

# Request to Add a Graduate Minor

Office of Graduate Enrollment Services, The Pennsylvania State University, 114 Kern Graduate Building, University Park, PA 16802-3396; 814-865-1795;

Graduate Education Policy Reference, [GCAC-611 Minor Research Doctorate](#), [GCAC-709 Minor Professional Doctorate](#), [GCAC-641 Minor Research Masters](#), [GCAC-741 Minor Professional Masters](#)

Student Last Name	Student First Name	Middle Initial	9-digit Penn State ID
Email Address	Major Plan of Study and Degree	Minor Plan of Study Requested	
Student Signature	Printed Name	Date	

I certify the statements below are accurate for this student's minor plan and the plan is in compliance with the relevant minor Graduate Education Policy and the minor will not be approved for graduation until all minor requirements have been completed.

Doctoral Minor

- 1.) The minor consists of a minimum of 15 credits at the 400, 500, or 800 level.
- 2.) For research doctorates, at least 50% of the credits must be at the 500-level. For professional doctorates, at least 50% of the credits must be at the 500, or 800 level.
- 3.) At least one Graduate Faculty member must be on the student's doctoral committee.
- 4.) The student will be admitted to the minor prior to scheduling the comprehensive examination.

Master's Minor

- 1.) The minor consists of a minimum of 6 credits at the 400, 500, or 800 level.
- 2.) For a research master's minor, at least 50% of the credits must be at the 500 level.
- 3.) For a professional master's minor, at least 50% of the credits must be at the 500 or 800 level.

Minor Graduate Program Head Signature	Printed Name	Date
Major Graduate Program Head Signature	Printed Name	Date

**Student's major program staff should submit the completed form to Graduate Enrollment Services via the Graduate Request Management System ([GRMS](#)) so the minor may be added to the student's official record. The minor must be requested no later than after the 3<sup>rd</sup> week in the semester prior to graduation for master's minor. Doctoral minor requests must be requested and on record prior to the scheduling of the comprehensive examination.**

**COURSE REQUIREMENTS**  
for  
**Ph.D. DEGREE WITH MINOR IN OPERATIONS RESEARCH**

**PREREQUISITES:**

- I Calculus (MATH 140,141)
- II Linear Algebra (MATH 220)
- III Computer Programming (CMPSC 101, 201 or 203)
- IV Probability and Statistics (3 credits)

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**Colloquium requirements:** students must enroll in OR 590 Colloquium for 1 credit in each year enrolled in the major graduate program and in residence. The maximum number of OR 590 credits required for a Ph.D. with a minor in OR is 4.

**REQUIREMENTS: (15 credits minimum, at least 50% of the credits must be at the 500 level. These 15 credits must be in addition to the Graduate Major Requirements):**

STOCHASTIC METHODS/STATISTICAL METHODS (6 credits minimum)		
Statistical Methods (3 credits min)	Stochastic Processes (3 credits min)	Credits taken
ECON: 501	EE: 560	
ECON/EEFE: 510	IE/SC&IS: 516	
IE: 511, 532, 583, 584	MATH/STAT: 416, 516, 519	
MATH/STAT: 414, 415, 418	ME: 577	
SC&IS: 535	METEO: 527	
STAT: 460, 501, 502, 503, 553, 561, 562	STAT: 515	

OPTIMIZATION (6 credits minimum)			
Linear Optimization (3 credits min)	Deterministic Optimization		Credits taken
EEFE: 527	CHE: 512	IE/EE: 585	
IE: 405, 505	CSE/MATH: 555	MATH: 484, 485, 486	
	ECON: 534	ME: 444	
	IE: 468, 510, 512, 520, 521, 588, 589	SC&IS: 525	
Stochastic Optimization			Credits taken
EME: 523	IE: 513	IE/SC&IS: 519	

COMPUTATIONAL METHODS (3 credits minimum)			
Numerical Methods		Simulation Methods	Credits taken
CMPSC/MATH: 451, 455, 456	GEOG: 485	IE: 453, 522	
CSE/MATH: 550, 553	GEOSC: 561	SC&IS: 545	
Data Analytics/ Data Science			Credits taken
BAN: 541, 550, 830	EE: 456, 556, 582	IE: 562, 575, 582	
CMPSC: 410, 448	EME: 524	IST/STAT: 557, 558	
CSE/EDSGN/IE/IST: 561	GEOG: 463, 465, 580, 586	MKTG: 540	
CSE/STAT: 584	GEOG: 514	STAT: 508	

