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Chapter 1 : Statistics and Probability â€“ Variation Theory

P robability Probability is the measure of the likelihood that an event will occur in a Random Experiment. Probability is quantified as a number between 0 and 1, where, loosely speaking, 0 indicates impossibility and 1 indicates certainty.

Statistics and probability theory Submitted by plusadmin on March 1, March The Plus teacher packages are designed to give teachers and students easy access to Plus content on a particular subject area. Most Plus articles go far beyond the explicit maths taught at school, while still being accessible to someone doing A level maths. They put classroom maths in context by explaining the bigger picture â€” they explore applications in the real world, find maths in unusual places, and delve into mathematical history and philosophy. We therefore hope that our teacher packages provide an ideal resource for students working on projects and teachers wanting to offer their students a deeper insight into the world of maths. Statistics and probability theory This teacher package brings together all Plus articles on statistics and probability theory. In addition to the Plus articles, the try it yourself section provides links to related problems on our sister site NRICH. Fun and games â€” The articles in this category use stats and probability to understand games of chance, sports, and strange coincidences; Understanding life â€” This category explores how stats and probability are used to understand all aspects of life, from death and disease to fraud. Lies, damn lies â€” This category focuses on those pitfalls and conundrums that sometimes contribute to our mistrust of stats. Fun and games Winning odds â€” When you flip a coin we assume it has equal chance of coming up head or tails, so any coin flipping game should be a fair one. This article explores what can give you the winning advantage. But it turns out that poker is actually a very complicated game indeed. Curious dice â€” This article looks at a set of unusual dice and a two-player game in which you will always have the advantage. We explore the philosophy of probability in this pair of articles, Struggling with chance and Still struggling with chance. The logic of drug testing â€” Doping is a major issue in sport and drug tests are being used to find the culprits. But when an athlete fails a test can we really conclude that they are cheating? Anyone for tennis and tennis and tennis Just how freaky was their titanic fifth set and what odds might a bookmaker offer for a repeat? Harder, better, faster, stronger â€” Using statistics to predict the Olympic medal count. The home advantage â€” Using statistics to see if the host nation has an advantage in the Olympics. Ping-Pong is coming home â€” Table tennis first became an Olympic sport in , but changed its scoring system in to make matches more exciting for spectators. How does the new system compare to the old one in terms of your chances of winning? The Plus sports page: Power trip â€” This article looks at the tenure length of football managers and fits a model to the data. An almighty coincidence â€” How do you figure out if something is really as unlikely as it seems? This article gives a hands-on introduction to statistical modelling using a real-life coincidence as an example. Football crazy â€” On May 22nd the English Premier league had one more match day ahead, with West Bromwich Albion at the bottom of the league and Manchester United at the top, sure to remain there. Find out how they did it. It had taken them six months and a generous helping of mathematical analysis, including probability theory. Thomas Bayes and Mr Zootpooper â€” The three door problem has become a staple mathematical mindbender, but even if you know the answer, do you really understand it? The UK National Lottery - a guide for beginners â€” In the early days of the UK National Lottery, it was quite common to see newspaper articles that looked back on what numbers had recently been drawn, and attempted to identify certain numbers as "due" or "hot". Running a lottery - for beginners â€” There are many different types of lottery around the world, but they all share a common aim: This article explains why lotteries are the way they are. The coloured hat exam â€” This Plus puzzle gets you thinking about probability in terms of all possible outcomes of a situation. To mark the occasion of the cricket world cup, this article explored what it takes to be the best. Backgammon, doubling the stakes and Brownian motion â€” Backgammon is said to be one of the oldest games in the world. This article discusses one particularly interesting aspect of the game â€” the doubling cube. It shows how a model using Brownian motion can help a player to decide when to double or accept a double. On the ball â€” If your team scores first in a football match, how likely is it to win? And when is it worth committing a professional foul? This article shows us how to use probability to answer these and other questions, and explains the implications for the rules of the game. Understanding life Understanding uncertainty: Visualising probabilities â€” Probabilities and statistics: This article explores modern