University of Houston – Clear Lake

MATH 4434: Introduction to Probability
Syllabus: Fall 2013
T, TH 5:30-6:50pm
Bayou Bldg. 1104

UHCL Quality Enhancement Plan (QEP) Motto:
Applied Critical Thinking (ACT) for Lifelong Learning and Adaptability

This course has been authorized by UHCL as an Applied Critical Thinking (ACT) Course which means that in addition to learning about the specified course content, students will be engaged with some or all of the Elements of Thought and Universal Intellectual Standards of critical thinking. The objective of an ACT course is to develop the student's ability to become skilled at analysis and evaluation by applying a set of intellectual tools that may be effectively used across all disciplines (as well as to the student's personal life). Based on the Foundation for Critical Thinking model (http://www.criticalthinking.org/), critical thinking involves thinking for a *purpose*, asking *questions*, using *information*, applying *concepts*, drawing *inferences and conclusions*, identifying *assumptions*, anticipating *implications and consequences*, and recognizing *points of view.* The Universal Intellectual Standards that are applied to these Elements of Thought of critical thinking in order to develop Intellectual Traits include *clarity, accuracy, precision, relevance, depth, breadth, logic, significance,* and *fairness*.

Instructor: Raj Chhikara, Ph.D.

Office: Bayou Building 3521-3
Phone: 281-283-3726
Email: chhikara@uhcl.edu

Office Hours: T, TH 4:00-5:30 pm or by appointment

Pre-requisite: Calculus II

Textbook: Probability & Statistical Inference, 8th Edition, by Hogg & Tannis, Pearson

Course Description:
This is an introductory course in probability designed for students in mathematics and related fields to learn and appreciate basic concepts and approaches to measuring uncertainty that commonly arise in all aspects of life. The central concept of a random experiment where outcomes are uncertain, and yet can occur, forms the basis of probabilistic reasoning, modeling and application. Emphasis will be on principles and concepts, not formulas. Major topics to be covered are: concepts of randomness and probability, random variable and probability distribution, expectation, discrete and continuous probability models, statistics and sampling distribution, normal distribution theory and central limit theorem.

Why Critical Thinking Is Essential in Probability & Statistics:
Mathematical reasoning requires critical thinking to comprehend the range of uncertainty involved in a phenomenon of scientific inquiry and to formulate it quantitatively with clarity and relevance to the underlying problem. Students taking this course would have to engage in the process of developing probability models that requires understanding the concept of randomness, stating with clarity the assumptions or axioms necessary, and making conclusions based on logical interpretation and/or valid inference derived from empirical analysis.

Students will learn to critically think and answer questions basic to their understanding of probability:

(1) What is a random phenomenon, and how to characterize and represent it mathematically?
(2) How to quantify chances associated with different outcomes of a random experiment?
(3) What are the salient features of discrete and continuous probability models?
(4) How well does a probability model fit the observed data?
(5) What is the significance of normal distribution and the role of Central Limit Theorem in inferential statistics?

Student Learning Outcomes:
Upon completion of this course, students will be able to fully comprehend the basic probability *concepts*, have developed necessary analytical skills and be able to apply their knowledge of the subject matter to analyze real life phenomena. In specific, they are expected to do the following:

(1) Explain the *concept* of randomness reflected in physical and other various phenomena, with *clarity* and *accuracy*, and describe the sample space of a random experiment with *precision* for the *specific purpose* of computing probabilities for events of interest based on *relevant information*.
(2) Develop a probability distribution, with *accuracy*, for the variable of interest based on *logical assumptions* and determine its parametric characteristics (mean, variance, etc.).
(3) Construct a probability plot from sample data provided for the *purpose* of making a *logical* statistical *inference* for the underlying probability model.
(4) Find sampling distribution for a statistic by applying the *concept* of random sample with *accuracy*.
(5) Apply the *concept* of *Central Limit Theorem* based on *relevant information* to approximate probabilities for both discrete and continuous distributions.

These learning outcomes are the result of students' grasp of the following fundamental and powerful concepts:

(1) Uncertainty (involved in occurrence of a phenomenon).
(2) Probability (as a measure of uncertainty), and conditional and marginal probabilities.
(3) Probability model.
(4) Normal distribution and Central Limit Theorem.

Vocabulary of Critical Thinking:
In this course, students will learn and use the vocabulary of critical thinking which will include an understanding and use of both the Elements of Thought and the Universal Intellectual Standards.

Elements of Thought:*
In this course, we will consider and use eight (8) elements of thought:

1. **Purpose**: Goals and objectives
2. **Question at Issue**: Problem, issue, and misconception
3. **Information:** Facts, data, evidence, observations, reasons, and experiences
4. **Interpretation and Inference**: Solutions and conclusions
5. **Concepts:** Definitions, models, laws, theories and principles
6. **Assumptions:** Axioms, presuppositions, and a-priori facts or knowledge
7. **Implications and Consequences**: Inferences, effects, and outcomes
8. **Point of View**: Perspectives, frames of reference, and orientations

Universal Intellectual Standards:*
In this course, we will consider and use nine (9) universal intellectual standards including **clarity, accuracy, precision, relevance, depth, breadth, logic, significance, and fairness.**

*Paul, R., & Elder, L. (2009). *Critical thinking: Concepts and Tools* (6th ed.). Tomales, CA: Foundation for Critical Thinking Press.

