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Should Actuaries Get Another Job?

NASSIM TALEB'S WORK AND ITS SIGNIFICANCE FOR ACTUARIES

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> MY PRODUCT LINE IS COMING UP WITH A SYSTEMATIC AND UNIFIED WAY TO DEAL WITH WHAT WE DON'T KNOW.—Nassim Taleb

INTRODUCTION

Nassim Nicholas Taleb is not kind to forecasters. In fact, he states—with characteristic candor—that forecasters are little better than "fools or liars," that they "can cause more damage to society than criminals," and that they should "get another job."[1] Because much of actuarial work involves forecasting, this article examines Taleb's assertions in detail, the justifications for them, and their significance for actuaries. Most importantly, I will submit that, rather than search for other employment, perhaps we should approach Taleb's work as a challenge to improve our work as actuaries. I conclude this article with suggestions for how we might incorporate Taleb's ideas in our work.
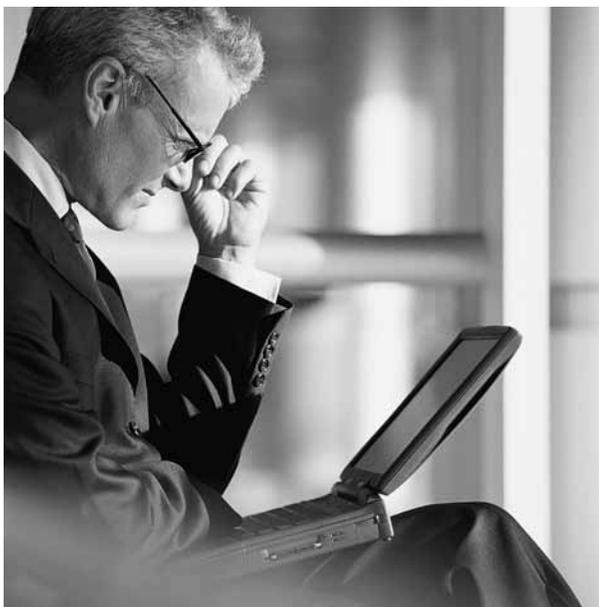
Drawing on Taleb's books, articles, presentations and interviews, this article distills the results of his work that apply to actuaries. Because his focus is the finance sector, and not specifically insurance or pensions, the comments in this article relating to actuarial work are mine and not Taleb's. Indeed, in his work, Taleb only mentions actuaries once, as a model for the wrong kind of forecaster (the pathetic Dr. John in *The Black Swan*). Concerning insurance and pensions, in *Fooled by Randomness,* he writes derisively, "… pension funds and insurance companies in the United States and in Europe somehow bought the argument that 'in the long term equities always pay off 9%' and back it up with statistics." We may safely conclude that actuaries are not Taleb's heroes.

Be forewarned: it is not easy to reach the germ of Taleb's ideas, partly because Taleb himself—and, by extension, his writing—is unusually multilayered, complex, and, yes,

entertaining. Perhaps more importantly, though, it is not easy to communicate paradigm-shifting ideas. As one critic stated, "His writing is full of irrelevances, asides and colloquialisms, reading like the conversation of a raconteur rather than a tightly argued thesis."[2] Since Taleb says that his hero of heroes is Montaigne, it is hardly surprising that his style is that of a raconteur, mixing autobiographical material, philosophy, narrative fiction and history with science and statistics. Indeed, Taleb calls himself a literary essayist and epistemologist.[3] But he is also a researcher, a professor of Risk Analysis, and a former Wall Street trader specializing in derivatives, as well as a polyglot (but because he was born in Lebanon, and grew up partly in France, he is naturally more comfortable in Arabic and French than English.) He characterizes his books *The Black Swan* and *Fooled by Randomness* as literary works, rather than technical expositions, and he encourages serious students to read his scholarly works (many of which are referenced on his Web site, *www.FooledByRandomness.com*). I concur.

WE ARE SUCKERS

Taleb's main point is that our most important financial, political and other social decisions are based on forecasts that share a fatal flaw, thus leading to disastrous consequences. Or, as he says more concisely, "We are suckers."

His contribution is to vividly and vociferously expose this flaw, and then suggest how to mitigate its negative impact.

Specifically, Taleb says that forecasts are flawed when applied to support decisions in the "fourth quadrant." He divides the decision-making domain into four quadrants, as shown in Table 1.[4]

Taleb divides the decision-making domain according to whether the decision payoff, or result, is simple or complex, and whether the underlying probability distribution (or frequency) of relevant events on which the decision is based is Type I or Type II.

