

# The Black Swan: The Impact of the Highly Improbable

*Reviewed by David Aldous*

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**The Black Swan: The Impact of the Highly Improbable**

Nassim Nicholas Taleb

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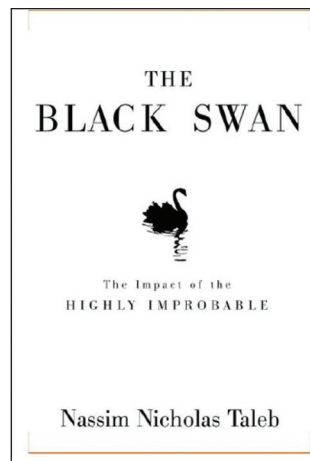
Taleb has made his living (and a small fortune, perhaps transformed into a large fortune by the 2008 market) in an unusual way—by financial speculation in contexts in which he spots a small chance of making a very large gain. As with others who have had unusual careers (say, Neil Armstrong or Marcel Marceau), it is interesting to hear his experiences, but when such a person declares *I am a philosopher of ideas*, one is wise to be cautious (italics denote quotes from Taleb, boldface denotes my own emphasis).

The phrase “Black Swan” (arising earlier in the different context of Popperian falsification) is here defined as an event characterized [p. xviii] by *rarity, extreme impact, and retrospective (though not prospective) predictability*, and Taleb’s thesis is that such events have much greater effect, in financial markets and the broader world of human affairs, than we usually suppose. The book is challenging to review because it requires considerable effort to separate the content from the style. The style is rambling and pugnacious—well described by one reviewer as “with few exceptions, the writers and professionals Taleb describes are knaves or fools, mostly fools. His writing is full of irrelevances,

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*This is a slight revision of an article posted January 2009 on the reviewer’s website <http://www.stat.berkeley.edu/~aldous/>, which contains further argumentative essays.*



asides and colloquialisms, reading like the conversation of a raconteur rather than a tightly argued thesis”. And clearly this is perfectly deliberate. Such a book invites a review that reflects the reviewer’s opinions more than is customary in the *Notices*. My own overall reaction is that Taleb is sensible (going on prescient) in his discussion of financial markets and

in some of his general philosophical thought but tends toward irrelevance or ridiculous exaggeration otherwise. Let me run through some discussion topics, first six on which I broadly agree with Taleb, then six on which I broadly disagree, then five final thoughts.

(1) [p. 286] *The sterilized randomness of games does not resemble randomness in real life*; thinking it does constitutes the *Ludic Fallacy* (his neologism). This is exactly right, and mathematicians should pay attention. In my own list of one hundred instances of chance in the real world, exactly one item is “Explicit games of chance based on artifacts with physical symmetry—exemplified by dice, roulette, lotteries, playing cards, etc.”

(2) Taleb is dismissive of prediction and models (explicitly in finance and econometrics, and implicitly almost everywhere). For instance [p. 138], *Why on earth do we predict so much? Worse, even, and more interesting: why don’t we talk about our record in predicting? Why don’t we see how we (almost) always miss the big events? I call this the scandal of prediction.* And [p. 267] *In the absence*

of a feedback mechanism [not making decisions on the basis of data] you look at models and think they confirm reality. He's right; people want forecasts in economics, and so economists give forecasts, even knowing they're not particularly accurate. The culture of academic research in numerous disciplines encourages theoretical modeling which is never seriously compared with data.

(3) Taleb is scathing about stock prediction models based on Brownian motion (Black-Scholes and variants) and of the whole idea of measuring risk by standard deviation [p. 232]: *You cannot use one single measure for randomness called standard deviation (and call it "risk"); you cannot expect a simple answer to characterize uncertainty. And [p. 278] if you read a mutual fund prospectus, or a description of a hedge fund's exposure, odds are that it will supply you... with some quantitative summary claiming to measure "risk". That measure will be based on one of the above buzzwords [sigma, variance, standard deviation, correlation, R square, Sharpe ratio] derived from the bell curve and its kin.... If there is a problem, they can claim that they relied on standard scientific method.*

(4) Ask someone what happened in a movie they've just watched; their answer will not be just a list (this happened, then this happened, then this happened...) but will also give reasons (he left town **because** he thought she didn't love him...). We habitually think about the past in this way, as events linked by causal explanations. As Taleb writes [p. 73]: *narrativity causes us to see past events as more predictable, more expected, and less random than they actually were...* and he calls this the *Narrative Fallacy*.

(5) Chapter 3 introduces neologisms *Mediocristan* and *Extremistan* for settings in which outcomes do [do not] have finite variance. His writing is lively and memorable, and his examples are apposite, so that it would make a useful reading accompaniment to a technical statistics course, though as indicated below I disagree with his interpretation of the relative significance of the two categories.

