BACHELOR OF ARTS (BA) DEGREE WITH A MAJOR IN OPERATIONS RESEARCH

Program Learning Outcomes for the BA Degree with a Major in Operations Research

Upon completing the BA degree with a major in Operations Research, students will be able to:

1. Formulate appropriate mathematical programs and stochastic processes that model real-world situations.
2. Calibrate models with appropriate real-world data, using statistical and data science tools.
3. Use commercial and open-source software to solve operations research models.
4. Communicate the solutions and insights generated by operations research models to a non-technical audience.

Requirements for the BA Degree with a Major in Operations Research

For general university requirements, see Graduation Requirements (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/). Students pursuing the BA degree with a major in Operations Research must complete:

- A minimum of 17 courses (53-56 credit hours, depending on course selection) to satisfy major requirements.
- A minimum of 120 credit hours to satisfy degree requirements.
- A minimum of 11 courses (33-35 credit hours, depending on course selection) taken at the 300-level or above.
- A maximum of 4 courses (12 credit hours) from study abroad or transfer credit **after** matriculation at Rice may be applied towards specific major requirements. For additional departmental guidelines regarding transfer credit, see the Policies (p. 2) tab.

The courses listed below satisfy the requirements for this major. In certain instances, courses not on this official list may be substituted upon approval of the major's academic advisor or, where applicable, the department's Director of Undergraduate Studies. (Course substitutions must be formally applied and entered into Degree Works by the major's Official Certifier (https://registrar.rice.edu/facstaff/degreeworks/officialcertifier/).) Students and their academic advisors should identify and clearly document the courses to be taken.

Summary

Code	Title	Credit Hours
	Total Credit Hours Required for the Major in Operations Research	53-56
	Total Credit Hours Required for the BA Degree with a Major in Operations Research	120

Degree Requirements

Code	Title	Credit Hours
Introductory Requirements		
COMP 140	COMPUTATIONAL THINKING	4
MATH 101	SINGLE VARIABLE CALCULUS I	3
or MATH 105	AP/OTH CREDIT IN CALCULUS I	
MATH 102	SINGLE VARIABLE CALCULUS II	3
or MATH 106	AP/OTH CREDIT IN CALCULUS II	
MATH 212	MULTIVARIABLE CALCULUS	3
Intermediate Requirements		
Select 1 course from the following:		3
CMOR 302	MATRIX ANALYSIS	
CMOR 303	MATRIX ANALYSIS FOR DATA SCIENCE	
MATH 354	HONORS LINEAR ALGEBRA	
MATH 355	LINEAR ALGEBRA	
CMOR 350	STOCHASTIC MODELS	3
CMOR 360	INTRODUCTION TO OPERATIONS RESEARCH AND OPTIMIZATION	3
ELEC 378	MACHINE LEARNING: CONCEPTS AND TECHNIQUES	3
Select 1 course from the following:		3-4
STAT 310 / ECON 307	PROBABILITY AND STATISTICS	
STAT 311	HONORS PROBABILITY AND MATHEMATICAL STATISTICS	
STAT 315 / DSCI 301	PROBABILITY AND STATISTICS FOR DATA SCIENCE	
Advanced Requirements		
CMOR 442	LARGE-SCALE OPTIMIZATION	3
or CMOR 451	SIMULATION MODELING AND ANALYSIS	
CMOR 452	SERVICE SYSTEMS ANALYTICS	3
CMOR 461	LOGISTICS AND SUPPLY CHAIN MANAGEMENT	3
CMOR 462	OPTIMIZATION METHODS IN FINANCE	3
Elective Requirements		
Select 3 elective courses (see course list below)		9-11
Senior Design		
Select 1 from the following:		4
DSCI 435 / COMP 449	APPLIED MACHINE LEARNING AND DATA SCIENCE PROJECTS	
CMOR 492 & CMOR 493	SENIOR DESIGN PROJECT I and SENIOR DESIGN PROJECT II	
Total Credit Hours Required for the Major in Operations Research		**53-56**
Additional Credit Hours to Complete Degree Requirements [*]		33-36
University Graduation Requirements (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements/) [*]		31
Total Credit Hours		**120**

Footnotes and Additional Information

*   Note: <u>University Graduation Requirements</u> include 31 credit hours, comprised of Distribution Requirements (Groups I, II, and III), FWIS, and LPAP coursework. In some instances, courses satisfying major requirements may additionally meet distribution requirements, such as the Analyzing Diversity (AD) requirement, or some of the student's declared major, minor, or certificate requirements. <u>Additional Credit Hours to Complete Degree Requirements</u> include general electives, coursework completed as upper-level, residency (hours taken at Rice), and/or any other additional academic program requirements.

Course List to Satisfy Requirements

Elective Requirements

To fulfill Elective Requirements, students must complete a total of 3 courses (9-11 credit hours, depending on course selection) from the following department approved electives.

