

# PhD Graduate Program Student Handbook



**NUS**  
National University  
of Singapore

Institute of Operations  
Research and Analytics

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## **Research in IORA**

The Institute of Operations Research and Analytics (IORA) aims to achieve research excellence through cutting edge and focused research.

The institute conducts interdisciplinary research in the following areas:

- Analytical Tools in OR
- Supply Chain Systems
- Healthcare Services Systems
- Machine Learning
- Environmental and Water Resource Systems

The key operational principle underpinning the institute's research efforts is "modeling and analytical". Particular emphasis is directed towards the development and delivery of research work in the field of operations research, data analytics, statistics, logistics and supply chain.

## **Academic Year**

Semester 1 : 18 weeks from the 1st Monday of August each year, with a week's break in September.

Vacation : 19th week till 23rd week (5 weeks)

Semester 2 : 24th week till 40th week (17 weeks) with a week's break in February.

## **Registration of Candidature**

All students must register as candidates of the University on admission and in each subsequent year of their candidature at times stipulated by the Registrar. A candidate who fails to register within the period stipulated by the Registrar will have his/her name deleted from the class enrolment list. Full-time candidates are not permitted to be employed without permission from the University. Those found doing so may have their candidatures terminated immediately.

## **Responsibilities of the Research Student**

### Principles

The completion of a successful program of study leading towards a research degree requires commitment from the research student, the supervisor(s), the university and any collaboration of partnership.

Research Students at the outset of the research project, the various roles and responsibilities of all parties involved should be identified and agreed in order to help establish a clear understanding between all parties. The research student should recognize the expectations, responsibilities and reporting mechanisms involved with the research project within the department.

### General Aspect

a) The research student must accept ultimate responsibility for his/her own research activity and candidacy for a degree.

b) Satisfactory progress at all times should be maintained with respect to the research project and any program of work agreed with the supervisor(s).

c) Any circumstances that might require the student's mode of study to be modified or the student's institutional registration to be extended, suspended or withdrawn, must be made known to the student's supervisor(s).

#### Research Aspect

a) The research student must be responsible for the directions of any innovation in the development of the research project.

b) Problems arising related to the project must be highlighted to the supervisor(s) as well as providing adequate explanation of any failure to attend meetings, datelines or other commitments, so that appropriate guidance may be offered.

c) The research student is encouraged to make use of appropriate teaching and learning facilities made available by the university.

d) The research student is required to familiarize himself/herself with relevant aspects of the university or any other interested party.

#### Written Aspect

a) To submit written work in a specified and agreed time before meeting with the supervisor(s).

b) To prepare periodic progress reports on the research project.

c) To communicate to others in the academic community, both orally and in written form on the students' research findings.

d) To successfully complete any training program arranged by, provided, through the university or third party.

e) Please note that plagiarism is a serious offence. Any student caught plagiarizing will be seriously dealt with.

Most importantly, the research student must act as a responsible member of the institution's Academic community.

#### Working Hours

Please note that all full-time research students are normally expected to be in campus:

Monday to Thursday : 8.30 am – 6.00 pm

Friday : 8.30 am – 5.30 pm

Unless students have specific approval from supervisor(s), it is expected that students be doing their research work, attending classes or consulting with supervisor(s) on the research work during the above stipulated hours or longer if required.

## **Program Structure**

The PhD students are required to complete a **minimum of 40 MCs graduate-level modules** comprising **three** core modules (4 MCs each) and 28 MCs of elective modules by the end of their fourth year.

The students may also select other modules offered at NUS with approval by their advisors and the IORA PhD program director.

### **OR Core Modules**

Module	Title	MC
BDC6111	Foundations of Optimization	4
BDC6112	Stochastic Processes I	4

The above mandatory core modules in the area of Operations Research will be tested in the written Qualifying Examination scheduled at the end of the Student's first year.

### **Analytics Core Modules**

Module	Title	MC
BDC6307	Introduction to Data Analytics	4
CS5339	Theory and Algorithms for Machine Learning	4

The students must also complete one Analytics core module; with an option to choose between BDC6307 or CS5339.

### **Electives Modules**

Apart from the mandatory core modules, students will have the flexibility to customize the elective modules to match their research interests. Among the electives chosen, at least **two** must be in OR Methods, **one** in Data Analytics and **one** in OR Modeling.

