Undergraduate Economics Program

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Carol Dr. Goldberg, Executive Director of Undergraduate Economics
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Advising Appointment Online Scheduler: http://tinyurl.com/tepper-econadvising
http://www.tepper.cmu.edu/undergraduate-economics

At its most fundamental level, economics is the study of how scarce resources are allocated. What will be produced and consumed, how much, and by whom? These questions are central to the well-being of people throughout the world. Economists identify, model, and analyze problems with the objective of designing practical and efficient solutions to challenges confronting society. Economists are also active participants in the processes and institutions through which economic policies are implemented. In the public arena sphere, economists contribute to design of programs and incentive systems to foster efficient implementation of policies. In the private sector, economists bring modeling and data-analytic skill to bear, both in identifying ways to enhance productive efficiency within the firm and in developing strategies to enhance effectiveness of the firm as it competes in the global marketplace. Increasingly, economists are taking advantage of advances in technology to design new exchange systems in applications as diverse as global electronic markets, kidney exchanges, pollution control, and school choice mechanisms.

Carnegie Mellon University enjoys a rich history of innovative research in the field of economics. The university has a distinctive culture that fosters collaborative, problem-oriented, theoretically rigorous, and empirically tested research. The success of this distinctive approach is manifest in the international recognition accorded past and present faculty, including nine Nobel Prizes in Economics. In the classroom, faculty bring the same rigorous, innovative approach to help develop the tremendous intellectual potential and analytic skills of students who are drawn to study economics at Carnegie Mellon. Project courses and hands-on applications in classes enable our students to gain valuable practical experience in honing their skills in economic reasoning, modeling, and data analysis.

The Undergraduate Economics Program has a unique position at Carnegie Mellon University. It is the sole undergraduate program that is a joint program of the Tepper School of Business and the Dietrich College of Humanities and Social Sciences. The combination of research strength (Tepper has been home to nine Nobel Laureates in Economics) and environment to liberal arts and interdisciplinary studies (Dietrich has “the most creative general education program of any American university” – New York Times) provides our undergraduates with a world-class economics program.

Economics majors are considered members of both colleges and enjoy the full support and services of both. Undergraduate economics students should consult the program’s website for details about applicable Tepper and Dietrich academic policies and procedures.

Educational Objectives

The Undergraduate Economics Program offers a range of degrees in economics designed to develop strong analytical skills and a solid foundation in the discipline of economics. More specifically, measurable objectives for our economics curriculum are the following:

- Students should be able to identify, explain, and use economic concepts, theories, models, and data-analytic techniques.
- Students should acquire and use knowledge of economics, mathematics, statistics, and computing flexibly in a variety of contexts, providing the foundation for success in graduate studies and careers in the public and private sectors.
- Students should be able to apply their economic tools to formulate positions on a wide range of social and economic problems and engage effectively in policy debates.
- Students should use the investigative skills necessary for conducting original economic research and participating effectively in project teams.
- Students should be able to deliver effective presentations in which they combine visual communication design with oral arguments and/or the written word.

Advising

The Undergraduate Economics Program is committed to providing students with the opportunity to have meaningful and informative discussions about their academic, intellectual, and career interests with a wide range of advisors and mentors. Advising meetings are extended discussions which may address both immediate and long-term interests, concerns, and desires/needs. Students pursuing a degree in economics are assigned an economics advisor who meets with them on a regular basis. Any CMU undergraduate student interested in taking an economics courses is invited to meet with an economics advisor. To facilitate scheduling advising meetings, please use the online appointment scheduler (http://tepper.cmu.edu/undergraduate-advising).

The economics curriculum is cumulative; higher-level courses build upon the foundations learned in the core courses. This results in students needing to be aware of course-sequencing and the schedule of classes.

Students are encouraged to meet frequently with their Undergraduate Economics Program academic advisor to ensure that their courses fulfill the requirements towards their degree and are appropriately sequenced. Successful students check-in with their advisor frequently and seek the advice of their academic advisor in selecting courses, pursuing additional degrees, and planning ahead for study abroad.

First-Year Advising

First-year students who major in economics enter Carnegie Mellon University as Dietrich College students, and are assigned a Dietrich College Academic Advisory Center (http://www.cmu.edu/hsa/advisory-center) (AAC) advisor. While the AAC advisors are the advisors of record until students formally declare their majors, students who are considering majoring in economics are encouraged to contact the Undergraduate Economics Program academic advisor so that they will have access to program resources; program-level advising; and the community of faculty, staff, and students.

First-year students are not expected to know which degree option they wish to pursue. For this reason, the first-year curricula are quite similar for the four primary degrees awarded by the program. As students become involved in their course work, participate in the extra- and co-curricular activities sponsored by the Undergraduate Economics Program, and have discussions with faculty and economics advisors, the decision of which degree to pursue becomes evident.

Study Abroad

The Undergraduate Economics Program encourages students to consider enriching their undergraduate experience by studying abroad at some point during their undergraduate tenure. Studying abroad is widely defined as either study, work, internship, volunteer, or research opportunities abroad during your college career. Studying abroad provides students with not only more awareness of cultural literacies, but it further enhances their education by providing them with the opportunity to compare and contrast different economies and regimes. Many students consider their study abroad experience to be a watershed moment in their studies. With a bit of careful planning, study abroad can be worked into most any economics student's 4-year schedule.

Preparation for Professional School Programs

Many economics students will attend professional graduate school programs (e.g., DDS, JD, MBA, MD, MPP, M.Sc. Finance, etc.) immediately after graduation or within the first five years of earning their undergraduate degree. Students who are considering applying to professional graduate schools are encouraged to meet with an economics advisor early in their career at CMU. The economics advisors can provide structure and mentoring to students who are considering applying to professional schools.

