HONG KONG BAPTIST UNIVERSITY
Faculty of Science

1. **Course Code and Course Title**
MATH 4877 Special Topics in Statistics III (3,3,0)

2. **No. of Units**
3

3. **Offering Department**
Department of Mathematics

4. **Pre-Requisite**
Year 3 standing or above or consent of instructor

5. **Co-Requisite / Anti-Requisite (if any)**
Nil

6. **Aims & Objectives**
The course aims at providing a general introduction to students whose research fields are within statistics. It covers some fundamental and important topics in mathematical statistics and asymptotic theory. Applications to real-world problems will be discussed, such as industrial growth, product innovation and infrastructure development.

7. **Course Intended Learning Outcomes (CILOs)**

CILO	By the end of the course, students should be able to:	PILO Alignment
1	Derive asymptotic normality of statistics	1
2	Apply bootstrap and empirical likelihood to some hypothesis testing and confidence interval construction problems	2,3
3	Employ likelihood methods in hypothesis testing problems	2,3
4	Explain the basic techniques and the mathematical theory in some parametric and nonparametric methodologies	1
5	Derive asymptotic properties of statistics	1
6	Solve statistical problems independently with the statistical methods and the computational skills acquired	2,3

8. **Teaching & Learning Activities (TLAs)**

CILO	TLAs will include the following:
1,2,3,5	**Lecture** Instructor will introduce the subjects of the course material and ample of examples will be given in order to aid the learning of the subjects. Students will consolidate the knowledge through lectures.

1,2,3,5	**In-class activities** Instructor will hold some in-class activities for students who have questions regarding the homework assignments and the lectures. Students will consolidate the knowledge through discussion within the in-class activities.
2,3,4,6	**Assignments** Instructor will give assignments to allow students to apply the statistical methods learnt during the lectures and to consolidate their understanding of the methods and their limitations. Also, instructor will assign some high-level research articles on the topics being discussed to students to read, even though their difficulties are beyond the expected requirement of this course. This reading will broaden the scope of students and help them appreciate the beauty of the topics. In addition, this will prepare them better for more advanced graduate courses and cutting-edge research in the future.

9 **Assessment Methods (AMs)**

Type of Assessment Methods	Weighting	CILOs to be Address	Description of Assessment Tasks
Written Assignments	40%	1,2,3,4,5	High-level questions, including open-ended problems and black box explorations in each chapter will be given. There will be 4 assignments. Each of them allows the instructor to keep track of how well the students master the concept, theory, and analytical techniques covered during different stages of the course.
Project	20%	2,3,6	The project is designed to facilitate students to work independently and apply the statistical methods learnt and the computation skills acquired to solve problems in practice. The project allows the instructor to assess how well students perform in the following criteria. • organization and motivation to sell the key points of the paper • selecting good notation and giving appropriate amounts of details • describe and analyze numerical results accurately Work readiness for submission
Final Examination (3 hours)	40%	1,2,3,4,5	Final Examination is designed to see how far students have achieved their intended learning outcomes especially in the knowledge domain. Students should have a thorough understanding of the knowledge and apply them correctly in different contexts to do well in the exam.

10. **Assessment Rubrics**

To be determined by the instructor

11. **Course Intended Learning Outcomes and Weighting**

CONTENT	CILO NO.	TEACHING (IN HOURS)
I. Asymptotic Methods	1,2,3,4,5	5
II. Estimation	1,2,3,4,5,6	8
III. Hypothesis Testing	1,2,3,4,5,6	9
IV. Confidence Sets	1,2,3,4,5,6	9
V. Bootstrap	1,2,3,4,5,6	8

12. **Textbooks / Recommended Remarks**

References

1. J. Shao, Mathematical Statistics, 2nd edition, Springer, 2003.
2. G. Casella, and R.L. Berger, Statistical Inference, 2 nd edition, Duxbury, 2001.

Software

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13. **Course Content**

	Topics	Hours
I	Asymptotic Methods	5
	A Introduction	
	B Modes of convergence	
	C Landau's notation	
	D Linear approximation	
	E Applications to statistics	
II	Estimation	8
	A Maximum likelihood method under parametric model	
	B Estimation under nonparametric models	
	C Distribution estimation	
	D Density estimation	
	E Empirical likelihood	

F Generalized estimating equations

III Hypothesis Testing 9

A General setup
B Testing under parametric models
C Testing under nonparametric models
D Goodness of fit test
E Sign Test
F One-sample signed rank test
G Two-sample rank test
H Kolmogorov-Smirnov test
I Cramer-von Mises test
J Empirical likelihood ratio test

IV Confidence Sets 9

A Introduction
B Pivotal Quantities
C Exact pivot
D Asymptotic pivot
E Asymptotically standard normal pivot
F Inverting a test
G Confidence sets based on likelihoods
H Confidence set based on sign test
I Confidence band for distribution function
J Empirical likelihood ratio confidence set

V Bootstrap 8

A Introduction
B Bootstrap estimation
C Bootstrap test
D Bootstrap confidence interval

*** END ***

Approved by Faculty Board meeting on 17 May 2023.

Approved by Faculty Board meeting on 31 October 2023.

Approved by Faculty Board via circulation on 30 August 2024.