INTERDISCIPLINARY STUDIES IN ECONOMICS AND MATHEMATICS (ECMA)

Faculty

Director: KB Boomer (Mathematics)

Coordinating Committee: Marcellus Andrews (Economics), KB Boomer (Mathematics), Michael R. Frey (Mathematics), Joaquin Gomez-Minambres (Economics), Thomas C. Kinnaman (Economics, spring 2017), Paul J. McGuire (Mathematics), Nancy E. White (Economics, fall 2016)

Mathematics has traditionally served as the language of the natural sciences, and more recently it has become a useful tool in the social sciences, particularly in economics.

The Bachelor of Science in Interdisciplinary Studies in Economics and Mathematics at Bucknell University was developed jointly by the Department of Mathematics and the Department of Economics. It is a coordinated curriculum that incorporates economics, mathematics, and statistics to provide the strong foundations that offer students both the intellectual and the quantitative skills to grapple with questions at the interface of these two disciplines.

Students interested in economics and mathematics could also consider a double major in economics and mathematics within the B.A. degree program, or combine a B.A. in one of these disciplines with an academic minor in the other. Students who plan to attend graduate school in economics might consider the Interdisciplinary Studies in Economics and Mathematics major, focusing on the theoretical track, and add MATH 304 Statistical Inference Theory. Students undecided among these options are encouraged to contact a member of the coordinating committee.

Interdisciplinary Studies Major

The B.S. **major** in Interdisciplinary Studies in Economics and Mathematics requires a total of 18 credits, eight from economics and 10 from mathematics.

Required Economics Courses

ECON 103	Economic Principles and Problems	1
ECON 257	Intermediate Macroeconomic [1]	1
ECON 258	Intermediate Political Economy [1]	1
ECON 259	Intermediate Mathematical Microeconomics [1]	1
ECON 341	Econometrics	1
Two economics courses [2]		2
Senior Seminar		
ECON 441	Advanced Econometrics	1
Total Credits		8

[1] The senior seminar ECON 441 Advanced Econometrics will serve as the Culminating Experience for the ECMA major, and will also address the speaking goal of the College Core Curriculum (CCC). ECON 257 Intermediate Macroeconomic and ECON 259 Intermediate Mathematical Microeconomics address the information literacy goals of the CCC and ECON 258 Intermediate Political Economy addresses the writing goals of the CCC.

[2] Selected in consultation with the student's academic adviser. One must be at the 300-level.

Students preparing for graduate studies in economics are strongly encouraged to complete a one-credit senior thesis in economics.

Required Mathematics Courses

MATH 201	Calculus I	1
MATH 202	Calculus II	1
MATH 211	Calculus III	1
MATH 216	Statistics I	1
MATH 217	Statistics II	1
MATH 245	Linear Algebra	1
MATH 303	Probability	1
Select one of the following tracks: [3]		3
Theoretical track		
MATH 280	Logic, Sets, and Proofs	

MATH 308	Real Analysis I
MATH 345	Advanced Linear Algebra
Computational track	
CSCI 203	Introduction to Computer Science I
MATH 343	Numerical Analysis
MATH 358	Topics in Operations Research
Statistical track	
MATH 304	Statistical Inference Theory
MATH 358	Topics in Operations Research
MATH 405	Statistical Modeling
Total Credits	**10**

[3]   The track is selected in consultation with the academic adviser.

The recommended sequence of courses for students is as follows:

First Year

First Semester	Credits	Second Semester	Credits
ECON 103	1	ECON 259	1
MATH 201	1	MATH 202	1
		MATH 216	1
	2		**3**

Sophomore

First Semester	Credits	Second Semester	Credits
ECON 257	1	MATH 245	1
MATH 211	1	MATH 303	1
MATH 217	1		
	3		**2**

Junior

First Semester	Credits	Second Semester	Credits
ECON 258[4]	1	Economics elective	1
ECON 341[4]	1	Mathematics track course 2	1
Mathematics track course 1	1		
	3		**2**

Senior

First Semester	Credits	Second Semester	Credits
Second economics elective[4]	1	Economics senior seminar[4]	1
Mathematics track course 3[4]	1		
	2		**1**

Total Credits: 18

[4]   Either first semester or second semester.