Students are encouraged to meet frequently with their Undergraduate Economics Program academic advisor to ensure that their courses fulfill the requirements towards their degree and are appropriately sequenced. Successful students check-in with their advisor frequently and seek the advice of their academic advisor in selecting courses, pursuing additional degrees, and planning ahead for study abroad.

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Advising

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Students are encouraged to meet frequently with their Undergraduate Economics Program academic advisor to ensure that their courses fulfill the requirements towards their degree and are appropriately sequenced. Successful students check-in with their advisor frequently and seek the advice of their academic advisor in selecting courses, pursu...
Preparation for Ph.D. Programs in Economics

The Undergraduate Economics Program has been successful in preparing students for admission into the nation’s most competitive doctoral programs. The life of a researcher (whether in academia or in the private research sector) requires a set of skills that undergraduate students will begin to acquire through course work, research, and focused conversations with faculty and advisors. Doctoral programs in economics are looking for specific analytical skills. Key determinants of acceptance into these programs are the choice of courses, student achievement, research experience, graduate school entrance exam test scores (specifically the GRE), and faculty recommendations. Students who are considering pursuing a higher academic degree are encouraged to meet an economics advisor early in their career at CMU. Interested students are encouraged to look at the B.S. in Economics and Mathematical Sciences curriculum.

Curricula

In order to accommodate students' wide variety of goals, four primary degree programs are available: Bachelor of Arts in Economics, Bachelor of Science in Economics, Bachelor of Science in Economics and Mathematical Sciences (jointly administered by the Department of Mathematics and the Undergraduate Economics Program), and Bachelor of Science in Economics and Statistics (jointly administered by the Department of Statistics and the Undergraduate Economics Program).

The four major degree programs have been designed to provide students with a solid understanding of the central theories and analytical tools of the field of economics, while maintaining the flexibility necessary to meet the needs of a diversity of career paths. The four degrees produce strong analytical thinkers who are able to model and analyze complex problems. Graduates of the Undergraduate Economics Program gain employment as economic analysts in both the private and public sectors; pursue advanced professional degrees in business, law, and public policy; as well as enter into Ph.D. programs in economics, statistics, finance, and related fields.

For students who major in other academic fields, additional major programs in Economics and in Economics and Statistics and a minor degree program in Economics are available. Information about these degrees can be found following the discussions about the major curricula.

Major Degree Requirements and Sample Schedules

In addition to completing a minimum 360 units and fulfilling both the Dietrich General Education requirements and all University requirements, recipients of an undergraduate degree in economics must complete courses in mathematics, probability and statistics, writing, economic theory, and economic analysis, as well as a set of advanced electives and other specialized courses. It is important for students to realize that degree requirements are actually the "minimum" set of degree requirements. In fact, most economics students take more courses in their major than is strictly required.

Following the list of requirements for each degree are sample four-year course schedules for a student pursuing an undergraduate degree in economics. As there are many different ways of completing the requirements, students are strongly encouraged to meet with an economics advisor to tailor their courses to their own particular needs. Students are responsible for ensuring that they understand all of the program requirements and that they meet the necessary conditions for graduation. When planning course schedules, students must give consideration to all prerequisite and co-requisite requirements.

In addition to meeting university and college graduation requirements, the Undergraduate Economics Program has the additional requirement: Economics courses counting towards any economics primary degree, additional major, or minor must be completed with a grade of "C" or higher.

B.A. in Economics

The B.A. in Economics provides a strong foundation in economic analysis and quantitative methods. The curriculum's breadth incorporates the study of political, historical, and social institutions so that students may use the economic toolkit to address the current challenges humanity faces. Built into the degree is the opportunity to study political, historical, cultural, and social institutions from other CMU departments; these courses are referred to as "Special Electives". The advanced data analysis component of the B.A. in Economics Curriculum pays additional attention to ordinal data and the study of surveys. The capstone of the curriculum is the Senior Project course where students use their qualitative and quantitative skills to contribute to the body of knowledge in empirical, experimental, and/or theoretical studies. Students pursuing this degree will be well-equipped to pursue graduate work (professional and academic), enter directly into the business world, or pursue public service.

