

**UNIVERSITY OF PUERTO RICO
RIO PIEDRAS CAMPUS
DEPARTMENT OF MATHEMATICS**

**PROBABILITY AND STATISTICS
M.S. EXAM SYLLABUS
NOVEMBER 2018**

The Masters Exam in Probability and Statistics will concentrate on the following topics:

1. The definition of probability, finite sample spaces, counting methods, combinatorial methods, multinomial coefficients. The probability of the union of two events. The definition of conditional probability, independent events, Bayes' theorem.
2. Random variables and discrete distributions, continuous distributions, the distribution function, bivariate distribution, marginal distributions, conditional distributions, multivariate distributions, functions of a random variable, functions of two or more random variables.
3. The expectation of a random variable, properties of expectations, variance, moments, the mean and the median, covariance and correlation, conditional expectation, the sample mean.
4. The Bernoulli and binomial distributions, the hypergeometric distribution, the Poisson distribution, the negative binomial distribution, the normal distribution, the central limit theorem, the correction for continuity, the Gamma distribution, the Beta distribution, the multinomial distribution,
5. Estimation: statistical Inference, prior and posterior distributions, conjugate prior distributions, Bayes estimators, maximum likelihood estimators, properties of maximum likelihood estimators, sufficient statistics.
6. Sampling distributions of estimators: the sampling distribution of a statistics, the chi-square distribution, the t distribution. Confidence intervals. Bayesian analysis of samples from a Normal distribution. Unbiased estimators. Fisher Information
7. Testing Hypotheses: problems of testing, testing simple hypotheses, Uniformly Most Powerful Tests. Two sided alternatives. The t Test. Comparing the means of two Normal distributions. The F distribution. Bayes test procedures.
8. Simple linear regression: least squares estimation, distribution assumptions, estimation, prediction and testing with normal errors.
9. Categorical data: Tests of goodness of fit, chi-square test, contingency tables.

References

1. Casella, G., & Berger, R. L. (2002). *Statistical inference* (2nd ed.). Pacific Grove, Calif.: Duxbury/Thomson Learning
2. DeGroot, M.H. and Schervish, M.J., *Probability and Statistics* (4th ed). Addison Wesley, 2012.