BACHELOR OF SCIENCE (BS) DEGREE WITH A MAJOR IN OPERATIONS RESEARCH

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

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

1. Formulate mathematical programs and stochastic processes that model real-world situations. *(Critical Thinking)*
2. Design and analyze exact and approximate approaches to solve operation research models. *(Design)*
3. Design, implement and debug software to solve operations research models. *(Design)*
4. Communicate the solutions and insights generated by operations research models to a non-technical audience. *(Communication)*

Requirements for the BS 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 BS degree with a major in Operations Research must complete:

- A minimum of 20-21 courses (64-70 credit hours, depending on course selection) to satisfy major requirements.
- A minimum of 120 credit hours to satisfy degree requirements.
- A minimum of 14 courses (43-45 credit hours, depending on course selection) taken at the 300-level or above.

The undergraduate program in operations research has been designed to accommodate a wide range of student interests. Students are strongly encouraged to take additional courses in pure and applied mathematics, computation, and modeling.

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	64-70
	Total Credit Hours Required for the BS Degree with a Major in Operations Research	120

Degree Requirements

Code	Title	Credit Hours
Introductory Requirements		
COMP 140	COMPUTATIONAL THINKING	4
COMP 182	ALGORITHMIC THINKING	4
COMP 215	INTRODUCTION TO PROGRAM DESIGN	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	
Select 1 from the following:		*3-6*
MATH 212	MULTIVARIABLE CALCULUS	
MATH 221 & MATH 222	HONORS CALCULUS III and HONORS CALCULUS IV	
Intermediate Requirements		
CMOR 350	STOCHASTIC MODELS	3
CMOR 360	INTRODUCTION TO OPERATIONS RESEARCH AND OPTIMIZATION	3
MATH 302	ELEMENTS OF ANALYSIS	3
or MATH 321	INTRODUCTION TO ANALYSIS I	
MATH 355	LINEAR ALGEBRA	3
or MATH 354	HONORS LINEAR ALGEBRA	
STAT 310 / ECON 307	PROBABILITY AND STATISTICS	3
Advanced Requirements		
CMOR 441	LINEAR AND INTEGER PROGRAMMING	3
CMOR 442	LARGE-SCALE OPTIMIZATION	3
CMOR 451	SIMULATION MODELING AND ANALYSIS	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)		*9-12*
Senior Design		
DSCI 435 / COMP 449	APPLIED MACHINE LEARNING AND DATA SCIENCE PROJECTS	4
Total Credit Hours Required for the Major in Operations Research		**64-70**
Additional Credit Hours to Complete Degree Requirements		19-25
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 FWIS or distribution requirements may additionally meet other 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.

1   Elective Requirements may not include CMOR 494, CMOR 495, or independent study courses (such as CMOR 490 or CMOR 491).

Course List to Satisfy Requirements
Elective Requirements

To fulfill Elective Requirements, students must complete a total of 3 courses (9-12 credit hours, depending on course selection) from the following department approved electives.

Code	Title	Credit Hours
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 448 / MATH 448	CONCRETE MATHEMATICS	3
COMP 480	PROBABILISTIC ALGORITHMS AND DATA STRUCTURE	4
CMOR 404	GRAPH THEORY	3
CMOR 531	CONVEX OPTIMIZATION	3
CMOR 533	NUMERICAL OPTIMIZATION	3
CMOR 543	COMBINATORIAL OPTIMIZATION	3
CMOR 544	STOCHASTIC OPTIMIZATION	3
ECON 443	FINANCIAL ECONOMICS	3
ECON 449	PRINCIPLES OF FINANCIAL ENGINEERING	3
ELEC 475	LEARNING FROM SENSOR DATA	3
INDE 511	GRAPH ALGORITHMS	3
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 BS Degree with a Major in Operations Research
Program Restrictions and Exclusions

Students pursuing the BS 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. 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 their academic program's transfer credit advisor when considering transfer credit possibilities.

Departmental Transfer Credit Guidelines

Students pursuing the major in Operations Research should be aware of the following departmental transfer credit guidelines:

- Requests for transfer credit will be considered by the program director (and/or the program's official transfer credit advisor) on an individual case-by-case basis.

Additional Information

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

Opportunities for the BS 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 <u>Latin Honors</u> (https://ga.rice.edu/undergraduate-students/honors-distinctions/university/) (*summa cum laude*, *magna cum laude*, and *cum laude*) and <u>Distinction in Research and Creative Work</u> (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) degree. For additional information, students should contact their undergraduate major advisor and the MCAAM program director.

Additional Information

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