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Book Review

THE IMPROBABILITY PRINCIPLE, BLACK SWANS & SULLY SULLENBERGER

BY JAY M. JAFFE

DAVID J. HAND has written a new book about improbability¹ (yes, improbability, not probability). Hand is a statistician and Ph.D. from Oxford University. At the opening of the book Hand describes the Improbability Principle succinctly: *Extremely improbable events are commonplace.* The remainder of the book explains why improbable events occur more often than people, including actuaries, assume and/or believe.

Without getting into the details—and for those you’ll have to read the book—Hand explains the Improbability Principle in terms of several laws:

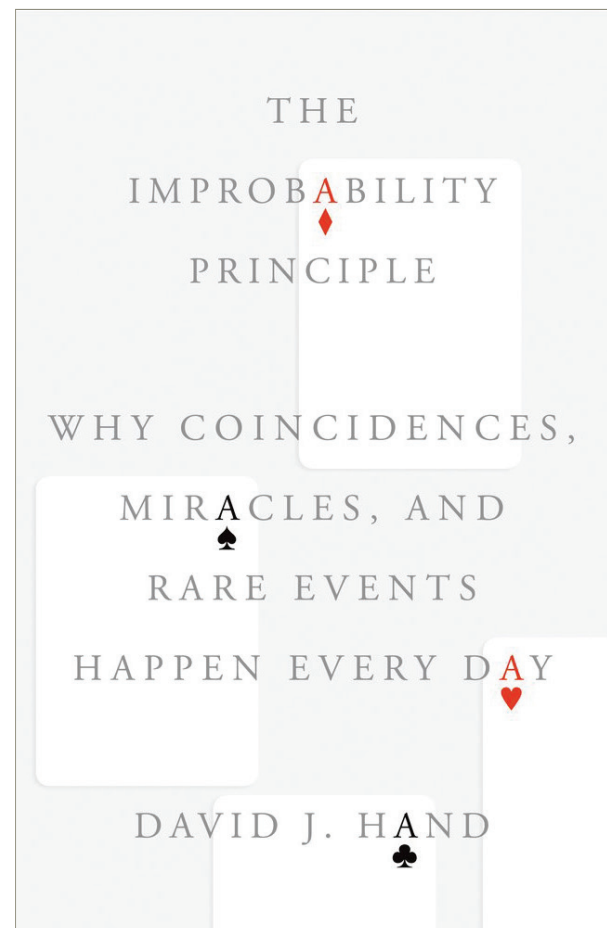
- The law of inevitability
- The law of truly large numbers
- The law of selection
- The law of the probability lever
- The law of near enough.

Each law by itself is interesting to review, and collectively they help to explain and understand the Improbability Principle. The book should help actuaries consider low-probability events in a different light and rethink how we advise our clients and employers. By the way, Hand has several references to actuaries in the book.

Every actuary should easily grasp the relevance and implications of Hand’s principle to our daily work: Even events with a low probability of occurrence need to be included in our models. The difficulty we face is how to explain to our audiences why and how we’ve included these very unlikely events in our models.

A few years ago Nassim Taleb popularized the black swan theory. The black swan theory is described by Wikipedia as “... a metaphor that describes an event that comes as a surprise, has a major effect, and is often inappropriately rationalized after the fact with the benefit of hindsight.” Taleb’s black swans are little more than improbable events.

Personally, I have never thought that describing improbable events as black swans was appropriate because before Taleb’s book my wife and I witnessed a



large flock (sometimes called a wedge) of black swans resting on the Derwent River in Tasmania. Maybe we were just lucky (i.e., experiencing an improbable event) to see the majestic black swans, but Taleb’s metaphor for describing difficult-to-predict



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events seems to ignore the fact that, as Hand explains, if you're around long enough even the improbable happens and needs to be factored into how one lives and works.

The handling of improbable events differs by profession. For example, aeronautical engineers work in a world of multiple fail-safe systems to recognize that no matter how hard they try to build a perfect plane, they can't achieve their goal. They also create procedures to prepare pilots for inevitable failures or emergencies and make it possible for Sully Sullenberger to land a plane on which multiple systems failed after encountering a flock of Canada geese (a rather mundane species as compared to "my" black swans).

In actuarial terms improbable events are those events that occur at the tail end of a distribution of occurrences and are extremely important because they are often the ones that have the most impact on actuarial models. We know that when low-probability, tail-end events occur, sometimes the ferocity of such events is mind-boggling and the financial and other consequences of such events can be devastating. Therefore, in our work we cannot dismiss such events as irrelevant but, instead, we need to find ways to make appropriate allowances for the reality that over time we'll encounter improbable events.

Once we recognize the reality of improbable events, our next task is to communicate how we treat such occurrences in our models. Fortunately, Hand's book can help us find ways to explain to our clients and employers why we must deal with improbable events regardless of what they are called. Our obligation is to make sure that our services don't ignore the improbable; but, at the

same time, we have to balance creating work products which, on the one hand, are either completely immune from or, on the other hand, give overly conservative weight to improbable events. This is a tremendously hard balancing act!

My observation is that many people tend to ignore improbable events for three reasons. First, the events we're describing are rare and it is difficult to imagine them happening. Hand describes this attitude as an application of Borel's Law:

Once we recognize the reality of improbable events, our next task is to communicate how we trust such occurrences in our models.

Sufficiently unlikely events are impossible!

Second, including improbable events in a model becomes problematic because it is difficult to attach a believable value or a consequence to an improbable event. Third, when improbable events are incorporated into an actuarial model with adverse impact, often the decision is made to ignore the highly improbable because the results are "out of bounds" as compared to models used by competitors or others in a similar position.

The decision to ignore improbable events is, to some extent, understandable since even experts cannot assign an exact probability nor place a firm cost to these unlikely possible events. Moreover, Hand's book demonstrates that the actual probability of many events is counterintuitively much greater than assumed.

But if improbable events are ignored in financial models, sooner or later there are likely to be dire and sometimes even

fatal financial consequences. Actuaries need to find ways to recognize seemingly improbable events if for no other reason than we work directly in areas where improbable events definitely occur. In the insurance business each natural disaster by itself is an improbable event, but we know natural disasters regularly occur. And how about the reality that even in today's sophisticated aviation

environment, though the odds are very small, two commercial planes collide in midair or on the ground (and planes will collide again in the future in spite of all the precautions that are being taken)?

Hand's book will make it easier for actuaries to incorporate the two seemingly opposite concepts of probability and improbability in our work. Ironically, once we become more expert at improbability, it is more probable that our probability-based models may become more accurate. ▣

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END NOTES

¹ *The Improbability Principle: Why Coincidences, Miracles, and Rare Events Happen Every Day.* Scientific American/Farrar Straus and Giroux, Feb. 11, 2014, 288 pages.

Note: The Kindle edition of this book is available from online booksellers.