OPEN AREAS – APPLICATIONS / SPECIALIZATION*			
			Credits taken
ABE: 559	EEFE: 530, 531, 532	ME: 565	
BRS: 429W	EME: 522	MKTG: 555	
CE: 521, 525, 529	EMSC: 460	PHYS: 580	
CMPEN: 431	ERM: 412	PNG: 430, 511, 512	
CMPSC: 431W, 442, 465	GEOG: 464, 479, 560, 850, 855, 858	SC&IS: 505, 510, 520, 530, 546, 565, 570	
CSE: 556, 562, 564, 565	GEOG: 450	STAT: 510, 513, 514, 540, 551, 552	
ECON: 402, 500, 521, 589	IE: 402, 425, 454, 478, 507, 509, 517, 530, 566, 567, 568, 570		
EE: 567, 580, 581			
EE/ME: 550			

\*In addition to the courses listed above, students may include any appropriate level courses in information systems, quality control, scheduling, inventory, queueing, decision analysis, game theory, graph theory, supply chain, expert systems, econometrics, forecasting or other relevant topics.

**APPENDIX**

**NEW PRE-APPROVED COURSES TO SATISFY OR CREDIT REQUIREMENTS:**

The following courses are either new or given infrequently and thus do not have a unique numerical designation. These courses are pre-approved to be used for credits in the following areas or sub-areas. Some additional 497 and 597 “Special Topics” classes may be approved and not listed here. Please refer to the OR Program website for the updated list.

<b>STOCHASTIC METHODS/STATISTICAL METHODS</b>	
<u>Stochastic Processes</u>	<b>Credits taken</b>
IE: 597X <i>Advanced Stochastic Processes</i>	
<b>OPTIMIZATION</b>	
<u>Linear Optimization</u>	<b>Credits taken</b>
IE: 597X <i>Advanced Linear Programming**</i>	
<u>Stochastic Optimization</u>	<b>Credits taken</b>
IE: 597X <i>Robust Optimization</i>	
<b>COMPUTATIONAL METHODS</b>	
<u>Numerical Methods</u>	<b>Credits taken</b>
CE: 597X <i>Computational Analysis of Randomness in Engineering</i>	
I GQUE: 597X <i>Multivariate Analysis in Geosciences</i>	
<u>Data Analytics/Data Science</u>	<b>Credits taken</b>
CSE: 597X <i>Advanced Big Data Analytics</i>	
597X <i>Data Mining Analytics</i>	
EMSC: 497X <i>Environmental Data Analytics</i>	
IST: 597X <i>Big Data Fundamentals</i>	
<b>OPEN AREAS – APPLICATIONS / SPECIALIZATION</b>	
CE: 597X <i>Design of Public Transportation</i>	<b>Credits taken</b>
EMSC: 497X <i>Earth and Mineral Sciences</i>	
GEOSC: 497X <i>Data Visualization for Scientists and Engineers</i>	
IE: 597X <i>Optimization in Modern Data</i>	
STAT: 597X <i>Functional Data Analysis</i>	
EE: 597X <i>Reinforcement Learning</i>	

\*\* See Equivalent Courses List.

**EQUIVALENT COURSES:**

Some courses are considered equivalent within and across departments. When courses are equivalent, only one can be taken for credit to satisfy the OR course requirements in a specific area and sub-area.

The following courses are considered equivalent with respect to the OR degree qualification. Only one course from each bullet point below can be used for credit towards the OR course requirements.

**Stochastic Methods/ Statistical Methods:**

- MATH/STAT 416, IE/SC&IS 516

**Optimization**

- IE 405, MATH 484
- IE 505, IE 597 (Advanced Linear Programming)
- IE 468, CHE 512
- MATH 486, ECON 534

**Computational Methods**

- CMPSC/MATH 451, CMPSC/MATH 455

**RESTRICTIONS FOR UNDERGRADUATE COURSES:**

Students cannot use credits from courses that are required courses in the undergraduate curriculum of their major graduate program. For example, Industrial Engineering students cannot select IE 405, IE 425 or IE 453.