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# Introduction to probability blitzstein

Developed from celebrated Harvard statistics lectures, Introduction to Probability provides essential language and tools for understanding statistics, randomness, and uncertainty. The book explores a wide variety of applications and examples, ranging from coincidences and paradoxes to Google PageRank and Markov chain Monte Carlo (MCMC). Additional application areas explored include genetics, medicine, computer science, and information theory. The authors present the material in an accessible style and motivate concepts using real-world examples. Throughout, they use stories to uncover connections between the fundamental distributions in statistics and conditioning to reduce complicated problems to manageable pieces. The book includes many intuitive explanations, diagrams, and practice problems. Each chapter ends with a section showing how to perform relevant simulations and calculations in R, a free statistical software environment. The second edition adds many new examples, exercises, and explanations, to deepen understanding of the ideas, clarify subtle concepts, and respond to feedback from many students and readers. New supplementary online resources have been developed, including animations and interactive visualizations, and the book has been updated to dovetail with these resources. Supplementary material is available on Joseph Blitzstein's website [www.stat110.net](http://www.stat110.net). The supplements include: Solutions to selected exercises Additional practice problems Handouts including review material and sample exams Animations and interactive visualizations created in connection with the edX online version of Stat 110. Links to lecture videos available on iTunes U and YouTube There is also a complete instructor's solutions manual available to instructors who require the book for a course. Probability and Counting Why study probability? Sample spaces and Pebble World Naive definition of probability How to count Story proofs Non-naive definition of probability Recap R Exercises Conditional Probability The importance of thinking conditionally Definition and intuition Bayes' rule and the law of total probability Conditional probabilities are probabilities Independence of events Coherency of Bayes' rule Conditioning as a problem-solving tool Pitfalls and paradoxes Recap R Exercises Random Variables and Their Distributions Random variables Distributions and probability mass functions Bernoulli and Binomial Hypergeometric Discrete Uniform Cumulative distribution functions Functions of random variables Independence of rvs Connections between Binomial and Hypergeometric Recap R Exercises Expectation Definition of expectation Linearity of expectation Geometric and Negative Binomial Indicator rvs and the fundamental bridge Law of the unconscious statistician (LOTUS) Variance Poisson Connections between Poisson and Binomial \*Using probability and expectation to prove existence Recap R Exercises Continuous Random Variables Probability density functions Uniform Universality of the Uniform Normal Exponential Poisson processes Symmetry of iid continuous rvs Recap R Exercises Moments Summaries of a distribution Interpreting moments Sample moments Moment generating functions Generating moments with MGFs Sums of independent rvs via MGFs \*Probability generating functions Recap R Exercises Joint Distributions Joint, marginal, and conditional D LOTUS Covariance and correlation Multinomial Multivariate Normal Recap R Exercises Transformations Change of variables Convolutions Beta Gamma Beta-Gamma connections Order statistics Recap R Exercises Conditional Expectation Conditional expectation given an event Conditional expectation given an rv Properties of conditional expectation \*Geometric interpretation of conditional expectation Conditional variance Adam and Eve examples Recap R Exercises Inequalities and Limit Theorems Inequalities Law of large numbers Central limit theorem Chi-Square and Student-t Recap R Exercises Markov Chains Markov property and transition matrix Classification of states Stationary distribution Reversibility Recap R Exercises Markov Chain Monte Carlo Metropolis-Hastings Recap R Exercises Poisson Processes Poisson processes in one dimension Conditioning, superposition, thinning Poisson processes in multiple dimensions Recap R Exercises A Math A Sets A Functions A Matrices A Difference equations A Differential equations A Partial derivatives A Multiple integrals A Sums A Pattern recognition A Common sense and checking answers B R B Vectors B Matrices B Math B Sampling and simulation B Plotting B Programming B Summary statistics B Distributions C Table of distributions Bibliography Index Developed from celebrated Harvard statistics lectures, Introduction to Probability provides essential language and tools for understanding statistics, randomness, and uncertainty. The book explores a wide variety of applications and examples, ranging from coincidences and paradoxes to Google PageRank and Markov chain Monte Carlo (MCMC). Additional application areas explored include genetics, medicine, computer science, and information theory. The authors present the material in an accessible style and