

Contents

| | |
|---|-----------|
| Preface | v |
| Chapter 1. Combinatorics and Calculus for Probability | 1 |
| 1.1 Factorials and binomial coefficients | 1 |
| 1.2 Basic results from calculus | 7 |
| Chapter 2. Basics of Probability | 11 |
| 2.1 Foundation of probability | 12 |
| 2.2 The concept of conditional probability | 21 |
| 2.3 The law of conditional probability | 26 |
| 2.4 Bayesian probability | 29 |
| 2.5 The concept of random variable | 40 |
| 2.6 Expected value and standard deviation | 42 |
| 2.7 Independent random variables and the square root law | 51 |
| 2.8 Generating functions | 55 |
| Appendix: Proofs for expected value and variance | 58 |
| Chapter 3. Useful Probability Distributions | 63 |
| 3.1 The binomial and hypergeometric distributions | 63 |
| 3.2 The Poisson distribution | 70 |
| 3.3 The normal probability density | 74 |
| 3.4 Central limit theorem and the normal distribution | 80 |
| 3.5 The uniform and exponential probability densities | 85 |
| 3.6 The bivariate normal density | 93 |
| 3.7 The chi-square test | 97 |
| Appendix: Poisson and binomial probabilities | 101 |

| | |
|---|------------|
| Chapter 4. Real-Life Examples of Poisson Probabilities | 103 |
| 4.1 Fraud in a Canadian lottery | 103 |
| 4.2 Bombs over London in World War II | 105 |
| 4.3 Winning the lottery twice | 107 |
| 4.4 Santa Claus and a baby whisperer | 108 |
| 4.5 Birthdays and 500 Oldsmobiles | 110 |
| Chapter 5. Monte Carlo Simulation and Probability | 113 |
| 5.1 Introduction | 113 |
| 5.2 Simulation tools | 116 |
| 5.3 Applications of computer simulation | 123 |
| 5.4 Statistical analysis of simulation output | 127 |
| Appendix: Python programs for simulation | 135 |
| Chapter 6. A Primer on Markov Chains | 137 |
| 6.1 Markov chain model | 137 |
| 6.2 Absorbing Markov chains | 144 |
| 6.3 The gambler's ruin problem | 148 |
| 6.4 Long-run behavior of Markov chains | 150 |
| 6.5 Markov chain Monte Carlo simulation | 153 |
| Solutions to Selected Problems | 159 |
| Index | 173 |