جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

# Course Syllabus: Introduction to Probability & Statistics - AMCS 143

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| **Division** | Computer, Electrical and Mathematical Sciences & Engineering |
| **Course Number** | AMCS 143 |
| **Course Title** | Introduction to Probability & Statistics |
| **Academic Semester** | Fall |
| **Academic Year** | 2019/2020 |
| **Semester Start Date** | 08/25/2019 |
| **Semester End Date** | 12/10/2019 |
| **Class Schedule** (Days & Time) | 09:00 AM - 10:30 AM \| Sun Wed |

## Instructor(s)

| Name | Email | Phone | Office Location | Office Hours |
|---|---|---|---|---|
| Ahmed Sultan Salem | Ahmed.Salem@kaust.edu.sa | +966128080416 | 3134, 1, Al-Khawarizmi (bldg. 1) | TBA |

## Teaching Assistant(s)

| Name | Email |
|---|---|
| TBA | |

## Course Information

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| **Comprehensive Course Description** | Introduction to probability and statistics. Topics include probability axioms, conditional probability, the law of total probability, Bayes' theorem, independence, discrete and continuous random variables, multiple random variables, sum of random variables, the sample mean, and introduction to statistical inference, linear regression and, hypothesis testing. |
| **Course Description from Program Guide** | This course provides an elementary introduction to probability and statistics with applications. Topics include: basic probability models; combinatorics; random variables; discrete and continuous probability distributions; statistical estimation and testing; confidence intervals; and an introduction to linear regression. |

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| **Goals and Objectives** | At the end of this course, students should:<br>1. Understand concepts of discrete probability, conditional probability, independence, and be able to apply these concepts.<br>2. Understand mathematical descriptions of random variables including probability mass functions (PMFs), cumulative distribution functions (CDFs), probability distribution functions (PDFs), conditional mass, conditional distribution and conditional density functions.<br>3. Be familiar with some of the more commonly encountered random variables, in particular the Gaussian random variable.<br>4. Be able to calculate various moments of common random variables including at least means, variances and standard deviations.<br>5. Be able to calculate the distribution of a function of a random variable.<br>6. Be able to apply the concepts of random variables to engineering applications (selected by instructor).<br>7. Be able to mathematically characterize multiple random variables using joint PMFs, joint CDFs and joint PDFs.<br>8. Understand how to formulate the joint PDF of multiple Gaussian random variables.<br>9. Understand correlation, covariance, correlation coefficient and how these quantities relate to the independence of random variables<br>10. Be able to apply the concepts of multiple random variables to engineering applications (selected by instructor).<br>11. Be able to compute the sample mean and sample standard deviation of a series of independent observations of a random variable.<br>12. Be able to estimate the CDF and PDF of a random variable from a series of independent observations.<br>13. Understand the law of large numbers and the central limit theorem and how these concepts are used to model various random phenomena (selected by instructor).<br>14. Be able to compute confidence intervals associated with sample means<br>15. Be able to use statistical concepts to analyze and interpret engineering data with particular emphasis on linear regression and hypothesis testing. |
| **Required Knowledge** | Calculus |
| **Reference Texts** | -Required Textbook: Introduction to Probability, by Dimitri P. Bertsekas and John N. Tsitsiklis, 2nd Edition |
| **Method of evaluation** | **25.00**% - Attendance and Participation<br>**25.00**% - Final exam<br>**25.00**% - Exam 2<br>**25.00**% - Exam 1 |
| **Nature of the assignments** | Three Exams, each worth 25% of the grade.<br>All exams are open notes.<br>Quizzes during the tutorial sessions: 25% of the grade<br>The quizzes are closed notes and are based on the homework problems.<br>Attending the tutorial sessions is mandatory.<br>Problem sets will be given as ungraded homework.<br>The grading is given in a Satisfactory(S)/Unsatisfactory(U) system. To pass the course the final grade should be at least 70%. |
| **Course Policies** | Attending the tutorial sessions is mandatory. |
| **Additional Information** | The course may be demanding to some. It is a 100-level course because its topics start from the very beginning of axiomatic probability theory and the notion of random variables. However, this does not mean that the content is light. The course has a high dose of self-study and requires patience and diligence. |

| Tentative Course Schedule<br>*(Time, topic/emphasis & resources)* | | |
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| **Week** | **Lectures** | **Topic** |
| 1 | Sun 08/25/2019<br>Wed 08/28/2019 | Construction of Probability Spaces and Measures |
| 2 | Sun 09/01/2019<br>Wed 09/04/2019 | Conditional Probability, Total Probability Theorem, and Bayes Rule |
| 3 | Sun 09/08/2019<br>Wed 09/11/2019 | Independence and Counting Methods |
| 4 | Sun 09/15/2019<br>Wed 09/18/2019 | Discrete Random Variables |
| 5 | Sun 09/22/2019<br>Wed 09/25/2019 | Pairs of Random Variables |
| 6 | Sun 09/29/2019<br>Wed 10/02/2019 | Continuous Random Variables |
| 7 | Sun 10/06/2019<br>Wed 10/09/2019 | Useful Continious Random Variables and Transformation of Random Variables |
| 8 | Sun 10/13/2019<br>Wed 10/16/2019 | Pairs of Continous Random Variables |
| 9 | Sun 10/20/2019<br>Wed 10/23/2019 | Multivariate Distributions |
| 10 | Sun 10/27/2019<br>Wed 10/30/2019 | Sum of Random Variables |
| 11 | Sun 11/03/2019<br>Wed 11/06/2019 | Parameter Estimation |
| 12 | Sun 11/10/2019<br>Wed 11/13/2019 | Estimation of a Random Variable I |
| 13 | Sun 11/17/2019<br>Wed 11/20/2019 | Estimation of a Random Variable II |
| 14 | Sun 11/24/2019<br>Wed 11/27/2019 | Hypothesis Testing |
| 15 | Sun 12/01/2019<br>Wed 12/04/2019 | Final Exam |
| 16 | Sun 12/08/2019 | Exams |

**Note**

The instructor reserves the right to make changes to this syllabus as necessary.