ECE 303: Introduction to Communication Principles

IN

Sequences and Series (MATH 161)

- Understands convergence of sequences and series.
- Knows series and sequence representations for exp(x).
- Can evaluate finite and infinite geometric sums.
- Knows Binomial theorem.

Differentiation (MATH 161, 261)

- Can compute partial and total derivatives.
- Knows chain rule.
- Knows and can apply Liebnitz rule.

Integration (MATH 161, 261)

- Can integrate by parts.
- Can compute 2D integrals.

Pre-requisites:

- MATH261

* = Optional

As of 12/9/08

Concepts:

* Games and counting formulas.
* Polling and the hypergeometric distribution.
- The probability space of outcomes and events.
- Probability measure
- Conditional probability, total probability, and Bayes rule
- Random variables, cdfs, pmfs, and pdfs.
- Moments and their uses.
- Mean and conditional mean as minimum mean-squared error estimators.
- Classical distributions and their origins.
- Averaging and Chebyshev's inequality, WLLN.
* Histograms and the multinomial distribution.
* Simulations
- Multiple random variables.
- Transformation of random variables
- The linear system theory of probability:
  - sums of IID random variables,
  - convolution of pdfs,
  - product of characteristic functions
* Noise through linear systems.
- Binary communication and error probability.

Applications:

- Optics
- Solid-State Engineering
- Reliability and OR
- Control and Robotics
- Communication
- Signal/Image Processing and Computer Vision
- Radar and Remote Sensoring
- Biomedicine
- Finance

Tools:

* MATLAB Programs and Simulations

OUT

Experiments & Probability Spaces

- Can specify probability space and probability measure for an experiment.
- Understands independence and conditional probability.
- Can apply Bayes Rule.

Random Variables

- Can compute pmf, pdf, cdf, characteristic functions, and moments.
- Can compute pdf for functions of independent random variables.

Probability Distributions

- Understands Bernoulli, binomial, geometric, and Pascal distributions from Bernoulli experiment.
- Understands exponential and Erlang distributions from Poisson experiment.
* Can derive uniform, Rayleigh, chi-squared, Cauchy, and beta distributions from bivariate normal experiment.
* Can derive hypergeometric distribution for polls.
* Can derive multinomial distribution for histograms.

Binary Communication

- Can use standard Gaussian tables.
- Can compute error probability for binary communication.

Averaging

- Can use Chebyshev's inequality to design averages to meet specifications.
- Understands Weak Law of Large Numbers.

Simulations

* Can simulate samples and construct histograms.
* Can generate arbitrarily distributed random variables.

Correlation and Spectrum Analysis

* Can compute correlation and spectrum for WSS random process (including white noise) through a linear time-invariant system.