Simple payoffs are binary, true or false. For example, to determine headcounts for a population census, it only matters whether a person is alive or dead. Very alive or very

> WE ARE SUCKERS FOR THOSE WHO HELP US NAVIGATE UNCERTAINTY, WHETHER THE FORTUNE-TELLER OR THE 'WELL-PUBLISHED' (DULL) ACADEMICS OR CIVIL SERVANTS USING PHONY MATHEMATICS.—Nassim Taleb

Table 1: Four quadrants of the decision-making domain		
Underlying probability distribution	**Payoff**	
	Simple (binary)	Complex
Type I	**I** **(safe)**	**II** **(safe)**
Type II	**III** **(safe)**	**IV** **(dangerous)**

Figure 1: Type 1 (Gaussian) noise and Type 2 (Power-law) noise

Type 1 noise

Type 2 noise
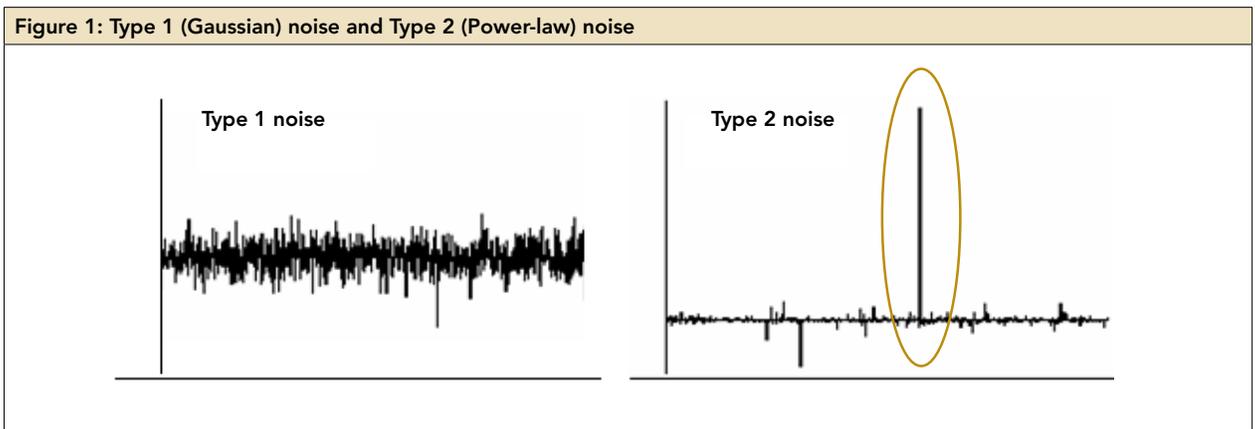
dead does not matter. Simple payoffs only depend on the zeroth moment, the event probability. (In a moment, we'll look at the importance of moments.) For complex payoffs, frequency and magnitude both matter. Thus, with complex payoffs, there is another layer of uncertainty. Actuarial work typically supports decisions with complex payoffs, such as decisions related to medical expenditures, life insurance proceeds, property and casualty claims, and pension payouts. For complex payoffs with linear magnitudes, payoffs depend on the first moment, whereas for non-linear magnitudes (such as highly-leveraged reinsurance) higher moments are important.

as social economies, health care systems and property/casualty disasters (earthquakes, hurricanes, etc.).[6] Importantly, for fat-tailed distributions, higher moments are often unstable over time, or are undefined; they are wildly different from thin-tailed distribution moments. And, for Type II distributions, the Central Limit Theorem fails: aggregations of fat-tailed distributions are often fat-tailed.[4]

Figure 1 above illustrates the difference between Type 1 and Type 2 distributions. On the left is Type 1 noise (white noise) which is Gaussian distributed. On the right is Type 2 noise

ANY SYSTEM SUSCEPTIBLE TO A BLACK SWAN WILL EVENTUALLY BLOW UP.—Nassim Taleb

Borrowing from the work of Benoit Mandelbrot, Taleb divides probability distributions into Type I and Type II (Mandelbrot calls them, respectively, mild chance and wild chance[5]). Type I distributions are thin-tailed distributions common to the Gaussian family of probability distributions (normal, Poisson, etc.). Type II distributions are fat-tailed distributions (such as Power-law, Pareto, or Lévy distributions). Type II distributions are commonly found in complex adaptive systems such

The scandal of prediction
Writing about forecasting in security analysis, political science and economics:

I am surprised that so little introspection has been done to check on the usefulness of these professions. There are a few—but not many—formal tests in three domains: security analysis, political science and economics. We will no doubt have more in a few years. Or perhaps not—the author of such papers might become stigmatized by his colleagues. Out of close to a million papers published in politics, finance and economics, there have been only a small number of checks on the predictive quality of such knowledge. … 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.