Please see the Economics section and the Mathematics section of this catalog for a list of courses with course descriptions.

The goal of Bachelor of Science major in Interdisciplinary Studies in Economics and Mathematics is to combine the quantitative methods and the theoretical foundations of mathematics with the study of economics to address economic problems.

Economics Courses

ECON 102. Workshop in Social Science Methods. .5 Credits.
Offered Spring Semester Only; Lecture hours:1
Covers basic introduction to research methods, skills, and ethics. Both qualitative and quantitative methods are covered. Offered as a prerequisite to summer research assistantship. Prerequisite: permission of the instructor.

ECON 103. Economic Principles and Problems. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
General introduction to both macroeconomics and microeconomics, along with an introduction to economic history, international economics, and political economy. The course also examines the origin of economic ideas in the works of Adam Smith, John Maynard Keynes, Karl Marx, and others.

ECON 1NT. Economics Non-tradtional Study. 1 Credit.
Offered Fall, Spring, Summer; Lecture hours:Varies,Other:3
Non-traditional study in economics. Prerequisite: permission of the instructor.

ECON 201. Independent Study. 1 Credit.
Offered Either Fall or Spring; Lecture hours:Varies,Other:3
Individual product or project supervised by a member of the economics department typically resulting in the production of a long research paper. Prerequisite: permission of the instructor.

ECON 222. Economic Topics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3; Repeatable
Selected issues in economic theory or policy. Prerequisite: permission of the instructor.

ECON 224. African Political Economy. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Analysis of topics in films and novels by Ousmane Sembene: pre-colonial history, colonialism, post-colonial independence, racial and gender oppression, worker exploitation, religious conflict, and modernization. Prerequisite: ECON 103. Crosslisted as WMST 224.

ECON 225. Cultivating Change. 1 Credit.
Offered Occasionally; Lecture hours:15,Other:15
Explores limits to growth and sustainable alternatives. Includes work on an organic farm, and discussions of rhetoric and debates regarding sustainability. Crosslisted as UNIV 224.

ECON 227. International Economics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
An examination of international economic relations today and of the theory used to analyze trade and financial relations. Attention is given to the problems of government policy with respect to international issues. Prerequisite: ECON 103 or permission of the instructor.

ECON 231. Resources and the Environment. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
This course will develop economic concepts to explain why well-intentioned individuals so often choose to abuse their own environment and stock of natural resources and suggest and evaluate policies designed to remedy the situation. Prerequisite: ECON 103 or permission of the instructor.

ECON 235. African Economic Development. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
A historical, institutional analysis of Sub-Saharan African economic, social, and political development. Primary emphasis will be on the analysis of the economic crisis facing the subcontinent since the late '70s and the structural adjustment programs that have been instituted to deal with the crisis. Prerequisite: ECON 103.

ECON 236. Unemployment and Poverty. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
A study of the causes of unemployment and poverty in the United States and policies to generate full employment and eliminate poverty. Prerequisite: ECON 103 and/or permission of the instructor. Crosslisted as WMST 236.

ECON 237. Health Politics and Health Policy. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
History of health care delivery and financing in the United States and introduction to and evaluation of current topics in health policy. Prerequisite: ECON 103 or permission of the instructor. First- or second-year standing, others by permission.

ECON 238. Urban Economics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Study of household and business location decisions, and public policies aimed at congestion, pollution, and crime. Prerequisite: ECON 103. First- and second-year standing, others by permission.

ECON 245. Sports Economics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
The study of the economics of professional sports teams and leagues, including ticket pricing, the market for broadcast rights, the effects of revenue sharing and other league practices on the distribution of talent and player salaries, and government subsidies for stadiums. Prerequisites: ECON 103 and MATH 216 or MATH 226 or MGMT 102 or PSYC 215.

ECON 251. Logic Limits Economic Justice. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Investigation of the nature of the "good society" from an economist's point of view, ranging from Right libertarian to anarcho-communist perspectives. Prerequisites: ECON 103 and permission of the instructor.

