MTH 3340 (Formerly 359): Probability Modeling  
Fall 2020

Name: Greg Miller, PhD  
Department: Mathematics and Statistics  
Email: gmiller@sfasu.edu  
Phone: 468-1860  
Office: 312 – Math & Nursing  
Office Hours: Monday 3:45-5:00 (after class)  
Tuesday 2:30-5:00  
Wednesday 3:45-5:00 (after class)  
There are no office hours on Thursday/Friday  

Text and Materials:  
Supplemental: Your Calculus Textbook  

Course Requirements:  

Course Objectives: To familiarize the student with the basics of probability theory, while retaining a focus on probability as a tool for modeling real world phenomena. This includes mastery of elementary probability laws, conditional probability, the concept of random variables and their features & distribution theory (both discrete and continuous), Further, a main objective of the course is to expose students to applications of the theory with a heavy emphasis on applied stochastic processes. These include the study of the Poisson Process and ideas from Markov Chains, as well as other selected areas. Examples are provided from the sciences of Engineering, Medicine, Physics, Chemistry and others.  

Daily Work: First and foremost, you will always be expected to read in the textbook. At times, I will pick homework problems that exclusively relate to reading assignments.  
Each day in class there will be a few homework problems from the book given out that are for your practice. The total number of problems assigned works out to about one per calendar day (seven per week). You should keep all of the homework organized in one place and separate from the place where you keep notes from class. Each problem must be started on a separate piece of paper. Do not work two or more problems on the same page. Be prepared to turn in any the assigned problems at any point one week after they are assigned.  

How Daily Work is Assessed: Each class meeting of the semester (after the first day) you will turn in one or two homework problems (usually one, but sometimes two). The homework MUST be turned in when asked at the beginning of the class period. NO EXCEPTIONS. Homework is NOT accepted at the end of class or later in the day. Do not ask to turn in homework at that time. There will not be a homework pick up the day after an exam.
This means you will have approximately 25 daily grades. Once homework problems have been assigned for a week, they can be called for at any time – even much later in the semester. That is, a problem assigned on September 10 could be asked to be turned in on September 17 or November 14, etc.

**Midterm Exams:** There will be four midterm exams during the semester. Exams 1, 2 and 3 will be given on THURSDAY and are taken outside of class time at a specific time that you sign up for. There is no exception to this. You should plan on roughly three hours of time per exam. You can sign up to start the exam at 8:30 AM at the earliest and 3:00 PM at the latest. Exams in MTH 3340 tend to be long and thorough.

The exam dates will be announced at least 10 days in advance. However, the tentative dates for the first three exams are: September 17, October 8, and October 29.

The fourth exam begins at 2:30 PM (start of class time) on Wednesday, November 18. There will be no “lecture” this day and when you finish this exam then you have officially finished the face-to-face portion of this course since we will be remote learning after Thanksgiving.

The exams are technically not cumulative, but it is certainly true that knowledge from prior exams is expected to be applied on future exams. This will be clarified as we go along, but generally speaking, you should always review the MOST major of definitions, equations and theorems from past exams while studying the current material.

**Final Exam:** In lieu of a formal final exam, a collection of homework problems and/or a small project will be assigned the week before Thanksgiving. This final “assignment” will be due via email on **Wednesday, December 9 at 5:00 PM.**

**Provisions For If SFA Switched to All Remote Instruction During Fall 2020:**

If SFA cancels all face-to-face instruction and turns to all remote instruction for Fall 2020, then:

1) the exam structure and dates in this syllabus are null and void. The exams will shift to being of the “take-home” variety and new instructions as to their dates and requirements will be sent out via email

2) The fourth exam will shift back to “Finals Week” and the final “assignment” described above will be cancelled. However, regular homework assignments will still be given up through the last week of class.

