ECONOMICS

THE SCHOOL OF SOCIAL SCIENCES

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DEGREES OFFERED: BA, MA, PHD

Undergraduates may major in either economics or mathematical economic analysis. The latter is recommended for students who intend to continue on to graduate work in economics or pursue a business or governmental job in which analytical and quantitative skills are required.

The eight major fields available for graduate study are econometrics, economic development, economic theory, industrial organization and regulation, international trade and finance, labor, macroeconomics and/or monetary theory, and public finance.

DEGREE REQUIREMENTS FOR BA IN ECONOMICS OR MATHEMATICAL ECONOMIC ANALYSIS

Economics Major—All economics majors must complete a minimum of 10 courses with a grade point average of at least 2.00.

1. These courses include 9 economics courses and 1 course in quantitative analysis as specified in 4 below. Major requirements are not reduced for multiple majors, although some courses can satisfy the requirements for more than one major. (Please note that students may not pursue a double major in economics and mathematical economic analysis.)
2. The following courses are required for all economics majors:
   - ECON 211 *Principles of Economics I*
   - ECON 212 *Principles of Economics II*
   - ECON 370 *Microeconomic Theory*
   - And either ECON 355 *Financial Markets and Institutions*, ECON 375 *Macroeconomic Theory,* or ECON 455 *Money and Financial Markets.*

We suggest that economics majors take ECON 211 and 212 in the freshman year and take ECON 370 in the first semester of their sophomore year, leaving the junior

andsenior years for advanced electives. This plan is optional, but please note that failure to take prerequisite courses in earlier years may cause scheduling problems in later years.

3. Given that item 2 has been satisfied, at least 3 of the remaining 5 required economics courses must be selected from the following courses in applied economics.

ECON 355 *Financial Markets and Institutions*
ECON 375 *Macroeconomic Theory*
ECON 415 *Labor Economics*
ECON 420 *International Economics*
ECON 421 *International Finance*
ECON 435 *Industrial Organization*
ECON 436 *Government Regulation of Business*
ECON 437 *Energy Economics*
ECON 438 *Economics of Law*
ECON 439 *Torts, Property, and Contracts*
ECON 440 *Risk, Uncertainty and Information*
ECON 445 *Managerial Economics*
ECON 448 *Corporate Finance*
ECON 449 *Basics of Financial Engineering*
ECON 450 *World Economic and Social Development*
ECON 451 *The Political Economy of Latin America*
ECON 452 *Principles of Islamic Economics*
ECON 455 *Money and Financial Markets*
ECON 461 *Urban Economics*
ECON 472 *Introduction to Game Theory*
ECON 480 *Environmental and Energy Economics*
ECON 481 *Health Economies*
ECON 482 *Distributive Justice—A Microeconomic Approach*
ECON 483 *Public Finance—Tax Policy*
ECON 484 *Public Expenditure Theory and Social Insurance*
ECON 485 *Contemporary Economic Issues*
ECON 486 *Contemporary Economic Issues*
ECON 495 *Senior Seminar*

Please note that if you count ECON 355, 375, or 455 as 1 of the required courses in item 2, you may not also count that course as 1 of the 3 courses satisfying item 3.

4. The quantitative methods course may be selected from the following, or an equivalent or higher-level course approved in advance by the chairman of the undergraduate committee may be taken.

ECON 382 *Probability and Statistics*
ECON 400 *Econometrics*
ECON 446 *Applied Econometrics and Economic Modeling*
ECON 475 *Integer and Combinatorial Optimization*
ECON 477 *Mathematical Structure of Economic Theory*
ACCO 305 *Introduction to Accounting*
CAAM 210 *Introduction to Engineering Computation*
CAAM 211 *Introduction to Engineering Computation*
CAAM 321 *Introduction to Real Analysis*
CAAM 322 *Introduction to Real Analysis II*
CAAM 335 *Matrix Analysis*
CAAM 336 *Differential Equations in Science and Engineering*
CAAM 353 *Computational Numerical Analysis*
CAAM 376 *Introduction to Management Science*
CAAM 378 *Introduction to Operations Research*
CAAM 400 *Case Studies in Applied Mathematics*
CAAM 435 *Ordinary Differential Equations*
CAAM 436 *Partial Differential Equations I*
CAAM 437 *Partial Differential Equations II*
CAAM 451 *Numerical Linear Algebra*CAAM 452 *Computational Methods for Differential Equations*
CAAM 453 *Numerical Analysis and Ordinary Differential Equations*

