The Economic Analysis of Random Events

Economic Perspectives on Probability Theory, Statistical Inference and the Nature of Chance

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Preface

The outline of this book has been designed during my lectures over the years. It was first appeared in the form of an idea upon which I thought out about the difference between random events and random 'economic' events. The shape and dimension of that idea gradually improved and broadened. This framework calls forth the importance of human action as a matter of experimental design in probability theory. The origins of probability and the nature of chance can be traced back to the correspondence between Pascal and Fermat on a question about game of chance posed by Chevalier de Méré in the second half of the seventeenth century. Since Pascal's first letter to Fermat in this correspondence is lost and never known by the literati, the most important part of the story itself remains untold under the shadows of time. What is left behind allows us only to make some of our best guestimates. Majority of scholars who engaged in that unfinished game or interrupted event focused their attention on the calculation problem as if the human element was absent. But the real problem brought about an interruption due to pure human condition. It is interrupted in the first place because of the intervention by external situations of world affairs occurring outside of the experimental setting.

Thereby the introduction of Husserlian life-world in which human action does matter takes place not as opposed to but in the face of abstract world of science occupied by stylized facts. Obviously, stylized facts cannot reflect reality in the same manner human action can. Besides, human action can cause facts whether stylized or not. Since chance is a

phenomenon, redux to Husserlian phenomenology fits for the purpose of tackling the big bad bug called mischance. By the same token, the engine of thinking thought in human mind amenable to learning serves as a useful model for the Compensated Bayesian Function formulated at the beginning of the second chapter. Another important apparatus is the construction of the Matrix of Epistemological Basic Knowledge Categories. Together with its counterpart matrix for degrees of *Docta Ignorantia*, it clarifies the definitional glossary and sets the taxonomy of concepts such as certainty, probability, possibility and impossibility in relation to known knowns, known unknowns, unknown knowns and unknown unknowns respectively. The Matrix of Epistemological Basic Knowledge Categories is revised by degrees of observability whereas the Matrix for Degrees of *Docta Ignorantia* is revised by states of learnability in Chapter 7.

Hereby, I would like to give some brief account concerning the composition of the book and particular points about writing style that is indeed dense in some sense at certain sections of the text. The structure of the language stems from the very nature of the material which is a vast collection of output by scholar minds in history. The resources I refer to are much more difficult to apprehend by an ordinary reader. I've already made it as clear as possible with various examples, footnotes, appendices, etc. For instance, Appendix 6.3 concerns with critical considerations about the belief in the law of small numbers versus scaling law with a clear-cut theoretical discussion as a comment on the first mutual paper of Tversky and Kahneman published in 1971. Furthermore, the experimental dialogue between human agent and ChatGPT robot in Chapter 4 rests upon a single question: "Could artificial intelligence meditate?" The immediate answer given by bot is linguistically and semantically analyzed in detail. The upshot is that the discourse of artificial intelligence is not stylistic but rather synthetic.

The role of women scientists in the development of statistical thinking and probability theory is also highlighted where appropriate such as in the prominent scientific figure of Hilda Geiringer. It is also important to note that an elementary knowledge of statistics is necessary for the target audience of the book especially for students. An attempt to make the language simpler than a certain limit may mar technical integrity and hamper quality of the text. Consider Professor Paul A. Samuelson's seminal book *Foundations of Economic Analysis* (1947) as an example. Albeit its intricate structure and heavy mathematical tongue, it was and is on the top of the

reading list of students since their sophomore classes. Because the best attitude for students is not to avoid but to get acquainted with those scientific texts as early as possible that will bestow a sort of intellectual privilege upon them in their future researches. After all, this book can be read as an integration of human action into the anatomy of probability, statistics and truth.

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I wish to thank Professor Martina Morris from the University of Washington for her permission to reproduce the computer-based Monte Carlo simulation model of repetitive random event for coin tossing experiment trials depicted in Figure 5.2. The permanent link of the source material is provided in the reference section where R codes of command can also be found. The Table 6.7 in Appendix 6.2 titled "Chi-Square Probability Distribution of Right-Tail Critical Values with Different Degrees of Freedom and Various Levels of Significance" is reconstructed from the spreadsheet by the courtesy of James Jones the Professor of Mathematics at the Richland Community College located in Decatur, Illinois. My editor Ellie Duncan at Palgrave Macmillan has been very supportive, understanding, attentive, helpful and cooperative during the preparation of the manuscript.

