

TABLE OF CONTENTS

Introduction

Licensing

Object Library

Credits

Sources and Resources

1: Foundations

- 1.1: Sets
- 1.2: Functions
- 1.3: Relations
- 1.4: Partial Orders
- 1.5: Equivalence Relations
- 1.6: Cardinality
- 1.7: Counting Measure
- 1.8: Combinatorial Structures
- 1.9: Topological Spaces
- 1.10: Metric Spaces
- 1.11: Measurable Spaces
- 1.12: Special Set Structures

2: Probability Spaces

- 2.1: Random Experiments
- 2.2: Events and Random Variables
- 2.3: Probability Measures
- 2.4: Conditional Probability
- 2.5: Independence
- 2.6: Convergence
- 2.7: Measure Spaces
- 2.8: Existence and Uniqueness
- 2.9: Probability Spaces Revisited
- 2.10: Stochastic Processes
- 2.11: Filtrations and Stopping Times

3: Distributions

- 3.1: Discrete Distributions
- 3.2: Continuous Distributions
- 3.3: Mixed Distributions
- 3.4: Joint Distributions
- 3.5: Conditional Distributions
- 3.6: Distribution and Quantile Functions
- 3.7: Transformations of Random Variables
- 3.8: Convergence in Distribution
- 3.9: General Distribution Functions

- 3.10: The Integral With Respect to a Measure
- 3.11: Properties of the Integral
- 3.12: General Measures
- 3.13: Absolute Continuity and Density Functions
- 3.14: Function Spaces

4: Expected Value

- 4.1: Definitions and Basic Properties
- 4.2: Additional Properties
- 4.3: Variance
- 4.4: Skewness and Kurtosis
- 4.5: Covariance and Correlation
- 4.6: Generating Functions
- 4.7: Conditional Expected Value
- 4.8: Expected Value and Covariance Matrices
- 4.9: Expected Value as an Integral
- 4.10: Conditional Expected Value Revisited
- 4.11: Vector Spaces of Random Variables
- 4.12: Uniformly Integrable Variables
- 4.13: Kernels and Operators

5: Special Distributions

- 5.1: Location-Scale Families
- 5.2: General Exponential Families
- 5.3: Stable Distributions
- 5.4: Infinitely Divisible Distributions
- 5.5: Power Series Distributions
- 5.6: The Normal Distribution
- 5.7: The Multivariate Normal Distribution
- 5.8: The Gamma Distribution
- 5.9: Chi-Square and Related Distribution
- 5.10: The Student t Distribution
- 5.11: The F Distribution
- 5.12: The Lognormal Distribution
- 5.13: The Folded Normal Distribution
- 5.14: The Rayleigh Distribution
- 5.15: The Maxwell Distribution
- 5.16: The Lévy Distribution
- 5.17: The Beta Distribution
- 5.18: The Beta Prime Distribution
- 5.19: The Arcsine Distribution
- 5.20: General Uniform Distributions
- 5.21: The Uniform Distribution on an Interval
- 5.22: Discrete Uniform Distributions
- 5.23: The Semicircle Distribution
- 5.24: The Triangle Distribution
- 5.25: The Irwin-Hall Distribution
- 5.26: The U-Power Distribution
- 5.27: The Sine Distribution
- 5.28: The Laplace Distribution
- 5.29: The Logistic Distribution

- 5.30: The Extreme Value Distribution
- 5.31: The Hyperbolic Secant Distribution
- 5.32: The Cauchy Distribution
- 5.33: The Exponential-Logarithmic Distribution
- 5.34: The Gompertz Distribution
- 5.35: The Log-Logistic Distribution
- 5.36: The Pareto Distribution
- 5.37: The Wald Distribution
- 5.38: The Weibull Distribution
- 5.39: Benford's Law
- 5.40: The Zeta Distribution
- 5.41: The Logarithmic Series Distribution

6: Random Samples

- 6.1: Introduction
- 6.2: The Sample Mean
- 6.3: The Law of Large Numbers
- 6.4: The Central Limit Theorem
- 6.5: The Sample Variance
- 6.6: Order Statistics
- 6.7: Sample Correlation and Regression
- 6.8: Special Properties of Normal Samples

7: Point Estimation

- 7.1: Estimators
- 7.2: The Method of Moments
- 7.3: Maximum Likelihood
- 7.4: Bayesian Estimation
- 7.5: Best Unbiased Estimators
- 7.6: Sufficient, Complete and Ancillary Statistics

