1. ECE/STAT 303: Introduction to Communications Principles

2. 3 credits: 2-75 minute lecture sessions/week

3. Diego Krapf; Rockey Luo

4. Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers. Yates, R. D. and Goodman, D. G. 2013.

5. Course Information
    a. Basic concepts in design and analysis of communication systems
    b. Prerequisites: MATH 261 with a C or higher; MATH 340 or concurrent registration or MATH 345 or concurrent registration
    c. Required

6. Goals for the Course
    a. Course Learning Objectives
        i. Conduct analyses using basic concepts of probability theory
        ii. Describe independence and conditional probability
        iii. Apply Bayes rule
        iv. Write joint PMF, PDF and CDF of multiple random variables
        v. Compute PDF of functions of random variables
        vi. Compute moments of random variables
        vii. Explain Bernoulli, binomial, geometric, Poisson, exponential, and normal distributions
        viii. Apply transform methods to sums of independent random variables
        ix. Compute error probability for binary communications
        x. Simulate samples and construct histograms
        xi. Use the central limit theorem
        xii. Describe Poisson process
    b. Student Outcomes
        1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        2. An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and welfare, as well as global, cultural, social, environmental, and economic factors
        3. An ability to communicate effectively with a range of audiences
        4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
        5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability acquire and apply new knowledge as needed, using appropriate learning strategies

7. Topics Covered

Axioms of probability
Conditional probability
Binary communication channel
Independence
Counting methods
Cumulative distribution function
Moments of discrete random variables; expected value and variance
Special probability distributions: Bernoulli, Binomial, Geometric, Discrete uniform, Poisson
Joint CDF
Joint PMF/PDF
Marginal PMF/PDF
Conditional probability models
Independent random variables
Covariance, correlation
Conditional probability (7.3, 7.4, 7.5)Functions of one random variables
Expected value of derived random variables
Functions of two random variables
Maximum and minimum of independent random variables
Sums of random variables, i.i.d. random variables
Characteristic function
Moment generating function
Application of transform methods to sums of independent random variables, convolution
Random sums of random variables
CLT
Sample mean
Weak and strong laws of large numbers, convergence in probability
Confidence intervals
i.i.d. random series
Poisson process
Brownian motion
Johnson noise and Shot noise
Stationarity