ECON 253. Gender and Migration. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Role of gender in internal and international migration flows; economic restructuring; state policies; transnational domestic laborers and sex workers; and migration effects. Crosslisted as WMST 253.

ECON 256. Intermediate Microeconomic. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Intermediate economic theory of the consumer, the firm, market structures, and resource allocation. Not open to students who have completed ECON 259. Prerequisite: ECON 103 and ACFM majors or permission of the instructor.

ECON 257. Intermediate Macroeconomic. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
The study of national income, employment, inflation, interest rates, and the impact of monetary and fiscal policy on the economy. Prerequisite: ECON 103 and MATH 192 or MATH 201.

ECON 258. Intermediate Political Economy. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Intermediate study of Marxist and institutionalist political economy. The ideas of Marx and Veblen applied to such matters as the distribution of income and power, the environment, working conditions, consumerism, and race and gender issues. Prerequisite: ECON 103.

ECON 259. Intermediate Mathematical Microeconomics. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Intermediate microeconomic theory of the consumer, the firm, market structures, and resource allocation. Topics are introduced using differential calculus. Not open to students who have completed ECON 256. Prerequisites: ECON 103 and MATH 192 or MATH 201.

ECON 266. Political Economy of Caribbean. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
The development of the Caribbean from colonial times to the present. A look at the social, political, and economic development of the Caribbean as a whole rather than as independent aspects of development.

ECON 268. Migrations: Africa to America. 1 Credit.
Offered Alternating Spring Semester; Lecture hours:3
This course examines forced and voluntary migrations of Africans and their North American descendants. It will begin with an analysis of west and central African history and will then focus on the period from the beginning of the Trans-Atlantic Slave trade to the present.

ECON 270. South Africa: Social Entrepreneurship. 1 Credit.
Lecture hours:15
The course examines the legacy of apartheid and the role of social entrepreneurship in transforming communities. Students are placed in community organizations in nearby townships. Crosslisted as MGMT 270 and WMST 275 and PSYC 270. Prerequisite: permission of the instructor.

ECON 271. The British Economy: Structures and Policies. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Offered as an option for Bucknell in London students. This course will treat a distinct topic relating to British economic affairs.

ECON 273. Latin American Economic Development. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
The course deals with historic and contemporary economic problems, starting from colonial times and reaching the present integration into world economy. Prerequisite: ECON 103. Crosslisted as LAMS 273.

ECON 277. The French Economy: Structures and Policies. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Analysis of government planning since 1945. The conflict of liberal and socialist ideologies today. Open to Bucknell en France students only.

ECON 280. Political Economy of Media and Advertising. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Examines the interrelationship of cultural, political, and economic aspects of media content and advertising from the perspective of Institutional and Marxian political economy. Prerequisite: ECON 103 or permission of the instructor.

ECON 299. Teaching Assistants in Economics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
This course can only be taken by economic majors who have permission and have taken the prerequisites. Prerequisites: ECON 256 or ECON 259, ECON 257, and ECON 258 and permission of the instructor.

ECON 2NT. Economics Non-traditional Study. 1 Credit.
Offered Fall, Spring, Summer; Lecture hours:Varies,Other:3; Repeatable
Non-traditional study in economics. Prerequisite: permission of the instructor.

ECON 301. Independent Study. .5-1 Credits.
Offered Either Fall or Spring; Lecture hours:Varies; Repeatable
Individual study or project, supervised by instructor. Prerequisite: permission of the instructor.

ECON 302. Honors Thesis in Economics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3; Repeatable
Individual research, leading to an honors thesis in economics, undertaken by qualified students, and supervised by an instructor in the department of economics. Prerequisites: ECON 256 or ECON 259, ECON 257, ECON 258, and permission of the instructor and University Honors Council.

ECON 309. Globalization and Its Implications. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
The course explores opposing economic views on globalization and its effect on the social, cultural, and environmental aspects of life in developed and developing countries. Prerequisites: junior or senior status; ECON 257 and ECON 258. Preference given to ECON and ECMA majors.