visualisation techniques and finds that the right picture really can be worth a thousand words. But some statistical thinking is required to understand exactly what a match is, and importantly, how juries should assess this as part of the evidence in a trial. Why are we here? In this article he explains how, and why the answer can help shape our theories of physics. The best we can do is come up with estimates, but the trouble is that different statistical methods for doing this can produce vastly different results. So how do we know how different methods compare? Evaluating a medical treatment: But how does it work? Small but lethal â€” Comparing and communicating small lethal risks is a tricky business, yet this is what many of us are faced with in our daily lives. One way of measuring these risks is to use a quantity called the micromort. Infinite monkey business â€” An infinite number of monkeys producing the complete works of Shakespeare is not just a probabilistic certainty, it also gives us an insight into how long we can expect to wait for a rare event to happen. The Carol syndrome â€” Being attractive: Does the Iranian election stand up to statistics? How long will you live? Breast screening, a statistical controversy â€” One in nine women will get breast cancer in her lifetime, and it seems sensible to screen women for breast cancer to treat them as early as possible. But screening is a controversial issue. The best medicine â€” To make hard decisions, you need hard facts. Medical statistics can help us to decide what treatment to look for when we are ill, and to estimate our chances of recovery. The mathematics of diseases â€” Over the past one hundred years, mathematics has been used to understand and predict the spread of diseases, relating important public-health questions to basic infection parameters. This article describes some of the mathematical developments that have improved our understanding and predictive ability. Keeping track of immunity â€”Dengue fever does the opposite of what you might expect. So keeping track of the strains of the diseases is an important problem which can be solved with the help of a little randomness. Death and statistics â€” Actuarial science began as the place where two branches of mathematics meet: Financial planning for the future is therefore rooted firmly in the past. This article takes us through some of the mathematics involved, introducing us to some of the colourful characters who led the way. The compassionate statistician â€” Florence Nightingale survives in our imaginations as an inspired nurse. But the "lady with the lamp" was also a pioneering and passionate statistician. She understood the influential role of statistics and used them to support her convictions. Pools of blood â€” A biologist has developed a blood test for detecting a certain minor abnormality in infants. Obviously if you have blood samples from children, you could find out which children are affected by running separate tests. But mathematicians are never satisfied by the obvious answer. This article uses information theory to explain how to cut down the number of tests significantly, by pooling samples of blood. The crystal ball â€” If you had a crystal ball that allowed you to see your future, what would you arrange differently about your finances? This article explores the pensions crisis, and how actuaries use statistical and modelling techniques to plan for all our futures. How big is the terrorist threat? And should we trust league tables? Maths in the dock â€”Two chemists talk to Plus about the vital role of maths in presenting criminal evidence. Modelling catastrophes â€” Hardly six months go by without a natural disaster striking some part of the globe. Measuring catastrophic risk â€” Insurance companies offer protection against rare but catastrophic events like hurricanes or earthquakes. But how do they work out the financial risks associated to these disasters? But what does this mean? If it was, then cricket would be to blame for high oil prices. Do they illuminate or mislead? This article takes a look at numbers in the media and shows that a little maths goes a long way in unravelling dodgy media claims. A league table lottery â€” How reliable are league tables? The first article in a two-part series on league tables, using the National Lottery as an example. The Premiere League â€” The second article in the two-part series on league tables, using the Premiere League as an example. Damn lies â€” "Lies, damned lies, and statistics Or that Paris is rainier than London This article explores the dangers that face the unwary when using a single number to summarise complex data. Coincidence, correlation and chance â€” How much evidence would you need before buying into a get rich quick scheme? Do high ice cream sales cause shark attacks? And just how likely was it that you were ever born? Find out how, when it comes to probability, our instincts can lead us seriously astray. Beyond reasonable doubt â€” In solicitor Sally Clark was found guilty of murdering her two baby sons. Highly flawed statistical arguments may have been crucial in securing her conviction. As her second appeal approached, Plus looked at the case and finds out how courts deal with statistics.