B.A. in Economics Curriculum

<table>
<thead>
<tr>
<th>Total Number of Units for the Major:</th>
<th>173/182</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses (19 units)</td>
<td></td>
</tr>
<tr>
<td>21-120 Differential and Integral Calculus</td>
<td>10 Units</td>
</tr>
<tr>
<td>Passing the MCS assessment test is an acceptable alternative to completing 21-120.</td>
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</tr>
<tr>
<td>21-256 Multivariate Analysis</td>
<td>9</td>
</tr>
<tr>
<td>Sophomore Economics Colloquium (1 unit)</td>
<td></td>
</tr>
<tr>
<td>73-450 Economics Colloquium</td>
<td>1</td>
</tr>
<tr>
<td>Writing Requirement (9 units)</td>
<td></td>
</tr>
<tr>
<td>73-270 Writing for Economists</td>
<td>9</td>
</tr>
<tr>
<td>Economic Theory Requirements (27 units)</td>
<td></td>
</tr>
<tr>
<td>73-100 Principles of Economics</td>
<td>9</td>
</tr>
<tr>
<td>73-230 Intermediate Microeconomics</td>
<td>9</td>
</tr>
<tr>
<td>73-240 Intermediate Macroeconomics</td>
<td>9</td>
</tr>
<tr>
<td>Economic History Requirement (9 units)</td>
<td></td>
</tr>
<tr>
<td>73-476 American Economic History</td>
<td>9</td>
</tr>
<tr>
<td>Quantitative Analysis Requirements (36 units)</td>
<td></td>
</tr>
<tr>
<td>36-201 Statistical Reasoning and Practice</td>
<td>9 Units</td>
</tr>
<tr>
<td>or 36-207 Probability and Statistics for Business Applications</td>
<td></td>
</tr>
<tr>
<td>or 70-207 Probability and Statistics for Business Applications</td>
<td></td>
</tr>
<tr>
<td>36-202 Statistical Methods</td>
<td>9</td>
</tr>
<tr>
<td>or 36-208 Regression Analysis</td>
<td>9</td>
</tr>
<tr>
<td>or 70-208 Regression Analysis</td>
<td></td>
</tr>
<tr>
<td>73-407 Fundamentals of Statistical Modeling</td>
<td>9 Units</td>
</tr>
<tr>
<td>36-303 Sampling, Survey and Society</td>
<td>9</td>
</tr>
<tr>
<td>Advanced Economics Electives (36 units)</td>
<td></td>
</tr>
<tr>
<td>Students must take four advanced elective courses. Advanced elective courses are those numbered 73-300 through 73-495 (excluding 73-374 Econometrics II, 73-407 Fundamentals of Statistical Modeling, 73-476 American Economic History, and 73-450 Economics Colloquium) as well as selected courses designated by the Program offered by other departments/programs. Additionally, students may work with their advisor to structure alternative sets of courses to meet these requirements based on their particular interests, subject to course availability.</td>
<td></td>
</tr>
<tr>
<td>Special Electives (27 units)</td>
<td></td>
</tr>
</tbody>
</table>
| Students must take three special elective courses in the humanities and social sciences. The complete list of courses designated as special electives is available to current students at MyTepper (http://
mytepper.tepper.cmu.edu). The list below is representative of the courses that qualify as "Special Electives"; this is not an exhaustive list of qualifying courses. In particular, the graduate courses from Heinz College which open to B.A. in Economics students are not presented.

Course List

Representative List of Special Elective Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-402</td>
<td>Telecommunications Technology, Policy &amp; Management</td>
<td>12</td>
</tr>
<tr>
<td>19-403</td>
<td>Policies of Wireless Systems and the Internet</td>
<td>12</td>
</tr>
<tr>
<td>19-421</td>
<td>Emerging Energy Policies</td>
<td>9</td>
</tr>
<tr>
<td>19-425</td>
<td>Sustainable Energy for the Developing World</td>
<td>9</td>
</tr>
<tr>
<td>79-221</td>
<td>Development and Democracy in Latin America</td>
<td>9</td>
</tr>
<tr>
<td>79-245</td>
<td>Capitalism and Individualism in American Culture</td>
<td>9</td>
</tr>
<tr>
<td>79-246</td>
<td>Industrial America</td>
<td>9</td>
</tr>
<tr>
<td>79-266</td>
<td>Russian History: From Communism to Capitalism</td>
<td>9</td>
</tr>
<tr>
<td>79-288</td>
<td>Bananas, Baseball, and Borders: Latin America and the United States</td>
<td>9</td>
</tr>
<tr>
<td>79-300</td>
<td>History of American Public Policy</td>
<td>9</td>
</tr>
<tr>
<td>79-310</td>
<td>Modern U.S. Business History: 1870 to the Present</td>
<td>9</td>
</tr>
<tr>
<td>79-320</td>
<td>Women, Politics, and Protest</td>
<td>9</td>
</tr>
<tr>
<td>79-371</td>
<td>African American Urban History</td>
<td>9</td>
</tr>
<tr>
<td>79-381</td>
<td>Energy and Empire: How Fossil Fuels Changed the World</td>
<td>9</td>
</tr>
<tr>
<td>79-386</td>
<td>Entrepreneurs in Africa, Past, Present and Future</td>
<td>9</td>
</tr>
<tr>
<td>79-392</td>
<td>History of Modern Warfare</td>
<td>9</td>
</tr>
<tr>
<td>80-130</td>
<td>Introduction to Ethics</td>
<td>9</td>
</tr>
<tr>
<td>80-136</td>
<td>Social Structure, Public Policy &amp; Ethics</td>
<td>9</td>
</tr>
<tr>
<td>80-221</td>
<td>Philosophy of Social Science</td>
<td>9</td>
</tr>
<tr>
<td>80-305</td>
<td>Choices, Decisions, and Games</td>
<td>9</td>
</tr>
<tr>
<td>80-321</td>
<td>Causation, Law, and Social Policy</td>
<td>9</td>
</tr>
<tr>
<td>80-324</td>
<td>Philosophy of Economics</td>
<td>9</td>
</tr>
<tr>
<td>80-337</td>
<td>Philosophy, Politics &amp; Economics</td>
<td>9</td>
</tr>
<tr>
<td>80-348</td>
<td>Health Development and Human Rights</td>
<td>9</td>
</tr>
<tr>
<td>84-310</td>
<td>International Political Economy and Organizations</td>
<td>9</td>
</tr>
<tr>
<td>84-362</td>
<td>Diplomacy and Statecraft</td>
<td>9</td>
</tr>
<tr>
<td>84-386</td>
<td>The Privatization of Force</td>
<td>9</td>
</tr>
<tr>
<td>84-414</td>
<td>International and Subnational Security</td>
<td>9</td>
</tr>
<tr>
<td>88-411</td>
<td>Rise of the Asian Economies</td>
<td>9</td>
</tr>
<tr>
<td>88-260</td>
<td>Organizations</td>
<td>9</td>
</tr>
<tr>
<td>88-444</td>
<td>Public Policy and Regulation</td>
<td>9</td>
</tr>
</tbody>
</table>