ECON 311. Labor Economics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
An examination of economic models related to labor markets, current labor market trends, and the influence of related government policies. Prerequisites: ECON 256 or ECON 259 and one semester of statistics. Preference given to ECON and ECMA majors.

ECON 319. Economic History of Women in the United States. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Examination of the history of women in the U.S. economy, with particular attention to racial-ethnic and class differences among women. Prerequisites: ECON 256 or ECON 257 or ECON 258 or ECON 259 and permission of the instructor. Preference given to ECON and ECMA majors. Crosslisted as WMST 318.

ECON 320. Race, Economics and Inequality. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Analytically rigorous study of the connections between law, philosophy and policy in the micro and macro economics of racial and social inequality in democratic market societies. Prerequisites: ECON 256 or ECON 259 and ECON 257 and MATH 192 or MATH 201 and permission of the instructor.

ECON 324. European Economic History. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Development of the market economy and its major institutions. The changing place of the economy in society. Prerequisites: at least one of the following: ECON 256, ECON 257, ECON 258, or ECON 259 and/or permission of the instructor. Preference given to ECON and ECMA majors.

ECON 326. History of Economic Thought. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Discussion of original sources of economic ideas. Readings in Smith, Malthus, Ricardo, Mill, Marx, Jevons, Keynes, and others. Prerequisites: ECON 326 and permission of the instructor.

ECON 327. International Economic Theory. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Covers trade theory, tariffs and non-tariff barriers, economic integration, balance of payments, fixed and flexible exchange rates. Prerequisites: ECON 256 or ECON 259 and ECON 257.

ECON 328. Money and Financial Institutions. 1 Credit.
Offered Spring Semester Only; Lecture hours:3; Repeatable
An analysis of the role of the financial system in the U.S. economy. Topics include determinants of asset prices, risk management, and financial regulations. Prerequisites: ECON 256 or ECON 259 and ECON 257 and MATH 216 or MATH 226 or MGMT 102 . Preference given to ECON and ECMA majors.

ECON 330. Law and Economics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
This course examines several areas of law from the "Law and Economics" perspective and analyzes the assumptions that underlie this approach to law. Property rights law, contract law, and tort law will be covered. Prerequisite: ECON 256 or ECON 259.

ECON 333. Seminar in Economic Topics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3; Repeatable
Guided discussion of economic issues. Topics to be announced at time of preregistration. Prerequisite: permission of the instructor. Preference given to ECON and ECMA majors.

ECON 337. International Monetary and Financial Economics. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
The course covers balance of payments, foreign exchange markets, international monetary systems, the adjustment mechanism, macroeconomic policy in an open economy and monetary integration. Prerequisites: ECON 256 or ECON 259 or permission of the instructor. Preference given to ECON and ECMA majors.

ECON 339. China and East Asian Economics. 1 Credit.
Lecture hours:3
An analysis of economic transition and development in China, with emphasis on its role in the Asia-Pacific and world economies.

ECON 341. Econometrics. 1 Credit.
Lecture hours:3
The application of statistical methods to quantify and test economic theories, analyze government policies, and forecast economic variables.

ECON 350. Classical Marxism. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
The goal is to develop an understanding of Marx's analysis of capitalism by reading mainly original texts by Marx and consider its applications to disciplinary thinking. Crosslisted as GEOG 350.

ECON 357. Economic Development. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
The main theories of development; economic and social dualism; agricultural, industrial, and trade strategies; and the role of less developed countries in the emerging global economy. Prerequisites: ECON 256 or ECON 259 and ECON 257 and permission of the instructor. Preference given to ECON and ECMA majors.

ECON 358. Marxian Economics. 1 Credit.
Lecture hours:3
Examines the implications of class struggle on microeconomic competition, the distribution of value within and between firms, and macroeconomic instability accumulation and crises at the national and international level.

ECON 380. Marx on Media. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Examines a number of media industries to critically examine the effects of capitalist competition on media content and industry dynamics from a Marxian perspective. Prerequisite: ECON 258 or permission of the instructor. Preference given to ECON and ECMA majors.