CAAM 454 *Optimization Problems in Computational Engineering and Science*CAAM 460 *Optimization Theory*
CAAM 471 *Linear Programming*
CAAM 474 *Theory of Linear Inequalities*
CAAM 475 *Integer and Combinatorial Optimization*
CAAM 483 *Markov and Martingale Sequences—Renewal Processes*
COMP 212 *Intermediate Programming*
COMP 312 *Program Construction*
COMP 314 *Applied Algorithms and Data Structures*
COMP 440 *Artificial Intelligence*
COMP 480 *Concrete Mathematics*
COMP 482 *Design and Analysis of Algorithms*
STAT 305 *Introduction to Statistics for Biosciences*
STAT 310 *Probability and Statistics*
STAT 331 *Applied Probability*
STAT 381 *Introduction to Applied Probability*
STAT 400 *Econometrics*
STAT 410 *Introduction to Statistical Computing and Linear Models*
STAT 421 *Introduction to Time Series Analysis*
STAT 431 *Mathematical Statistics*
STAT 450 *Practicum in Statistical Modeling*
STAT 486 *Market Models*

5. We strongly recommend that students take two semesters of calculus (MATH 101/l02 or MATH 111/112) and a course in probability and statistics (ECON 382/STAT 310). Failure to take these courses will limit the range of electives available to the student.
6. No more than 3 of the 9 economics courses may be transferred from other schools. Additional transfer credits in economics may count toward meeting university graduation requirements but not toward fulfillment of the departmental major requirements. The required course in quantitative analysis may also be transferred. AP credits do not count as transfer credits. In order to transfer either ECON 211 or ECON 212, the student must pass a qualifying examination. Students wishing to take either the ECON 211 or ECON 212 qualifying examination must apply to the economics department office in Baker Hall 266B. For additional information on transfer credits, consult "Procedures for Transfer Credit," available in the economics department office.
7. Students may graduate with "Honors in Economics" by achieving a B+ (3.33) average in all economics courses and doing two semesters of independent research. For details, consult ECON 403/404 *Senior Independent Research,* available in the Economics Department Office.
8. For additional course information, consult "Economics Course Descriptions," compiled by the Rice chapter of the Omicron Delta Epsilon National Economics Honor Society.
9. Please note that it is primarily the responsibility of the student to satisfy all degree requirements, including the general degree requirements (see pages 14–15). Consult with the appropriate departmental adviser, who must sign all registration forms for each major.
10. Students who are considering either graduate work in economics or a business or governmental job in which analytical and quantitative skills are required should seriously consider obtaining the alternative major in mathematical economic analysis.

Mathematical Economic Analysis Major—Students majoring in mathematical economic analysis must take at least 16 courses.

1. The major in mathematical economic analysis is designed for students who are interested in graduate work in economics or a business or governmental job in which analytical and quantitative skills are required.
2. Students must choose between the 2 majors offered by the economics department; that is, students may not double major in economics and mathematical economic analysis. Major requirements are not reduced for students with multiple majors.
3. A minimum of 16 courses in 6 areas is required.These courses must include:

(a) 5 courses in Economic Principles:

ECON 211 *Principles of EconomicsI*
ECON 212 *Principles of Economics II*
ECON 370 *Microeconomic Theory*
ECON 477 *Mathematical Structure of Economic Theory*
ECON 375 *Macroeconomic Theory*

(b) 3 courses in Applied Economics, selected from the following:

