeting, and
- Submit an article based on the project.

Application, contract forms and other information can be found at <http://www.uu.edu/dept/math/honors.cfm>.

## Assessment of Majors

All senior mathematics majors must take the Major Field Test in mathematics as one requirement for MAT 498 (see below). Those majors completing a teacher licensure program are required to take the PRAXIS II.

## Student Organizations

Kappa Mu Epsilon, honor society in mathematics, selects students who have achieved standards of

scholarship, professional merit, and academic distinction. A student must have completed 3 semesters' rank in the upper 35%, completed 3 courses in MAT, to include calculus, and have a minimum 3.0 Math GPA.

**Sigma Zeta** is a national honorary science society for those who have completed 15 hours in natural science and math with a minimum GPA of 3.0 in these courses.

## Course Offerings in Mathematics (MAT)

( ) Hours Credit; F–Fall, W–Winter; S–Spring; Su–Summer

### @101. Mathematics for Elementary Teachers (3) F, S

This course is designed to introduce the student to problem solving strategies and the real number system. Topics will include the whole numbers, integers, fractions and decimals, functions and coordinate geometry.

### @107. Mathematics for the Liberal Arts (3) F, S

This course is designed to introduce the student to the basic concepts of several areas of mathematics. Topics of focus will include counting techniques, descriptive statistics, probability and geometry.

### @\*111. College Algebra (3) F, W, S; Su As Needed

Prerequisite: Two years of high school algebra.

Topics include equations in two variables, functions, graphing techniques, systems of equations and inequalities, exponential and logarithmic functions, matrices, and the theory of polynomial equations.

### @\*112. Plane Trigonometry (3) S—As Needed

Prerequisite: MAT 111.

Topics include the definition of the trigonometric functions, radian measure, linear and angular velocity, graphing techniques, trigonometric identities and equations, the inverse trigonometric functions, and solving triangles.

### @114. Introduction to Statistics and Probability (3) F, W, S; Su—As Needed

Prerequisite: Two years of high school algebra.

Descriptive statistics with introduction to inferential statistics. Topics include organization of data into frequency distribution tables and histograms, measures of central tendency, standard deviation, basic probability, continuous distributions through the normal distribution, introduction to sampling theory and hypothesis testing.

### @\*116. Precalculus (4) F; S

Prerequisites: Two years of high school algebra and one of geometry.

An introduction to polynomial, exponential, logarithmic, trigonometric, circular and inverse circular functions. The course also includes trigonometric identities and basic analytic geometry. This course is intended for students planning to take MAT 211 and is not recommended for students who have taken MAT 111 and/or 112.

### @201. Applied Calculus (3) As Needed

Prerequisite: MAT 111 or its equivalent.

Topics include a review of algebra principles, development of differential calculus with an emphasis on applications of the derivative to business and biological sciences, and an introduction to integral calculus with elementary applications of the definite integral. Is not recommended for students that have taken MAT 211-12.

### 205. Discrete Mathematics (3) F—As Needed

Prerequisite: MAT 111 or its equivalent.

Topics include elementary logic, sets, proof techniques including induction, relations and graphs, recurrence relations, basic counting techniques, equivalence relations, Boolean algebra, and algebraic structures.

### 207. Transition Mathematics (3) S

Corequisite: MAT 212

An introduction to abstract mathematical reasoning, including reading and writing proofs. Topics include logic, types of proofs, set theory, functions and relations.

### 208. Statistics (3) F; S—As Needed

Prerequisite: MAT 201 or 211.

This is a calculus-based statistics course. Topics include descriptive statistics, probability theory, discrete and continuous random variables, common discrete distributions, the normal distribution, sampling distributions, and applications to confidence interval estimates and hypothesis testing.

### 211. Calculus and Analytic Geometry I (4) F, S

Prerequisite: Pass Calculus Readiness Test or MAT 116.

Topics include basic concepts of plane analytic geometry, functions, limits, differentiation of algebraic and trigonometric functions, applications of the derivative, the indefinite and the definite integral, and the fundamental theorem of calculus.

### 212. Calculus and Analytic Geometry II (4) F, S

Prerequisite: MAT 211.

Topics include integration by substitution, numeral integration, applications of the definite integral, the calculus of transcendental functions, techniques of integration, and the calculus of parametrized curves.

### 213. Calculus and Analytic Geometry III (4) F, S

Prerequisite: MAT 212.