Code	Title	Credit Hours
CMOR 404	GRAPH THEORY	3
CMOR 441	LINEAR AND INTEGER PROGRAMMING	3
CMOR 446	GRAPH ALGORITHMS	3
CMOR 455	STOCHASTIC CONTROL AND APPLICATIONS	3
CMOR 463	OPERATIONS RESEARCH IN HEALTHCARE	3
CMOR 464	MANUFACTURING PROCESSES AND SYSTEMS	3
CMOR 531	CONVEX OPTIMIZATION	3
CMOR 533	NUMERICAL OPTIMIZATION	3
CMOR 543	COMBINATORIAL OPTIMIZATION	3
CMOR 544	STOCHASTIC OPTIMIZATION	3
COMP 382	REASONING ABOUT ALGORITHMS	4
COMP 414	OPTIMIZATION: ALGORITHMS, COMPLEXITY AND APPROXIMATIONS	3
COMP 416	GENOME-SCALE ALGORITHMS AND DATA STRUCTURES	4
COMP 441	LARGE-SCALE MACHINE LEARNING	3
or ELEC 478	INTRODUCTION TO MACHINE LEARNING	
or ELEC 578	INTRODUCTION TO MACHINE LEARNING	
or INDE 577	DATA SCIENCE AND MACHINE LEARNING	
or STAT 413	INTRODUCTION TO STATISTICAL MACHINE LEARNING	
COMP 459	MACHINE LEARNING WITH GRAPHS	3
ECON 437 / ENST 437	ENERGY ECONOMICS	3
ECON 443	FINANCIAL ECONOMICS	3
ECON 449	PRINCIPLES OF FINANCIAL ENGINEERING	3
ECON 456	TOPICS IN BUSINESS ECONOMICS: FINANCIAL MARKET AND INVESTMENTS	3
ECON 470	MARKET DESIGN	3
ECON 481	HEALTH ECONOMICS	3
ELEC 475	LEARNING FROM SENSOR DATA	3
ELEC 533 / CMOR 553 / STAT 583	INTRODUCTION TO RANDOM PROCESSES AND APPLICATIONS	3
INDE 597	TOPICS IN INDUSTRIAL ENGINEERNG	3
STAT 313 / CEVE 313	UNCERTAINTY AND RISK IN URBAN INFRASTRUCTURES	3
STAT 410	LINEAR REGRESSION	4
STAT 418	PROBABILITY	3
STAT 419	STATISTICAL INFERENCE	3
STAT 421	APPLIED TIME SERIES AND FORECASTING	3
STAT 449	QUANTITATIVE FINANCIAL RISK MANAGEMENT	3
STAT 482	QUANTITATIVE FINANCIAL ANALYTICS	3
STAT 486	MARKET MODELS	3
STAT 581 / CMOR 552	MATHEMATICAL PROBABILITY I	3
STAT 582	MATHEMATICAL PROBABILITY II	3

Policies for the BA Degree with a Major in Operations Research

Program Restrictions and Exclusions

Students pursuing the BA Degree with a Major in Operations Research should be aware of the following program restrictions:

- As noted in <u>Majors, Minors, and Certificates</u> (https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/), under *Declaring Majors, Minors and Certificates,* students may not obtain both a BA and a BS in the same major. Students pursuing the BA Degree in Operations Research may not additionally pursue the BS Degree with a Major in Operations Research.
- As noted in <u>Majors, Minors, and Certificates</u> (https://ga.rice.edu/undergraduate-students/academic-opportunities/majors-minors-certificates/), students may not major and minor in the same subject.
- Students pursuing the major in Operations Research may not additionally declare the major in Computational and Applied Mathematics.
- Students pursuing the major in Operations Research may not additionally declare the minor in Computational and Applied Mathematics.

Transfer Credit

For Rice University's policy regarding transfer credit, see <u>Transfer Credit</u> (https://ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit/). Some departments and programs have additional restrictions on transfer credit. Requests for transfer credit must be approved for Rice equivalency by the designated transfer credit advisor for the appropriate academic department offering the Rice equivalent course (corresponding to the subject code of the course content). The Office of Academic Advising maintains the university's official list of <u>transfer credit advisors</u> (https://oaa.rice.edu/advising-network/transfer-credit-advisors/) on their website: https://oaa.rice.edu. Students are encouraged to meet with the applicable transfer credit advisor as well as their academic program director when considering transfer credit possibilities.

Departmental Transfer Credit Guidelines

Students pursuing the major in Operations Research should be aware of the following program-specific transfer credit guideline:

- No more than 4 courses (12 credit hours) of transfer credit from U.S. or international universities of similar standing as Rice may apply towards major requirements ***after*** matriculation at Rice.

Additional Information

For additional information, please see the Computational Applied Mathematics and Operations Research website: https://cmor.rice.edu/.

Opportunities for the BA Degree with a Major in Operations Research

Academic Honors

The university recognizes academic excellence achieved over an undergraduate's academic history at Rice. For information on university honors, please see Latin Honors (https://ga.rice.edu/undergraduate-students/honors-distinctions/university/) (*summa cum laude*, *magna cum laude*, and *cum laude*) and Distinction in Research and Creative Work (https://ga.rice.edu/undergraduate-students/honors-distinctions/university/). Some departments have department-specific Honors awards or designations.

Fifth-Year Master's Degree Option for Rice Undergraduate Students

In certain situations and with some terminal master's degree programs, Rice students have an option to pursue a master's degree by adding an additional fifth year to their four years of undergraduate studies.

Advanced Rice undergraduate students in good academic standing typically apply to the master's degree program during their junior or senior year. Upon acceptance, depending on course load, financial aid status, and other variables, they may then start taking some required courses of the master's degree program. A plan of study will need to be approved by the student's undergraduate major advisor and the master's degree program director.

As part of this option and opportunity, Rice undergraduate students:

- must complete the requirements for a bachelor's degree and the master's degree independently of each other (i.e. no course may be counted toward the fulfillment of both degrees).
- should be aware there could be financial aid implications if the conversion of undergraduate coursework to that of graduate level reduces their earned undergraduate credit for any semester below that of full-time status (12 credit hours).
- more information on this *Undergraduate - Graduate Concurrent Enrollment* opportunity, including specific information on the registration process can be found here (https://ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment/).

Rice undergraduate students completing studies in science and engineering may have the option to pursue the Master of Computational and Applied Mathematics (MCAAM) or the Master of Industrial Engineering (MIE) degree. For additional information, students should contact their undergraduate major advisor and the MCAAM/MIE program director.

Additional Information

For additional information, please see the Computational Applied Mathematics and Operations Research website: https://cmor.rice.edu/.