3) All instruction will revert to asynchronous videos (videos that you can watch when you want, no attendance as a “class” will be required at any specific times). [Note: this is how the last week of instruction is scheduled currently. (Nov. 30 – Dec. 4)]

**Course Calendar:** See Attached
**Grading Policy:**
Everything counts 20%: Exam 1, Exam 2, Exam 3, Exam 4, Homework Average.

**Attendance Policy:** Attendance is mandatory and taken every day. All health-related absences are excused if you follow the following protocol:

1) On the day you miss class, notify me by email that you intend to get a doctor’s note.

2) Within 36 hours of missing class obtain a doctor’s note (written or electronic) and sent it to me via email.

Failure to follow the two steps above will result in your absence being logged as “unexcused”.

If you are not feeling well or have ANY symptoms of COVID-19 you should immediately seek medical attention. Do NOT wait. Research has shown that you are most contagious within 48 hours of showing first symptoms. You MUST contact a doctor on campus on your primary care doctor on the day that you first begin to feel ill.

Any university deemed excused absence will be honored if the student can point me to a list of students and events that have such a designation.

All other absences that are not health-related and/or university sanctioned events will be considered unexcused.

The following attendance penalties are strictly enforced and have the backing of the Department of Mathematics & Statistics and the College of Sciences & Mathematics

<table>
<thead>
<tr>
<th>Number of Unexcused Absences</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three or Less</td>
<td>No Penalty</td>
</tr>
<tr>
<td>Four or Five</td>
<td>One Letter Penalty on Final Grade</td>
</tr>
<tr>
<td>Six</td>
<td>Two Letter Penalty on Final Grade</td>
</tr>
<tr>
<td>Seven Grade</td>
<td>Student Receives an F for Final</td>
</tr>
</tbody>
</table>

Provisions for Excused Absences: A customized email will be sent to you including a video link and assignments. Obtaining the formal notes from a classmate is also strongly suggested upon your return to class. There is no such provision for an unexcused absence. Students that are absent for unexcused reasons bear the full responsibility of obtaining notes and additional information from their classmates.

Assigned Seating: At the end of the first week of class, students will choose their seat for the semester in Room 123. From the second week of class onward, students will be expected to sit at the same table for each subsequent class meeting. [Note: Each student will have their own table. There are 24 tables in Room 123.]
**Face Covering Mandate:** Face coverings are required for all students to enter Room 123 and are required to be worn during class meetings. If you have a health related issue that prevents you from wearing a face covering, please notify me upon reading this syllabus. Any student who does not comply with the face covering protocol will be asked to wear a face covering or leave the classroom. A student who resists such a suggestion will be removed from the class by the SFA University Police Department. This protocol has the approval of the Office of the President of SFA, Academic Affairs, The Department of Mathematics & Statistics and the College of Sciences & Mathematics.

If any time during the semester SFA waives the campus-wide face covering protocol, our class protocol will also cease to exist.

While at this time, I do not intend to wear a face covering while lecturing, this may change. I certify to you that I will perform daily self-temperature checks before attending class and I will not attend class if I show any signs of illness.

While working alone in my enclosed office, I will not wear a face covering (I am not required to by the university). However, any time a student enters my office, I will immediately wear a face covering since social distancing of six feet cannot be maintained while working together in my office.

Please do not let COVID-19 and face covering mandates prevent you from taking advantage of office hours. I strongly encourage you to ask questions during office hours and we can most certainly do so in a way that is safe for both the student and myself.

**A Final Word Before the Formalities:** With dedication and hard work you will find that you will do well. With laziness and poor time management you will find that you will do poor. You choose. One of my goals is to give you every opportunity to show me that you have mastered the material. Your success is largely governed by your effort, attitude, and persistence. I will do my part - I will be available for your consultation - I will lecture well, I will ask fair questions of you - I will give lively lectures. Grades are earned and I assure you that you will receive what you earn. The responsibility lies with you.

