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Randomness Does Not Occur in Nature: Philosophical Assumptions at the Boundary of Knowledge and Certainty

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Randomness (1) does not occur in nature. Intuitively we think the premise is false. In this essay I argue that what we imagine to be randomness in nature is chaos (2). In the main, for objects, events and relationships that occur in large numbers, randomness and chaos behave very much the same. At the margins, in rare events randomness and chaos are very different. One's understanding of objects, events and relationships is at stake.

Random events occur without measurable determinants. That is: if A causes B, where A and B are states of an object, event or relationship, then a random outcome is independent of A and is "undetermined". A classic example of such usage is the proposition that "random" mutations and natural selection are the engines of evolution. In nature all events are determined, though the outcome is still unpredictable. The certainty with which one interprets an observation is related to the resolution of one's instruments for measurement. For example, pointillist art, including portraits by Chuck Close, are more understandable from a distance than from close-up where the objects overwhelm retinal resolution resulting in uncertainty of interpretation in awareness.

The goal of statistical analysis is to measure the degree of uncertainty by determining how well one's observations eliminate the occurrence of randomness. By measuring uncertainty, one infers the degree of certainty with which one may trust measurements of objects, events and relationships. Statistics assume the existence of randomness in order to control for the occurrence of "chance" observations. Therefore, randomness exists in nature, yes?

No, randomness does not occur in nature. The declaration is counterintuitive for four understandable reasons. First, our observations of objects, events and relationships must be expressed and revealed with symbolic representation, such as words, numbers, drawings, sculpture or models (mathematics, literature, art). These are not the things themselves, only symbols for them. Second, when our observations are expressed with numerical symbols, statistical analysis is the only method by which to understand how trustworthy those observations are (3). Third, until the mathematics and science of chaos were developed by Lorenz (4) and Mandelbrot (5), among others, in the 20th century, randomness was the only concept by which to understand the occurrence of "chance" and unpredictability; and fourth, the colloquial, but mistaken meaning of chaos is disorganization.

Chaos and disorganization are not synonyms. Disorganization is a property of entropy (6), related to chaos but quite separate from it. Chaotic events appear disorganized, but they are not. Disorganization derives from unpredictability, but is, again, separate from it. Natural events are chaotic, fully determined but unpredictable. Only numerical symbols can have the property of undetermined randomness. I do not intend this argument to refute the value and utility of statistical analysis. On the contrary, I argue that statistics are all one has with which to understand the meaning of observations expressed in numerical symbols. Analytical modeling that assumes chaos (complexity), not randomness (statistics) is coming (7). Until complexity analysis (8, 9) replaces statistical analysis, if it ever does, at the margins of incidence and prevalence, nonetheless, we must be very careful how we use statistical analysis (10-12).

Conflict of interest

The author has no financial or competing interest to declare.

References

1. Kendall MG, Smith BB. Randomness and random sampling numbers. Journal of the Royal Statistical Society. 1938;101(1):147-166.
2. Gleick J. Chaos: Making a new science. New York: Viking Penguin Books; 1987.
3. King G, Zeng L. Logistic regression in rare events data. Political Analysis. 2001;9:137-163.
4. Lorenz EN. Deterministic non-periodic flow. Journal of the Atmospheric Sciences. 1963;20(2):130–141.
5. Mandelbrot B. The fractal geometry of nature. New York: Freeman; 1977.
6. Ben-Naim A. Entropy demystafied: The second law reduced to plain common sense. Singapore: World Scientific Publishing; 2008.
7. Strevens M. How are the sciences of commplex systems possible? Philosophy of Science. 2005;72:531-556.
8. Kelso JAS, Engstrom DA. The complementary nature. Cambridge, MA: MIT Press; 2006.
9. Johnson N. Simply complexity: A clear guide to complexity theory. Oxford: One World; 2009.
10. Gallopín GC, et al. Science for the twenty-first century: From social contract to the scientific core. Int. Journal Social Science. 2001;168:219-229.
11. Kuhn TS. The Structure of Scientific Revolutions: 50th Anniversary Edition. Chicago: The University of Chicago Press; 2012 [1962].
12. Nagel E. The structure of science: Problems in the logic of scientific explanation. Indianapolis: Columbia University: Hackett Publishing; 1979.