(6) Given that Taleb's thesis is already well expressed by the bumper sticker "Expect the unexpected", what more is there to say? Well, actually he makes several memorable points, such as his summary [p. 50] of themes related to Black Swans:

(a) *We focus on preselected segments of the seen and generalize from it to the unseen: the error of confirmation.*

(b) *We fool ourselves with stories that cater to our Platonic thirst for distinct patterns: the narrative fallacy.*

(c) *We behave as if the Black Swan does not exist; human nature is not programmed for Black Swans.*

(d) *What we see is not necessarily all that is there. History hides Black Swans from us [if they didn't happen] and gives a mistaken idea about the odds of these events: this is the distortion of silent evidence.*

(e) *We "tunnel": that is, we focus on a few well-defined sources of uncertainty, on too specific a list of Black Swans (at the expense of others that do not come so readily to mind).*

And here is his investment strategy [pp. 295–296]: *Half the time I am hyperconservative in the conduct of my own [financial] affairs; the other half I am hyperaggressive. This may not seem exceptional, except that my conservatism applies to what others call risk-taking, and my aggressiveness to areas where others recommend caution. I worry less about small failures, more about large, potentially terminal ones. I worry far more about the "promising" stock market, particularly the "safe" blue chip stocks, than I do about speculative ventures—the former present invisible risks, the latter offer no surprises since you know how volatile they are and can limit your downside by investing smaller amounts.... In the end this is a trivial decision making rule: I am very aggressive when I can gain exposure to positive Black Swans—when a failure would be of small moment—and very conservative when I am under threat from a negative Black Swan. I am very aggressive when an error in a model can benefit me, and paranoid when an error can hurt. This may not be too interesting except that it is exactly what other people do not do. In finance, for instance, people use flimsy theories to manage their risks and put wild ideas under "rational" scrutiny.*

Maybe not easy for you or me to emulate, but surely conceptually useful for us to keep in mind.

## Criticisms

(7) Taleb dismisses *Mediocristan* as uninteresting and basically attributes Life, The Universe, and Everything to *Extremistan* [p. xix]: *it is easy to see that life is the cumulative effect of a handful of significant shocks.* Now power laws (in the present context, distributions with power law tails, roughly what *Extremistan* is; pedantically, I am now talking about Gray Swans) have received much attention in popular science and popular economics over the last twenty years, and they really do arise in various aspects of the natural world, and (for different reasons) in various aspects of the human economic world. But my view is that

(a) the apparent prevalence of *Extremistan* is exaggerated by several cognitive biases;

(b) outside rather narrow economic contexts, each example of *Extremistan* in the human world is surrounded by numerous equally significant examples of *Mediocristan*—it's just a small part of a big picture.

In other words Taleb's assertion quoted above, like much of the popular literature, wildly overstates the significance of *Extremistan*. A building might be damaged in a few seconds by an earthquake, in a few minutes by a fire, in a few hours by a flood, or in a few decades by termites. The

first three are visually dramatic and may affect a large and unpredictable number of buildings at once (Extremistan); not so the fourth (Mediocristan); the first three appear in the news as “natural disasters” but the fourth doesn’t. But none of this is relevant to the quantitative impact of such events, which is an empirical matter (termites win). Similarly, “number of deaths in different wars” is in Extremistan; childhood deaths from poor sanitation and consequent disease is in Mediocristan. Guess which caused more deaths worldwide in the twentieth century. That’s an empirical matter (poor sanitation wins). So:

**Extremistan is sometimes dramatic; Mediocristan is never dramatic. But this has no necessary connection with quantitative impact.**

Setting aside drama aspects, the simple fact is that our minds focus on the variable aspects of life because we don’t **need** to focus on the nonvariable aspects. If I ask you what you did yesterday, you don’t tell me the usual things (commuting to work, brushing teeth, breathing), you tell me what was different about yesterday. If I ask you to describe your dog, you don’t say “four legs, one tail, vocalizes by barking”, you tell me how your dog differs from the average dog. So:

**Our minds focus on variability. Extremistan is, by definition, more variable than Mediocristan, so it attracts relatively more of our attention. But this has no necessary connection with quantitative impact.**

Turning to (b), take any example, even a standard “economic” one such as financial success of different movies. Most movies lose money; a few make enormous profits. So this aspect of the movie sector of the economy is indeed in Extremistan. But how much, and to whom, does this matter? The size of the sector (number of employed actors and technicians, number of cinemas) isn’t affected in any obvious way by this variability, just by our taste for watching movies as opposed to other entertainment. Of the movies you and I enjoy, some were commercial successes and some were flops—how would our experience be different if the successes and failures were less extreme? Even an investor diversified across the movie business isn’t much affected. It’s hard to think of any very substantial consequences—for instance, logic suggests that in Extremistan one should “take risks” by making unconventional movies, but Hollywood is generally criticized for exactly the opposite, for making formulaic movies.

