Preface

It is dawn and the battlefield is waiting. It is sometime in the 12th century B.C. and a critical moment in the Trojan War must be decided. Paris seduced and ran away with Helen, the wife of the king of Sparta; and now Menelaus, the king and a unified Greek army have invaded the Trojan land and are asking for revenge. The war has been dragging on for years and Troy is not falling. In fact, it appears that the Trojans, led by Hector, are gaining the upper hand. Somebody from the Greek army has to step in and fight man-to-man with Hector. Who will it be? The decision will be left to chance. Each of the volunteer marks his own lot, then the lots are put in a helmet and are shaken. A lot is drawn from the helmet and identifies the soldier who will fight Hector. It is Ajax.

In Homer's *Iliad* and in many other early epics, such decisions were often left to chance. The concept of randomness appears to have been an integral part of the actions and feelings of early cultures. One might wonder why this would ever happen. After all, early in human history, people believed that the gods controlled every little detail (determinism) and therefore nothing was left to chance. This, however, is not a paradox. Randomness in early civilizations emerges as part of God. It is controlled only by God, thus eliminating human intervention and allows the will of God to apply. Thus, randomness cannot be separated from God (determinism). Randomness and determinism are thus established early in the human mind as being interconnected and associated with something bigger like God, who is boundless and everywhere at any time.

This sentiment is clearly reflected in Aristotle's *Physics Book II, 4.*
"Others there are who believe that chance is a cause but that it is inscrutable to human intelligence as being a divine thing and full of mystery."

Later, in his *Metaphysics, Book XI, 8*, Aristotle extended his logical arguments about chance to relate "the divine thing" to reason and nature.

"Since nothing accidental is prior to the essential neither are accidental causes prior. If, then, luck or spontaneity is a cause of the material universe, reason and nature are causes before it."

This cyclic, counterintuitive association and interplay of randomness and rules is a fascinating mathematical issue and is the main reason for writing this book. In doing so I made an effort to present and communicate to the reader the mathematical and scientific ideas step by step, using examples as simple as possible. Parts I and II open with a hypothetical story where the main characters engage in a fictitious conversation. This blend of fiction and scientific facts is designed to familiarize the reader with the mathematical and physical concepts that follow. In some cases, for the more mathematically inclined reader, notes on some of the details have been included at the end of the book. The sequence of chapters has been designed so that what follows is understood from what has been presented up to that point. I hope that you will enjoy the book.

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