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Chapter 2 : Statistics and Probability | Khan Academy

Probability theory is the branch of mathematics concerned with calendrierdelascience.comgh there are several different probability interpretations, probability theory treats the concept in a rigorous mathematical manner by expressing it through a set of axioms.

Experiments, sample space, events, and equally likely probabilities Applications of simple probability experiments The fundamental ingredient of probability theory is an experiment that can be repeated, at least hypothetically, under essentially identical conditions and that may lead to different outcomes on different trials. It is important to think of the dice as identifiable say by a difference in colour , so that the outcome 1, 2 is different from 2, 1. A third example is to draw n balls from an urn containing balls of various colours. In spite of the simplicity of this experiment, a thorough understanding gives the theoretical basis for opinion polls and sample surveys. For example, individuals in a population favouring a particular candidate in an election may be identified with balls of a particular colour, those favouring a different candidate may be identified with a different colour, and so on. Probability theory provides the basis for learning about the contents of the urn from the sample of balls drawn from the urn; an application is to learn about the electoral preferences of a population on the basis of a sample drawn from that population. Another application of simple urn models is to use clinical trials designed to determine whether a new treatment for a disease, a new drug, or a new surgical procedure is better than a standard treatment. In the simple case in which treatment can be regarded as either success or failure, the goal of the clinical trial is to discover whether the new treatment more frequently leads to success than does the standard treatment. Patients with the disease can be identified with balls in an urn. The red balls are those patients who are cured by the new treatment, and the black balls are those not cured. Usually there is a control group , who receive the standard treatment. They are represented by a second urn with a possibly different fraction of red balls. The goal of the experiment of drawing some number of balls from each urn is to discover on the basis of the sample which urn has the larger fraction of red balls. A variation of this idea can be used to test the efficacy of a new vaccine. Perhaps the largest and most famous example was the test of the Salk vaccine for poliomyelitis conducted in It was organized by the U. Public Health Service and involved almost two million children. Its success has led to the almost complete elimination of polio as a health problem in the industrialized parts of the world. Strictly speaking, these applications are problems of statistics, for which the foundations are provided by probability theory. In contrast to the experiments described above, many experiments have infinitely many possible outcomes. Another example is to twirl a spinner. Many measurements in the natural and social sciences, such as volume, voltage, temperature, reaction time, marginal income, and so on, are made on continuous scales and at least in theory involve infinitely many possible values. If the repeated measurements on different subjects or at different times on the same subject can lead to different outcomes, probability theory is a possible tool to study this variability. Because of their comparative simplicity, experiments with finite sample spaces are discussed first. The probability of an event is defined to be the ratio of the number of cases favourable to the eventâ€”i. An outcome of the experiment is an n-tuple, the kth entry of which identifies the result of the kth toss. Since there are two possible outcomes for each toss, the number of elements in the sample space is 2n. Page 1 of

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Chapter 3 : Theory of Probability | Mathematics | MIT OpenCourseWare

7-Probability Theory and Statistics amounts of data or characteristics of that data are also called statistics. Finally, the entire study of the analysis of large quantities of data is referred to as the study of statistics.

Random Experiment A random experiment is a physical situation whose outcome cannot be predicted until it is observed. Sample Space A sample space, is a set of all possible outcomes of a random experiment. Random Variables A random variable, is a variable whose possible values are numerical outcomes of a random experiment. There are two types of random variables. Discrete Random Variable is one which may take on only a countable number of distinct values such as 0,1,2,3,4,â€¦â€¦. Discrete random variables are usually but not necessarily counts. Continuous Random Variable is one which takes an infinite number of possible values. Continuous random variables are usually measurements. Probability Probability is the measure of the likelihood that an event will occur in a Random Experiment. Probability is quantified as a number between 0 and 1, where, loosely speaking, 0 indicates impossibility and 1 indicates certainty. The higher the probability of an event, the more likely it is that the event will occur. Example A simple example is the tossing of a fair unbiased coin. Conditional Probability Conditional Probability is a measure of the probability of an event given that by assumption, presumption, assertion or evidence another event has already occurred. The probability of getting any number face on the die is no way influences the probability of getting a head or a tail on the coin. Conditional Independence Two events A and B are conditionally independent given a third event C precisely if the occurrence of A and the occurrence of B are independent events in their conditional probability distribution given C. In other words, A and B are conditionally independent given C if and only if, given knowledge that C already occurred, knowledge of whether A occurs provides no additional information on the likelihood of B occurring, and knowledge of whether B occurs provides no additional information on the likelihood of A occurring. I choose a coin at random and toss it twice. If C is already observed i. Expectation The expectation of a random variable X is written as E X. In more concrete terms, the expectation is what you would expect the outcome of an experiment to be on an average if you repeat the experiment a large number of time. So the expectation is 3. If you think about it, 3. Variance The variance of a random variable X is a measure of how concentrated the distribution of a random variable X is around its mean. The mathematical definition of a discrete probability function, p x , is a function that satisfies the following properties. This is referred as Probability Mass Function. The mathematical definition of a continuous probability function, f x , is a function that satisfies the following properties. This is referred as Probability Density Function. Joint Probability Distribution If X and Y are two random variables, the probability distribution that defines their simultaneous behaviour during outcomes of a random experiment is called a joint probability distribution. It means for every possible combination of random variables X, Y we represent a probability distribution over Z. Some of the important operations are as below. It means we already know their assignment. Then the rows in the JD which are not consistent with the observation is simply can removed and that leave us with lesser number of rows. This operation is known as Reduction. Marginalisation This operation takes a probability distribution over a large set random variables and produces a probability distribution over a smaller subset of the variables. This operation is known as marginalising a subset of random variables. This operation is very useful when we have large set of random variables as features and we are interested in a smaller set of variables, and how it affects output. The set of input random variables are called scope of the factor. For example Joint probability distribution is a factor which takes all possible combinations of random variables as input and produces a probability value for that set of variables which is a real number. Factors are the fundamental block to represent distributions in high dimensions and it support all basic operations that join distributions can be operated up on like product, reduction and marginalisation.