ECON 3NT. Economics Non-traditional Study. .5-2 Credits.
Offered Fall, Spring, Summer; Lecture hours:Varies,Other:Varies; Repeatable
Non-traditional study in economics. Prerequisite: permission of the instructor.

ECON 401. Recessions and Depressions. 1 Credit.
Offered Occasionally; Lecture hours:3
This course will explore the main theories of the business cycle that explain the causes of depressions and recessions, and would try to use them to explore the main differences and similarities between the Great Depression and the most recent recession. The differences between Keynesian (including New Keynesian) and Monetarist (New Classical) views of the cycle, and Real Business Cycles schools will be contrasted with heterodox/radical (post-Keynesian and Marxist) views of cycles and crises. The objective of the course is to apply economic models of the business cycle to explain the historical and institutional causes of the Great Depression and the Great Recession. Prerequisite: ECON 257.

ECON 405. Comparative Economic Systems. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
A critical analysis of the organization of economic systems. The characteristics of selected capitalist and socialist economics studied and assessed from both mainstream and Marxian analytical perspectives. Prerequisite: ECON 258 or permission of the instructor. Preference given to ECON and ECMA majors.

ECON 412. Health Economics. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Theoretical and empirical examinations of issues in health economics. Course includes semester-long research project on a health topic. Prerequisites: ECON 256 or ECON 259 and MATH 216 and one semester of statistics or permission of the instructor. Preference given to ECON and ECMA majors.

ECON 413. Public Finance. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
An analysis of the government's role in the economy. Topics include the economic rationale for government, expenditure analysis, and the allocative and distributive consequences of taxation. It is strongly recommended that students have one semester of statistics. Prerequisite: permission of the instructor. Preference given to ECON and ECMA majors.

ECON 415. Population and Family Economics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
The course investigates the economic determinants and consequences of demographic changes in the context of both developing and developed countries. Topics include household formation and structure including marriage, divorce, dowry, and fertility. Prerequisites: MATH 216 and ECON 256 or ECON 259. Preference given to ECON and ECMA majors.

ECON 418. American Economic History. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
An examination of the development and influence of American economic institutions from colonial to current times. Prerequisites: ECON 256 or ECON 259 and ECON 257, or permission of the instructor. Preference given to ECON and ECMA majors.

ECON 420. The British Economic Miracle. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
This course examines the early British economy and the role it played and continues to play in influencing the modern world. Prerequisites: ECON 256 or ECON 259 and ECON 257.

ECON 425. Behavioral Economics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
To examine theories (Behavioral Economics) as well as evidence in laboratory and field experiments (experimental Economics) related to the psychology of economic decision making. Prerequisites: ECON 103 and ECON 256 or ECON 259.

ECON 427. International Economic Theory. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Theoretical principles underlying international trade, investment, commercial policy, economic integration, adjustment mechanisms, and balance of payments policy will be examined with an application to current national/international policies. Prerequisites: ECON 256 or 259 and ECON 257. Not open to students who have taken ECON 227. Preference to ECON and ECMA majors.

ECON 429. Political Economy of Financial Crises. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
This course will explore the causes and consequences of financial crises from macroeconomic perspectives, with most of the attention given to the recent financial crisis in the United States. Prerequisite: ECON 258 or permission of the instructor. Preference given to ECON and ECMA majors.

ECON 431. Industrial Organization Economics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Topics include market structure, industrial concentration, firm conduct, mergers, advertising, market performance, examined in the context of U.S. antitrust policy. Prerequisites: ECON 256 or ECON 259 and permission of the instructor. Preference given to ECON and ECMA majors.

ECON 439. China and the World Economy. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
An analysis of economic transition and development in China, with emphasis on its role in the Asia-Pacific and world economies. Prerequisites: ECON 256 and ECON 257 or permission of the instructor. Crosslisted as EAST 339. Preference given to ECON and ECMA majors.

ECON 441. Advanced Econometrics. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Advanced panel data methods, instrumental variables and two stage least squares, simultaneous equations, limited dependent variables, sample selection bias, advanced time series, and writing and presenting an empirical research project. Prerequisite: ECON 341.

