

Analogy and intuition in mathematics



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Term Report on Analogy and Intuition in Mathematics

Content

1 Introduction... .. 3

1. 1 Introduction on Freshman Seminar... .. 3

1. 2 Important functions of Analogy and Intuition in Mathematics... .. 3

1. 3 Method of Research and Presentation... .. 3

2 Report on Randomness... .. 4

2. 1 Randomness on Communication Theory... ..

2. 1. 1 Introduction of Noise in Communication Theory... ..

... ..

2. 1. 2 Laws and Criteria Used to Distinguish Colors and Features of Noise... ..

2. 1. 3 Inner Beginnings of Noise... ..

5

2. 1. 4 Outer Sources of Noise... ..5

2. 1. 5 Categorization of Different Colors of Noise... ..

... .. 6

2. 2 Randomness on Finance... .. 8

2. 2. 1 Brief Introduction to Efficient Market Hypothesis... ..8

2. 2. 2 Historical Backgrounds of Efficient Market Hypothesis... .. 8

2. 2. 3 Three Major Types of Markets: Weak, Semi-Strong and Strong... ..9

2. 2. 4 Aruguments and Critics on Efficiency Market Hypothesis... ..10

2. 2. 5 Interesting Counter-intuitive Narratives on Monkeies... .. 10

2. 3 Randomness on Physics and Biology... .. 11

2. 1. 1 Application of Randomness in Modern Physics... .. 11

2. 1. 2 Application of Randomness in Biology... ..11

3 Mentions of the Term Paper... .. 12

Part I Introduction

1. Introduction on Freshman Seminar

Freshman seminar 1205M offers great chances for pupils to work closely with professors from the Science module on assorted countries of mathematics.

The seminar was targeted to promote us to open our heads to creative thoughts and develop wonder of influential mathematical theories and assorted subgroups of modern-day mathematics. In add-on to exposure to selected subtopics in modern-day mathematics, we had valuable chances to develop our presentation and academic essay composing accomplishments.

1. 2 Important functions of Analogy and Intuition

The historical development of mathematics is significantly influenced by intuition acquired from existent life experience and analogy quoted from assorted other countries (Harrison & A ; Treagust, 1993) . Analogy is an extraordinary method in developing new constructs in the history of scientific discipline. In this faculty, celebrated subjects in the modern-day mathematics, including geometry, figure theory, set theory, entropy and game theory have been discussed. Among all subjects, our squad worked on Analogy and Intuition of Randomness. In this seminar, assorted originative analogy thoughts and intuition/counter-intuition thought have been presented based on specific instances in modern mathematics.

1. 3 Method on Research and Presentation

Our squad collected relevant beginning stuffs on the entropy, including books, diaries, and websites on the Internet. As for showing applications of entropy, in peculiar, we focused on the historical development of entropy theory, the simplified cardinal constructs in entropy, the counter-intuitive narratives happened, overlapping with other Fieldss in nature, and some important and influential applications of entropy theory in our day-to-day life. We omitted complicated theories, proficient expression and strict cogent

evidence. Throughout the whole semester, our squad has conducted two informal presentations on entropy. In order to exemplify entropy clearly and intuitively, we adopted assorted methods: job resolution, in-class quizzes, presentations and attractive narratives. Subtopics included: Biology, quantum natural philosophies, finance, audio technology, statistics and so on.

Part II Report on Randomness

2. 1 Randomness on Communication Theory

2. 1. 1 Introduction of Noise in Communication Theory

In statistics, irrelevant or meaningless informations is considered noise (random mistake) . Whereas in communicating theory, random perturbation in a signal is called “ noise ” . In kernel, noise consists of a big figure of perturbations with a statistically randomised clip distribution.

It is assumed that noise signals have power spectral denseness that is relative to $1/f^\alpha$, where degree Fahrenheit stands for frequencies of noise. For illustration, the spectral denseness of white noise is $\alpha = 0$, while pink noise has $\alpha = 1$. This particular character is widely used for separating among colourss of noise.

