6//09/20

Math 5710 Syllabus **Summer, 2020 Semester

Course Title: *Introduction to Probability*

Catalog Description: "Discrete and continuous probability, random variables, distribution and density function, joint distributions, conditional probabilities and expectations, Bayes' theorem, moments, moment generating functions, inequalities, convergence in probability and distribution, and central limit theorem. Prerequisite: C- or better in Math 2210 and Math 2250 or 2270. (3 semester credits)"

Class Meeting Schedule: MTWHF, 8:00 a.m.– 9:10 a.m.; June 22–August 7 (USU Distance Delivery Sites; originating in HH 132 on Logan campus)

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Office hours: By appointment

Math 5710 is organized into the following 4 concurrent units:

1. **Interrelationships Among Set Theory, Modern Algebra, Calculus, and Probability**

   The goal of Unit 1 is to use our understanding of naive set theory and modern algebra (i.e., abstract algebra or algebraic structures) to communicate in the language of probability theory.

   Topics to be studied or reviewed include naive set theory, functions (injective, surjective, bijective, and otherwise), propositions, inductive reasoning, deductive reasoning, derivatives, integrals, and probability theorems.

   About 20% of our time in the course is expected to be devoted to Unit 1.

2. **Experiments, Data, and Probability Functions**

   The goal of Unit 2 is to examine and deepen our understanding of the logical foundations of probability.

   Topics to be studied include experiments, outcomes, randomness, events (dependent, independent, and mutually exclusive), complements of events, sample spaces, probability functions (conditional and otherwise), measurements, data (discrete and continuous), measurement usefulness (relevance, reliability, and usability), standard error of measurement, counting (including permutations and combinations, odds, and binomial theorem

   About 40% of our time in the course should be devoted to Unit 2.

3. **Random Variables**

The goal of Unit 3 is to deepen our understanding of probability functions, methods for computing probabilities, and expected values and variance of the ranges of probability functions.

Topics to be studied include random variables, cumulative probability functions continuous probability density functions, cumulative, expected values, and variances.

About 15% of your time in the course should be devoted to Unit 3.

4: Probability Functions Climaxing with the Central Limit Theorem

The goal of Unit 4 is to comprehend how (1) a string of interrelated probability functions is foundational to the family of Gaussian functions and (2) the Central Limit Theorem is applied in the world of inferential statistics.

Topics to be studied include Bernoulli trials, binomial probabilities, hypothesis testing, principle of large numbers, the Central Limit Theorem, null hypotheses testing, types I and II error, and probability functions that are spinoffs of the Central Limit Theorem.

About 25% of your time in the course should be devoted to Unit 3.

The final course grade should reflect how well you achieve the four unit goals. You will be provided with four opportunities to demonstrate how well you are achieving the goals. These opportunities are tentatively scheduled and will influence the final course grade as follows:

Oppor-tunity	Tentative Dates	Units Involved	Relative Influence on Final Grade
#1	06/22–08/03 (Quizzes 1–29)	1, 2, 3, 4	20%
#2	06/22–08/03 (HW 1–29)	1,2, 3, 4	20%
#3	07/15–07/16	1, 2,	20%
#4	08/04–08/07	1, 2, 3, 4	40%

Instructional and learning resources (e.g., class meeting notes, homework assignments, class meeting agendas, sample proofs of theorems, sample constructions and computations, glossaries, sample responses to and explanations for homework and quiz/opportunity prompts, and files for video recordings) will be provided electronically via *Canvas*. There is no textbook to be purchased for this class.

The following is a tentative schedule of class meeting activities:

Meeting #: Date	Activities
01: M/6/22	1. Comprehend a brief overview of our course. 2. Comprehend an overarching title for Math 5710. 3.Take advantage of Quiz 01.
02: T/6/23	1. Acquaint or re-acquaint ourselves with some critical shorthand notations. 2. Acquaint or re-acquaint ourselves with naive set theory. 3.Take advantage of Quiz 02.
03: W/6/24	1. Continue to acquaint or re-acquaint ourselves with naive set theory. 2. Associate naive set theory with conventions of the language of probability. 3.Take advantage of Quiz 03.
04: H/6/25	1. Deepen our conceptual understanding of functions. 2. Comprehend the role of functions in structure and practices of probability. 3.Take advantage of Quiz 04.
05: F/6/26	1. Immerse ourselves into the modern algebra of bijections, equivalence of sets, and set cardinality 2. Take advantage of Quiz 05
06: M/6/29	1. Construct the following concepts and comprehend associated communication structures: experiments, outcomes, randomness, sample spaces, and events 2. Take advantage of Quiz 06.
07: T/6/30	1. Construct the following concepts and comprehend associated communication structures: complement of events and probability functions. 2. Formulate conjectures w/r probability functions and possibly elevate them to the rank of theorems. 3. Take advantage of Quiz 07.
08: W/7/01	1. Deepen our conceptualization of discrete probability functions 2. Construct the concepts of random sampling and random outcomes. 3. Take advantage of Quiz 08.
09: H/7/02	1. Construct the following concepts, comprehend associated communication structures, and discover interrelations among them: evaluations or judgments, measurements, measurement results or data, and measurement scales 2. Take advantage of Quiz 09.
10: M/7/06	1. Construct the following concepts, comprehend associated communication structures, and discover interrelations among them: data relevance, data reliability, data validity, data usability, validation studies, standard error of measurement, and discrete data v. continuous data 2. Take advantage of Quiz 10.

