Program Cover Document --- MAT 316: Probability

I. Basic Course Information

MAT 316 (Probability) is primarily a sophomore/junior level course. It is scheduled for two 80-minute meetings each week. Its prerequisite is MAT 200 or (CSC 270 and permission from the chair). Its corequisite is MAT 229.). It is required of all Data Science and Statistics majors, and is an option for all other majors and minors in the Department of Mathematics & Statistics.

II. Learning Goals

Probability introduces students to the fundamental methods of modeling uncertainty using both discrete and continuous models, for one and two variables. Students will learn to choose appropriate mathematical models for real-world situations, and evaluate probabilities from those models by hand and using software. The course should also develop a student's ability to read and write proofs. Since probability models the real world, it is often possible for students to come very close to guessing answers before they derive them, and if their answers do not verify their intuition, they should realize this. The course should provide a firm foundation in probability for students taking STA 410 (Mathematical Statistics) and the first actuarial exam.

The learning goals are threefold for the students. The first goal is to introduce the basic methods of modeling uncertainty, for both discrete and continuous variables and both univariate and bivariate situations. The second goal is to have students develop the ability to create a mathematical model that addresses real-world problems that are probabilistic in nature. Students should be able to make real-world predictions about such systems using techniques from probability, and assess the reasonableness of their answers. The third learning goal is developing more mathematical sophistication, particularly in students' ability to read, write, and understand proofs.

III. Student Assessment

Students will receive regular feedback on their work through homework, quizzes, projects, and or/exams. These assessments should include both application problems and proofs, and students should receive regular feedback on their work and progress.

Assessment of the success of Probability in meeting its learning goals will be done through a combination of student performance in the course and in their subsequent use of probability in higher-level courses such as Mathematical Statistics (STA 410). Students' success on the first actuarial exam will also provide information on the success of the course.

IV. Learning Activities

The specific choices of learning activities will depend upon the instructor, but it is expected that they will consist of some combination of lectures, group work, student presentations, individual homework, computer assignments, quizzes, tests, and a final exam.

Departmental Course Syllabus --- MAT 316: Probability

Introduction: A typical syllabus for Probability follows this sheet. Any syllabus for Probability should include the points listed below (the required course requirement sections).

I. **Basic information on course and instructor**

A. Purpose statement: Probability introduces students to the fundamental methods of modeling uncertainty using both discrete and continuous models, for one and two variables. Students will learn to choose appropriate mathematical models for real-world situations, and evaluate probabilities from those models by hand and using software The course should develop a student's ability to read and do proofs. Since probability models the real world, it is often possible for students to come very close to guessing answers before they derive them, and if their answers do not verify their intuition, they should realize this. The course should provide a firm foundation in probability for students taking STA 410 (Mathematical Statistics) and the first actuarial exam.

B. Course description: An introduction to probability. Topics include mathematical models, sample spaces, conditional probability, discrete and continuous distributions, expected values, moment-generating functions, Central Limit Theorem, multivariate distributions, and marginal distributions.

C. Course prerequisite: MAT 200. Course corequisite: MAT 229.

II. **Learning goals**

A. Content goals: Students will gain proficiency with many basic topics in probability. The course will introduce students to the definition of probability and proofs using this definition, as well as the basic discrete and continuous probability distributions and their associated expected values, including means, variances, and moment-generating functions.

B. Performance goals: At the completion of the course, students should demonstrate competence with probability concepts. They should be able to find probabilities by using counting rules, as well as identify the situations modeled by discrete random variables. They should know the shapes modeled by the continuous random variables. For all random variables they should be able to find the means, variance, moment-generating functions, and other expected values. They should know the relationships between the different variables and how to find distributions of sums, using both moment generating functions and the Central Limit Theorem. They should be able to do proofs using the definitions of probability, expected values, and other probability concepts. Finally, they should be able to determine the reasonableness of all numeric answers.

III. **Student assessment**

A. Assessment Plan: Students will receive regular feedback on their work through the

assignment of homework and examinations. A syllabus should clearly describe the schedule for these assessment tools and how they will be used to calculate grades.

B. Rationale: Through the use of regular feedback from homework, quizzes, student presentations and examinations, students will be able to see and correct their misunderstandings and improve their performance.
C. Methods and criteria: We will use the assessment of homework, quizzes, student presentations, and/or examinations to evaluate student accomplishment of the course learning goals. These assessment tools are similar to the manner in which students will need to use their knowledge in the future and are an appropriate way to assess the accomplishment of course learning goals.

IV. **Learning activities**

A. Summary of learning activities: The specific choices of learning activities will depend upon the instructor, but it is expected that they will consist of some combination of lectures, group work, student presentations, individual homework, quizzes, tests, and a final exam.
B. Calendar or outline: A guide to the organization of the course, a schedule of assessment tools, and a plan for the coverage of topics should be provided to the students. Homework, quizzes, and examinations should be spaced at appropriate intervals throughout the semester. As a general rule, it is expected that each of the major topics of basic probability rules, discrete variables, continuous variables, and multivariate random variables will be given equal emphasis.
C. Rationale: By giving students a multitude of ways to learn and do mathematics, the learning activities promote a deeper understanding of probability and contribute to the learning goals of these programs. A regular spacing of assessment tools ensures that students receive continual regular feedback on their work.

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