Course Objectives
Probability & Statistics II
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2017

Length of Course: One semester
Prerequisites: Math 301, Probability & Statistics I and Math 283 (Calculus III), with a grade of 'C' or better.
Texts: None.
Texts (supplemental):
The instructor may suggest supplemental reading or exercises from a number of sources.

Course Objective:

This course is designed to provide the student with a continued intense foundation in fundamental concepts of stochastic mathematics used in advanced mathematics that was begun in Math 301. This course focuses on the theory of applied mathematics in the form of mathematical statistics. As such, we consider the form and way that the theory creates the applications. So, there we shall be discussing and proving certain results and then we shall consider how they are applied to econometrics, edumetrics, technometrics, decision science, etc. After completing the course the student should be able to work basic problems and proofs in probability and mathematical statistics with special attention to joint probability mass or density functions, properties of expectation, limit theorems, estimation (point and interval), hypothesis testing, and regression.

A student should have mastered and demonstrated the following skills after completing Math 302:

- the student is able to think logically
- the student is able to reason and recognise patterns and be able to make conjectures
- the student is able to use mathematical symbols
- the student is able to prove conjectures based on the axioms of probability.
- the student is able to work with *a posteriori* and *a priori* probability.
- the student is able to work with probability mass, density, and distribution functions.
- the student is able to compute moments for a random variable directly or through a moment generating function.
- the student is able to prove properties of a random variable.
- the student is able to compute point estimates, confidence intervals, and make inferences based on said.
- the student is able to compute covariance, correlation, and work basic problems in linear regression.

Some of the random variables considered in Math 302 (some were considered in Math 301) are the:

Uniform, Bernoulli, Binomial, Multinomial, Gaussian (Normal), Gaussian (Normal) bivariate, Geometric, Hypergeometric, Hazard, Chi- Squared (χ^2), Dirichlet, Erlang, Dirichlet bivariate, Error, Exponential, Gumbel, Fischer- Snedecor (F), Weibull, Cauchy, Beta, Laplace, Logistic, Lognormal, Pareto, Poisson, Rayleigh, Student (Gossett- t), von Mises, Wishart, and Birnbaum.

	Outline of the Course:	**Suggested Pace:**
I	Review of Univariate Random Variables PMFs, CDFs, PDFs, MGFs, Gamma Function, etc. Special attention to the Normal, (χ^2), Erlang, Exponential, Fischer- Snedecor (F), Rayleigh, Student (Gossett t) distributions.	1 week
II	Joint Distributed Random Variables Joint pdfs and pmfs, covariance, correlation, independence, marginal distributions, conditional distributions, & applications. Special attention to the Multinomial, Dirichlet bivariate, Gaussian (Normal) bivariate, and some discrete bivariate generalisations of soem univariate distributions of interest from Math 301.	$3\frac{1}{2}$ weeks
III	Some Properties of Expectation Sum of independent random variables, independent identically distributed (i. i. d.) random varialbes, Expectation of a sum of random variables, covariance, Pearson product-moments, moment generating functions, conditioning, and applications.	2.5 weeks
IV	Limit Theorems & Functions of Random Variables The distribution function technique, other transformation techniques, more on Tchebyshev's inequality, the weak law of large numbers, the strong law of large numbers, the Central Limit Theorem, bounding, and applications.	3 weeks
V	Sampling Theory The distribution of μ, the distribution of σ^2 , the χ^2, F and t distributions, and some applications.	3 weeks
VI	Estimation Theory Sufficiency, bias, efficiency, consistency, robustness, the method of moments, the method of maximum likelihood, and applications.	3 weeks
VII	Hypothesis Testing Statistical hypotheses, the Neyman-Pearson lemma, point-estimates, confidence intervals, inferences about μ, inferences about σ^2 , the F and t distributions, and applications.	4 weeks
VIII	Regression Linear regression, the method of least squares, parametric inferences, and applications.	rest of the semester