11: T/7/07	1. Focus on methods of counting, comprehend associated structures, and discover and prove theorems with respect the following: multiplication principle, permutations, and combinations 2. Take advantage of Quiz 11.
12: W/7/08	1. Construct the concept of a permutation, focus on methods of counting, comprehend associated structures, and discover and prove a theorem with respect the permutations. 2. Take advantage of Quiz 12.
13: H/7/09	1. Construct the concept of a combination, focus on methods of counting, comprehend associated structures, and discover and prove a theorem with respect the combinations. 2. Take advantage of Quiz 13.
14: F/7/10	1. Rediscover and prove the binomial theorem and relate it its role in our counting techniques as well as its role in our march toward the *Central Limit Theorem* (i.e., Theorem 15 (Glossary Entry # 050)). 2. Take advantage of Quiz 14.
15: M/7/13	1. Construct the concept of conditional probability, comprehend associated communication structures, and employ associated algorithms. 2. Discover and comprehend Bayes' Theorem. 3. Take advantage of Quiz 15.
16: T/7/14	1. Prove Bayes' Theorem and comprehend its implications for real-life situations. 2. Construct the following concepts, comprehend associated communication structures, and employ associated algorithms: independent events, dependent events, and mutually exclusive events 3. Take advantage of Quiz 16.
17: W/7/15	1. Rehearse for Opportunity #3. 2. Review and interrelate our Units 1–2 topics.
18: H/7/16	Take advantage of Opportunity #3.
19: F/7/17	1. Construct the following concepts, comprehend associated communication structures, and employ associated algorithms: random variables and discrete distribution functions 2. Take advantage of Quiz 19.
20 M/7/20	1. Construct the following concept, comprehend associated communication structures, and employ associated algorithms: odds, uniform discrete distribution functions, population statistical parameters, expected values of discrete random variables, and variance of discrete random values 2. Take advantage of Quiz 20

21 T/7/21	1. Construct the following concepts, comprehend associated communication structures, discover associated relationships, and employ associated algorithms: Bernoulli trials, binomial probabilities, 2. Comprehend and design a proof for Theorem 11. 3. Take advantage of Quiz 21.
22 W/7/22	1. Acquaint ourselves and comprehend the role of the following types of discrete random variables and their related probability distributions: geometric, negative binomial, hypergeometric, and Poisson 2. Take advantage of Quiz 22.
23: H/7/23	1. Deepen our conception of continuous random variables. 2. Construct the following concept, comprehend associated communication structures, and employ associated algorithms: continuous probability density functions, sample space coordinates, cumulative density functions of continuous random variables, and assignment of probabilities 3. Take advantage of Quiz 23.
24: M/7/27	1. Deepen our conception of continuous probability functions. 2. Construct the following concepts, comprehend associated communication structures, and employ associated algorithms: expected values and variance of the range of continuous probability functions 3. Take advantage of Quiz 24.
25: T/7/28	1. Deepen our application-level understanding of continuous random variables and their associate probability functions. 2. Take advantage of Quiz 25
26: W/7/29	1. Focus on experiments that involve random sampling from a population. 2. Discover, comprehend, and outline a proof for the principle of large numbers theorem. 2. Take advantage of Quiz 26.
27: H/7/30	1. Overview and interrelate topics to be studied in the remainder of our Math 5710 time. 2. Comprehend the development of the Central Limit Theorem and attributes of {Gaussian probability distributions}. 2. Take advantage of Quiz 27.
28: F/7/31	1. Construct the following concepts and comprehend associated communication structures: inferential statistics, null hypothesis, types I & II errors, sampling distributions, and probability functions that are spinoffs of the Central Limit Theorem. 2. Take advantage of Quiz 28.
29: M/8/03	1. Apply our understanding of inferential statistics to bivariate experiments and correlation. 2. Construct the concept of statistical power and comprehend its application in applications of inferential statistics 3. Take advantage of Quiz 29.

30: T/8/04	1. Rehearse for Opportunity #4. 2. Review and interrelate our Units 1–4 topics.
31: W/8/05	Take advantage Opportunity #4
32 H/8/06	Continue taking advantage of Opportunity #4.
33 F/8/07	Learn from our experiences with Opportunity #4

Note: In coordination with the Disability Resource Center, reasonable accommodations will be provided for qualified students with disabilities. If you need accommodations because of special exceptionalities, please meet with Jim during the first week of the semester to make arrangements. Accommodations and alternative format materials (e.g., large print, audio, or Braille) are available through the Disability Resource Center, located in Taggart Student Center room 104, phone number 797-2444.