ECON 355 *Financial Markets and Institutions*
ECON 415 *Labor Economics*
ECON 420 *International Economics*
ECON 421 *International Finance*
ECON 430 *Comparative Economic Systems*
ECON 435 *Industrial Organization*
ECON 436 *Government Regulation of Business*
ECON 437 *Energy Economics*
ECON 438 *Economics of Law*
ECON 439 *Torts, Property, and Contracts*
ECON 440 *Financial Theory*
ECON 445 *Managerial Economics*
ECON 446 *Applied Econometrics and Economic Modeling*
ECON 448 *Corporate Finance*
ECON 449 *Basics of Financial Engineering*
ECON 450 *World Economic and Social Development*
ECON 451 *The Political Economy of Latin America*
ECON 452 *Principles of Islamic Economics*
ECON 455 *Money and Financial Markets*
ECON 461 *Urban Economics*
ECON 472 *Introduction to Game Theory*
ECON 480 *Environmental and Energy Economics*
ECON 481 *Health Economies*
ECON 482 *Distributive Justice—A Microeconomic Approach*
ECON 483 *Public Finance—Tax Policy*
ECON 484 *Public Expenditure Theory and Social Insurance*
ECON 485 *Contemporary Economic Issues*
ECON 486 *Contemporary Economic Issues*

(c) *1 additional 400-level course in Applied Economics as listed in (b) or a course in advanced analysis, selected from the following:*

ECON 475 *Integer and Combinatorial Optimization*
CAAM 451 *Numerical Linear Algebra*
CAAM 452 *Computational Methods for Differential Equations*
CAAM 453 *Numerical Analysis and Ordinary Differential Equations*
CAAM 454 *Optimization Problems in Computational Engineering and Science*
CAAM 460 *Optimization Theory*
CAAM 471 *Linear Programming*
CAAM 474 *Theory of Linear Inequalities*
CAAM 475 *Integer and Combinatorial Optimization*
CAAM 483 *Markov and Martingale Sequences—Renewal Processes*
STAT 421 *Introduction to Time Series Analysis*
STAT 450 *Practicum in Statistical Modeling*
STAT 486 *Market Models*

(d) 1 course in Econometrics:
ECON 400 *Econometrics*

(e) 5 courses in Mathematics and Statistics:

MATH 101 *Single Variable Calculus I*

MATH 102 *Single Variable Calculus II*

MATH 211 *Ordinary Differential Equations and Linear Algebra or* MATH 355 *Linear Algebra or CAAM 335 Matrix Analysis*

MATH 212 *Multivariable Calculus or* MATH 221 *Honors Calculus III*

ECON 382/STAT 310 *Probability and Statistics* or STAT 410 *Introduction to Statistical Computing and Linear Models* or STAT 431 *Mathematical Statistics*

(f) 1 Senior Seminar or Senior Research:

ECON 495 or 496 *Senior Seminar* or ECON 403 or 404 *Senior Independent Research*

4. No more than 3 of the required economics courses and 2 of the required Mathematics (or computational and applied mathematics or statistics) courses may be transferred from other schools. Additional transfer credits in economics, mathematics, computational and applied mathematics or statistics may count toward meeting university graduation requirements but not toward fulfillment of the departmental major requirements. AP credits do not count as transfer credits. In order to transfer either 211 or 212, the student must pass a qualifying examination. Students wishing to take either the 211 or 212 qualifying examinations must apply to the economics department office in Baker Hall 266B. For additional information on transfer credits, consult "Procedures for Transfer Credit," available in the economics department office.
5. Students may graduate with "Honors in Mathematical Economic Analysis" by achieving a B+ (3.33) average in the 16 courses required for the major and any other economics electives taken.
6. For additional course information, consult "Economics Course Descriptions," compiled by the Rice chapter of the Omicron Delta Epsilon National Economics Honor Society.
7. Please note that it is primarily the responsibility of the student to satisfy all degree requirements, including the "University Credit Requirements" and "University Distribution Requirements" specified in the *General Announcements*. Consult with the appropriate departmental adviser, who must sign all registration forms for each major.

Substituting Economics Graduate Courses for Undergraduate Courses—Undergraduate majors satisfying the course prerequisites may, subject to the approval of the instructor and of the departmental undergraduate program chair, substitute certain graduate courses for undergraduate courses. Only highly motivated students with excellent aptitudes for economics and a strong background in mathematics should consider making such substitutions. Typically, but not necessarily, such students will be majors in mathematical economic analysis. Permitted substitutions are as follows:

- ECON 501 for ECON 370 (if student has completed ECON 211 at Rice)
- ECON 502 for ECON 375 (if student has completed ECON 212 at Rice)
- ECON 504 for ECON 382

- ECON 510 for ECON 400
- Furthermore, ECON 505 and ECON 508 also may be taken by undergraduates and may be used toward satisfying MTEC requirements. Specifically, ECON 505 could be used as 1 of the courses in the applied economics category or in the advanced analysis category, while ECON 508 could be used only in the advanced analysis category.

