

## 《Probability Theory and Mathematical Statistics》 Course Syllabus

<b>Course Chinese Title:</b> 概率论与数理统计	<b>Course Category (Compulsory/ Elective) :</b> Compulsory	
<b>Total Hours/ Hours Per Week/ Credit(s):</b> 48/3/3	<b>Lab Practice/ Practical Hours:</b> 0	
<b>Prerequisites:</b> Advanced Mathematics		
<b>Follow-up course:</b> Statistics, Econometrics		
<b>Time:</b> 8:30-10:05 Tuesday (biweek); 8:30-10:10 Thursday	<b>Classroom:</b> 3302 Guancheng Campus	
<b>Class:</b> International Economics and Trade (International Business Industry-University International Program) 2022 class		
<b>College:</b> School of Economics and Management		
<b>Instructor Name/ Academic Title:</b> Joseph Chih-Yuan Hung/ Lecturer		
<b>Office Hour:</b> 10:15-11:25 Monday at Room 2303, Guanchen Campus/ <b>Online:</b> WeChat group		
<b>Course Assessment Method:</b> Open book test ( )    Close book test (✓)    Report (✓)    Other (✓), see <b>Assessment and Grading table below</b>		
<b>Required Textbook:</b> Gui, Wenhao, Lichuan Wang and Linchen Kong, <i>Probability Theory and Mathematical Statistics</i> , English edition, Tsinghua University Press		
<b>Supplementary Materials:</b> Miller & Miller. John E. Freund’s Mathematical Statistics (8th Edition). Pearson Education, 2014.		
<b>Course Description:</b>  This is a course of Probability and Mathematical Statistics for the sophomores in the program of Financial Management. Probability is the fundamental knowledge for further studies in quantitative analysis. It deals with that what is a random event, how we measure the randomness and how we make the prediction. The course starts from counting principles and the axiom of probability. Then group things into what we call “distributions,” in order to figure out the patterns of random. Next, we construct some measures about the distributions and how these measures represent the population behind the distributions. Finally, we dig deeper into the statistical inference, which include point estimations and hypothesis testing.		
<b>Course Learning Objectives and its supporting on the requirement for graduation:</b>		
<b>Course Learning Objectives</b>	<b>Measurements on Requirement for Graduation</b>	<b>Requirement for Graduation</b>

<b>CO1:</b> Student will be able to well understand probability theories and relative concepts.	<b>LO 1.1</b> Students shall have basic theoretical knowledge and professionalism of Humanities and Social Science.	<b>CG1</b> Students are able to systematically acquire the knowledge required for the discipline of applied economics.
<b>CO2:</b> Student will be able to apply probability theories and skills of mathematic statistics to analyze, predict, and estimate for economic issues.	<b>LO 2.3</b> Students shall be familiar with using existing analysis tools to solve the problems in positive economics and management practice.	<b>CG2</b> Students shall be able to analyze problems with using quantitative and information technology (IT) tools.
<b>CO3:</b> Student will be able to have the awareness of randomness in mind and properly evaluate states of the world with the lens of probability and statistics.	<b>LO 5.1</b> Students should have Strong critical thinking skills, able to identify problems, refine key points and propose appropriate solutions	<b>CG5</b> Students shall have innovative consciousness and the ability to apply innovative spirit to solve diversified business problems.

#### Lecturing Plan

Week	Topic	Instructor	Hours	Contents (Key point、Difficulty、 Ethical and political learning)	Instructional Mode (Online/ Blended/	Activities	Assignment	Supported Measurements
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					Offline)			
1	Introduction	Chih-Yuan Hung	2	<p><b>Key points:</b> Principles of arithmetic, permutations and combinations, binomial coefficients, polynomial theorems.</p> <p><b>Difficulties:</b> the idea and skill behind the proof of binomial theorem</p> <p><b>Ethical Learnings and Political Learning:</b> Distinguish between risk and uncertainty so that student can be well prepared to develop his/her awareness about the world of uncertainty.</p>	Offline	Lecturing/ Discussion	Reading: Chapter 1	CO3
1/2	Probability I	Chih-Yuan Hung	4	<p><b>Key points:</b> sample space; (random) events; the probability of an event; some rules of probability</p> <p><b>Difficulties:</b> the distinguish between frequency approach and axiomatic approach of definition of probability.</p>	Offline	Lecturing	Reading: Chapter 2	CO1
3	Probability II	Chih-Yuan Hung	2	<p><b>Key points:</b> conditional probability; Bayes Rule.</p> <p><b>Difficulties:</b> the concept of prior probability and posterior probability; the linkage of conditional probability and Bayes Rule.</p> <p><b>Ethical and Political Learnings:</b> Student would learn how do people learn (by updating information rationally), in which he or she can better understand the fundamental idea behind artificial intelligence and deep machine learning so that can dealing the relationship between humans and computers</p>	Offline	Lecturing	Reading: Chapter 2 Assignment 1	CO1
3/4	Probability Distribution and Density I	Chih-Yuan Hung	4	<p><b>Key points:</b> random variables; probability distributions; continuous random variables; probability density functions</p> <p><b>Difficulties:</b> how to well define a random variable from sample space and events.</p>	Offline	Lecturing	Reading: Chapter 3	CO1