**Formalities Which Must Be Included in This Document:**

**Academic Integrity (A-9.1)**

The penalty for violating Academic Integrity policy A-9.1 at any time during this semester is failure of the course. No exceptions. No grade will be calculated for a student who violates the policy. They will be asked to sign an academic dishonesty form after evidence of their violation has been provided to them and they will receive an F in the course no matter what grades have been accumulated to that point in the semester.

Academic integrity is a responsibility of all university faculty and students. Faculty members promote academic integrity in multiple ways including instruction on the components of academic honesty, as well as abiding by university policy on penalties for cheating and plagiarism.

**Definition of Academic Dishonesty**

Academic dishonesty includes both cheating and plagiarism. Cheating includes but is not limited to (1) using or attempting to use unauthorized materials to aid in achieving a better grade on a component of a class; (2) the falsification or invention of any information, including citations, on an assigned exercise; and/or (3) helping or attempting to help another in an act of cheating or plagiarism. Plagiarism is presenting the words or ideas of another person as if they were your own. Examples of plagiarism are (1) submitting an assignment as if it were one's own work when, in fact, it is at
least partly the work of another; (2) submitting a work that has been purchased or otherwise obtained from an Internet source or another source; and (3) incorporating the words or ideas of an author into one's paper without giving the author due credit.

Please read the complete policy at http://www.sfasu.edu/policies/academic_integrity.asp

Withheld Grades Semester Grades Policy (A-54)

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.

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/.
MTH 3340 – Detailed List of Topics Covered

- Introduction to Modeling [read by students during Week 1]
  - the modeling process
  - probability models vs. other models
  - a first model: the random walk
  - applications of random walks in science

- Sets and Functions [≈ 2 weeks]
  - 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

- Probability Laws Based on the Axioms [≈ 1 week]
  - The Complement Rule
  - The Addition Rule
  - The Inclusion-Exclusion Principle and extensions to the Addition rule

- Conditioning [≈ 2 weeks]
  - 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

- Language of Random Variables and Stochastic Processes [≈ 2 weeks]
  - Definition of random variable
  - Discrete v. Continuous random variables
  - Mass and density functions
  - Expected Value (Mean and Variance) of random variables
  - Moment Generating Functions
  - Introduction to multiple random variables and independence
  - Roles, types and characteristics of stochastic processes
  - More on the random walk and more on Markov chains

- Modeling with discrete distributions [≈ 4 weeks]
  - Bernoulli and Binomial models
    - with application to random walks
  - Hypergeometric models
  - Poisson models
    - with application to the Poisson process
  - Geometric and Negative Binomial Models
    - with application to queueing and birth & death processes
• Modeling with continuous distributions [≈4 weeks]
  o continuous uniform models
    • with application to simulation
    • with application to the Poisson process
  o Exponential models
    • with application to the Poisson process
    • with application to renewal processes and recurrence times
  o Gamma models
    • with applications to queueing
    • chi-square as a special case, with application to goodness-of-fit
  o Normal models
    • with discussion of limit theorems including CLT
    • with applications to Brownian motion

Note: one topic that many cover in a probability class is the idea of "transformation theory". While I usually don't lecture over transformation of random variables, I do assign problems that take students through the CDF method, the MGF method and the theorems that allow one to obtain the distribution of \( Y = g(X) \) if \( X \sim f \) when \( g \) monotone.

For all of the distributions listed above, we discuss
• when the model should be used
• how it relates to other probability models
• how to use the mass or density function to compute probabilities
• properties such as expected value, variance, and moment generating functions (if helpful)

• More than a dozen other distributions are explored in exercises

• I (very briefly) introduce the class to need for estimating parameters in statistical settings. They read about the method of moments and maximum likelihood estimation and obtain a few estimators in some simple cases.

• the class is very heavy on modeling, distribution theory and a very large set of examples in stochastic processes

• the class makes particularly intense use of integral calculus in the back half the semester (MTH 2314 [234])