8: Set Estimation

- 8.1: Introduction to Set Estimation
- 8.2: Estimation the Normal Model
- 8.3: Estimation in the Bernoulli Model
- 8.4: Estimation in the Two-Sample Normal Model
- 8.5: Bayesian Set Estimation

9: Hypothesis Testing

- 9.1: Introduction to Hypothesis Testing
- 9.2: Tests in the Normal Model
- 9.3: Tests in the Bernoulli Model
- 9.4: Tests in the Two-Sample Normal Model
- 9.5: Likelihood Ratio Tests
- 9.6: Chi-Square Tests

10: Geometric Models

- 10.1: Buffon's Problems
- 10.2: Bertrand's Paradox
- 10.3: Random Triangles

11: Bernoulli Trials

- 11.1: Introduction to Bernoulli Trials
- 11.2: The Binomial Distribution
- 11.3: The Geometric Distribution
- 11.4: The Negative Binomial Distribution
- 11.5: The Multinomial Distribution
- 11.6: The Simple Random Walk
- 11.7: The Beta-Bernoulli Process

12: Finite Sampling Models

- 12.1: Introduction to Finite Sampling Models
- 12.2: The Hypergeometric Distribution
- 12.3: The Multivariate Hypergeometric Distribution
- 12.4: Order Statistics
- 12.5: The Matching Problem
- 12.6: The Birthday Problem
- 12.7: The Coupon Collector Problem
- 12.8: Pólya's Urn Process
- 12.9: The Secretary Problem

13: Games of Chance

- 13.1: Introduction to Games of Chance
- 13.2: Poker
- 13.3: Simple Dice Games
- 13.4: Craps
- 13.5: Roulette
- 13.6: The Monty Hall Problem
- 13.7: Lotteries
- 13.8: The Red and Black Game
- 13.9: Timid Play
- 13.10: Bold Play
- 13.11: Optimal Strategies

14: The Poisson Process

- 14.1: Introduction to the Poisson Process
- 14.2: The Exponential Distribution
- 14.3: The Gamma Distribution
- 14.4: The Poisson Distribution
- 14.5: Thinning and Superposition
- 14.6: Non-homogeneous Poisson Processes
- 14.7: Compound Poisson Processes
- 14.8: Poisson Processes on General Spaces

15: Renewal Processes

- 15.1: Introduction
- 15.2: Renewal Equations
- 15.3: Renewal Limit Theorems
- 15.4: Delayed Renewal Processes
- 15.5: Alternating Renewal Processes
- 15.6: Renewal Reward Processes

16: Markov Processes

- 16.1: Introduction to Markov Processes
- 16.2: Potentials and Generators for General Markov Processes
- 16.3: Introduction to Discrete-Time Chains
- 16.4: Transience and Recurrence for Discrete-Time Chains
- 16.5: Periodicity of Discrete-Time Chains
- 16.6: Stationary and Limiting Distributions of Discrete-Time Chains
- 16.7: Time Reversal in Discrete-Time Chains
- 16.8: The Ehrenfest Chains
- 16.9: The Bernoulli-Laplace Chain
- 16.10: Discrete-Time Reliability Chains
- 16.11: Discrete-Time Branching Chain
- 16.12: Discrete-Time Queuing Chains
- 16.13: Discrete-Time Birth-Death Chains
- 16.14: Random Walks on Graphs
- 16.15: Introduction to Continuous-Time Markov Chains
- 16.16: Transition Matrices and Generators of Continuous-Time Chains
- 16.17: Potential Matrices
- 16.18: Stationary and Limiting Distributions of Continuous-Time Chains
- 16.19: Time Reversal in Continuous-Time Chains
- 16.20: Chains Subordinate to the Poisson Process
- 16.21: Continuous-Time Birth-Death Chains
- 16.22: Continuous-Time Queuing Chains
- 16.23: Continuous-Time Branching Chains

17: Martingales

- 17.1: Introduction to Martingales
- 17.2: Properties and Constructions
- 17.3: Stopping Times
- 17.4: Inequalities
- 17.5: Convergence
- 17.6: Backwards Martingales

18: Brownian Motion

- 18.1: Standard Brownian Motion
- 18.2: Brownian Motion with Drift and Scaling
- 18.3: The Brownian Bridge
- 18.4: Geometric Brownian Motion

[Index](#)

[Glossary](#)

[Detailed Licensing](#)