MOREHOUSE COLLEGE
DEPARTMENT OF MATHEMATICS

INTRODUCTION TO PROBABILITY AND STATISTICS I
MATH 341

PREREQUISITE:	**Math 162 (Calculus II) and [Math 255 (Set Theory) or Math 211 (Discrete Mathematics)] with a grade of "C" or better.** It is also *strongly* recommended that the student has completed Math 157 (Principles of Mathematics) previous to entrance to this course and is enrolled in Math 361(Real Analysis I).
TEXT:	*Mathematical Statistics with Applications*, John E. Freund (7th Edition). Pearson/Prentice Hall.
RECOMMENDED SUPPLEMENT:	*Fundamentals of Probability*, Gharamani (3rd Edition). Prentice Hall *Probability, Random Variables and Random Processes*, Hsu, McGraw Hill
COVERAGE:	**Chapters 1-8,**

COURSE OUTLINE

1. **Introduction**
   - 1.2. Combinatorial Methods
   - 1.3. Binomial Coefficients

2. **Probability**
   - 2.2 Sample Spaces
   - 2.3 Events
   - 2.4 The Probability of an Event
   - 2.5 Some Rules of Probability
   - 2.6 Conditional Probability
   - 2.7 Independent Events
   - 2.8 Bayes' Theorem

3. **Probability Distribution and Probability Densities**
   - 3.1 Random Variables
   - 3.2 Probability Distributions
   - 3.3 Continuous Random Variables
   - 3.4 Probability Density Functions
   - 3.5 Multivariate Distributions
   - 3.6 Marginal Distributions
   - 3.7 Conditional Distributions

4. **Mathematical Expectation**
   - 4.2 The Expected Value of a Random Variable
   - 4.3 Moments
   - 4.4 Chebyshev's Theorem
   - 4.5 Moment-Generating Functions
   - 4.6 Product Moments
   - 4.7 Moments of Linear Combinations of Random Variables
   - 4.8 Conditional Expectations

5. **Special Probability Distributions**
   - 5.2 The Discrete Uniform Distribution
   - 5.3 The Bernoulli Distribution
   - 5.4 The Binomial Distribution
   - 5.5 The Negative Binomial and Geometric Distributions

5.6 The Hypergeometric Distribution
5.7 The Poisson Distribution
5.8 The Multinomial Distribution
5.9 The Multivariate Hypergeometric Distribution

6. Special Probability Densities

6.2 The Uniform Distribution
6.3 The Gamma, Exponential, and Chi-Square Distributions
6.4 The Beta Distribution
6.5 The Normal Distribution
6.6 The Normal Approximation to the Binomial Distribution
6.7 The Bivariate Normal Distribution

7. Functions of Random Variables

7.2 Distribution Function Technique
7.3&4 Transformation Technique: One variable & Several Variables
7.5 Moment-Generating Function Technique

8. Sampling Distribution

8.2 The Distribution of the Mean
8.3 The Distribution of the Mean: Finite Population
8.4 The Chi-Square Distribution
8.5 The *t* Distribution
8.6 The *F* Distribution
8.7 Order Statistics

* "Introduction" and "The Theory in Practice" sections in each chapter will be covered.

COURSE OBJECTIVES

This course is designed to provide the student with an intense foundation in fundamental concepts of stochastic mathematics used in advanced mathematics. After completing the course the student should be able to work basic problems and proofs in probability, combinatorics (with special attention to those aspects of the subject most relevant to statistics), and early statistics [density, distribution, and functional random variables]. The second course (Math 342) continues from whence 341 ends with a deeper discussion of mathematical statistics. It is *highly* recommended that a student in Actuarial Science, Engineering, Physics, Economics, Computer Science, or Applied Mathematics opt to include Math 342 in his programme of study. If the student is interested in an applied statistics course where one simply applies work others proved - this is not for you. In this course we prove as well as compute. Further, this is not a course that is computer driven, it is a theoretical course designed for an intense foundation in statistics. The computer driven course at Morehouse is Math 155 (Basic Statistics).

A student should have mastered and demonstrated the following skills after completing Math 341:

- the student is able to use the basic ingredients of probability and elementary combinatorial analysis from a non-measure as well as measure theoretic point of view.
- the student is able to work with permutations, combinations, binomials, and multinomials; to prove conjectures based on the axioms of probability; to work with *a posteriori* and *a priori* probability; to work with probability density functions and probability distribution functions; to compute expectation, variance, and covariance.