Syllabus

Course Goals: To introduce the student to basic theoretical concepts and computational tools in probability and statistics with emphasis on their role in solving engineering problems.

Course Catalog Description: Introduction to probability, random variables and random processes; probability distribution/density functions, expectation, correlation, power spectrum, WSS processes; confidence intervals; transmission through LTI systems; applications of probability.

Prerequisites: Math 314 (in addition, ECE 314 is highly recommended).


Instructor: Prof. Majeed Hayat
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TA: TBA

Course Requirements

1) Conduct
Students are expected to comply with the Student Code of Conduct found in the UNM Student Handbook. In particular, exchange of information during exams and quizzes is strictly prohibited.

2) Verbal and written communication
Oral and written communications are important in the educational setting. Each student is expected to participate in classroom discussions. Students are also expected to exhibit good writing when working homework assignments, quizzes and examinations.

3) Homework
Homework assignments will include problems from the text as well as special problems. Some problems may require the use of MATLAB, which is available in the ECE Computer labs. Computer-aided simulation and analysis (using MATLAB) of random phenomena will be an integral part of the course for two reasons. Firstly, simulation of practical problems will motivate students and gives them a realistic and enjoyable feel to the concept of chance. Secondly, Monte
Carlo based methods are necessary for the simulation and analysis of certain problems that cannot be solved analytically. Completion of homework assignments is a key component of this course, as it will help students master the course material and prepare for the exams. Late submissions are generally not accepted unless under extreme conditions. Solutions will be provided when the assignments are graded and returned.

4) Examinations

There will be two required midterms and a final. Make-up exams are given only under extreme conditions (such as in a medical emergency).

5) Quizzes

There will be a 5-minute quiz every Wednesday in the beginning of the class period (with the exception of the first week of class). Each quiz will be on the material covered in the two lectures before the quiz. The purpose is to encourage students to read the class notes and be in synch with the course.

6) Attendance

Attendance is mandatory. Missing more than two lectures requires the permission of the instructor.

7) Small-group project

Groups of 2-3 students will be required to work on a small project comprising experimentation (of a random phenomenon) and analysis of results. The specifics of the project will be announced approximately 8 weeks before the due date, which will be on the final class period. Each group will be asked to prepare a brief report. Tools learned in class should be used to complete the design. The use of Matlab will be required to complete the project.

8) Recitation sessions

There will be weekly recitation sessions on problem solving. Attendance is required. Day and time will be decided upon in the first class period. More details will be announced in class.

Grading

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<tr>
<th>%</th>
<th>Assignment</th>
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<tbody>
<tr>
<td>10%</td>
<td>Completion of homework assignments</td>
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<tr>
<td>10%</td>
<td>Weekly 5-minute quizzes every Thursday in the beginning of class</td>
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<tr>
<td>20%</td>
<td>First Exam, <strong>Monday, Feb. 22</strong></td>
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<tr>
<td>20%</td>
<td>Second Exam, <strong>Monday, Apr. 12</strong></td>
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<tr>
<td>30%</td>
<td>Final Exam: <strong>Monday, May 10</strong>, 5:30-7:30 PM, Room ECE-210</td>
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<tr>
<td>10%</td>
<td>Small-group project (details to be announced)</td>
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**Tentative grade assignment:**
- 90-100 (A);
- 80-89 (B);
- 70-79 (C);
- 60-69 (D);
- 59 or below (F).
**Some important dates:**
- Last day to drop without a grade: Feb. 5
- Spring break: Mar. 14 – 21
- Last class period for this course: May 5
- Final examination: Monday, May 10, 5:30 PM – 7:30 PM

**Outline of topics to be covered**

<table>
<thead>
<tr>
<th>Main topics and chapters</th>
<th>Subtopics</th>
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| Introduction and some motivating examples  
Chapter 1: 1.1 | Why do we need probabilistic analysis in science and engineering?  
Some motivating examples. |
| Fundamentals of probability  
Chapter 1: 1.2 – 1.11 | Sample space, events, examples, axiomatic definition of probability, some combinatorics, the Binomial law, conditional probability and Bayes’ rule, law of total probability, independence, random-number generation |
| Random variables  
Chapter 2: 2.1 – 2.9 and class notes | Meaning and significance of random variables, types of random variables, distribution functions, density functions, some important random variables, functions of a random variable, expectation, mean and moments, Chebychev’s inequality. |
| Multiple random variables  
Chapter 3: 3.1 – 3.7 | Bi-variate and multivariate distribution functions, density functions, independence, conditional density functions, expectations and conditional expectation, distribution of sums of independent random variables, transformations, covariance matrices, characteristic functions. |
| Elements of statistics and inference  
Chapter 4: 4.1- 4.5 | Sample mean and sample variance, confidence intervals, hypothesis testing |
| Introduction to random processes  
Chapters 5-8: 5.1-5.4; 6.1-6.8; 7.1-7.2, 7.6-7.7; 8.1-8.3, 8.7 | Definition and examples, wide-sense-stationarity, autocorrelation functions, white noise, power-spectral density, response of LTI systems to random signals. |