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Reflections and Comments on Randomness

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Abstract

This article is not directed to any purpose other than conveying the effort of understanding to the ones that are able to understand randomness.

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1. Introduction

Human beings who are in the effort of understanding and helping others understand the things happening in the universe, construct models about the events and processes they are interested in and try to shed light on the future of the events by means of those models. Models are meant to express the structure and process of the systems in the real world by the help of the terms and laws of the related discipline. Models are also representation of various phenomena in the real world. They are not identical with the truth itself and because of the simplifying assumptions involved, they only present certain aspects of the truth, not every. In summary, a model is a product of the perception who builds it. Models are classified under different categories. Mathematical models are the ones with the most valid and highest power of expression. Different models can be proposed in order to explain the same phenomenon.

Deterministic world view and related terms, 'causality' and 'randomness' are controversial concepts in science, philosophy, and arts. Psychologists explain the pursuit of certainty as the desire to return to the first days of the life when no emotion of suspicion existed and one was safe in the arms of his/her mother and father. This desire is generally intensified by an education which regards suspicion as a sin and trust as a religious requisite.

2. Philosophical Approach

In every moment of life, people consciously or unconsciously observe the events or processes going on around them, gather information about how these events evolve, and respond accordingly. Searching the relations among events and processes is a type of behavior that a person with a holistic view of life would do. People tend to set relations between events in accordance with their purposes. One's ability to have control over the conditions is determined by their ability to change and transform them.

If an event does not emerge necessarily and essentially from the existing processes or, has a possibility to occur independent of other processes, and is unnecessary, then it is random. Every case of randomness has its own reasons. In other words, randomness is conditioned by causality. The distinction between randomness and causality is not absolute but relative, which means that it only appears under specific conditions. An event which happens inevitably under specific conditions can also happen randomly under different conditions. Also the reverse is possible. A random event can transform into a necessity during a process. As necessity always comes with randomness, randomness is a complement of necessity; that is, a necessary event is always complemented with random elements. Randomness is not a necessity whose reasons are unknown. Randomness still exists even if reasons are defined. Every fact and event occur necessarily as a result of their internal reasons. But also every event and fact are affected by the external reasons. External reasons are not fundamental and determinate as the internal reasons. Everything existing in the society and nature is intertwined and has a feature of affecting each other.

One's place of birth and the environment in which he lives are random while his eating and drinking are necessities to survive. In order to decide whether an event or fact comes into being randomly or from a necessity, it should be examined whether it is an outcome of an internal or external reason. By taking the necessary measures, events that bear randomness can be removed. Winning a lottery is regarded as a chance, but to obtain this chance you have to buy a lottery

ticket. A car accident is a random event, but its probability will decrease in the societies where everyone obeys the traffic rules, the ped-ways and motorways are highly ordered, and public transportation is preferred. Randomness is objective, which means that it is independent of one's ideas and will. Randomness in some cases can inhibit the process of necessities. Necessity finds its own way between several random events and serves its duty.

Necessity in nature and society is the result of laws. Every law is the indication of necessity which objects and facts are bound to. Every event and fact are bound to another with either an internal and essential or an external and unessential connection. Randomness always hides an objective necessity, which is a law. Saying that occurrence of an event is necessary means that its connections are completed, and it has resistance to further external effects so that it cannot be changed or transformed to its opposite disposition.

Each of the many events the general result of which is a law creates deviations from the law and has randomness in it. In this case the law does not act unsuccessfully; it is just counter-observed. If a law works despite all of its deviations, it is by the help of randomness. Law is in this case incomplete, narrow, and convergent. Science is nothing but the application of the statistical models. In the Kinetic Theory of Gases, every gas molecule moves in a complex orbit, but due to the Law of Large Numbers, observable average events obey the simple laws like Mariot and Gay-Lussac. Gas molecules in a closed container hit the walls of the container randomly but mandatorily every hit applies the same amount of pressure to the walls. Physical and chemical necessities are observed on the movements of the gas molecules. Science always takes randomness into account but aims to minimize it.

It should be understood that under the universal laws of correlation no fact and event are absolute, but they are in the state of continuous formation and transformation. There can be cases when many disconnected single events can somehow unite and exhibit orderliness and relation. These relations can repeat, and when it reaches a continuous and general form, the randomness is terminated. Random event is one that is formed under defined conditions, or it is one that is impossible to happen. However, in philosophical approach it has a dual character, which is opposite to each other. While some philosophers deny randomness and accept that the events obey the laws, others name all events as random. What is the relationship between necessity and randomness in the world surrounding us? One answer to this question could be that there is nothing that happens inevitably and nothing that is impossible. Every event can happen with some probability, even if it seems unbelievable. This view accepts everything as possible. It states that there is nothing as necessity. It also states that everything in the world is random.