Chapter 4 : Introduction to Probability and Statistics | Mathematics | MIT OpenCourseWare

Probability theory, a branch of mathematics concerned with the analysis of random phenomena. The outcome of a random event cannot be determined before it occurs, but it may be any one of several possible outcomes.

History of probability The mathematical theory of probability has its roots in attempts to analyze games of chance by Gerolamo Cardano in the sixteenth century, and by Pierre de Fermat and Blaise Pascal in the seventeenth century for example the " problem of points ". Christiaan Huygens published a book on the subject in [3] and in the 19th century, Pierre Laplace completed what is today considered the classic interpretation. Eventually, analytical considerations compelled the incorporation of continuous variables into the theory. This culminated in modern probability theory, on foundations laid by Andrey Nikolaevich Kolmogorov. Kolmogorov combined the notion of sample space , introduced by Richard von Mises , and measure theory and presented his axiom system for probability theory in This became the mostly undisputed axiomatic basis for modern probability theory; but, alternatives exist, such as the adoption of finite rather than countable additivity by Bruno de Finetti. The measure theory-based treatment of probability covers the discrete, continuous, a mix of the two, and more. Motivation[edit] Consider an experiment that can produce a number of outcomes. The set of all outcomes is called the sample space of the experiment. The power set of the sample space or equivalently, the event space is formed by considering all different collections of possible results. For example, rolling an honest die produces one of six possible results. One collection of possible results corresponds to getting an odd number. These collections are called events. If the results that actually occur fall in a given event, that event is said to have occurred. To qualify as a probability distribution , the assignment of values must satisfy the requirement that if you look at a collection of mutually exclusive events events that contain no common results, e. This event encompasses the possibility of any number except five being rolled. When doing calculations using the outcomes of an experiment, it is necessary that all those elementary events have a number assigned to them. This is done using a random variable. A random variable is a function that assigns to each elementary event in the sample space a real number. This function is usually denoted by a capital letter. This is not always the case. For example, when flipping a coin the two possible outcomes are "heads" and "tails". In this example, the random variable X could assign to the outcome "heads" the number "0" X.

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Statistics I: Probability Theory & Statistical Inference () The objectives of the course are to introduce the underlying concepts of probability and statistical calendrierdelascience.com particular, this course will provide a foundation in the underlying probability theory and distribution theory required for application of statistical inference.

Mathematical Statistics with Applications, 7th ed. Goals The purpose of this course is to give you an introduction to probability theory and probability distributions. The material presented will not only serve as a basis for the following course STAT , Mathematical Statistics II, but is extremely useful and fascinating on its own. The course has a prerequisite of the equivalent of a standard two-semester course in calculus, and a strong familiarity with concepts such as differentiation, integration, infinite series, sequences, and related facts, is necessary. We will cover Chapters in Wackerly et al. In particular, we will explore the axiomatic approach to probability, various counting techniques, Bayes theorem, and other probability laws, random variables, probability distributions for both discrete and continuous random variables, expectations, moment generating functions, joint and conditional distributions for n random variables, measures of association covariance and correlations , distributions of functions of random variables, order statistics, sampling distributions and the Central Limit theorem. We will focus on both theory and application in this course. You will be expected to derive theoretical results using algebra and calculus, and apply these results to real-life problems. Exam Schedule We will have two in-class midterm examinations and one take home exam. The first midterm will be 1st week in October last half of class. The second midterm will be the first week in November last half of class. The take-home will be before Thanksgiving. A cumulative final exam will be during finals week. Date and Time to be announced in class. Attendance at examinations is crucial. Absence will be only due to legitimate excuses. Allowable materials for the test will be announced. At this point, all tests are closed notes, closed books, and closed calculators. Homework Assignments There will be approximately homework assignments during the semester. Homework should be written up neatly, organized, and stapled. The homework assignments are an important component of the course. All problems assigned should be done as complete as possible. Solutions will be available for most homework assignments. Each homework group will count towards your final grade. Homework must be turned in at the due date. Late homework with a legitimate excuse must be turned prior to the next class from the due date. Final course grades will be assigned on the standard grading system. Sufficient notice is needed in order to make the accommodations possible. The University desires to comply with the ADA of If you need to be absent, please let me know.

Chapter 6 : Probability theory - Wikipedia

Probability theory is not restricted to the analysis of the performance of methods on random sequences, but also provides the key ingredient in the construction of such methods - for instance more advanced gene ï¬•nders.

Chapter 7 : Basic Probability Theory and Statistics â€“ Towards Data Science

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tion to probability and mathematical statistics and it is intended for students course in probability theory and mathematical statistics. The book contains.

Chapter 9 : Statistics I: Probability Theory & Statistical Inference () - West Chester University

Probability Theory. Because data used in statistical analyses often involves some amount of "chance" or random variation, understanding probability helps us to understand statistics and how to apply it.