motivate concepts using real-world examples. Throughout, they use stories to uncover connections between the fundamental distributions in statistics and conditioning to reduce complicated problems to manageable pieces. The book includes many intuitive explanations, diagrams, and practice problems. Each chapter ends with a section showing how to perform relevant simulations and calculations in R, a free statistical software environment. The second edition adds many new examples, exercises, and explanations, to deepen understanding of the ideas, clarify subtle concepts, and respond to feedback from many students and readers. New supplementary online resources have been developed, including animations and interactive visualizations, and the book has been updated to dovetail with these resources. Supplementary material is available on Joseph Blitzstein's website [www.stat110.net](http://www.stat110.net). The supplements include: Solutions to selected exercises Additional practice problems Handouts including review material and sample exams Animations and interactive visualizations created in connection with the edX online version of Stat 110. Links to lecture videos available on iTunes U and YouTube There is also a complete instructor's solutions manual available to instructors who require the book for a course. Showing 1-30 Start your review of Introduction to Probability Jan 18, 2016 Deepak rated it it was amazing Sometime ago I got interested in machine learning. Since machine learning involves a good amount of statistics, I started looking for books or resources on probability. After abandoning two widely recommended books, I chanced upon Blitzstein's lectures, I felt that his book would have much more to offer than the lectures. I found it immensely interesting, the authors provide lucid explanations for every concept. There is a lot of emphasis on building intuition about statistical concepts. To drive these concepts home, the book has a good collection of exercises, for me these were the most exciting part. The problems are carefully crafted and will make you think, merely plugging in the formula won't work. I would heartily recommend this book as a first course in probability. ...more May 19, 2019 Dan rated it really liked it This book starts from the basic concepts of probability theory and develops it up to the law of large numbers and the central limit theorem (and more). I really like the approach this book takes, with a more intuitive explanation of the concepts rather than just focusing on the mathematics, which often (for me at least) doesn't provide any idea of \*why\* these probabilistic results should be true. The book uses the concept of a "story" to define distributions, which is basically learning by generi This book starts from the basic concepts of probability theory and develops it up to the law of large numbers and the central limit theorem (and more). I really like the approach this book takes, with a more intuitive explanation of the concepts rather than just focusing on the mathematics, which often (for me at least) doesn't provide any idea of \*why\* these probabilistic results should be true. The book uses the concept of a "story" to define distributions, which is basically learning by generic example. I find this way more useful than merely stating the density functions, as it becomes a lot easier to recognise when the distributions occur in practice. The book only relies on basic real analysis, and a tiny bit of linear algebra. As the authors also emphasise: probability isn't hard mathematics, but what makes it hard is connecting it with the real world and knowing how to apply the vast array of tools available. ...more May 17, 2017 Anthony Mowers rated it it was amazing I discovered that if I wanted to develop a solid foundation in machine learning then a familiarity with the basics of probability theory and statistical inference would be useful. This book teaches basic probability and several of the more common statistical distributions in an academic but easy to read style. It's a good prep before learning statistical inference. Prerequisite is only first year university level mathematics skills. 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I couldn't imagine a better introduction to probability theory. ...more Matt rated it liked it Apr 21, 2015 Evan Zamir rated it it was amazing Feb 03, 2020 Ova15 rated it really liked it Aug 01, 2018 Henry Cooksley rated it really liked it Feb 22, 2021 Leo G. rated it it was amazing Dec 13, 2018 Mai rated it it was amazing Dec 12, 2015 Skavanik rated it it was amazing Oct 25, 2020 René rated it it was amazing Feb 14, 2021 Omar rated it it was amazing Dec 02, 2020 Lucy rated it really liked it Dec 23, 2018 May 05, 2018 Xi Gong rated it it was amazing Without much exaggeration, this is the single most important book I have read in my life. It introduced me to the possibility of extending logic to the realm of unpredictability and chaos. The abundant amount of concrete and vivid examples helped me to appreciate many of the core concepts of probability and statistics. I sincerely recommend this book to anyone who wants a lucid, fascinating, and at times challenging read.





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