#### **➤ OR Methods**

Module	Title	MC
BDC6304	Robust Modeling and Optimization	4
BDC6302	Discrete Optimization and Algorithms	4
BDC6301	Bayesian Modeling and Decision-Making	4
BDC6305	Theory and Algorithms for Dynamic Programming	4
BDC6306	Stochastic Processes II	4
BDC6303	Queues and Stochastic Networks	4

IE6511	Surrogate and Metaheuristic Global Optimization	4
MA5268	Theory and Algorithms for Nonlinear Optimization	4
MA5248	Stochastic Analysis in Mathematical Finance	4
ST5214	Advanced Probability Theory	4
EC5101	Microeconomic Theory	4
EC6101	Advanced Microeconomic Theory	4
EC6312	Advanced Game Theory	4
EC6316	Contract Theory and Applications	4
CS5234	Combinatorial and Graph Algorithms	4
CS6234	Advanced Algorithms	4

➤ **Data Analytics**

Module	Title	MC
EE6735	Algorithms for Statistical Inference	4
MA4270	Data Modeling and Computation	4
ST5215	Advanced Statistical Theory	4
ST5224	Advanced Statistical Theory II	4
ST5222	Advanced Topics in Applied Statistics	4
ST5223	Statistical Models: Theory/Applications	4
BZD6003	Applied Econometrics I	4
EC5103	Econometric Modelling and Applications I	4
EC6103	Econometric Modelling and Applications II	4
EC6313	Topics in Econometrics	4

➤ **OR Modeling**

Module	Title	MC
BDC6113	Foundations of Inventory Management	4

BDC6114	Logistics and Supply Chain Management	4
MA5269	Optimal Stopping and Stochastic Control in Finance	4
EE5138R	Optimization for Communication Systems	4

### **Qualifying Examinations (QE)**

The PhD students are also required to pass the written QE at the end of the first year and the oral QE at the end of the second year.

#### **Written QE**

The written QE comprises two closed book written exams based on the core modules. Students who have failed the written QE may be rescheduled for another written test within the next six months.

#### **Oral QE**

The oral QE comprises two components as follows:

1. presentation of research oriented (RO) paper and
2. oral examination of two elective modules chosen by the candidate.

Students who have cleared the written QE can commence their RO papers, which will be submitted for their oral QE at the end of the second year. The purpose of the RO paper is to examine students' ability to conduct independent research under the guidance of their advisor.

The advisors from IORA are only meant to be helpers - to provide consultation if required. They are not by any means responsible for the quality of students' research outputs.

The IORA PhD committee will be responsible for the appointment of the QE committee, which will include the candidate's advisor. The committee will examine the candidate's RO paper and proficiency in the two elective modules before recommending a pass/fail.

### **Faculty Advising and Thesis Supervision**

During the first year of study, the PhD students will not have any formal advisors. Students should take the initiative to find out the interests of the IORA faculty and explore research opportunities. By the end of the first year, students are expected to have identified their faculty advisors who would guide them in their RO papers and well as their choice of elective modules.

At any point in time, the students and faculty members can request for a change in their roles within supervisory relationship through the PhD program office – where the student can request a change in advisor, and the faculty member may choose not to serve as the student's advisor.

### **Dissertation Proposal**

Students can submit their dissertation proposals at any time after the completion of the oral examination.

## **Time line for planning your PhD components**

<b><u>Date</u></b>	<b><u>Milestone</u></b>
1 year, 4 months	<ul style="list-style-type: none"> <li>• Set and confirm thesis committee (supervisor and 2 other members, both of which may be internal) with HOD</li> <li>• Reading lists from student to thesis committee for comments (Committee members have 1 month to suggest changes)</li> </ul>
1 year, 5 months	<ul style="list-style-type: none"> <li>• Reading lists with comments back to student. After the list is finalized, a copy should be emailed to Ms. Loh Poh Yee, who will then submit the lists to HOD for approval</li> </ul>
1 year, 10 months	<ul style="list-style-type: none"> <li>• Student should have completed 5 of the required modules (CAP min 3.5); this includes the empirical research project PL6208</li> <li>• Student should now take the QE:</li> <li>• Comprehensive Exams 1 and 2, oral defence of thesis proposal</li> <li>• Student should submit thesis proposal to committee 4-8 weeks prior to the defence</li> </ul>
2 years	<ul style="list-style-type: none"> <li>• Students should have completed all QE components (Comprehensive Examinations 1 and 2, oral defence of thesis proposal)</li> </ul>
4 years	<ul style="list-style-type: none"> <li>• The student should complete the remaining required module. The University does not set a deadline for thesis submission. However, given the duration of research scholarship and candidacy, the student should now be ready to submit thesis for examination. After the reviewers have sent their evaluation, an oral defence has to be scheduled.</li> </ul>

## **Teaching Assistantships**

You will be required to devote some hours per week to performing a service as part of the academic programme. In most cases, this service will entail a teaching assistantship, which will be assigned to you at the beginning of each academic year. In this context, you are expected to do 3 to 4 hours of in-class room teaching. It is understood that you would use additional time to prepare for your teaching performance and to assist the lecturer in matters of course administration (e.g., answering student queries on IVLE, grading).

At the beginning of the semester, you will complete a Teaching Assistant Agreement form, together with the instructor you are assigned to. This form will explicitly specify the nature of your duties and the amount of time you are expected to allocate to different duties. Although your teaching constitutes a service to the institution, please see the service as a valuable opportunity for learning effective class room teaching. As such, we encourage you to closely work together with the lecturer to optimize your learning experience.