2. 1. 2 Laws and Criteria Used to Distinguish Colorss and Features of Noise

The colour names for noise are derived from an analogy between the spectrum of noise and the tantamount spectrum of visible radiations with different seeable colourss. For case, if we translate the sound moving ridge

of “ white noise ” into light moving ridges, the ensuing visible radiation will be viewed as white colour. In electronics, natural philosophies, and many other countries, the colour of a noise signal is normally understood as some features of its power spectrum. As different colourss of noise have significantly different belongings. Therefore, each sort of noise requires a specific “ colour ” to fit with it.

Start with the most well-known 1: “ White noise ” , people name different noise after colourss. This is in analogy with white colour visible radiation, which has a level spectrum of power on its frequency scope. Other colourss, such as violet, blue, ruddy, tap, are so given to different noises with highly similar spectrum features.

Although most of them have standardized noise forms with specific subjects, there are besides plentifulness of noise spectrums with imprecise and informal definitions, like black noise, green noise, brown noise and so on.

These below parts were summarized from Wikipedia footings: Noise (electronics)

Sites: hypertext transfer protocol: //en. wikipedia. org/wiki/Noise_ % 28electronics % 29

2. 1. 3 Inner Beginnings of Noise

Thermal noise is generated from the random thermic gesture of charges (normally negatrons) indoors electrical music directors. The amplitude of the signal has a chance denseness map similar to the Gaussian (Normal)

distribution. The amplitude of thermic noise depends on the temperature of the circuit.

Shot noise consequences from ineluctable random fluctuations when the charges (such as negatrons) leap over a spread inside the electric circuits. It sounds instead similar to the noise created by rain falling on a Sn roof.

Flicker noise has a frequency spectrum that falls down into the higher frequencies countries steadily.

Burst noise consists of sudden step-like passages between two or more degrees at random and unpredictable times. It sounds like eating Zea mays everta.

2. 1. 4 Outer beginnings of Noise

Atmospheric noise is the natural perturbation caused by electricity discharges in electrical storm and other natural perturbations happening in nature, like breaks of high-voltage wires.

Industrial noises are produced by cars, aircrafts and so on. The perturbations are produced by the discharge processes in these operations every bit good, which is similar to the atmospheric noise.

Extraterrestrial noises come from the existence. These noises include: Solar Noise, which is a radiation from the Sun due to its intense atomic reactions and the attendant high temperature, and Cosmic Noise, which are able to convey its radiation and cosmic beams to about everyplace.

2. 1. 5 Categorization of Different Colors of Noise

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This portion was adapted and summarized from an on-line introductory article: “ White, pink, blue and violet: The colourss of noise” from the Wired Magazine Science Column, Author: Duncan Geere, Date: Apr. 07, 2011

White noise

White noise has a changeless power distribution denseness on its spectrum. It is named after the white colour visible radiation, which has a flatten frequency everyplace on the spectrum. The term is widely applied in many scientific and proficient countries, including natural philosophies, audio technology, telecommunications, statistical prediction and many other countries. Specifically, White noise is used as a generator for random Numberss. In add-on, conditions prediction web sites besides use white noise to bring forth random figure forms and imitate existent conditions.

Pink noise

The power denseness of pink noise decreases proportionately to $1/f$. In the yesteryear, the term of spark noise sometimes refers to tap noise, but it will be more appropriate if we purely use it merely to electronic circuits. Furthermore, Pink noise is besides used in analysis of meteoric informations and end product radiation power of some astronomical organic structures.

Brown noise

Harmonizing to the precise definition, the term Brown noise refers to a noise whose power denseness decreases reciprocally relative to f^2 .

The denseness map can be generated from incorporating white noise or via an algorithm of Brownian gesture simulation. Brown noise is non named after the colour brown spectrum, which is distinguishable from other noises. It can be used in climatology to depict climate displacements. However, within the scientific community, scientists have been reasoning about its value for such intents for a long clip.