(8) In other words the whole *Extremistan* metaphor, suggesting a country in which everything is ruled by power laws, is misleading. A better metaphor is an **agora**, a marketplace, which is a useful component of a city but is surrounded by other components with different roles. This provides a segue to a quotable proclamation of my own.

**Financial markets differ from casinos in many ways, but they are almost equally unrepresentative of the operation of chance in other aspects of the real world. Thinking otherwise is the *Agoran fallacy*.**

Here are three facets of this fallacy.

(a) Money is “simply additive”—your career investment profit is the sum of your profits and losses each day. The rest of life doesn’t work that way—your happiness today isn’t a sum of incremental happiness and unhappiness of previous days.

(b) In financial speculation one doesn’t care about actual outcomes, merely about the competitive issue of being able to guess outcomes better than others can, like “betting against the spread” on football. But in most important decisions under uncertainty (choosing a spouse, choosing a cancer treatment), one seeks desirable outcomes rather than to beat others.

(c) Imagine you have woken from a twenty-five-year sleep and want to catch up on what’s happened. Taleb and I agree that looking at the roughly nine thousand daily headlines you missed would not be helpful—these are “just noise” from a long-term perspective. Taleb views Black Swans as the only alternative. But he ignores the cumulative effect of slow trends (because they are uninteresting to a speculator?). One can think of an endless list of slow changes in the United States over the last generation (increase in childhood obesity, increased consumption of espresso, increased proportion of occupations requiring a college education, increased visibility of pornography), as well as the more prominent ones (acceptability of a black president, increase in health care sector to around 16% of GDP). Consider a fifty-five-year-old thinking about changes in the United States over the last thirty years—how is the experience of being twenty-five in 2011 different from the experience of being twenty-five in 1981? Perhaps most obvious is the Internet (more precisely, the things we now do using the Internet) and the prevalence of laptop computers. This is a change that our fifty-five-year-old experienced as an individual—we remember the first time we used a browser or a search engine. We have a natural cognitive bias toward changes such as the Internet that we experienced as individuals rather than those such as “increase in childhood obesity” that we didn’t. One can hardly quantify such matters, but contrary to Taleb I would assert

**Most of the differences in life experience from one generation to the next are the cumulative results of slow changes that do not have much impact on a typical individual and therefore that we don’t pay much attention to. Of course in the long term the nature, time of origination, and duration of slow trends is unpredictable—but it**

**is this, not Black Swans, that actually constitute long-term unpredictability.**

(9) The word **prediction** has a range of meaning. Stating “Microsoft stock will rise about 20% next year” is a deterministic prediction, whereas stating your opinion about the stock’s performance as a probability distribution is a statistical prediction. Any attempt by a reader to make more precise sense of Taleb’s rhetoric about prediction requires the reader to keep firmly in mind which meaning is under discussion, since Taleb isn’t careful to do so. For instance, Taleb discusses [p. 150] data showing that security analysts’ predictions are useless, as if this were a novel insight. But in this setting he is talking about deterministic prediction, and he is just repeating a central tenet of thirty years of academic theory (the **efficient market hypothesis** and all that), not to mention the classic best-seller [1]. On the other hand, the standard mathematical theory of finance starts with some statistical assumption—that prices will move like Brownian motion or some variant. Taleb’s criticisms of this theory—that it ignores Black Swans, and that future probabilities are intrinsically impossible to assess well—have considerable validity, but he doesn’t make sufficiently clear the distinction between this and traditional stockbroker advice.

(10) A book on (say) the impact of empires on human history might be expected to contain an explicit list of entities the author considered as empires; that way, a reader could analyze any asserted generality about empires by pondering whether it applied to at least most empires on the list. Similarly, one might expect this book to contain some explicit list of past events the author considered Black Swans (here I am thinking of unique Black Swans, not Gray Swans). But it doesn’t; various instances are certainly mentioned, but mostly via asides and anecdotes. If you read the book and extracted the mentioned instances, and then read it again to see how much of the material was directly relevant to most of the listed Black Swans, then it would be a very small proportion. In other words, the summary (6) of Taleb’s views is interesting, but instead of expanding the summary to more concrete and detailed analysis, the book rambles around scattered philosophical thoughts.

(11) The style of Taleb’s philosophizing can be seen in the table [p. 284] “Skeptical Empiricism vs Platonism”, in which he writes a column of ideas that he explicitly identifies with and contrasts this with another column that no one would explicitly identify with. This is straw man rhetoric. Indeed, much of the book is rhetoric about empiricism, with a remarkable lack of actual empiricism, i.e., rational argument from data.