Nassim Taleb
The Black Swan

(typical of electronic signal noise) which is Power-law distributed. The striking difference between the two is that Type 2 noise has one spike of extreme magnitude that dwarfs all other events, and that is not predictable. This spike is a Black Swan. Such Type 2 patterns are typical of complex adaptive systems.

Thus, the problematic fourth quadrant refers to decision making where payoffs are complex (i.e., not binary) and underlying probability distributions are fat-tailed and wild. In this area, according to Taleb, our forecasts fail: They can-

not predict events that have massively adverse (or positive) consequences (the Black Swans). Because most decisions in our world fall squarely in the fourth quadrant, most actuarial work supports fourth quadrant decision making and is subject to the forecasting flaw.

To support his thesis, Taleb cites numerous instances when we have been suckers, when dire consequences flowed from our inability to forecast in the fourth quadrant, among which are the collapse of the Soviet Union, U.S. stock market collapses, and the current financial crisis. He also observes that in the areas of security analysis, political science and economics, no one seems to be checking forecast accuracy (see sidebar on page 24).

Although the consequences have not yet been as dramatic as those cited by Taleb, many actuarial forecasts are notorious for their inaccuracy. For example, actual 1990 Medicare costs were 7.39 times higher than original projections.[7] More recently, CMS reports that one-year NHE drug trend projections during 1997-2007 missed actual trends by 2.7 percent on average.[8] And, although experience studies are certainly more prevalent in actuarial work than in security analysis, political science or economics, in many areas of actuarial work we are perhaps also negligent in assessing and reporting our prediction accuracy.

WHY FORECASTS FAIL
Taleb gives three interrelated reasons why our fourth quadrant forecasts (and, thus, decisions based on these forecasts) fail:

1. Our minds have significant cognitive biases that cloud our ability to reason accurately.
2. We do not understand that our world is increasingly complex and unpredictable.
3. Our forecasting methods are inappropriate for quadrant IV decisions.

> THE PROBLEM WITH EXPERTS IS THAT THEY DO NOT KNOW WHAT THEY DO NOT KNOW.
> —Nassim Taleb

COGNITIVE BIASES

Drawing on the work of behavioral economists, evolutionary psychologists and neurobiologists, Taleb takes considerable pains to demonstrate that human mental makeup is not suitable for dealing with important decisions in the modern world. He shows that we have significant cognitive biases that cloud our reasoning ability, such as:

Confirmation bias: Humans focus on aspects of the past that conform to our views, and generalize from these to the future. We are blind to what would refute our views. We only look for corroboration. This is the central problem of induction: We generalize when we should not. For example, as actuaries, we often base our expenditure projections on a couple of years of recent data from limited sources that conform to our expectations.

Narrative bias: People like to fabricate stories, to weave narrative explanation into a sequence of historical facts, and thereby deceive ourselves that we understand historical causes and effects and can apply this understanding to the future. This bias gives us a false sense of forecasting confidence, a sense that the world is less random and complex than it really is—a complacency leading to forecast error. As actuaries, we think we understand trend drivers, when perhaps we really do not.

Survivorship bias: We follow what we see, because it happened to survive. We don't follow the alternatives that did not have the luck to survive, even though they may be superior.[9] As actuaries, we often use the actuarial methods that continue to be used by our colleagues, even though other methods may be superior.

> THE WORLD WE LIVE IN IS VASTLY DIFFERENT FROM THE WORLD WE THINK WE LIVE IN.
> —Nassim Taleb

Poincaré's three body problem and the limits of prediction
As you project into the future you may need an increasing amount of precision about the dynamics of the process that you are modeling, since your error rate grows very rapidly. The problem is that near precision is not possible since the degradation of your forecast compounds abruptly—you would eventually need to figure out the past with infinite precision. Poincaré showed this in a very simple case, famously known as the "three body problem." If you have only two planets in a solar-style system, with nothing else affecting their course, then you may be able to indefinitely predict the behavior of these planets, no sweat. But add a third body, say a comet, ever so small, between the planets. … Small differences in where this tiny body is located will eventually dictate the future of the behemoth planets.

Our world, unfortunately, is far more complicated than the three body problem; it contains far more than three objects. We are dealing with what is now called a dynamical system. … In a dynamical system, where you are considering more than a ball on its own, where trajectories in a way depend on one another, the ability to project into the future is not just reduced, but is subjected to a fundamental limitation. Poincaré proposed that we can only work with qualitative matters—some properties of systems can be discussed, but not computed. You can think rigorously, but you cannot use numbers. … Prediction and forecasting are a more complicated business than is commonly accepted, but it takes someone who knows mathematics to understand that. To accept it takes both understanding and courage.