Senior Work (9 Units; 18 Units for students working on an honors thesis in economics)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>73-497</td>
<td>Senior Project</td>
<td>9</td>
</tr>
<tr>
<td>or 73-500</td>
<td>Tepper College Honors Thesis I</td>
<td>9</td>
</tr>
<tr>
<td>&amp; 73-501</td>
<td>Tepper College Honors Thesis II</td>
<td>9</td>
</tr>
<tr>
<td>or 66-501</td>
<td>H&amp;SS Senior Honors Thesis I</td>
<td>9</td>
</tr>
<tr>
<td>&amp; 66-502</td>
<td>H&amp;SS Senior Honors Thesis II</td>
<td>9</td>
</tr>
</tbody>
</table>

Sample Schedule for B.A. in Economics

The sample schedule below is an illustration of how students might plan their four-year schedules. This schedule has been designed to highlight the following characteristics of the degree program: 1) the work load is roughly 45-50 units per semester, hence there is no need for course overloading; and 2) room has been built into the schedule that would allow students to pick up additional degrees and/or study abroad. It is important for students to realize that degree requirements are the actually the "minimum" set of degree requirements. In fact, most economics students take more courses in their major than is strictly required.

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-201 Statistical Reasoning and Practice</td>
<td>36-202 Statistical Methods</td>
<td>73-450 Economics Colloquium</td>
<td>73-407 Fundamentals of Statistical Modeling</td>
</tr>
<tr>
<td>73-270 Writing for Economists</td>
<td>36-303 Sampling, Survey and Society</td>
<td>73-497 Senior Project</td>
<td>Economics Elective</td>
</tr>
<tr>
<td>73-476 American Economic History</td>
<td>&quot;Special Elective&quot;</td>
<td>Economics Elective</td>
<td>&quot;Special Elective&quot;</td>
</tr>
</tbody>
</table>

Senior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-270 Writing for Economists</td>
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<td>73-497 Senior Project</td>
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<td>73-476 American Economic History</td>
<td>&quot;Special Elective&quot;</td>
<td>Economics Elective</td>
<td>&quot;Special Elective&quot;</td>
</tr>
</tbody>
</table>

*In each semester, ----- represents courses that are not directly required for the major.
** While not required, 73-160 is strongly recommended.

B.S. in Economics

The B.S. in Economics provides a strong foundation in economic theory and advanced quantitative analysis. The curriculum focuses on using "real-world" data to forecast behavior and to investigate the relationships between observed phenomenon and economic models. Combining these sophisticated economic modeling data analytic skills with our wide range of upper-level economic electives provides students with a rigorous analytical foundation that will allow them to pursue any career that interests them. The capstone of the curriculum is the Senior Project course where students use their qualitative and quantitative skills to contribute to the body of knowledge in empirical, experimental, and/or theoretical studies. Students completing this degree will be well-equipped to pursue graduate work (professional and academic) or enter directly into the business world or public service.

B.S. in Economics Curriculum

Total Number of Units for the Major: 156/165

Mathematics Requirement (29 Units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td>10</td>
</tr>
<tr>
<td>21-256</td>
<td>Multivariate Analysis</td>
<td>9</td>
</tr>
<tr>
<td>21-259</td>
<td>Calculus in Three Dimensions</td>
<td>9</td>
</tr>
<tr>
<td>21-122</td>
<td>Integration and Approximation</td>
<td>10</td>
</tr>
<tr>
<td>21-127</td>
<td>Concepts of Mathematics</td>
<td>9</td>
</tr>
<tr>
<td>21-257</td>
<td>Models and Methods for Optimization</td>
<td>9</td>
</tr>
</tbody>
</table>

Sophomore Colloquium (1 Unit)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-450</td>
<td>Economics Colloquium</td>
<td>1</td>
</tr>
</tbody>
</table>

Quantitative Analysis Requirements (27 Units)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>36-225</td>
<td>Introduction to Probability Theory</td>
<td>9</td>
</tr>
<tr>
<td>36-217</td>
<td>Probability Theory and Random Processes</td>
<td>9</td>
</tr>
</tbody>
</table>
or 21-325 Probability
73-274 Econometrics I
73-374 Econometrics II

Writing Requirement (9 Units)
73-270 Writing for Economists

Economic Theory Requirements (27 Units)
73-100 Principles of Economics
9
73-230 Intermediate Microeconomics
9
73-240 Intermediate Macroeconomics
9

Advanced Economics Electives (54 Units)
Students must take six advanced elective courses. Advanced elective courses are those numbered 73-300 through 73-495 (excluding 73-374 Econometrics II, 73-407 Fundamentals of Statistical Modeling, and 73-450 Economics Colloquium). For the purpose of these requirements, the Undergraduate Economics Program may also designate as advanced electives courses from other departments/programs. Additionally, students may work with their advisor to structure alternative sets of courses to meet these requirements based on their particular interests, subject to course availability.

Senior Work (9 Units; 18 Units for students working on an honors thesis in economics)
73-497 Senior Project
9
or 73-500 Tepper College Honors Thesis I
& 73-501 and Tepper College Honors Thesis II
or 66-501 H&SS Senior Honors Thesis I
& 66-502 and H&SS Senior Honors Thesis II

Sample Course Schedule for the B.S. in Economics
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### Freshman

<table>
<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120</td>
<td>Principles of Computing</td>
<td></td>
</tr>
<tr>
<td>21-254</td>
<td>Multivariate Analysis</td>
<td></td>
</tr>
<tr>
<td>36-201</td>
<td>Statistics for Business</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-374</td>
<td>Econometrics I</td>
<td></td>
</tr>
<tr>
<td>73-375</td>
<td>Econometrics II</td>
<td></td>
</tr>
</tbody>
</table>

