Subject Description Form

Subject Code	AMA619
Subject Title	Advanced Mathematical Statistics
Credit Value	3
Level	6
Pre-requisite	A course in college calculus, college linear algebra, and basic mathematical statistics
Objectives	The objectives of this course are to introduce the most important and modern methods and theory in mathematical statistics and provide systematic theoretical training to graduate students who are interested in pursuing a PhD degree in statistics and related fields.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: a. Have a systematic understanding of the basic theory and methods of modern mathematical statistics. b. Acquire the ability and skill to critically read the theoretical statistics literature. c. Develop skills to develop formal arguments for providing theoretical justifications to a statistical method. d. Be well prepared for conducting methodological and applied research in statistics and the related fields.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	1. Convergence of random vectors: basic convergence concepts, laws of large numbers and central limit theorems, delta-method. 2. Estimation Methods: moment estimators, maximum likelihood estimators, M- and Z-estimators. 3. Some basic results from empirical process theory: stochastic convergence in metric spaces, Glivenko-Cantelli and Donsker classes, applications to M- and Z-estimators. 4. Comparisons of estimators, contiguity, local asymptotic normality, relative efficiency of estimators. 5. Selected topics in high-dimensional statistics: Lasso and related methods, non-asymptotic error bounds, debiased Lasso, hypothesis testing in high-dimensional models.

<table>
<tr><td>Teaching/Learning Methodology
(Note 3)</td><td>The subject will be delivered mainly through lectures and tutorials, and class discussions, questions, and answers. Additional reading of relevant books and research papers will be encouraged. The teaching and learning approach are mainly problem-solving oriented. The approach aims at the development of statistical learning methods, theories, and algorithms and how they can be applied to solving research and real application problems. Students are encouraged to adopt a deep study approach by employing high level cognitive strategies, such as critical and evaluative thinking, relating, integrating, and applying theories to practice.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes
(Note 4)</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td></td></tr>
<tr><td>Assignment</td><td>20%</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Quiz</td><td>20%</td><td>✓</td><td></td><td>✓</td><td></td><td></td></tr>
<tr><td>Projects</td><td>60%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="5"></td></tr>
</table>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignment: assessment of the understanding the basic concepts and the ability for self-learning by acquiring knowledge from published works and online information.
Quiz: assessment of the ability for comprehension of fundamental concepts, principles, algorithms, and theories by providing answers to given questions.
Project: assessment of the ability for developing methods and algorithms for solving practical problems. The results will be presented in written reports and oral presentations.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorials</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignment</td><td>30 Hrs.</td></tr>
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</td></tr>
</table>

	▪ Self-study	61 Hrs.
	Total student study effort	130 Hrs.
Reading List and References	• Lehmann, E. and Casella, G. (1998). Theory of Point Estimation. Springer, New York. • Van der Vaart, A. W. (2007). Asymptotic Statistics. Cambridge University Press. • Van der Vaart A. W. and Wellner, J. A. (1996). Weak Convergence and Empirical Processes. Springer, New York. • Wainright, M. (2019). High-Dimensional Statistics: A Non-Asymptotic Viewpoint. Cambridge University Press. • Vershynin, V. (2018). High-Dimensional Probability: An Introduction with Applications in Data Science. Cambridge University Press.	