ECON 444. Senior Seminar in Economic Topics. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Topics to be announced at the time of preregistration.

ECON 458. Marxian Economics. 1 Credit.
Offered Either Fall or Spring; Lecture hours:3
Examines the implications of class struggle on microeconomic competition, the distribution of value within and between firms, and macroeconomic instability accumulation and crises at the national and international level. Prerequisite: ECON 258 and permission of the instructor. Preference given to ECON and ECMA majors.

Mathematics Courses

MATH 112. Introduction to Mathematical Modeling. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Introduction for the non-specialist to mathematical modeling of real-world phenomena such as voting and networks, using graph theory, probability, and other accessible tools.

MATH 117. Introduction to Mathematical Thought. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Lab:1.5
An investigation of number, numeration, and operations from the perspective of elementary school teachers and pupils. Open only to B.S. in Education Early Childhood Pre-K to 4 students. Required fieldwork.

MATH 118. Elementary Geometry and Statistics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Investigation of geometric, probabilistic, and statistical concepts related to Pre-K to 4 mathematics and how children learn and make sense of these concepts. Prerequisite: permission of the instructor. Prerequisite: MATH 117 or permission of the instructor.

MATH 192. Topics in Calculus. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Elementary calculus and applications taken primarily from economics. Topics include algebraic, exponential, and logarithmic functions, graphs, limits, derivatives and integration. Not open to students who have taken MATH 201.

MATH 201. Calculus I. 1 Credit.
Offered Both Fall and Spring; Lecture hours:4
An introduction to the calculus of algebraic, trigonometric and transcendental functions. Interpretation, significance and calculations of a derivative. Applications to geometry, biology, physics, economics, and other subjects. Introduction to the definite integral, including the Fundamental Theorem of Calculus. Not open to students who have taken MATH 192.

MATH 202. Calculus II. 1 Credit.
Offered Both Fall and Spring; Lecture hours:4
Methods of integration including substitution, integration by parts, numerical approximations, and improper integrals. Series, including Taylor series. Complex numbers, polar coordinates, differential equations, and applications. Prerequisite: MATH 201.

MATH 207. The Teaching of Mathematics in Secondary Schools. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:.5
Investigation into the components of effective secondary school mathematics instruction, including lesson design/ implementation (curriculum, tasks, discourse, and assessment). Required fieldwork. Prerequisite: EDUC 201 or permission of the instructor.

MATH 208. Mathematical Explorations. .5 Credits.
Offered Fall Semester Only; Lecture hours:1.5
An exploration of topics from pure mathematics, applied mathematics and statistics, illustrating the power and beauty of mathematical reasoning. For students considering a major in mathematics. Corequisites: MATH 201 or MATH 202 or MATH 211 or MATH 212 or MATH 216. Open to first-year students only.

MATH 209. Mathematical Problem Solving. .5 Credits.
Offered Fall Semester Only; Lecture hours:Varies; Repeatable
Mathematical problem solving, with an emphasis on problems and topics that appear in contests such as the Putnam Competition. Prerequisite: permission of the instructor.

MATH 211. Calculus III. 1 Credit.
Offered Both Fall and Spring; Lecture hours:4
Calculus of vector-valued functions and functions of several variables. Multiple, line, and surface integrals; applications, and extrema. Green's, Stokes' and Divergence Theorems. Prerequisite: MATH 202.

MATH 212. Differential Equations. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Basic methods of solving ordinary differential equations. Systems of linear differential equations, Laplace transform, applications and selected topics. Prerequisite: MATH 211. Not open to students who have taken MATH 222.

MATH 216. Statistics I. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3,Other:1
Exploratory data analysis, sampling distributions, regression, sampling designs, confidence intervals, hypothesis testing, ANOVA. Statistical software is used and applications, including projects, are undertaken. Not open to students who have taken MATH 226 or PSYC 215.

MATH 217. Statistics II. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Other:1
Exploratory data analysis, design of experiments and inference emphasizing applications to a range of disciplines. Includes multiple linear regression, analysis of variance, categorical data analysis, nonparametric statistics. Prerequisite: MATH 216 or equivalent. Crosslisted as MATH 617.