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CHAPTER 1

General Overview and Structural Organization

1.1 Introduction

The general overview and structural organization of the book follow logical succession rather than historical chronology. The economic analysis of random events naturally covers wide range of topics. The most important distinction at the outset of the argument is in between the concepts of random events and random 'economic' events or—on the counterpart—random variables and random 'economic' variables. The distinction signifies the introduction of human action into the theory of probability. The role of human agent is a key factor for the general construction of probabilistic experiments of repetitive events. The foundations of the modern probability theory date back to the correspondence between Fermat and Pascal upon the problem proposed by Chevalier de Méré. It is also known as the problem of unfinished game—the same name is given to his book by Devlin (2010)—or the problem of points which centers about the division of stakes.

A game of chance with two players is interrupted by human condition. This calls forth another distinction between hypothetical world of pure mathematical science and the world of human life. As people pay attention on the solution of the problem, they ignore or overlook the root cause of it comes from the human factor. The interruption occurs due to unfavorable external circumstances, in some occasions, it is because of a bad news—for instance, loss of a beloved one—that one player received

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and drew back from the game. So the introduction of the correspondence between Pascal and Fermat as a foundation of probability theory is not given in Chapter 2 or 3 but rather it is retarded to Chapter 4 in which the effect of human action on random economic events is concerned to explain praxeological learning in relation to Artificial Intelligence (AI). This example explains the structural and systematic organization of the chapters which follows logical succession instead of historical chronology.

Another example for the structural organization of the book is the introduction of the concept of Husserlian life-world as an alternative to world of science in the sense of pure mathematical and hypothetical construction. The concept first appears under the subtitle of basic chance principle and Humean supervenience in Chapter 3 where chance situations differ in terms of different circumstances of life in general: "As the degree of personal beliefs attached to separate chance situations in likelihood function, the degree of possibilities can be connected to different 'worlds' in probability function. The spectrum of possible futures is *grounded* in 'life-world' ['*Lebenswelt*'[1]] coined by Husserl (1970) as a phenomenological conception with a perspective from social geography. The 'life-world' is a sort of repository in which the output and data of experiments are processed and stored in the form of accumulated knowledge. The solid life-world is the universe of observation that provides grounding soil [*der gründende Boden*] for the scientifically or objectively true world (Husserl, 1970)."

Another division rather than distinction is made between the concepts of randomness and probability. Kalman (1994, p. 141) declares a manifesto as he feels himself responsible for applications of probability to the real-world phenomena. The manifesto questions the ontology of probability distributions as opposed to circumstances of certainty with a quotation from De Finetti (1974, 1975) "the late pope" of probability: "PROBABILITIES DO NOT EXIST!" The context of this phrase is used in the preface of the book where Bayesian approach dominates the idea

[1] "*Eine Lebenswelt konstituiert sich über einen bestimmten Sinnhorizont als Sonderwelt. Sie konstitutiert sich im Sinne der Phänomenologie über einen thematischen Interessenshorizont, innerhalb dessen Subjekte tätig sind. Deshalb kann man von der 'Lebenswelt' als Horizont sprechen.*" LEXIKON DER GEOGRAPHIE – "Lebenswelt," https://www.spektrum.de. ["A life-world is constituted as a special world through a certain horizon of meaning. In the sense of phenomenology, it is constituted by a thematic horizon of interests within which subjects operate. That is why one can speak of the 'life-world' as a horizon."].

that probability is the measure of subjective personal belief of human agents and therefore *probability does not* exist as a separate property of objective world especially in the form of mathematical constructions in hypothetical distributions. Hence De Finetti (1974, 1975) concludes that probability is inevitable as long as human factor is concerned. Accordingly, in Chapter 2, subjective and objective probability theories are viewed from the perspective of modern approaches. The debate between the Frequentist and Bayesian approaches is also discussed. Chapter 3 is an apprehension of human action from classical parable of broken window. Epistemological demarcation between reality, knowledge and belief is depicted in the conclusion section of Chapter 4.

De Finetti (1989) also uses the term "probabilism" to show that truth is in the thinking thought of human mind: "Truth no longer lies in an imaginary equation of the spirit with what is outside it, and which, being outside it, could not possibly touch it and be apprehended; truth is in the very act of the thinking thought. The absolute is not outside our knowledge, to be sought in a realm of darkness and mystery; it is in our knowledge itself. Thought is not a mirror in which a reality external to us is faithfully reflected; it is simply a biological function, a means of orientation in life, of preserving and enriching it, of enabling and facilitating action, of taking account of reality and dominating it" (Tilgher, 1923, pp. 23–24, 46, 49). Hence Chapter 5 integrates human action with truth, probability and statistics. Chapter 6 considers random walk again in relation to human action together with its economic consequences. Chapter 7 concludes with examinations of observability and learnability with some references to recent literature from computer science. At the end of the last chapter, the final section for a brief comparison of how random events are treated in economics versus other fields of science follows the traces of scientific thought from the historical background of the past to the present investigations.

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