Nassim Taleb
The Black Swan

Tunneling: We focus on a few well-organized sources of knowledge, at the expense of others that are messy or do not easily come to mind. For example, it is not common to find actuaries who perform complete risk analyses, running through an exhaustive set of potentially harmful scenarios. In the main, we stay to well-worn paths, the tried and true. This is natural. As Taleb says, "The dark side of the moon is harder to see; beaming light on it costs energy. In the same way, beaming light on the unseen is costly in both computational and mental effort."[1]

MISUNDERSTANDING OUR COMPLEX UNPREDICTABLE WORLD

As scientists are coming to realize, we live in a world more and more characterized by complex adaptive systems that are on the edge of chaos.[10] A corollary to this realization is that more and more modern decisions are in Quadrant IV, because complex adaptive systems are replete with Type 2 probability distributions, and because modern decisions typically have complex payoffs.

The key point about complex adaptive systems is that their behavior is not forecastable over more than a short time horizon. For example, we cannot forecast weather for more than 14 days, or even the trajectories of billiard balls on a table (see sidebar on page 26). Even less can we forecast complex social systems where the vagaries of human desire are involved. Yet, we continue to act as if events in our world are forecastable, and we base our important decisions on flawed forecasts. As our world becomes increasingly interconnected and complex, our forecasting flaws become more consequential. "The gains in our ability to model (and predict) the world may be dwarfed by the increases in its complexity."[1]

INAPPROPRIATE FORECASTING METHODS

Taleb's ludic fallacy is that we use Quadrant I and II statistical methods to prepare forecasts for Quadrant IV decisions. Ludic comes from ludus, Latin for "game." Because of familiarity and tractability, we use forecasting methods based on our knowledge of games of chance—methods and analyses largely based on the Gaussian family of probability distributions that are appropriate for Quadrants I and II—to generate forecasts for Quadrant IV decisions, a domain where such methods are completely inappropriate. These methods—including such esteemed methods as value-at-risk, Extreme Value Theory, modern portfolio management, linear regression, other least-squares methods, methods relying on variance as a measure of dispersion, Gaussian Copulas, Black-Sholes, and GARCH—are incapable of prediction where fat-tailed distributions are concerned. Part of the problem is that these methods mis-

calculate higher statistical moments (which, as we saw above, matter a great deal in the Quadrant IV), and thus lead to catastrophic estimation errors. And, of course, the point is not that we need better forecasting methods in Quadrant IV, the point is that no method will work for more than a short time horizon.

RETHINKING OUR APPROACH

Rather than get new jobs, perhaps we can accept Taleb's work as a challenge to rethink how we approach our work. This section summaries Taleb's suggestions for correcting faulty forecasts, and their application to actuaries:

1. CORRECT OUR COGNITIVE BIASES

Taleb suggests several ways to correct our cognitive biases:

Confirmation bias: Use the method of conjecture and refutation introduced by Karl Popper: formulate a conjecture and search for observations that would prove it wrong. This is the opposite of our search for confirmation. For actuaries, this might mean casting wider nets: using much larger data samples over much longer time periods to form our opinions, and seriously searching for counter-examples to our preliminary results.

Actuaries in the womb of Mediocristan

(In *The Black Swan*, Taleb calls Quadrants I and II "Mediocristan," a place where Gaussian distributions are applicable. By contrast, he calls Quadrant IV "Extremistan.")

Actuaries like to build their models on the Gaussian distribution. When they make 40-year projections for Medicare and Social Security solvency, sign Schedule B's for airline and steel company defined benefit pension plans, or do cash flow testing for life insurance company solvency, they aren't displaying professional expertise as much as they are fooling themselves by retreating to the comfort and safety of the womb of Mediocristan. That's what they learned in the agonizing process of studying for those exams. And it's easier to double your 25-year projection for the price of oil than to quit your job and admit that what you've learned and devoted your life to is largely nonsense.

Gerry Smedinghoff
Contingencies May/June 2008

> I PROPOSE THAT IF YOU WANT TO STEP TO A HIGHER FORM OF LIFE, AS DISTANT FROM THE ANIMAL AS YOU CAN GET, THEN YOU MAY HAVE TO DENARRRATE, THAT IS, SHUT DOWN THE TELEVISION SET, MINIMIZE TIME SPENT READING NEWSPAPERS, IGNORE THE BLOGS.
>
> —Nassim Taleb

Narrative bias: Favor experimentation over stories, the empirical over the narrative. For actuaries, this means that we should consider performing controlled experiments (as behavioral economists are doing) to tease out causes and effects, and that we should carefully record the accuracy of our predictions. We should avoid thinking that our correlation studies provide meaningful insights into causality.