MATH 219. Topics in Applied Mathematics. 1 Credit.
Offered Occasionally; Lecture hours:3; Repeatable
Topics such as financial mathematics, mathematical biology, cryptography, social networks, etc. Topic varies by semester. Prerequisite: varies by topic.

MATH 222. Differential Equations for Engineers. .5 Credits.
Offered Spring Semester Only; Lecture hours:3
First order differential equations, second order linear equations, higher order linear equations, numerical approximations. Prerequisite: MATH 211. Open only to civil engineering and computer science engineering students. Not open to students who have taken MATH 212.

MATH 226. Probability and Statistics for Engineers. .5 Credits.
Offered Fall Semester Only; Lecture hours:3
Descriptive modeling and statistics, sampling and experimental design, discrete and continuous random variables, central limit theorem, and elementary inference. Prerequisite: MATH 202. Open only to engineering students and students in computer science. Not open to students who have taken MATH 216.

MATH 240. Combinatorics and Graph Theory. .5 Credits.
Offered Spring Semester Only; Lecture hours:3
Counting techniques and traversal problems. Does not count toward the major. Students join MATH 241 mid-semester. Corequisite: MATH 280. Only for computer science students or students seeking secondary certification.

MATH 241. Discrete Structures. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Logic, sets; mathematical induction; relations, functions; combinatorics and graph theory. Does not count toward the mathematics major. Prerequisite: MATH 202.

MATH 245. Linear Algebra. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Linear equations, matrices, vector spaces, linear transformations, determinants, eigenvalues. Prerequisite: MATH 202.

MATH 260. Applications of Calculus to Medicine and Biology. 1 Credit.
Offered Occasionally; Lecture hours:3
Biology has been described as the most mathematical science. Researchers in biology use mathematical models to design strategies for controlling epidemics, administering drugs, and managing ecosystems. In this class you will learn how to develop your own models, approximate solutions to your models, and compare these solutions to real data. Crosslisted as BIOL 360 or BIOL 662.

MATH 280. Logic, Sets, and Proofs. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Logic, sets; proof techniques; relations, functions, sequences and convergence; cardinality. Skills and tools for independent reading, problem solving and exploration. Prerequisite: MATH 211 or MATH 245.

MATH 291. Undergraduate Readings. .5-2 Credits.
Offered Either Fall or Spring; Lecture hours:Varies; Repeatable
Readings and research in special topics at an intermediate level. Prerequisites: permission of the instructor, adviser, and department chair.

MATH 303. Probability. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Elementary probability, random variables, moments, central limit theorem, conditional expectation, statistical distributions derived from the normal distribution. Probability simulations and applications from various fields. Prerequisite: MATH 211. Crosslisted as MATH 603.

MATH 304. Statistical Inference Theory. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Point and interval estimation, hypothesis testing, Fisher's likelihood theory, frequentist versus Bayesian approach, computational statistics. Crosslisted as MATH 604.

MATH 308. Real Analysis I. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Real numbers and elementary topology of Cartesian spaces, convergence, continuity, differentiation, and history of the development of analysis. Prerequisites: MATH 211, MATH 245, and MATH 280.

MATH 311. Theory of Numbers. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Classical number theory in an algebraic setting. Topics include unique factorization, diophantine equations, and linear and quadratic congruences. Advanced topics from algebraic or analytic number theory. Prerequisites: MATH 245 and MATH 280 and permission of the instructor. Crosslisted as MATH 611.

MATH 319. Topics in Advanced Mathematics. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3; Repeatable
Special topics, to be selected from algebra, analysis, geometry, statistics, applied mathematics, etc. Crosslisted as MATH 619.

MATH 320. Abstract Algebra I. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3
Groups and rings; homomorphisms and isomorphism theorems; history of the development of algebra. Additional selected topics. Prerequisites: MATH 245 and MATH 280.

MATH 333. Topology. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Topological spaces, connectedness, compactness, continuity, separation, and countability axioms. Metric, product, function, and uniform spaces. Prerequisites: MATH 211 and MATH 280, or permission of the instructor. Crosslisted as MATH 633.