Note that this set of substitutable graduate courses includes 6 of the 7 courses required during the first year of the PhD program at Rice. Accordingly, such advanced course work would be excellent preparation for graduate study in economics or in some related field such as finance. Taking such graduate courses should also open more opportunities for the student who will be seeking employment immediately after graduation.

The Five-Year MA Program

Advanced undergraduate students can, subject to the approval of the departmental five-year MA adviser, enter our five-year MA program. In this program, a student who has taken advantage of the full menu of graduate course substitutions available could, with an additional year of study at Rice, earn an MA in economics.

To obtain the MA degree, students must satisfy all of the requirements for PhD candidacy. In particular, students must pass general examinations in microeconomic theory and in macroeconomic theory and econometrics, must pass an examination in a specialized field of study in economics, and must complete an original research project (a dissertation prospectus) that could be developed into a PhD dissertation under the supervision of a faculty member. This work could be an extension of a paper written as a senior independent research project (ECON 403/404). In some cases, at the discretion of the independent research adviser, the paper produced in ECON 403/404 may fulfill this requirement. Finally, the first-year graduate requirement to take ECON 507 Mathematical Economics would be waived with the approval of the departmental five-year MA adviser.

Note that any student who subsequently decides to enter the economics PhD program at Rice would be given graduate credit for all 500 level economics courses completed while an undergraduate. The completion of the PhD dissertation typically requires at least one additional year of research (but no additional courses) beyond the MA degree.

Students who opt for the five-year MA degree program will have different backgrounds and interests on entering Rice and will choose to pursue this option at different stages in their academic careers. The following illustrates two (of many) possible paths to satisfying the MTEC major requirements, while at the same time completing all of the requirements for the MA degree over a five-year period.

Courses: Sample Path One

The student enters with AP credit for ECON 211/212 and MATH 101/102, and has an early interest in the five-year MA program.

Freshman Year

ECON 370, 375, 477, and MATH 211/212

Sophomore Year

ECON 501; 1 course from Applied Economics category; and MATH 355 or CAAM 310

Junior Year

ECON 502, 504, 505, 510, and 1 course from Applied Economics category

Senior Year

ECON 403/404 and ECON 508

Fifth Year

Complete all remaining graduate courses and pass all remaining examinations required to achieve PhD candidacy.

(Note that with AP credit for MATH 101/102, but not for ECON 211/212, the student could substitute ECON 211/212 for ECON 370 and ECON 375 in the freshman year.)

Courses: Sample Path Two

The student has no relevant AP credit and/or decides to enter the five-year MA program only near the end of the sophomore year.

Freshman Year

ECON 211/212 and MATH 101/102

Sophomore Year

ECON 370, 375, 477, and 1 course from applied economics category; MATH 211/212

Junior Year

ECON 501, 502, 505, 508; MATH 355 or.CAAM 310

Senior Year

ECON 504, 510, 403/404, and 1 course from applied economics category

Fifth Year

Complete all remaining graduate courses and pass all remaining examinations required to achieve PhD candidacy.

Degree Requirements for PhD in Economics

Preparation for PhD Program. Applicants to the PhD program should have had at least two semesters in calculus and one in linear algebra. Students who have not met these requirements may complete these prerequisites as Class III students (pages 76–77) before being admitted to the graduate program. All applicants are required to take the Graduate Record Exam.

Requirements. For general university requirements, see Graduate Degrees (pages 57–58). Candidates for the PhD degree usually spend from two to two and one-half years in full-time course work and at least one year writing the dissertation; four to five years is a reasonable goal for completing the program. For the PhD, students must:

- Complete an approved program of at least 14 courses not including ECON 593/594 *Workshop in Economics I* and ECON 595/596 *Workshop in Economics II*
- Complete an approved program of at least 4 sections of ECON 593/594 *Workshop in Economics I* and ECON 595/596 *Workshop in Economics II*
- Perform satisfactorily on written general examinations in economic theory and econometrics
- Demonstrate proficiency in a major field by taking the relevant courses in that field and performing satisfactorily on a written examination
- Complete and defend orally a doctoral dissertation setting forth in publishable form the results of original research

See ECON in the Courses of Instruction section.