# **Statistics and Actuarial Science**

- A. For postgraduate students admitted in August 2023 and thereafter:
  ➤ 3 compulsory courses & 3 elective courses
- B. For postgraduate students admitted in January 2023 or before:
  ➤ 4 compulsory courses & 1 elective course

# A. <u>Departmental Coursework Requirement 2023-24</u><sup>^</sup> (For RPG students enrolled in August 2023 and thereafter)

Course Code	Course Title	Compulsory (C)/ Elective (E)	
SSAF6001*	Basic Laboratory Safety Course for RPg Candidate in the Faculty of Science	С	
STAT6003	Research Postgraduate Seminar	С	
STAT6018	Research Frontiers in Data Science	С	
Students are required to choose 3 courses from the following:			
STAT6005	Special Studies in Statistics	E	
STAT6008	Advanced Statistical Inference	E	
STAT6009	Research Methods in Statistics	E	
STAT6010	Advanced Probability	E	
STAT6011	Computational Statistics and Bayesian learning	E	
STAT6025	Special Studies in Machine Learning	E	

## B. <u>Departmental Coursework Requirement 2022-23</u> (For RPG students enrolled in January 2023 or before)

Course Code	Course Title	Compulsory (C)/ Elective (E)
SSAF6001*	Basic Laboratory Safety Course for RPg Candidate in the Faculty of Science	С
STAT6003	Research Postgraduate Seminar	С
STAT6008	Advanced Statistical Inference	С
STAT6009	Research Methods in Statistics	С
STAT6019	Current Topics in Statistics	e
Students are required to choose 1 course from the following in the first semester:		
STAT6005	Special Studies in Statistics	E
STAT6010	Advanced Probability	E
STAT6011	Computational Statistics and Bayesian learning	E

\* Starting from the academic year 2010-11, SSAF6001 "Basic Laboratory Safety Course for RPg Candidates in Faculty of Science" will be made compulsory to students with the following registration dates (MPhil candidates registered on or after January 1, 2009), (3-year PhD candidates registered on or after January 1, 2008) & (4-year PhD candidates registered on or after January 1, 2007).

### **Departmental Course Details**

### The minimum mark for final exams for all RPGs is <u>50</u>. The passing mark for the departmental courses (STAT6XXX) taken by RPGs is <u>55</u>.

The following courses are mainly designed for RPG students with strong statistical background. Students without sufficient statistical trainings (e.g., non-statistical majors) are advised to consult with the course instructors before registration.

<u>STAT6003 Research postgraduate seminar (COMPULSORY)</u> (only offered to RPG in Department of Statistics & Actuarial Science)

#### STAT6005 Special studies in statistics

The aim of the course is to introduce students to the statistical topics which are of relevance to their research study but have not been taken previously. Students will be instructed to attend one course or a combination of courses from the department as prescribed by the supervisor(s) and approved by the Chairman of the Departmental Research Postgraduate Committee. Alternately this course may consist of supervised reading supplemented by written work and prescribed coursework.

Students are permitted to replace this course by another RPG course from the MPhil/PhD curricula offered by other Departments, subject to the approval of the Departmental Research Postgraduate Committee.

Assessment: to be determined.

#### STAT6008 Advanced statistical inference

This course covers the advanced theory of point estimation, interval estimation and hypothesis testing. Using a mathematically-oriented approach, the course provides a formal treatment of inferential problems, statistical methodologies and their underlying theory. It is suitable in particular for students intending to further their studies or to develop a career in statistical research. Contents include: (1)Decision problem – frequentist approach: loss function; risk; decision rule; admissibility; minimaxity; unbiasedness; Bayes' rule; (2)Decision problem – Bayesian approach: prior and posterior distributions, Bayesian inference; (3) Estimation theory: exponential families; likelihood; sufficiency; minimal sufficiency; completeness; UMVU estimators; information inequality; large-sample theory of maximum likelihood estimation; (4) Hypothesis testing: uniformly most powerful (UMP) test; monotone likelihood ratio; UMP unbiased test; conditional test; large-sample theory of likelihood ratio; confidence set; (5) Nonparametric inference; bootstrap methods.

Assessment: One 2-hour written examination; 40% coursework, 60% examination.

#### STAT6009 Research methods in statistics

This course aims to provide graduate students with a strong foundation in statistical concepts and methods essential for their research degree in statistics. The course covers a range of topics, including set theory, measure theory, independence, modes of convergence, the law of large numbers, central limit theory, probability models, principles of data reduction, unbiased estimation, maximum likelihood estimation (MLE), delta-method, quantiles, U-Statistics, bootstrap, jackknife, Bayesian rules, empirical Bayes, and statistical functionals. Undergraduate students interested in pursuing a research degree in statistics may also enroll in this course.

Assessment: One 2-hour written examination; 40% coursework, 60% examination.

#### STAT6010 Advanced probability

This course provides an introduction to measure theory and probability. The course will focus on some basic concepts in theoretical probability which are important for students to do research in actuarial science, probability and statistics. Contents include: sigma-algebra, measurable space, measure and probability, measure space and probability space, measurable functions, random variables, integration theory, characteristic functions, convergence of random variables, conditional expectations, martingales.

Assessment: one 2-hour written examination; 40% coursework, 60% examination.

#### STAT6011 Computational statistics and Bayesian learning

This course aims to give postgraduate students an introduction on modern computationally intensive methods in statistics. It emphasizes the role of computation as a fundamental tool of discovery in data analysis and statistical inference, and for development of statistical theory and methods. Contents include: Bayesian statistics, Markov chain Monte Carlo methods such as Gibbs sampler, Metropolis-Hastings algorithm, and data augmentation; generation of random variables using the inversion methods, rejection sampling, the sampling/importance resampling method; optimization techniques including Newton's method, expectation-maximization (EM) algorithm and its variants, and minorization-maximization (MM) algorithm; integration including Laplace approximation, Gaussian quadrature, the importance sampling method, Monte Carlo integration; and other topics such as hidden Markov models, , and Bootstrap methods. More advanced Bayesian learning methods cover approximate Bayesian computation, the Hamiltonian Monte Carlo algorithm. hierarchical models and nonparametric Bayes.

Assessment: One 2-hour written examination; 50% coursework, 50% examination.

#### STAT6018 Research Frontiers in Data Science

This course aims to equip postgraduate students with the latest knowledge and practical skills in data science and relevant domains, in order to enhance their research capabilities. The course comprises of different modules and guest lectures, with topics encompassing: 1) big data analytics; 2) machine learning; 3) image processing and computer vision; 4) high-dimensional data analysis; 5) statistical methods and their applications in medical research; 6) time series econometrics; 7) data analytics in actuarial science; and 8) other areas as determined by the instructor.

#### Assessment: 100% coursework

#### STAT6025 Special studies in machine learning

The aim of the course is to introduce students to the machine learning topics which are of relevance to their research study but have not been taken previously. Students will be instructed to attend one course or a combination of courses from the department as prescribed by the supervisor(s) and approved by the Chairman of the Departmental Research Postgraduate Committee. Alternately this course may consist of supervised reading supplemented by written work and prescribed coursework.

Students are permitted to replace this course by another RPG course from the MPhil/PhD curricula offered by other Departments, subject to the approval of the Departmental Research Postgraduate Committee.

Assessment: to be determined