MATH 335. Geometry. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Historical and axiomatic foundations of geometry. Euclidean and non-Euclidean geometries. Prerequisite: MATH 280 or permission of the instructor. Crosslisted as MATH 635.

MATH 343. Numerical Analysis. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Lab:2
Floating point arithmetic, development of computational algorithms and error estimates for root approximation, interpolation and approximation by polynomials, numerical differentiation and integration, cubic splines, least-squares, linear systems, lab component. Prerequisites: MATH 211, CSCI 203, and one of MATH 241, MATH 245, or MATH 280; or permission of the instructor. Crosslisted as MATH 643.

MATH 345. Advanced Linear Algebra. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Systems of linear equations, determinants, vector spaces, canonical forms for linear transformations and matrices, bilinear forms, inner product spaces, applications to such other areas as geometry, differential equations, linear programming. Prerequisites: MATH 245 and either MATH 280 or permission of the instructor. Crosslisted as MATH 645.

MATH 350. Methods in Applied Mathematics. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Techniques drawn from partial differential equations, transform methods, Fourier and complex analysis, and variational calculus. Prerequisite: junior or senior status; MATH 212 or MATH 222 or permission of the instructor. Crosslisted as MATH 650.

MATH 358. Topics in Operations Research. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Mathematical and statistical techniques in operations research. Queueing theory. Additional topics may include simulation, forecasting, non-linear programming, inventory models. Methods and applications drawn from various fields. Prerequisite: MATH 303 or permission of the instructor. Crosslisted as MATH 658.

MATH 362. Complex Analysis. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Limits, analytic functions, integrals including contour integrals. Cauchy's Integral Theorem, entire functions and singularities. Prerequisites: MATH 211 and MATH 280, or permission of the instructor. Crosslisted as MATH 662.

MATH 378. Seminar. .5 Credits.
Offered Either Fall or Spring; Lecture hours:2; Repeatable
Seminar based on topics from algebra, analysis, topology, differential equations, statistics, or applied mathematics; topics selected according to demand or interest. Prerequisite: permission of the instructor. Crosslisted as MATH 678.

MATH 391. Reading and Research. .5-2 Credits.
Offered Either Fall or Spring; Lecture hours:Varies; Repeatable
Reading and research in various topics for qualified undergraduate students. Prerequisite: permission of the instructor.

MATH 405. Statistical Modeling. 1 Credit.
Offered Fall Semester Only; Lecture hours:3
Regression and analysis of (co)variance. Model diagnosis and remediation. Model selection, multicollinearity, logistic regression. R or SAS will be used. Prerequisites: MATH 245 and MATH 304. Crosslisted as MATH 605.

MATH 407. Statistical Design of Scientific Studies. 1 Credit.
Offered Spring Semester Only; Lecture hours:3
Experiments, observational studies. Completely randomized, block, mixed models, crossed, nested design. Simple random, stratified, cluster sampling. Estimation procedures, sample size calculations. Uses R or SAS. Prerequisite: MATH 304.

MATH 409. Real Analysis II. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Continuation of MATH 308. Integration theory and advanced topics in analysis. Prerequisite: MATH 308. Crosslisted as MATH 609.

MATH 416. Modern Applied Mathematics. 1 Credit.
Lecture hours:3
Possible topics include wavelets, harmonic analysis, computational mathematics, nonlinear dynamics, dynamical systems, scientific computing, or cryptography. Prerequisites: MATH 212 and MATH 308, or permission of the instructor.

MATH 446. Abstract Algebra II. 1 Credit.
Offered Alternate Fall or Spring; Lecture hours:3
Advanced topics in group theory including solvable groups, field theory and Galois theory. Prerequisite: MATH 320. Crosslisted as MATH 646.

MATH 491. Reading and Research. .5-2 Credits.
Offered Either Fall or Spring; Lecture hours:Varies; Repeatable
Reading and research in various topics for qualified undergraduates or graduate students at a level appropriate for a Culminating Experience. Prerequisite: permission of the instructor, adviser, and department chair.