Survivorship bias: Open the mind to alternatives that are not readily apparent and that may not have had the good fortune to survive, and adopt a skeptical attitude towards popular truths. Are our current actuarial methods really the best?

Tunneling: Train ourselves to explore the unexplored. As actuaries, perhaps we could make a greater effort—perhaps using new tools such as data mining—to make sense of our messy data.

2. STUDY THE INCREASING COMPLEXITY AND UNPREDICTABILITY OF OUR WORLD

To appreciate the complexity and unpredictability of our world, it helps to read a lot and to dispassionately observe the behavior of complex adaptive systems such as stock markets:

- Taleb provides excellent bibliographies in his works. He reads voraciously (60 hours a week) and lists the best resources in his bibliographies. For example, *The Black Swan's* bibliography lists about 1,000 references. Those related to complexity and unpre-

dictability include the works listed in footnotes six and 11 through 16.[6, 11-16]

- He also suggests that we "study the intense, uncharted, humbling uncertainty in the markets as a means to get insights about the nature of randomness that is applicable to psychology, probability, mathematics, decision theory, and even statistical physics."[1]

I would add that it helps to learn from agent-based simulation models of relevant complex adaptive systems. The purpose of such models is not to predict, but rather to learn about potential behaviors of complex systems.[17]

3. MITIGATE FORECAST ERRORS AND THEIR IMPACT

Taleb's suggestions to mitigate forecast errors fall into three classes:

- **Use forecasting methods appropriate to the quadrant.** In Quadrant IV, it is best to not even try to predict. The best we can do is apply

Mandelbrotian fractal models (which are based on Power laws) to better understand the behavior of Black Swans.[18] Mandelbrotian models will not help with prediction, but they aid our understanding. According to Taleb:

"… we use Power laws as risk-management tools; they allow us to quantify sensitivity to left- and right-tail measurement errors and rank situations based on the full effect of the unseen. We can effectively get information about our vulnerability to the tails by varying the Power-law exponent alpha and looking at the effect on the moments or the shortfall (expected losses in excess of some threshold). This is a fully structured stress testing, as the tail exponent alpha decreases, all possible states of the world are encompassed. And skepticism about the tails can lead to action and allow ranking situations based on the fragility of knowledge."[19]

In the other quadrants, our common Gaussian-based models do just fine. But simple models are generally better than complicated ones.

• **Be transparent and provide full disclosure.** Once we understand that we cannot accurately predict in Quadrant IV, we need to communicate this to those who rely on our work. Even though actuaries must provide point predictions in order to price insurance products, determine funding amounts, etc., we can effectively communicate our ignorance of the future by providing rigorous experience studies and confidence intervals around our predictions (ideally based on Power law distributions). As Taleb says, "Provide a full tableau of potential decision payoffs," and "rank beliefs, not according to their plausibility, but by the harm they may cause."[1]

• **Exit Quadrant IV.** Because Quadrant IV is where Black Swans lurk, if possible we should exit the quadrant. Although we can attempt to do this through payoff truncation (reinsurance and payoff maximums) and by changing complex payoffs to more simple payoffs (reducing leverage), nevertheless we often remain stuck in Quadrant IV. For example, health insurers try to exit Quadrant IV by reinsuring individual medical expenditures; but, they neglect to purchase aggregate catastrophic reinsurance, and so ignore the fact that aggregations of fat-tailed distributions are themselves fat-tailed distributions, and so remain in Quadrant IV.

Taleb also suggests that organizations should introduce buffers of redundancy "by having more idle 'inefficient'

> WHEN INSTITUTIONS SUCH AS BANKS OPTIMIZE, THEY OFTEN DO NOT REALIZE THAT A SIMPLE MODEL ERROR CAN BLOW THROUGH THEIR CAPITAL (AS IT JUST DID).—Nassim Taleb

capital on the side. Such 'idle' capital can help organizations benefit from opportunities."[4] Unfortunately, again using health insurers as examples, as companies grow larger, it appears that their capitalization is becoming thinner. Also, contrary to common wisdom, as such companies grow, they more thoroughly optimize their financial operations and thus generally become more susceptible to Black Swans.

One final piece of advice from Taleb: "Go to parties! … casual chance discussions at cocktail parties—not dry correspondence or telephone conversations—usually lead to big breakthroughs."[1] ▼

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