The group of philosophers which deny necessities and see everything as possible are called indeterminists. Science shows that everything obeys laws of the nature, and it is controlled by an unknown necessity. Nothing can happen in a different way than it happens in the real world. Something that happens against its natural occurence or without any reason is called a miracle in science. But miracles are not real; they cannot happen. Some philosophers think that everything in nature is predefined and not random. The ones who find this thought reliable also find Newton's deterministic classical mechanics laws true, and mechanical determinism has ruled the scientific world since then. But when science faces more complex problems than the orbits of objects, mechanical determinism collapses. Contending that nothing can be changed and that every event is somehow predetermined brings us to fatalism. The belief that predetermination is a result of mechanical determinism. The universe does not have a supreme theory; it only has infinite sequences of theories which define the universe better each time. Events can be

predictable to some extent, and the rest are arbitrary and happen by chance. In our era, the aim of natural sciences is to state the facts with laws whose limits are determined by law of uncertainty.

Some philosophers who think that mechanical determinism and indeterminism cannot be proven, state that events happen both necessarily and randomly. They choose the midway by stating that small events happen randomly and big ones happen necessarily. According to this view, random events are independent of laws since they do not occur due to the necessity and are nothing but miracles, and necessary facts are accepted as predefined. Both in nature and society, nothing is repeated identically. However, repetitions of some relations that are not absolute but approximate are still compulsory. Necessity manifests itself like this. Individual facts can deviate from laws in a certain limit, but sociologist Auguste Comte states that social facts happen due to absolute cause and effect relations like physical ones, which, according to Laplace, is a deterministic view. The reason is that social events do not occur as a result of mechanical cause and effect relations. Many relations and contradictions can not only form new conditions but also prevent the emergence of same results from the same causes. When viewed carefully it can be realized that the world has a probabilistic structure. We cannot think about our lives without randomness. Now we can answer the question "What is random?" in the following way:

It is the result of the mutual dependency of the universe.
It is a result of the uncertainty.
It is the result of material and the movements of the material.

For this reason, randomness can be explained by the characteristics of the universe as well as the mutual dependency of events.

3. Mathematical Approach

Probability concept is related to one of the most important problems about knowledge. Probability manifests itself in the natural laws first. According to classical probability theory, numerical probability value is calculated by dividing "probable results" by "all results". This definition leads to objective and subjective interpretations. The proposition that "throwing a 6 has a probability of 1/6" is an example for a numerical probability proposition. The problem arises in the interpretation.

Popper states that there are some psychological elements in subjective interpretation; for this reason, he evaluates the probability level as a measurement of the belief of certainty or uncertainty. Regarding rationalists, Reichanbach made the evaluation that "the thing that is called probability level is the product of mind in the absence of reasons". Popper's objective interpretation is that every numerical probability proposition is a proposition about the relative frequency of occurrence of specific events in the sequence of events. For example, a proposition in the form of "the probability of throwing a 1 in the next attempt is 1/6" is not a proposition of the next throwing but a proposition of the whole set of throwings. The proposition of the next result is also an element of this set, but this proposition only states that the relative occurrence of getting 1 is 1/6. According to this approach, numerical probability propositions are acceptable only when the interpretation of frequencies is possible.

The frequency model that ensures the validity of the essential propositions in the probability calculations was developed by R.V. Mises. Reichanbach named this model as the empirical

(experimental) philosophy of probability and stated that rationalist interpretation should not play a part in scientific philosophy. According to this model, probability calculation is the model of the sequence of events that have randomness. There are two axiomatic conditions completing the sequence of events: "border-value axiom" and "randomness axiom". When a sequence of facts satisfies these two conditions, Mises defines it as "collective" which refers to the trials believed to repeat infinitely. For example, a sequence of throwing with a non-corroding dice is a collective. Every such event has some characteristics; for example, "throwing a 5" is a characteristic. For every element in a sequence of events, a new "relative frequency sequence" can be assigned. When the "relative frequency sequences" get larger, according to the border-value axiom, the relative frequency sequence has to reach a border value.

According to Mises, the word "probability" is another expression of the border value of the relative frequency in the collective. According to Mises, the only aim of probability calculation is the calculation of another probability from a given probability. Reichanbach stated that the frequency interpretation of probability will be harder when a probability proposition is applied to a single event, and it is meaningless to name the probability of a single event as frequency. The modern definition of probability is made by Kolmogorov, who uses the terminology of a sub-branch of mathematics called "measurement theory". This way the theory of probability achieved an axiomatic structure. This definition also covers the classical probability definition. Probability theory is handled with Mises' frequency theory and takes its mathematical basis from Kolmogorov Axioms. It is used for modelling the processes containing randomness. Mises' frequency theory could be better understood mathematically by the help of Bernoulli Large Numbers Rule. Large Numbers Rule connects two numbers to each other, one of which is a theoretical and the other one is an experimental number. Thanks to this rule, probability theory is connected with experimental studies, and when the results obtained from this theory is applied to experimental fields of science, some deep laws of nature which could not be explained with absolute laws can be expressed mathematically.

While Pagels, a theoretical physicist, tries to answer the question "What is random?", he mentions the importance of making a distinction between physical and mathematical problems of randomness. He says, "Mathematical problem is the logical problem defining the meaning of random order of numbers or functions. Physical randomness problem is the evaluation of whether real events obey the criteria of mathematical randomness or not. We cannot predict if a sequence of natural events is random or not, without depending on a mathematical definition of randomness. Once we have this definition, then we further have an experimental problem of examining whether real events obey this definition or not. We face two problems here: mathematicians could not give an absolute definition of randomness, or they could never succeed in defining probability which is also related to the randomness."

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