Blue noise

The power denseness of Blue noise is relative to frequency. Blue noise has an increasing frequency over a finite frequency scope. Blue noise is similar to tap noise, but alternatively of a decreasing spectrum, we observe an increasing one. Sometimes it is mixed up with Violet noise in informal treatment.

Violet noise

Violet noise is besides known as the Purple noise. The power denseness of Violet noise is relative to f^2 , which means it increases in quadratic signifier. Violet noise is like another version of Brownian noise. Furthermore, as Violet noise is the consequence of distinguishing the white noise signal denseness, so people besides call it the “ Differentiated White noise” .

Grey noise

Grey noise is a particular sort of white noise procedure with characteristic equal volume curve. However, it has a higher power denseness at both terminals of the frequency spectrum but really small power near the centre. Apparently, this is different from the standard white noise which is equal

loud across its power denseness. However, really this phenomenon is due to the worlds hearing semblance.

2. 2 Randomness on Finance

2. 2. 1 Brief Introduction to Efficient Market Hypothesis

This portion was summarized based on an on-line informal introductory article: “ The Efficient Markets Hypothesis” , Writers: Jonathan Clarks, Tomas Jandik, Gershon Mandelker, Website: [www. e-m-h. org](http://www.e-m-h.org)

In fiscal Fieldss, the efficient-market hypothesis asserts that stock market monetary values will germinate with regard to to a random walk. They have the same chance distribution and independent of each other. Random walk provinces that stocks take a random and unpredictable way. The chance of a stock ‘ s future monetary value traveling up is equal to traveling down. Therefore, the past motion (or tendency) of a specific stock monetary value or the overall market public presentation can non be used as the footing to foretell future motions. In add-on, it is impossible to surpass the full market without taking extra hazard or seting excess attempts. However, EMH proves that a long-run buy-and-hold scheme is the most efficient, because long term monetary values will about reflect public presentation of the company really good, whereas short term motions in monetary values can be merely described as a random walk.

2. 2. 2 Historical Backgrounds of Efficient Market Hypothesis

This portion was summarized based on an on-line non-profit-making educational web site: [www. e-m-h. org](http://www.e-m-h.org) and a research paper: History of the <https://assignbuster.com/analogy-and-intuition-in-mathematics/>

Efficient Market Hypothesis, Nov. 2004, Author: Martin, Sewell, Publisher: University College London.

Historically, the entropy of stock market monetary values was foremost modelled by a Gallic agent, Jules Regnault, in 1863. Shortly after, a Gallic mathematician, Louis Bachelier, developed the mathematics of Brownian motion in 1900. In 1923, the celebrated economic expert, Keynes clearly stated that investors in fiscal markets would be rewarded not for recognizing better than other participants in the market, but instead for hazard pickings.

After the WWII, the efficient-market hypothesis emerged as an outstanding theory in the mid-1960s. In the sixties, Mandelbrot proposed a entropy theoretical account for stock pricing. Fama discussed about Mandelbrot's hypothesis and concluded that the market informations confirmed his theoretical account. In add-on, he defined the alleged " efficient market" for the first clip, in his paper " Random Walks in Stock Market Prices" . He explained how random walks in stock market significantly act upon single stock monetary values. Subsequently, he introduced definitions for three signifiers of fiscal market efficiency: weak, semi-strong and strong.

The term was finally popularized when Burton Malkiel, a Professor of Economics at Princeton University, published his authoritative and outstanding book: " A Random Walk Down Wall Street."

2. 2. 3 Three Major Types of Markets: Weak, Semi-Strong and Strong

The three types of EMH were summarized based on an on-line proficient web log: “ The Efficient Markets Hypothesis” , Author: Jodi Beggs, Website: About.com

Tungsten eak Form of Efficiency

We can non foretell hereafter monetary values through analysing monetary values from the yesteryear. And we can non gain inordinate returns by utilizing information based on historical informations. In this degree, proficient analysis is ever profitable, as portion monetary values exhibit no dependences on their yesteryear. This implies that future monetary values depend wholly on public presentation of companies.