Topics include infinite series, polar coordinates, vectors in three-space, functions of several variables, partial derivatives, multiple integrals, and line integrals.

**305. Statistical Methods (3) S—Odd Years**

Prerequisite: MAT 208.

Parametric and non-parametric statistical methods with an emphasis on applications. Topics include correlation and regression, analysis of variance, Chi-square distribution, contingency tables, and applications to the social sciences, life sciences, and business.

**310. History of Mathematics (3) S—Even Years**

Prerequisite: MAT 212.

A survey of the major developments in the history of mathematics with special emphasis to the areas usually discussed in high school and undergraduate mathematics courses: geometry, algebra, trigonometry, and calculus.

**314. Differential Equations (3) F, S**

Prerequisite: MAT 213.

Topics include linear first-order differential equations and applications, higher-order differential equations, and applications.

**315. Linear Algebra (3) S; W—As Needed**

Prerequisite: MAT 212.

Topics include systems of linear equations, matrices, determinants, linear transformations, diagonalization of matrices, and major applications to business and the sciences.

**320. Introduction to Complex Variables (3) F—Even Years**

Prerequisite: MAT 213.

Algebraic properties of the complex number system, complex transformations, analytic functions, complex integration, residues, and series representations of functions.

**360. Numerical Analysis (3) F—Odd Years or as Needed**

Prerequisite: CSC 115 or 255; MAT 207 and 213.

Numerical computations, roots of equations, simultaneous nonlinear and linear simultaneous equations, numerical integration and differentiation, and power series calculations.

**400. SOA Exam P Preparation (1) As Needed**

Prerequisite: MAT 213 and 305.

Application of calculus and statistics to risk management problems relevant to the Society of Actuaries first exam. Sitting for the SOA Exam P is required for successful completion of the course. Pass/Fail.

**401. Actuarial Mathematics I (3) As Needed**

Prerequisite: MAT 400

Measures of interest, annuities-certain, amortization schedules, sinking funds and bonds. Introduction to life tables, life annuities and life insurance.

**402. Actuarial Mathematics II (3) As Needed**

Prerequisite: 401.

Actuarial models, including survival models, stochastic processes, and loss models. Applications to insurance and annuity contracts.

**405. Mathematical Statistics (3) As Needed**

Prerequisites: MAT 305 and 212.

A calculus-based introduction to the theory of probability and statistics. Topics include conditional probability and independence, random variables, mathematical expectations, discrete and continuous distributions, central limit theorem, and sampling theory.

**411. Introduction to Analysis (3) Three-semester rotation**

Prerequisite: MAT 207 and 213.

A rigorous inquiry into sequences, limits, continuity, differentiation, and integration.

**413. College Geometry (3) Three-semester rotation**

Prerequisite: MAT 207 and 212.

Topics include axiomatic foundations of Euclidean and non-Euclidean geometry, models for incidence geometries, and development of theorems in the geometries of the Euclidean plane and the hyperbolic plane.

**415. Abstract Algebra (3) Three-semester rotation**

Prerequisite: MAT 207 and 212.

An introduction to number theory, group theory, and ring theory. Topics include divisibility in the integers, permutation groups, homomorphisms, normal subgroups and quotient groups, LaGrange's Theorem, ideals, and polynomial rings.

**498. Mathematics Seminar (2 or 3) F**

Prerequisite: 20 hours of MAT course work and Senior standing.

This course provides an appropriate setting for reviewing major topics in the mathematics curriculum and administering the Major Field Achievement Test, discussing how worldviews might contribute to our understanding of the Christian faith and demonstrating awareness of the nature of mathematics and its unifying principles through the presentation of current mathematical literature. The 3-credit option is reserved for students participating in discipline-specific honors.

\* Six hours maximum may be applied toward graduation from MAT 111-2, 116.

@ Does not apply toward the major or minor.

**179-279-379-479. External Domestic Study Programs (1-3) As Needed**

All courses and their applications must be defined and approved prior to registering.

**180-280-380-480. Study Abroad Programs (1-4)**

All courses and their application must be defined and approved prior to travel.

**195-6-7. Special Studies (1-4)**

**295-6-7. Special Studies (1-4)**

Lower-level group studies which do not appear in the regular departmental offerings.

**395-6-7. Special Studies (1-4)**

Upper-level group studies which do not appear in the regular departmental offerings.

**495-6-7. Independent Study (1-4)**

Individual research under the guidance of a faculty member(s).

**497-9. Seminar (1-3)**

To be used at the discretion of the department.