Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): MATH 4877 Special Topics in Statistics III (3,3,0)

Sub-title: Asymptotics in Statistics

Course Aims: The course aims at providing a general introduction to all research postgraduate students whose research fields are within statistics. It covers some fundamental and important topics in mathematical statistics and asymptotic theory.

Prerequisite: Year 3 standing or above or consent of instructor

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Course Intended Learning Outcomes (CILOs):

Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
1	Use asymptotic expansion to obtain asymptotic normality of statistics; apply Bootstrap to some hypothesis testing problems in practice and empirical likelihood to confidence interval construction; use likelihood based methods to hypothesis testing problems.
2	Recognize the basic techniques in some parametric and nonparametric methodologies, the mathematical theory; apply the theory to study asymptotic properties of statistics.
3	Solve problems independently

Teaching & Learning Activities (TLAs)

CILO	TLAs will include the following:
1,2	**Lecture and In-class activity** Instructor will use lectures to 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 discussion within lectures.
1,2,3	**Tutorial** Instructor will hold some tutorial sessions for students who have questions regarding the homework assignments and the lectures. Students will consolidate the knowledge through discussion within tutorials.
1,2,3	**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.

Assessment:

No.	Assessment Methods	Weighting	CILO Address	Remarks
1	Continuous Assessment (assignments, test, and mini-project)	40%	1,2,3	Continuous Assessment is designed to measure students' understanding of the theory and properties of parametric and nonparametric statistical methods. The mini-project is designed to achieve CILO 2-3 by facilitating students to work independently to apply statistical methods learnt and the computation skills acquired to solve problems in practice. This may involve, but not limited to, in class discussions of rigorous technical problems and their solutions.
2	Final Examination (3 hours)	60%	1,2,3	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.

Course Intended Learning Outcomes and Weighting:

Content	CILO No.	Teaching (in hours)
I. Asymptotic Methods	1,2	5
II. Estimation	1,2,3	8
III. Hypothesis Testing	1,2,3	9
IV. Confidence Sets	1,2,3	9
V. Bootstrap	1,2,3	8

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

1. R

Course Contents in Outline:

	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	
II	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	
III	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	

	Topics	Hours
IV	Bootstrap	8
	A Introduction	
	B Bootstrap estimation	
	C Bootstrap test	
	D Bootstrap confidence interval	