



MATH 3340 – Probability Modeling Course Syllabus

Course description: Elementary probability laws, conditional probability, the language of random variables and stochastic processes, modeling with discrete and continuous probability distributions, applications among various stochastic processes, methods of estimating parameters.

Credit hours: 3

The following is an excerpt from SFA Policy 5.4:

The federal definition of a credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally established equivalency that reasonably approximates:

1. *Not less than one hour of classroom or direct faculty instruction and a minimum of two hours out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or 10 to 12 weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time, or;*
2. *At least an equivalent amount of work as outlined in item 1 above for other academic activities as established by the institution including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours.*

To this end, all students in courses offered by the Department of Mathematics and Statistics that wish to be successful should plan to spend a minimum of two hours outside of class for every credit hour associated with this course. Expected activities to be completed in the time outside of class include reviewing notes from previous class meetings, reading assigned course resources, completing all assigned exercises and projects, and performing periodic assessment preparation.

Course Prerequisites and Corequisites: MATH 2314.

Course outline:	<u>Approximate time spent</u>
<ul style="list-style-type: none">• Introduction to Modeling<ul style="list-style-type: none">○ the modeling process○ probability models vs. other models○ a first model: the random walk○ applications of random walks in science	5%
<ul style="list-style-type: none">• Sets and Functions<ul style="list-style-type: none">○ Elementary set operations and theory○ Definition of function and set function○ Probability function and the axioms of probability○ Equally likely sample spaces and the need for counting rules	5%
<ul style="list-style-type: none">• Probability Laws Based on the Axioms<ul style="list-style-type: none">○ The Complement Rule○ The Addition Rule○ The Inclusion-Exclusion Principle and extensions to the Addition rule	10%
<ul style="list-style-type: none">• Conditioning<ul style="list-style-type: none">○ Conditional Probability definition and the Multiplication Rule○ Independent Events○ The Theorem of Total Probabilities and Bayes' Rule○ Extensions of the Multiplication Rule○ Introduction to Markov Chains	10%
<ul style="list-style-type: none">• Language of Random Variables and Stochastic Processes	15%

- Definition of random variable
- Discrete v. Continuous random variables
- Mass and density functions
- Expected Value (Mean and Variance) of random variables
- Moment Generating Functions
- Roles, types and characteristics of stochastic processes
- More on the random walk and more on Markov chains
- **Modeling with discrete distributions** 25%
 - Survey of popular models: Bernoulli, binomial, hypergeometric, Poisson, geometric, negative binomial
 - Relationships between discrete probability models
 - Investigation of settings in which each model is appropriate for use
 - Applications involving various stochastic processes
 - Estimating Parameters in Discrete Distributions: Method of Moments, MLE, bias, mean squared error
- **Modeling with continuous distributions** 30%
 - Survey of popular continuous distributions: uniform, exponential, gamma, normal
 - Using graphical methods to identify proper continuous models
 - Investigation of settings in which each model is appropriate for use
 - Applications involving various stochastic processes
 - Estimating Parameters in Continuous Distributions: Method of Moments, MLE, bias, mean squared error

Student Learning Outcomes (SLO): At the end of MATH 3340, a student who has studied and learned the material should be able to:

1. Discriminate between mathematical, statistical and probabilistic models. [PLO: 1, 2, 3]
2. Explain and apply the axioms and major laws associated with the probability function. [PLO: 1, 2, 3]
3. Explain the difference between unconditional and conditional probabilities and how to compute each in physical settings. [PLO: 1, 2, 3]
4. Model physical systems using popular discrete random variables. [PLO: 1, 2, 3]
5. Discriminate between popular discrete probability models based on physical scenarios that generate discrete data. [PLO: 1, 2, 3]
6. Apply various stochastic models that are associated with discrete random variables to physical settings. [PLO: 1, 2, 3]
7. Model physical systems using popular continuous random variables. [PLO: 1, 2, 3]
8. Apply various stochastic models that are associated with continuous random variables to physical settings. [PLO: 1, 2, 3]
9. Discriminate between key features seen in data that lead to the choice of a particular continuous probability model. [PLO: 1, 2, 3]
10. Estimate unknown parameters in order to complete the process of probability modeling. [PLO: 1, 2, 3]
11. Compare and contrast methods of estimating parameters. [PLO: 1, 2, 3]
12. Compare and contrast basic stochastic processes and provide illustrations of when they occur in nature. [PLO: 1, 2, 3]

Program Learning Outcomes (PLO): Students graduating from SFA with a B.S. Degree and a major in mathematics will:

1. Written Communication - SFA Mathematics majors communicate mathematical ideas effectively in written form, integrating mathematical notation correctly and consistently.
2. Verbal Communication - SFA Mathematics majors communicate mathematics effectively to diverse audiences.
3. Mathematical Maturation - SFA Mathematics majors grow from a computational understanding of mathematics to an integrated approach which includes critical thinking proficiency, computational facility, conceptual understanding, and problem-solving persistence.