5	Holiday		4				Reading: Chapter 3	CO1
6/7	Probability Distribution and Density II	Chih- Yuan Hung	4	<b>Key points:</b> multivariate distributions; marginal distributions; conditional distributions <b>Difficulties:</b> apply the conditional probability into multivariate distributions/densities.	Offline	Lecturing	Assignment 2	CO3
7	The Theory in Practice I	Chih- Yuan Hung	2	<b>Key points:</b> application of binomial methods; reliability; descriptive statistics <b>Difficulties:</b> application and the geographic characteristics of distribution and density function	Offline	Lecturing	Reading: Chapter 1-3	CO2
8/9	Mathematical Expectation I	Chih- Yuan Hung	4	<b>Key points:</b> Expected value of a random variable; moments; Chebyshev's theorem <b>Difficulties:</b> the proof and the usages of the proof of Chebyshev's theorem	Offline	Lecturing	Reading: Chapter 4	CO1
9	Mathematical Expectation II	Chih- Yuan Hung	2	<b>Key points:</b> moment-generating functions; product moments; conditional expectations <b>Difficulties:</b> calculation of moment-generating functions and conditional expectations	Offline	Lecturing/ Discussion/ Q&A	Reading: Chapter 4 Assignment 3	CO1
10	Midterm	Chih- Yuan Hung	2	<b>Midterm Exam, 2 hours/ The theory of Practice, 1hour</b> <b>Key points:</b> descriptive measures of random variables <b>Difficulties:</b> calculation of mean, median, and variance; distinguish between population and sample standard deviation <b>Ethical and Political Learnings:</b> emphasize the academic integrity. Students will be punished when there is academic dishonesty.	Offline	Lecturing	None	CO2

11	The Theory in Practice II /Special Probability Distributions	Chih-Yuan Hung	4	<b>Key points:</b> binomial family and Poisson distribution <b>Difficulties:</b> the relationships within binomial family	Offline	Lecturing	Reading: chapter 5	CO1
12/13	Special Probability Densities	Chih-Yuan Hung	4	<b>Key points:</b> uniform, exponential family, and normal distribution <b>Difficulties:</b> using varies techniques of integral to calculate the moments of random variables	Offline	Lecturing	Reading: chapter 6	CO1
13	Functions of Random Variables	Chih-Yuan Hung	2	<b>Key points:</b> distribution function technique; transformation technique; moment-generating function technique <b>Difficulties:</b> using varies techniques of integral to calculate the moments of random variables	Offline	Lecturing	Reading chapter 7 Assignment 4	CO1
14/15	Point Estimation	Chih-Yuan Hung	3	<b>Key points:</b> unbiased estimators; efficiency; consistency; sufficiency; robustness; the method of moments; the method of maximum likelihood; Bayesian estimation <b>Difficulties:</b> the comparison and timing of usage of the varies approaches of estimations.	Offline	Lecturing	Reading chapter 10	CO1
15	Hypothesis Testing	Chih-Yuan Hung	3	<b>Key points:</b> testing a statistical hypothesis; losses and risks; the Neyman-Pearson lemma; the power function of a test; likelihood ration tests <b>Difficulties:</b> the idea behind power function and different testing approaches.	Offline	Lecturing	Reading chapter 11 Assignment 5	CO1



**School Reviewal:**

Agree

Signature:

陈海东

Data:

2023. 9. 1

## Appendix: Grading Criteria Rubrics

### Assignment

Measurement	Criteria			
	A (100)	B (85)	C (70)	D (0)
Questions about relevant principles, theories, and applications of probability and statistics  Assignment 1, 2, 3, 4 CO1 (15%), CO3 (2%); Assignment 5 CO2 (5%), CO3 (3%)	Shows a full understanding of relevant principles, theories, and applications of probability and statistics.	Shows a good understanding of relevant principles, theories, and applications of probability and statistics.	Shows a fair understanding of relevant principles, theories, and applications of probability and statistics.	Shows no understanding of relevant principles, theories, and applications of probability and statistics.



## Discussion

Measurement	Criteria			
	A (100)	B (85)	C (70)	D (0)
Preparedness (CO2, 50%)	<ol style="list-style-type: none"> <li>1. Always prepared for class with assignments and required materials</li> <li>2. Accurately expresses foundational knowledge pertaining to issues raised during the discussion</li> </ol>	<ol style="list-style-type: none"> <li>1. Usually prepared with assignments and required materials</li> <li>2. Expresses basic foundational knowledge pertaining to class discussions</li> </ol>	<ol style="list-style-type: none"> <li>1. Seldom prepared with assignments and required materials</li> <li>2. Expresses limited foundational knowledge pertaining to class discussions</li> </ol>	<ol style="list-style-type: none"> <li>1. Consistently unprepared for class</li> <li>2. Expresses no relevant foundational knowledge</li> </ol>
Engagement (CO3 50%)	<ol style="list-style-type: none"> <li>1. Contributes to class activities by offering quality ideas and asking appropriate questions on a regular basis</li> <li>2. Actively engages others in class discussions by inviting their comments</li> <li>3. Constructively challenges the accuracy and relevance of statements made</li> <li>4. Effectively identifies and summarizes main points</li> </ol>	<ol style="list-style-type: none"> <li>1. Contributes to class activities by offering ideas and asking questions on a regular basis</li> <li>2. Often engages others in class discussions by inviting their comments</li> <li>3. Challenges the accuracy and relevance of statements made</li> <li>4. Identifies and summarizes main points</li> </ol>	<ol style="list-style-type: none"> <li>1. Occasionally contributes to class activities by offering ideas and asking questions</li> <li>2. Sometimes engages others in class discussions</li> <li>3. Sometimes has an understanding of main points</li> <li>4. Identifies and summarizes some of the main points</li> </ol>	<ol style="list-style-type: none"> <li>1. Fails to contribute to class activities</li> <li>2. Fails to invite comment/opinions from other students</li> <li>3. Demonstrates little understanding of main points</li> <li>4. Does not identify or summarize main points</li> </ol>