Semi-Strong Form of Efficiency

Information other than market informations is released, such as instant intelligence, companies’ direction, fiscal accounting studies, companies’ latest merchandises. Under such status, portion monetary values will reflect the new information really quickly. Therefore, investors can non derive any extra returns by trading on the public information. Semi-strong-form efficiency market implies that neither proficient analysis nor cardinal analysis can bring forth extra returns.

Strong Form of Efficiency

Under such status, information typically held by corporate insiders is released. Therefore, portion monetary values reflect non merely antecedently public information, but all private information every bit good. Theoretically, no 1 can gain extra returns. However, even before major

alterations are exposed to the populace, corporate insiders are able to merchandise their company's stocks from unnatural net incomes.

Fortunately, such insider trading is banned by surveillance governments, like the Securities and Exchange Commission.

2. 2. 4 Arguments and Critics on Efficiency Market Hypothesis

However, critics blame that the theory's applications in markets consequences in fiscal crisis. In response, advocates of the hypothesis province that the theory is merely a simplification theoretical account of the universe, which means that it may non ever keep true under every conditions. Hence, the market is merely practically efficient for simply investing intents in the existent universe instead than other purposes.

2. 2. 5 Interesting Counter-intuitive Narratives on Monkeies

The narrative was adapted from the Forbes Magazine, Personal Finance Column, Author: Rick Ferri, Date: Dec, 20, 2012

In order to verify the Efficient Market Hypothesis and exemplify the theories explicitly to the populace, a group of research workers conducted a monkey experiment. They indiscriminately picked up 30 stocks from a one 1000 stocks canvass and so allow a 100 monkeys throw darts at the stocks publishing on newspaper. They kept reiterating this experiment for five decennaries, and tracked the consequences.

In the terminal, to their surprise, monkeys' public presentation beat the index by 1. 7 % per twelvemonth, which indicates that, there is certain state of affairs where traditional proficient analysis can non even crush randomly-

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selected portfolios. The consequences have shocked the whole universe by how greatly randomness affects the market stock monetary values.

2. 3 Randomness in Physics and Biology

2. 3. 1 Application of Randomness in Modern Physics

In the early nineteenth century, physicists use the doctrine of entropy to analyze gestures and behaviours of molecules, and they build theoretical accounts in thermodynamics to explicate phenomenon in gas experiments.

In the twentieth century, when the epoch comes for quantum mechanics, microscopic phenomena are considered as wholly random. Randomness of things like radioactive decay, photons go through polarizers, and other eccentric quantum effects can not be explained and predicted with classical theories in the usual manner (Scott, 2009). Therefore, physicists propose a new theory, which claims that in a microscopic universe, some of the results appear insouciant and random. For illustration, when we describe a radioactive atom, we can not foretell when the atom will disintegrate.

What merely left for us is the chance of decay during a specific given period.

In order to work out this enigma, Einstein postulates the Hidden Variable theory, which states that nature contains irreducible entropy: belongings and variables work beyond our range somehow, but they really determine the results appear in our universe.

2. 3. 2 Application of Randomness in Biology

The modern evolutionary provinces that the diverseness of life is due to natural choice. Randomness, an indispensable constituent of biological

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diverseness, is associated with the growing of biological organisation during development (Longo & A ; Montevil, 2012) . It plays of import functions in finding familial mutant, and the significance of randomness effects appear at different sizes, from micro-organisms to big mammals (Bonner, 2013) . During this procedure, a figure of random familial mutants appear in the cistron library under both interior and other influences. Although this procedure is strictly random, it so consistently leads to a higher opportunity for endurance and reproduction of those persons who possess these mutants than those without them. This mechanism plays important functions in the endurances of animate beings.

Surprisingly, entropy in biological science has singular dealings to quantum natural philosophies. Schrodinger proposes his impression of negative information as a signifier of Gibbs free energy, which besides behaves likewise to randomness belongings in abstract quantum universe (Schrodinger, 1944) .

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1