This course meets educator preparation standards for one or more certification programs; a complete listing of all the educator preparation standards this course meets can be found at: <https://sfasu.edu/docs/jacksteach/jacksteach-standards-alignment-chart.xlsx>.

Academic Integrity

[The Code of Student Conduct and Academic Integrity](#) outlines the prohibited conduct by any student enrolled in a course at SFA. It is the responsibility of all members of all faculty, staff, and students to adhere to and uphold this policy.

Articles IV, VI, and VII of the new Code of Student Conduct and Academic Integrity outline the violations and procedures concerning academic conduct, including cheating, plagiarism, collusion, and misrepresentation. Cheating includes, but is not limited to: (1) Copying from the test paper (or other assignment) of another student, (2) Possession and/or use during a test of materials that are not authorized by the person giving the test, (3) Using, obtaining, or attempting to obtain by any means the whole or any part of a non-administered test, test key, homework solution, or computer program, or using a test that has been administered in prior classes or semesters without permission of the Faculty member, (4) Substituting for another person, or permitting another person to substitute for one's self, to take a test, (5) Falsifying research data, laboratory reports, and/or other records or academic work offered for credit, (6) Using any sort of unauthorized resources or technology in completion of educational activities.

Plagiarism is the appropriation of material that is attributable in whole or in part to another source or the use of one's own previous work in another context without citing that it was used previously, without any indication of the original source, including words, ideas, illustrations, structure, computer code, and other expression or media, and presenting that material as one's own academic work being offered for credit or in conjunction with a program course or degree requirements.

Collusion is the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any provision of the rules on academic dishonesty, including disclosing and/or distributing the contents of an exam.

Misrepresentation is providing false grades or résumés; providing false or misleading information in an effort to receive a postponement or an extension on a test, quiz, or other assignment for the purpose of obtaining an academic or financial benefit for oneself or another individual or to injure another student academically or financially.

Withheld Grades Semester Grades (SFA Policy 5.5)

Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average. The circumstances precipitating the request must have occurred after the last day in which a student could withdraw from a course. Students requesting a WH must be passing the course with a minimum projected grade of C. For additional information, go to <https://www.sfasu.edu/policies/course-grades-5.5.pdf>.

Students with Disabilities

To obtain disability related accommodations, alternate formats and/or auxiliary aids, students with disabilities must contact the Office of Disability Services (ODS), Human Services Building, and Room 325, 468-3004 / 468-1004 (TDD) as early as possible in the semester. Once verified, ODS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided. Failure to request services in a timely manner may delay your accommodations. For additional information, go to <http://www.sfasu.edu/disabilityservices>.

Student Wellness and Well-Being

SFA values students' overall well-being, mental health and the role it plays in academic and overall student success. Students may experience stressors that can impact both their academic experience and their personal

well-being. These may include academic pressure and challenges associated with relationships, emotional well-being, alcohol and other drugs, identities, finances, etc.

If you are experiencing concerns, seeking help, SFA provides a variety of resources to support students' mental health and wellness. Many of these resources are free, and all of them are confidential.

On-campus Resources:

The Dean of Students Office (Rusk Building, 3rd floor lobby)

www.sfasu.edu/deanofstudents

936.468.7249

dos@sfasu.edu

SFA Human Services Counseling Clinic Human Services, Room 202

www.sfasu.edu/humanservices/139.asp

936.468.1041

The Health and Wellness Hub "The Hub"

Location: corner of E. College and Raguet St.

To support the health and well-being of every Lumberjack, the Health and Wellness Hub offers comprehensive services that treat the whole person – mind, body and spirit. Services include:

- Health Services
- Counseling Services
- Student Outreach and Support
- Food Pantry
- Wellness Coaching
- Alcohol and Other Drug Education

www.sfasu.edu/thehub

936.468.4008

thehub@sfasu.edu

Crisis Resources:

- Burke 24-hour crisis line: 1.800.392.8343
- National Suicide Crisis Prevention: 9-8-8
- Suicide Prevention Lifeline: 1.800.273.TALK (8255)
- Crisis Text Line: Text HELLO to 741-741

Acceptable Student Behavior

Classroom behavior should not interfere with the instructor's ability to conduct the class or the ability of other students to learn from the instructional program (see the [Student Conduct Code, policy 10.4](#)). Unacceptable or disruptive behavior will not be tolerated. Students who disrupt the learning environment may be asked to leave class and may be subject to judicial, academic or other penalties. This prohibition applies to all instructional forums, including electronic, classroom, labs, discussion groups, field trips, etc. The instructor shall have full discretion over what behavior is appropriate/inappropriate in the classroom.

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