Critical Thinking Process:
There are four major aspects of the Applied Critical Thinking Process, termed as the 4 C's: curiosity, connections, creativity and communication. In this course, the predominant C in the student learning objectives is *connections*.

Attendance Policy:
Class attendance is considered essential for the students. They will be credited for their class participation as indicated in the grading criteria.
Note: It will be critically important for students not only to learn the course material which is completely different from what they had learned in the past but, also to know the topics or content emphasized and to think, acquire an aptitude for dealing with phenomena of randomness inherent in scientific inquiry.

Course Format:
The course format consists of lectures and problem solving by the instructor with student's participation in the form of questions and answers. At the end of each class period, students will be given the homework assignment. A teaching assistant (TA) will hold office hours for students to seek help on their homework problems and course instructions.

Exams:
Student testing will consist of two mid-term exams, a comprehensive final and a semester-end project. Arrangements must be made with the instructor at least 24 hours prior to missing an examination; otherwise it will be considered as failing the exam. Make-up exams are allowed only in the case of emergencies. The mid-terms and comprehensive final exam will feature questions requiring students to make *connections* to the concept of uncertainty and demonstrate *creativity* in arriving at the solution for computing probabilities and other measures of probability model.

Homework:
Homework assignments will be given on a regular basis and will consist primarily of exercises from the textbook. Unless otherwise stated, the homework assignments will be collected on Thursday of each week and will be graded. Completion of the homework assignments is considered essential for learning the course contents. These are to be turned in on time. Weekly homework assignment will focus on the exercises that require precise formulation of concept, clear approach and relevant method to solve the problems of practical nature.

Semester-End Project (Empirical Modeling and Analysis):
A semester-end project will be assigned for students to statistically summarize data provided for the purpose of estimating probabilities that demonstrate the breadth of their knowledge, the significance of different probability models covered in the course, showing the goodness of fit for the *assumed* probability distribution, and making logical inference. This project will be graded on a 10-point basis and it will be used to assess students' applied critical thinking for their conceptual understanding and making application for modeling a probabilistic process, which is a major **theme** of this course.

The outcome of this assessment will be separately recorded for the purpose of data collection and monitoring the students learning outcomes for Applied Critical Thinking. The project will assess SLOs 1 – 4 described earlier and the scores will be categorized in three levels: unacceptable (score < 7.0), acceptable (score between 7.0 and 9.0) and excellent (score > 9.0).

Student Evaluation and Grading:
Students grades will be based on weighted scores computed using the following weights:

Class Participation & Homework	15%
Exam I	20%
Exam II	25%
Final Exam (Comprehensive)	30%
Semester-end Project	10%

Applied Critical Thinking Assessment:
The semester-end project of empirical modeling and analysis will be the basis for assessing the student applied critical thinking. The following criteria will be used in order to assess the student learning outcomes, with SLOs indicated in parenthesis.

1. Student will make *connections* to the underlying random phenomenon and/or problem utilizing the *relevant information* and *logical assumptions* to conceptualize *accurately* the theoretical probability distribution for the variable of interest. (SLO #1, 2)
   For example, the students will examine the data provided for the semester-end project, identify the variable characteristics and justify its relevant probability distribution which is commensurate with the underlying random phenomenon.

2. Student will address with *clarity* the *purpose* and answer *question* related to *application* of probability modeling for a specified real situation or example, perform the necessary *data* analysis in *depth* and make *relevant inference* for the *assumed* model, and state significant *conclusion*. (SLO #3, 4)
   For example, the students will analyze the data and use it to construct probability plot to assess the goodness of fit for the assumed probability distribution.

Academic Honesty Code: Each student is expected to understand and abide by the UHCL Honesty Code: **I will be honest in all my academic activities and will not tolerate dishonesty.** See the catalog for a full description of the UHCL academic honesty policy.
http://prtl.uhcl.edu/portal/page/portal/PRV/FORMS/_POLICY_PROCEDURES/STUDENT_POLICIES/Academic_Honesty_Policy

Student Academic Adjustment Policy:
The University of Houston System complies with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, pertaining to the provision of reasonable academic adjustments/auxiliary aids for students with a disability. In accordance with Section 504 and ADA guidelines, each University within the System strives to provide reasonable academic adjustments/auxiliary aids to students who request and require them. If you believe that you have a disability requiring an academic adjustments/auxiliary aid, please contact your Student Disability Services office at 281-283-2627.

Course Outline*:

Week	Section	Topics
1	1.1-1.2	Concepts and Properties of Probability
2	1.3-1.4	Combinatorics and Conditional Probability
3	1.5-1.6	Independent Events and Bayes Theorem
4	2.1	Discrete Random Variables
5	REVIEW and EXAM I	
6	2.2-2.3	Expectation and Distribution Characteristics
7	2.4 & 2.6	Discrete Probability Distributions
8	2.5	Moment Generating Function

9	3.1-3.2	Continuous Variable Data & Exploratory Analysis
10	REVIEW and EXAM II	
11	3.3-3.5	Continuous Probability Distributions
12	3.6	The Normal Distributions
13	4.1-4.3	Bivariate Distributions
	5.1-5.2	Functions of Random Variables
14	5.3-5.4	Independent Random Variables
	Semester-end Project Assignment	
15	5.5-5.6	Distributions Related to Normal & Central Limit Theorem
16	FINAL EXAM	(Comprehensive)

*This course outline is subject to change. Important changes such as exam dates will be announced at least 2 class periods in advance. The Final Exam will be at the time it is scheduled and listed in the Class Schedule for Fall 2013.