### Sophomore

<table>
<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-120</td>
<td>Differential and Integral Calculus</td>
<td></td>
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<tr>
<td>21-256</td>
<td>Multivariate Analysis</td>
<td></td>
</tr>
<tr>
<td>36-201</td>
<td>Statistics for Business</td>
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</tbody>
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<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>73-374</td>
<td>Econometrics I</td>
<td></td>
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<tr>
<td>73-375</td>
<td>Econometrics II</td>
<td></td>
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</tbody>
</table>

### Junior

<table>
<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>21-120</td>
<td>Principles of Computing</td>
<td></td>
</tr>
<tr>
<td>21-254</td>
<td>Multivariate Analysis</td>
<td></td>
</tr>
<tr>
<td>36-201</td>
<td>Statistics for Business</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>73-374</td>
<td>Econometrics I</td>
<td></td>
</tr>
<tr>
<td>73-375</td>
<td>Econometrics II</td>
<td></td>
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</tbody>
</table>

### Senior

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<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>21-120</td>
<td>Principles of Computing</td>
<td></td>
</tr>
<tr>
<td>21-254</td>
<td>Multivariate Analysis</td>
<td></td>
</tr>
<tr>
<td>36-201</td>
<td>Statistics for Business</td>
<td></td>
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<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>73-374</td>
<td>Econometrics I</td>
<td></td>
</tr>
<tr>
<td>73-375</td>
<td>Econometrics II</td>
<td></td>
</tr>
</tbody>
</table>

*In each semester, ----- represents courses not directly required for the major.

**While not required, 73-160 is strongly recommended.

## B.S. in Economics and Mathematical Sciences

The B.S. in Economics and Mathematical Sciences is a collaborative effort between the Department of Mathematical Sciences and the Undergraduate Economics Program. Combining advanced mathematics with advanced economic theory is the hallmark of this curriculum. The curriculum provides students with courses that complement and develop depth of understanding of economic theory, applied economics, and applied mathematics. This degree offers an integrated curriculum, guiding students through a program of coursework that exploits and builds upon the synergies between mathematics and economics. This degree program equips students with the mathematical tools that are essential for success in Ph.D. programs in economics; mathematics; and key functional areas of business including finance, accounting, marketing, and information systems. Students pursuing this degree will be well prepared for the beginning of their research careers in academia, government, and industry. There are a limited number of student openings in this program; interested students may apply as early as their sophomore year. Acceptance into the degree program is based on academic performance, rigor of coursework, and initiative while at Carnegie Mellon. In order to graduate with the B.S. in Economics and Mathematical Sciences, students must maintain a cumulative Q.P.A. of 3.33.

## B.S. in Economics and Mathematical Sciences Curriculum

### Total Number of Units for the Major 230

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>73-100 Principles of Economics</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>73-230 Intermediate Microeconomics</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>73-240 Intermediate Macroeconomics</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>

### Quantitative Analysis Requirements (36 Units)

<table>
<thead>
<tr>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>36-225 Introduction to Probability Theory</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>or 36-217 Probability Theory and Random Processes</td>
</tr>
<tr>
<td>or 21-325 Probability</td>
</tr>
<tr>
<td>36-226 Introduction to Statistical Inference</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>36-401 Modern Regression</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>73-374 Econometrics II</td>
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<td>9</td>
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</tbody>
</table>

### Mathematical Sciences Requirements (85 Units)

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>21-120 Differential and Integral Calculus</td>
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<tr>
<td>10</td>
</tr>
<tr>
<td>21-122 Integration and Approximation</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>21-127 Concepts of Mathematics</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>21-228 Discrete Mathematics</td>
</tr>
<tr>
<td>9-12</td>
</tr>
<tr>
<td>or 15-251 Great Theoretical Ideas in Computer Science</td>
</tr>
<tr>
<td>21-241 Matrices and Linear Transformations</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>21-259 Calculus in Three Dimensions</td>
</tr>
<tr>
<td>9-10</td>
</tr>
<tr>
<td>or 21-256 Multivariate Analysis</td>
</tr>
<tr>
<td>or 21-268 Multidimensional Calculus</td>
</tr>
<tr>
<td>or 21-269 Vector Analysis</td>
</tr>
<tr>
<td>21-260 Differential Equations</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>or 21-355 Principles of Real Analysis I</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>or 21-356 Principles of Real Analysis II</td>
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<td>9</td>
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</tbody>
</table>

### Programming Requirement (10 Units)

<table>
<thead>
<tr>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>15-110 Principles of Computing</td>
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<tr>
<td>10</td>
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</table>

<table>
<thead>
<tr>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>73-270 Writing for Economists</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>
Advanced Economic Electives (36 Units)

Students must take four advanced economics elective courses. Advanced Elective courses are those courses numbered 73-300 through 73-495, (excluding 73-374 Econometrics II, 73-407 Fundamentals of Statistical Modeling, and 73-450 Economics Colloquium) as well as courses designated by the Undergraduate Economics Program which are offered by other departments/programs. Students are encouraged to work with their advisors to structure a set of courses which meet these requirements based on their particular interests, subject to course availability.

Recommended Advanced Economics Electives:

- 73-315 Market Design
- 73-338 Financial Crises and Risk
- 73-347 Game Theory for Economists
- 73-365 Firms, Market Structures, and Strategy
- 73-421 Emerging Markets

Mathematical Science Depth Electives (27 Units)

Students must take three advanced mathematics depth courses. Students are encouraged to work with their advisors to structure a set of courses which meet these requirements based on their particular interests, subject to course availability.

