

Problem Set 4 Conditional Probability Renyi

Katalin Marton

organised by Alfréd Rényi from 1966, meeting Roland Dobrushin in Debrecen in 1967 (which led to her visiting the Institute for Problems in Information Transmission

Katalin Marton (9 December 1941 – 13 December 2019) was a Hungarian mathematician, born in Budapest.

Peter Gacs

and Inf. Th., 2:149–162, 1973. Ahlswede, Gacs, Körner Bounds on conditional probabilities with applications in multiuser communication, Z. Wahrsch. und

Péter Gács (Hungarian pronunciation: [ˈpeːtɛr ˈɡaːtʃ]; born May 9, 1947), professionally also known as Peter Gacs, is a Hungarian-American mathematician and computer scientist, professor, and an external member of the Hungarian Academy of Sciences. He is well known for his work in reliable computation, randomness in computing, algorithmic complexity, algorithmic probability, and information theory.

Information theory

received during a unit time over our channel. Let $p(y|x)$ be the conditional probability distribution function of Y given X

Information theory is the mathematical study of the quantification, storage, and communication of information. The field was established and formalized by Claude Shannon in the 1940s, though early contributions were made in the 1920s through the works of Harry Nyquist and Ralph Hartley. It is at the intersection of electronic engineering, mathematics, statistics, computer science, neurobiology, physics, and electrical engineering.

A key measure in information theory is entropy. Entropy quantifies the amount of uncertainty involved in the value of a random variable or the outcome of a random process. For example, identifying the outcome of a fair coin flip (which has two equally likely outcomes) provides less information (lower entropy, less uncertainty) than identifying the outcome from a roll...

Entropy (information theory)

an additive property with respect to a partition of a set. Meanwhile, the conditional probability is defined in terms of a multiplicative property, P

In information theory, the entropy of a random variable quantifies the average level of uncertainty or information associated with the variable's potential states or possible outcomes. This measures the expected amount of information needed to describe the state of the variable, considering the distribution of probabilities across all potential states. Given a discrete random variable

X

$\{x_i\}_{i=1}^n$

, which may be any member

x_i

$\{x_i\}_{i=1}^n$

within the set

X

$\{\mathcal{X}\}$

and is distributed according to

p

:

X...

Random walk

$\dots$, where each variable is either 1 or -1 , with a 50% probability for either value, and set $S_0 = 0$ and $S_n = \sum_{j=1}^n Z_j$

In mathematics, a random walk, sometimes known as a drunkard's walk, is a stochastic process that describes a path that consists of a succession of random steps on some mathematical space.

An elementary example of a random walk is the random walk on the integer number line

Z

$\mathbb{Z}$

which starts at 0, and at each step moves +1 or -1 with equal probability. Other examples include the path traced by a molecule as it travels in a liquid or a gas (see Brownian motion), the search path of a foraging animal, or the price of a fluctuating stock and the financial status of a gambler. Random walks have applications to engineering and many scientific fields including ecology, psychology, computer science, physics, chemistry...

Theorem

theorems, is probably due to Alfréd Rényi, although it is often attributed to Rényi's colleague Paul Erdős (and Rényi may have been thinking of Erdős),

In mathematics and formal logic, a theorem is a statement that has been proven, or can be proven. The proof of a theorem is a logical argument that uses the inference rules of a deductive system to establish that the theorem is a logical consequence of the axioms and previously proved theorems.

In mainstream mathematics, the axioms and the inference rules are commonly left implicit, and, in this case, they are almost always those of Zermelo-Fraenkel set theory with the axiom of choice (ZFC), or of a less powerful theory, such as Peano arithmetic. Generally, an assertion that is explicitly called a theorem is a proved result that is not an immediate consequence of other known theorems. Moreover, many authors qualify as theorems only the most important results, and use the terms lemma, proposition...

Exponential family random graph models

common way to define the acceptance probability is to accept y' with the conditional probability $P(Y = y' | Y = y' \vee Y = y) = P$

Exponential family random graph models (ERGMs) are a set of statistical models used to study the structure and patterns within networks, such as those in social, organizational, or scientific contexts. They analyze how connections (edges) form between individuals or entities (nodes) by modeling the likelihood of network features, like clustering or centrality, across diverse examples including knowledge networks, organizational networks, colleague networks, social media networks, networks of scientific collaboration, and more. Part of the exponential family of distributions, ERGMs help researchers understand and predict network behavior in fields ranging from sociology to data science.

Quantum information

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The Rényi entropy is a generalization of Shannon entropy defined above. The Rényi entropy of order r , written as a function of a discrete probability distribution

Quantum information is the information of the state of a quantum system. It is the basic entity of study in quantum information science, and can be manipulated using quantum information processing techniques. Quantum information refers to both the technical definition in terms of Von Neumann entropy and the general computational term.

It is an interdisciplinary field that involves quantum mechanics, computer science, information theory, philosophy and cryptography among other fields. Its study is also relevant to disciplines such as cognitive science, psychology and neuroscience. Its main focus is in extracting information from matter at the microscopic scale. Observation in science is one of the most important ways of acquiring information and measurement is required in order to quantify the...

Order statistic

Order Statistics, Wiley Series in Probability and Statistics, p. 9, doi:10.1002/0471722162.ch2, ISBN 9780471722168 Rényi, Alfréd (1953). "On the theory of

In statistics, the k th order statistic of a statistical sample is equal to its k th-smallest value. Together with rank statistics, order statistics are among the most fundamental tools in non-parametric statistics and inference.

Important special cases of the order statistics are the minimum and maximum value of a sample, and (with some qualifications discussed below) the sample median and other sample quantiles.

When using probability theory to analyze order statistics of random samples from a continuous distribution, the cumulative distribution function is used to reduce the analysis to the case of order statistics of the uniform distribution.

Mean

Neuman-Sándor mean Quasi-arithmetic mean Root mean square (quadratic mean) Rényi's entropy (a generalized f -mean) Spherical mean Stolarsky mean Weighted geometric

A mean is a quantity representing the "center" of a collection of numbers and is intermediate to the extreme values of the set of numbers. There are several kinds of means (or "measures of central tendency") in mathematics, especially in statistics. Each attempts to summarize or typify a given group of data, illustrating the magnitude and sign of the data set. Which of these measures is most illuminating depends on what is being measured, and on context and purpose.

The arithmetic mean, also known as "arithmetic average", is the sum of the values divided by the number of values. The arithmetic mean of a set of numbers $x_1, x_2, \dots, x_n$ is typically denoted using an overhead bar,

$\bar{x}$

- ...

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