Chapter 6
Random Processes and Visual Perception:
Stochastic Art

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ABSTRACT

The objective of this chapter is to help solve a classic stochastic problem using tools of the graphic environment. Stochastic processes are associated with the concepts of uncertainty or chance. They are a major focus of studies in various scientific disciplines such as mathematics, statistics, finance, artificial intelligence/machine learning, and philosophy. Visual Arts also depend on elements of uncertainly and chance. To explore the commonality of concern between Science and Art and better understand stochastic processes, the authors use a graph theory reference model called the "shortest route problem" and add additional elements specific to the art-making process to highlight the relevance of interdisciplinary studies in the field of randomness and visual perception.

INTRODUCTION

Randomness by nature is challenging to define and is often associated with unpredictability. According to the Wolfram definition, the world random is synonymous with the term stochastic. It is of Greek origin and means "pertaining to chance". The term stochastic has been used in the past to differentiate art practices such as medicine or rhetoric in which the knowledge and skill of the practitioner cannot be measured by the direct result of their work as in most other applied sciences. Today, both terms designate events that are variable or carry unforeseeable outcome. The relationship between Mathematics and randomness has always been complex because of the fundamental significance of the concept of randomness and uncertainty. Snell (1997) states that every non-mathematical probabilistic assertion suggests a mathematical counterpart that sharpens the formulation of the non-mathematical assertion. Greek axiomatic geometry explores the logic of shape, quantity and arrangement. Mathematicians Richard Courant and Herbert Robbins (1996) state that Mathematics offers Science both a foundation of truth and a standard of certainty based on precision and

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rigorous proof. The theory of probability, to which the concept of random processes is attached, has opened mathematical research to broader and more complex investigation in the area of applied mathematics, mathematical physics, mathematical biology, control theory, and engineering. In the visual arts, the art-making process, its perception and appreciation also depend to a certain extend on random elements pertaining to light, optical alertness and various other physical and cultural parameters.

To illustrate the similarity of concern for stochastic occurrences in Science and Art, I selected a model used by professor of Management Science Evan D. Porteus (2002) for a demonstration of stochastic random processes calculation. I broke down each element of the statistical model into separate objects, recombined them according to the scientific narrative and added distinct components pertaining specifically to visual communication methodology. Finally, to insure the validity of the process, I tested the results with colleagues from the scientific and artistic communities to underscore the common interest of scientific and artistic collaboration in this field and gather information for possible additional interdisciplinary effort in the study of randomness and probability.

BACKGROUND

A random process, also called a stochastic process, is a collection of random variables defined on an underlying probability space. The first comprehensive study of a stochastic process according to M. Scott (2013) is attributed to botanist Robert Brown who describes the physical trajectories of pollen grains suspended in water. Many later mathematical stochastic processes models have been developed in the context of studying Brownian motion. Mathematics is based on precision and rigorous proof. It offers Science both a foundation of truth and a standard of certainty. It is a science of pattern and order that uses observation and simulation as means of discovering truth. According to a National Research Council report (2000) it relies on logic to demonstrate it. The focus of mathematical sciences throughout history has been to explore the logic of shape, quantity and arrangement. Edoxus, Archimedes Euclid and Greek axiomatic geometry are the foundation on which classic mathematical theories have been developed. However, randomness does not analyze or investigate numbers but instead focuses on the characteristics of a sequence of digits. G. Chaitin (1975) posits that a sequence of numbers is random if it has no shorter description than itself. The ensemble theory of probability, to which the concept of random processes is attached, opens mathematical researches to broader and more complex investigations. As early as 1905, Albert Einstein, using a probabilistic model, provided a satisfactory explanation of the Brownian motion. From 1930 to 1960 J. L. Doob and Kolmogorov, transformed the study of probability to a mathematical discipline and set the stage for major developments in the theory of continuous parameter stochastic processes. "Probability is mathematics", Doob clearly states in the preface of his 1953 book 'Stochastic processes'.

Art is the expression of an intuitive interpretation of the perceptual environment. While the production of a valid art statement is based on precision and rigorous use of technical mastery, the art-making process and its larger appreciation by the public is still subject to variables relating to chance and uncertainty such as proper display, light and meticulous conservation among other. It makes of art a significant field of activity in which the study of randomness can help develop the dynamic and understanding of perception. Today, many among the best artists reevaluate the framework and channels of communication in which they operate to integrate probability in original form of artistic expression and produce esthetic statements that open new dimension of appreciation for the audience.