Recommended Mathematical Science Depth Electives:

- 21-292 Operations Research I
- 21-329 Set Theory
- 21-365 Projects in Applied Mathematics
- 21-366 Topics in Applied Mathematics
- 21-371 Functions of a Complex Variable
- 21-374 Field Theory
- 21-441 Number Theory
- 21-484 Graph Theory
- 21-499 Undergraduate Research Topic

Note: Only one of the following three courses may count towards the required Mathematical Sciences Depth Electives: 21-365, 21-366, or 21-499.

Sample Course Schedule for the B.S. in Economics and Mathematical Sciences

The sample schedule below is an illustration of how students might plan their four-year schedules. This schedule has been designed to highlight the following characteristics of the degree program: 1) the work load is roughly 45-50 units per semester, hence there is no need for course overloading; 2) room has built into the schedule that would allow students to pick up 45-50 units per semester, hence there is no need for course overloading; 3) the demands of this degree require students to carefully plan their degree program while keeping in mind the college-level and university-level graduation requirements. It is important for students to realize that degree requirements are the actually the "minimum" set of degree requirements. In fact, most economics students take more courses in their major than is strictly required.

**While not required, 73-160 is strongly recommended.**

---

**Notice:**

- **I. Prerequisites 38-39 units**
  - 1. Mathematical Foundations 38-39 units
    - Calculus
      - 21-120 Differential and Integral Calculus 10
      and one of the following:
        - 21-122 Integration and Approximation 10
        - 21-127 Concepts of Mathematics 10
        - 21-257 Models and Methods for Optimization 9
      and one of the following:
        - 21-256 Multivariate Analysis 9
        - 21-259 Calculus in Three Dimensions 9
  - Note:** Passing the MSC 21-120 assessment test is an acceptable alternative to completing 21-120.
  - Note:** Taking both 21-111 and 21-112 is equivalent to 21-120. The Mathematical Foundations total is then 48-49 units. The Economics and Statistics major would then total 201-202 units.

**II. Foundations 18-27 units**

- 2. Economics Foundations 9 units
  - 73-100 Principles of Economics 9

- 3. Statistical Foundations 9-18 units
  - Sequence 1 (For students beginning their freshman or sophomore year)
  - Beginning*
    - Choose one of the following courses
      - 36-201 Statistical Reasoning and Practice 9
      - 36/70-207 Probability and Statistics for Business 9
      - Applications
      - 36-220 Engineering Statistics and Quality Control 9

---

*In each semester, ----- represents courses not directly required for the major. Please note that students pursuing the B.S. in Mathematical Sciences and Economics must fulfill the Mellon College General Education requirements and not the Dietrich College General Education requirements.
Professional Development

Students are strongly encouraged to take advantage of professional development opportunities and/or coursework. One option is 73-450 Economics Colloquium, a fall-only mini that provides information about careers in Economics, job search strategies, and research opportunities. The Statistics Department also offers a series of workshops pertaining to resume preparation, graduate school applications, careers in the field, among other topics. Students should also take advantage of the Career and Professional Development Center.

Sample Program

The following sample program illustrates one way to satisfy the requirements of the Economics and Statistics Major. Keep in mind that the program is flexible and can support other possible schedules (see footnotes below the schedule).

<table>
<thead>
<tr>
<th>Major</th>
<th>Freshman</th>
<th>Sophomore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>36-401 Modern Regression</td>
<td>73-270 Writing for Economists</td>
<td>Economics Elective</td>
</tr>
<tr>
<td>73-374 Econometrics II</td>
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</tbody>
</table>

*In each semester, ----- represents other courses (not related to the major) which are needed in order to complete the 360 units that the degree requires.

** Students can also take 21-127 or 21-257. Students should consult with their advisor.

73-160 is not required but it is recommended by the Economics department. Prospective PhD students might add 21-127 fall of sophomore year, replace 21-240 with 21-241, add 21-260 in spring of junior year and 21-355 in fall of senior year.

Students who elect Economics and Statistics as a second major must fulfill all Economics and Statistics degree requirements. Majors in many other programs would naturally complement an Economics and Statistics Major, including Business Administration, Social and Decision Sciences, Policy and Management, Social & Political History, and Psychology.

With respect to double-counting courses, it is departmental policy that students must have at least six courses (three Economics and three Statistics) that do not count for their primary major. If students do not have at least six, they typically take additional advanced electives.

Students are advised to begin planning their curriculum (with appropriate advisors) as soon as possible. This is particularly true if the other major has a complex set of requirements and prerequisites.

Supplemental Programs

Honors Program in Economics

Outstanding students are eligible for the honors programs in both the Tepper School of Business and the Dietrich College of Humanities and Social Sciences. For more information, consult the Dietrich Honors Program website (http://www.cmu.edu/dietrich/undergraduate/programs/shp).

The Tepper Senior Honors Program in Economics (http://tepper.cmu.edu/prospective-students/undergraduate/economics/curriculum/research/senior-honors-program) provides qualified students with the opportunity to engage in original research during their senior year at Carnegie Mellon. The
primary rewards of participating in the Honors Program in Economics are three-fold. First comes the satisfaction of undertaking and completing an original piece of research. Working independently or with a faculty member to identify a research question and claim ownership of its discovery process is a rewarding experience. Second is the opportunity to challenge oneself intellectually. The third advantage is the opportunity to graduate with Tepper Honors. For many, this process of intellectual inquiry and knowledge creation is the highlight and culmination of their undergraduate academic experience.

Students are invited into the Tepper Senior Honors Program in Economics during their junior year. Invitation is based on academic achievement at Carnegie Mellon University, ability to work independently, and tenacity of spirit.

