Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): STAT 1132 STATISTICAL METHODS AND THEORY II (3,3,1)

Course Aims: This course deals with the elementary probability theory and the mathematical foundation of some commonly used statistical methods. First the rigorous mathematical frame of the probability theory based upon the concepts of random variables and probability distributions are introduced. The general procedures of statistical inference, such as parameter estimation, hypothesis test, analysis of variance are demonstrated with detailed discussion about their mathematical features. Students are required to comprehend the most commonly used probability distributions and their relations. Central Limit Theorem and related statistical application should be well understood. Several optimal schemes for the estimation accuracy and the hypothesis test power form another important part of the course.

Prerequisite: STAT 1131 STATISTICAL METHODS AND THEORY I

Prepared by: Dr M L Tang

Learning Outcomes (LOs):
Upon successful completion of this course, students should be:

No.	Learning Outcomes (LOs)
	Knowledge
1	Able to comprehend basic probability theory
2	Able to well understand the concept of probability distributions and random variables
3	Able to acquire the basic concepts of multivariate probability distributions
4	Able to know the general procedures of statistical inference including parameter estimation and hypothesis test
5	Able to understand the basic ideas of hypothesis testing, including the Neyman-Pearson lemma, likelihood ratio and goodness of fit tests
6	Able to evaluate various quantities for probability distributions and random variables
	Skills
7	Able to make use of different probabilistic methods to solve problems in different situations
8	Able to apply statistical reasoning to analyze the essential structure of problems in various fields of human endeavour
9	Able to apply the basic ideas of hypothesis testing, including the Neyman-Pearson lemma, likelihood ratio and goodness of fit tests
10	Able to perform statistical computations involving parameter estimation and hypothesis tests
11	Able to use the methods of hypothesis testing and parametric estimation for some statistical problems
12	Able to extend their knowledge of statistical techniques

	Attitude
13	Aware that an understanding of fundamentals is necessary for effective application

Assessment:

No.	Assessment Methods	Weighting	Remarks
1	Continuous Assessment	30%	Continuous Assessment are designed to measure how well the students have learned the basic probability theory and theoretical statistics.
2	Final Examination	70%	Final Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be analysis and skills based to assess the student's ability in statistical inference, probability distributions, estimation, hypothesis test, and related statistical applications.

Learning Outcomes and Weighting:

Content	LO No.	Teaching (in hours)
I. Introduction to Probability Theory	1,7,8	7
II. Genisis and Derivation of Common Distributions	2,6-8	8
III. Multivariate Distributions	3,6-8	5
IV. Basic Sampling Distribution Theory	4,7,8,12,13	6
V. Theory of Estimation	4,7,8,10-12	7
VI. Theory of Hypothesis Testing	4,5,7-13	7

Textbook: I. Miller and M. Miller, John E. Freunder's Mathematical Statistics with Applications, 7th Ed., Pearson Prentice Hall, 2004.

References:
R.V. Hogg and A.T. Craig, Introduction to Mathematical Statistics, 5th Ed., Prentice Hall, 1995.
D. R. Cox and D. V. Hinkley, Problems and Solutions is Theoretical Statistics, Wiley, 1978.
W. Feller, Introduction to Probability Theory and Its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
J.E. Freund, Mathematical Statistics, 5th Ed., Prentice Hall, 1992.
S. Ross, A First Course in Probability, 6h Ed., Prentice Hall, 2001.
陳希孺，高等數理統計學，中國科學技術大學出版社，1999。
薛留根，概率論解題方法與技巧，國防工業出版社，1996。

Software: SAS, MINITAB, SPSS, S-PLUS or R

Course Content in Outline:

	Topic	Hours
I.	Introduction to Probability Theory	7
	A. Definition of probability	
	B. Conditional probability, Bayes theorem and independence	
	C. Random variables of the discrete type	
	D. Random variables of the continuous type	
	E. Expectation, moments and moment-generating functions	
II.	Genisis and Derivation of Common Distributions	8
	A. Uniform distribution	
	B. Binomial and related distributions - Bernoulli, hypergeometric, and negative binomial	
	C. Poisson and related distributions - exponential and gamma	
	D. Normal and related distributions	
III.	Multivariate Distributions	5
	A. Joint, marginal and conditional distributions	
	B. Moments	
	C. Independence and correlation	
	D. Bivariate normal distribution	
IV.	Basic Sampling Distribution Theory	6
	A. Distribution of functions of random variables	
	B. Sum of independent random variables	
	C. Central limit theorem	
	D. Transformation of random variables	
V.	Theory of Estimation	7
	A. Unbiased estimators	
	B. Minimum mean-square-error estimators	
	C. Maximum likelihood estimators	
	D. Sufficient statistics	
VI.	Theory of Hypothesis Testing	7
	A. Likelihood ratio tests	
	B. Uniformly most powerful tests	