(12) This love of rhetoric causes Taleb to largely ignore what I would consider interesting philosophical questions related to Black Swans. Here are two such. There are a gazillion things we might

think about during a day, but (unlike a computer rebooting) we don’t wake up, run through the gazillion, and consciously choose which to actually think about. For obvious reasons, in everyday life this question—What comes to one’s conscious attention as matters one might want to think about?—is no big deal. But it’s a central issue with Black Swans: if we believe there may be many low-probability high-impact future events that we can’t imagine this moment, how much effort should we put into trying to imagine them, and how do we go about doing so, anyway? Taleb’s comments [p. 207]—*For your exposure to the positive Black Swans, you do not need to have any precise understanding of the structure of uncertainty* [here Taleb is assuming power-law payoffs] and [p. 210] *the probabilities of very rare events are not computable; the effect of an event on us is considerably easier to ascertain*—are partially true, but don’t tell us how and where to look for potential Black Swans.

Second, it is easy to cite, say [p. xviii], *the precipitous demise of the Soviet bloc* as having been unpredictable, but what does this mean? If you had asked an expert in 1985 what might happen to the USSR over the next ten years—“give me a range of possibilities and a probability for each”—then they would surely have included something like “peaceful breakup into constituent republics” and assigned it some small probability. What does it mean to say such a prediction is right or wrong? In 2008, the day before John McCain was scheduled to announce his VP choice, the Intrade prediction market gave Sarah Palin a 4% chance. Was this right or wrong? Unlikely events will sometimes happen just by chance. Taleb’s whole thesis is that experts and markets do not assess small probabilities correctly, but he supports it with anecdote and rhetoric, not with data and analysis.

### Five Final Thoughts

(13) If you haven’t read *The Black Swan*, Taleb’s online essay [3] is a shorter and more cohesive account of some of his ideas.

(14) Taleb often seems to imagine that the views he disagrees with come from some hypothetical Financial Math 101 course, though in one case it was an actual course [p. 278]: *It seemed better to teach [MBA students at Wharton] a theory based on the Gaussian than to teach them no theory at all.* It is easy to criticize introductory courses in any subject as concentrating on some oversimplified but easy-to-explain theory that is not so relevant to reality (e.g., many introductory statistics courses exaggerate the relevance and scope of tests of significance; physics courses say more about gravity than about friction). It is much harder to rewrite such a course to make it more realistic without degenerating into vague qualitative assertions or scattered facts.

(15) I am always puzzled that writers on financial mathematics (Taleb included) tend to ignore what strikes me as the most important insight that mathematics provides. Common sense and standard advice correctly emphasize a trade-off between short-term risk and long-term reward, implicitly suggesting that this spectrum goes on forever. But it doesn't. At least, if one could predict **probabilities** accurately, there is a "Kelly strategy" that optimizes long-term return. This strategy, the subject of the popular book [2], carries a very specific level of short-term risk, given by the remarkable formula

with chance  $p\%$  your portfolio value will sometimes drop below  $p\%$  of its initial value.

Now actual stock markets are less volatile, and consequently one of the best (fixed, simple) investment strategies for a U.S. investor over the last fifty years has been to invest about 140% of their net financial assets in stocks (by borrowing money). It is easy to say that [p. 61] *The sources of Black Swans today have multiplied beyond measurability* and imply that this is a source of increased market volatility, but it is equally plausible or implausible to conjecture that mathematically based speculative activity is pushing the stock market toward the "Kelly" level of volatility.

(16) My own investment philosophy, as someone who devotes three hours a year to his investments, is:

**As a default, assume the future will be statistically similar to the past. Not because this is true in any Platonic sense, but because anyone who says different is trying to sell you something.**

(17) *The Black Swan* illustrates a general phenomenon that authors who deal with chance in specific contexts (finance, the logic of scientific inference, physics, luck in everyday life, philosophy, risks to the world economy, evolution, algorithmic complexity,...) can be very perceptive within these contexts, yet, by not keeping in mind the full extent of real-world occurrences of chance, assert generalizations about chance that are silly outside their particular context. An amusing antidote to such generalizations is to examine the contexts in which "ordinary people" perceive chance. For some data on this, derived from 100,000 queries to a search engine, see [http://www.stat.berkeley.edu/~aldous/Real-World/bing\\_chance.html](http://www.stat.berkeley.edu/~aldous/Real-World/bing_chance.html).

## References

- [1] B. G. MALKIEL, *A Random Walk Down Wall Street*, Norton, New York, 1973.
- [2] W. POUNDSTONE, *Fortune's Formula*, Hill and Wang, New York, 2005.
- [3] N. N. TALEB, *The fourth quadrant: A map of the limits of statistics*, [http://www.edge.org/3rd\\_culture/taleb08/taleb08\\_index.html](http://www.edge.org/3rd_culture/taleb08/taleb08_index.html).



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