Accelerated Master's Degree Programs


Dual Degree in Economics

A student pursuing a primary degree outside of the department may obtain a dual degree by completing all of the requirements for the B.S. in Economics or the B.S. in Economics and Statistics along with the Dietrich College general education requirements. In addition, the student’s total units completed must be at least 90 units in excess of the requirement for the student’s other degree(s) or at least 450 units, whichever is greater. Interested students should meet with an economics advisor.

Additional Major in Economics Curriculum

All university students are eligible to pursue an additional major in economics in conjunction with a major in any department in the university other than economics. The requirements for the Additional Major in Economics are the same as those for the B.S. in Economics, except that the Dietrich College General Education requirements are waived. In order to avoid “double counting” issues, students are encouraged to meet with an economics advisor. When courses are shared across degrees, students pursuing an Additional Major in Economics are asked to take additional advanced economics electives.

Additional Major in Economics and Statistics Curriculum

All university students are eligible to pursue a major in economics and statistics in conjunction with a major in any department in the university other than statistics or economics. The requirements for the Additional Major in Economics and Statistics are the same as those for the B.S. in Economics and Statistics, except that the Dietrich College General Education requirements are waived. In order to avoid “double counting” issues, students are encouraged to meet with an economics or statistics advisor. When courses are shared across degrees, students pursuing an Additional Major in Economics and Statistics are asked to take additional advanced economics or statistics electives.

Minor in Economics

The Minor in Economics degree program provides students with a solid understanding of economic theory and data analysis. All university students are eligible to pursue the Minor in Economics in conjunction with a major in any other department in the university. In order to avoid “double counting” issues, students are encouraged to meet with an economics advisor. When courses are shared across degrees, students pursuing a minor in Economics are asked to take additional advanced economics electives.

All economics course counting towards the minor must be completed with a grade of “C” or higher.

Minor in Economics (Total Number of Units for the Minor: 82/91)

Mathematics Requirements (19 Units)

<table>
<thead>
<tr>
<th>Units</th>
<th>Course</th>
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<tbody>
<tr>
<td>10</td>
<td>21-120 Differential and Integral Calculus</td>
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<tr>
<td>9</td>
<td>21-256 Multivariable Analysis</td>
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</tbody>
</table>

Economic Theory Requirements (18/27 Units)

<table>
<thead>
<tr>
<th>Units</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>73-100 Principles of Economics</td>
</tr>
<tr>
<td>9</td>
<td>73-230 Intermediate Microeconomics</td>
</tr>
<tr>
<td>9</td>
<td>73-240 Intermediate Macroeconomics</td>
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</tbody>
</table>

*Some students may choose to focus their minor in microeconomics and applications. These students may elect not to take 73-240 Intermediate Macroeconomics, and instead, replace it with an additional advanced economics elective.

Quantitative Analysis Requirements (18/27 Units)

The quantitative analysis path is often determined by the major requirements. The sequence is designed to give students an understanding of probability theory, regression analysis, and quantitative economic analysis. Students are encouraged to talk with an economics advisor to determine which requirements best complement their primary fields of study.

<table>
<thead>
<tr>
<th>Option</th>
<th>Units</th>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>Option One</td>
<td>9</td>
<td>36-201 Statistical Reasoning and Practice</td>
</tr>
<tr>
<td>or 36-202 Statistical Methods</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>or 36-309 Experimental Design for Behavioral and Social Sciences</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>73-407 Fundamentals of Statistical Modeling</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Option Two</td>
<td>9</td>
<td>70/36-207 Probability and Statistics for Business Applications</td>
</tr>
<tr>
<td>70/36-208 Regression Analysis</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>73-407 Fundamentals of Statistical Modeling</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Option Three</td>
<td>9</td>
<td>36-220 Engineering Statistics and Quality Control</td>
</tr>
<tr>
<td>or 36-407 Fundamentals of Statistical Modeling</td>
<td>9</td>
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<tr>
<td>Option Four</td>
<td>9</td>
<td>36-217 Probability Theory and Random Processes</td>
</tr>
<tr>
<td>or 36-225 Introduction to Probability Theory</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>36-202 Statistical Methods</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>or 36-309 Experimental Design for Behavioral and Social Sciences</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>or 36-226 Introduction to Statistical Inference</td>
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</tr>
<tr>
<td>73-407 Fundamentals of Statistical Modeling</td>
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<td></td>
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<tr>
<td>or 73-374 Econometrics II</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Advanced Economics Electives (18/27 Units)

Students must take two advanced elective courses. Advanced elective courses are those numbered 73-300 through 73-495 (excluding 73-374 Econometrics II, 73-407 Fundamentals of Statistical Modeling, and 73-450 Economics Colloquium) as well as courses designated by the program offered by other departments/programs. Additionally, students may work with their economics advisor to structure alternative sets of courses to meet these requirements based on their particular interests, subject to course availability.

Academic Standards and Policies

Undergraduate economics students are in the unique position of belonging to two CMU colleges, Mariana Brown Dietrich College of Humanities and Social Sciences and the Tepper School of Business. To find a detailed
description of policies governing economics students, please consult the undergraduate section of MyTepper (http://mytepper.tepper.cmu.edu).

Faculty

LAURENCE ALES, Assistant Professor of Economics – Ph.D., University of Minnesota; Carnegie Mellon, 2008–.
KATHARINE ANDERSON, Assistant Professor of Economics and Entrepreneurship – Ph.D., University of Michigan; Carnegie Mellon, 2010–.
STEPHEN M. CALABRESE, Visiting Associate Professor of Economics, Carnegie Mellon University-Qatar – Ph.D., Carnegie Mellon University-Public Policy; Carnegie Mellon, 2007–.
KAREN B. CLAY, Associate Professor of Economics and Public Policy, H. J. Heinz III College – Ph.D., Stanford University; Carnegie Mellon, 1998–.
ROBERT M. DAMMON, Dean; Education; Professor of Financial Economics – Ph.D., University of Wisconsin; Carnegie Mellon, 1984–.
TIMOTHY P. DERDENGER, Assistant Professor of Economics and Strategy – Ph.D., University of Southern California; Carnegie Mellon, 2009–.
KENNETH B. DUNN, Professor of Financial Economics – Ph.D., Purdue University; Carnegie Mellon, 1979–.
DENNIS N. EPPLER, Thomas Lord University Professor of Economics; Head, Economics Programs – Ph.D., Princeton University; Carnegie Mellon, 1974–.
MARIA MARTA FERREYRA, Associate Professor of Economics – Ph.D., University of Wisconsin; Carnegie Mellon, 2002–.
CHRISTINA FONG, Senior Research Scientist in Social and Decision Sciences, Dietrich College of Humanities and Social Sciences – Ph.D., University of Massachusetts; Carnegie Mellon, 2001–.
MARTIN GAYNOR, E. J. Barone Professor of Economics and Health Policy, H. J. Heinz III College – Ph.D., Northwestern University; Carnegie Mellon, 1995–.
MARVIN GOOFRIEND, Friends of Allan Meltzer Professorship; Professor of Economics – Ph.D., Brown University; Carnegie Mellon, 2005–.
RICHARD C. GREEN, Senior Associate Dean, Faculty and Research; Richard M. and Margaret S. Cyert Chair; Professor of Financial Economics – Ph.D., University of Wisconsin; Carnegie Mellon, 1982–.
JOACHIM RYOHEI GROEGER, Assistant Professor of Economics – Ph.D., London School of Economics; Carnegie Mellon, 2010–.
ISA E. HAFALIR, Associate Professor of Economics – Ph.D., Pennsylvania State University; Carnegie Mellon, 2007–.
BURTON HOLLIFIELD, PNC Professor of Finance; Professor of Financial Economics – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1999–.
KARAM KANG, Assistant Professor of Economics – Ph.D., University of Pennsylvania; Carnegie Mellon, 2012–.
ONUR KESTEN, Associate Professor of Economics – Ph.D., University of Rochester; Carnegie Mellon, 2005–.
YAROSLAV KRYUKOV, Assistant Professor of Economics – Ph.D., Northwestern University; Carnegie Mellon, 2008–.
REBECCA LESSEMM, Assistant Professor of Economics – Ph.D., University of Wisconsin-Madison; Carnegie Mellon, 2011–.
BENNETT T. MCCALLUM, H. J. Heinz Professor of Economics – Ph.D., University of Wisconsin; Carnegie Mellon, 2009–.
ALLAN H. MELTZER, The Allan H. Meltzer University Professor of Political Economy – Ph.D., University of California, Los Angeles; Carnegie Mellon, 1957–.
CHRISTOPHER MUELLER, Assistant Professor of Economics – Ph.D., University of Michigan; Carnegie Mellon, 2010–.
JOHN R. O’BRIEN, Associate Professor of Accounting and Experimental Economics – Ph.D., University of Minnesota; Carnegie Mellon, 1984–.
NICOLAS PETROSKY-NADEAU, Assistant Professor of Economics – Ph.D., University of Quebec; Carnegie Mellon, 2009–.
DUANE J. SEPPI, BNY Mellon Professor of Finance; Head, Master of Science in Computational Finance – Ph.D., University of Chicago; Carnegie Mellon, 1996–.
PATRICK W. SLEEO, Associate Dean, Carnegie Mellon University-Qatar; Associate Teaching Professor of Economics and Finance; Carnegie Mellon University-Qatar – Ph.D., Carnegie Mellon University-Public Policy; Carnegie Mellon, 1999–.
CHRISTOPHER SLEET, Professor of Economics – Ph.D., Stanford University; Carnegie Mellon, 2005–.
FALLAW B. SOWELL, Associate Professor of Economics – Ph.D., Duke University; Carnegie Mellon, 1988–.
CHESTER S. SPATT, Pamela R. and Kenneth B. Dunn Professor of Finance – Ph.D., University of Pennsylvania; Carnegie Mellon, 1979–.
STEPHEN E. SPEAR, Professor of Economics – Ph.D., University of Pennsylvania; Carnegie Mellon, 1982–.
CHRISTOPHER I. TELMER, Associate Professor of Financial Economics – Ph.D., Queen’s University (Canada); Carnegie Mellon, 1992–.
SEVIN YELTEKIN, Associate Professor of Economics – Ph.D., Stanford University; Carnegie Mellon, 2005–.

Undergraduate Economics Program

Visiting Faculty

SERRA BORANBAY-AKAN, Visiting Assistant Professor of Economics – Ph.D., Northwestern University; Carnegie Mellon, 2013–.
BILLIE MORROW DAVIS, Post-Doctoral Fellow, Economics – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2013–.

Adjunct Faculty

CAROL B. GOLDBURG, Executive Director, Undergraduate Economics Program; Adjunct Professor of Economics – Ph.D., Carnegie Mellon University; Carnegie Mellon, 2005–.
ELIF INCEKARA HAFALIR, Adjunct Assistant Professor of Economics – Ph.D., Pennsylvania State University; Carnegie Mellon, 2007–.
FREDERICK H. RUETER, Adjunct Professor of Economics – Ph.D., Carnegie Mellon University; Carnegie Mellon, 1998–.
C. SCOTT WYATT, Adjunct Professor of Business Communications – Ph.D., University of Minnesota, Twin Cities; Carnegie Mellon, 2013–.
BENJAMIN ZAMZOW, Adjunct Professor – Ph.D., University of Arizona; Carnegie Mellon, 2013–.